Jane's

All the World's Aircraft 2007-2008

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Jane's

All the World's Aircraft 2007-2008

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Ninety-eighth year of issue

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Contents

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Bill Gunston, OBE, FRAeS	GLOSSARY; AERO-ENGINES TABLES
Paul Jackson, FRAeS	AIRCRAFT: FRANCE (part) INTERNATIONAL (part), RUSSIAN FEDERATION (part), UKRAINE, UNITED KINGDOM (part) and UZBEKISTAN
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How to use *Jane's All the World's Aircraft* [5]

Executive Overview [11]

Notes and Acknowledgements [14]

Aircraft Type Classifications [15]

User's Charter [21]

First Flights [22]

Aerospace Calendar [25]

Official Records [29]

International aircraft registration prefixes [32]

Glossary [35]

Aircraft

Argentina 1
Australia 2
Austria 16
Belgium 24
Brazil 27
Bulgaria 43
Canada 44
Chile 96
China 96
Colombia 132
Czech Republic 134
Finland 165
France 165
Georgia 207
Germany 208
Hungary 241
India 243
Indonesia 256
International 256
Iran 347
Israel 355

Italy 356
Japan 391
Jordan 403
Kazakhstan 406
Korea, South 407
Lithuania 413
Malaysia 414
Netherlands 415
New Zealand 417
Pakistan 421
Poland 423
Romania 439
Russian Federation 443
Serbia 536
Slovakia 538
Slovenia 540
South Africa 542
Spain 547
Sweden 553
Switzerland 557
Taiwan 571
Turkey 571
Ukraine 572
United Kingdom 588
United States 607
Uzbekistan 931
Vietnam 932

Air-Launched Missiles 933

Aero-Engines 937

Propellers 947

Indexes 951

Jane's All the World's Aircraft website: jawa.janes.com

How to use: Jane's All the World's Aircraft

Content

Described on the following pages are all known powered aircraft, of which details have been received, currently in, or anticipating, commercial production in all countries of the World, apart from those built at home, entirely from plans; and rapidly dismantled, ultralight recreational machines. Exceptions to these criteria are made in the cases of 'one-off' aircraft of technical interest—for example, those undertaking pioneering work or designed as a practical exercise by aeronautical universities.

Many other of the World's aircraft remaining in service will be found in *Jane's Aircraft Upgrades* which contains full descriptions of military and commercial aircraft, both fixed- and rotary-wing, that are no longer in production or are coming to the end of their production cycles, but are still in commercial and/or military service worldwide. *Jane's Aircraft Upgrades* also includes subsequent upgrade programmes for featured types that maintain operational effectiveness. Some types that remain only in small-scale recreational use are not included—this embraces classic jets, as they are no longer in operational service.

Structure

Preliminary to the main section are the foreword, or Executive Overview and six compilations of—it is hoped—useful information:

Aircraft Type Classifications – Listing of the entire aircraft type description contents according to their role or function, thereby facilitating easy comparison of different makes of aircraft offered to fulfil the same role.

First Flights – Historical record of maiden flights during the immediately previous calendar year.

Aerospace Calendar – Historical record of significant aviation events during the immediately previous calendar year and concerning aircraft featured in this book.

Official Records – Current holders of the more significant aviation World records.

International Aircraft Registration Prefixes – Cross reference of international civil aircraft registration allocations.

Glossary – Explanation of aeronautical terms used in this book.

Entries in the main, **Aircraft** section are in alphabetical order (a) by country (including International) and then (b) by manufacturer's name. In the cases of manufacturers producing a diversity of aircraft, those of obvious military potential are presented first. However, it should be noted that a few of the larger constructors are divided into operating divisions, within which individual aircraft types are arranged. In the case of the multinational EADS, aircraft descriptions are in the French, Polish and Spanish sections.

Record Structure

Company entries begin with a brief introduction, including postal address, telephone/fax numbers, e-mail and website addresses and the names of some significant executives. The last-mentioned listing is by no means exhaustive and further details will be found in *Jane's International ABC Aerospace Directory* and *Jane's International Defence Directory*. Subcontractors and suppliers to the aerospace industry appear in *Jane's Aircraft Component Manufacturers*, which also provides rapid references to the subcontractors involved in certain prominent aircraft programmes.

Aircraft entries are subdivided under the following headings:

Type – A brief description of the aircraft's function. A full list of categories appears under the heading Type Classifications.

Programme – A record of key events in an aircraft's production history. In the case of significant aircraft, which may have a long and detailed development phase, a short summary lists the key dates in that phase in an easily retrievable format.

Current Versions – Where applicable, details of available models (marks) and cross-reference to earlier versions now out of production.

Customers – Present total on order and produced, often in tabular form, for military aircraft and those civil types for which such a list would not be of prohibitive length.

Costs – Price per unit or programme price, plus any other disclosed information on R&D expenditure.

Design Features – Where appropriate, opens with a broad statement of design objectives and the means by which they were achieved. This is followed by details such as aerofoil section and helicopter rotor speeds.

Flying Controls – Here is described the method of controlling the aircraft, it being assumed that the reader has a basic understanding of the function of ailerons, flaps, rudders, trim tabs and the other conventional manoeuvring surfaces (refer to 'conventional and manual' in the Glossary). Descriptions are concerned with the method by which the controls are operated (manual/powered) and appropriate control inputs determined (autopilot/fly-by-wire, for example).

Structure – Configuration, materials and any special manufacturing methods; details of subcontractors or partners producing significant elements of the airframe.

Landing Gear – Includes tyre sizes and pressures for wheeled aircraft, as well as ground turning circle. Braking parachutes, where fitted.

Power Plant – Number and power of engines; helicopter transmission ratings; fuel capacity. Brief additional details are provided in the Aero-Engines listing; fuller descriptions of turbine power plants are in *Jane's Aero-Engines*.

Accommodation – Seating arrangements, access, environmental control and, for transport aircraft, cargo loading capacity; type of ejection seat, if fitted.

Systems – Power generation provisions, de-/anti-icing equipment, pressurisation/air conditioning and similar equipment.

Avionics – The entry is subdivided into communications, radar, flight aids, instruments, mission equipment (mostly military or law-enforcement) and self-defence (military).

Equipment – Cargo-handling aids, spraying/firefighting apparatus, lighting, ballistic recovery parachutes and similar items.

Armament – Fixed and air-dropped/launched weapons listed by the manufacturer as actual or potential armament. Not all items may have been cleared for carriage and not all operators will use those which have. Refer also to the Missiles listing, where appropriate.

Dimensions, External – Includes door sizes and certain ground clearances.

Dimensions, Internal – Includes areas and volumes where relevant.

Areas – Wings, fixed tail surfaces and control surfaces.

Weights and Loadings – As supplied by the manufacturer; individual aircraft may vary.

Performance – Observations as above; all speeds assumed T AS unless stated otherwise.

Operational Noise Levels – Internationally recognised measurements of landing and take-off sound at airports.

Measurements of all types are given in both SI (metric) and Imperial units, the more common conversion factors for which are in the Glossary. Performance details are quoted in good faith and certain critical conversions 'rounded' to give a margin of safety, although *Jane's* does not purport to be an alternative to the manufacturer's operating notes.

In addition to the main section on aeroplanes, helicopters and lighter than air craft are others detailing Air-Launched Missiles, Aero-Engines and Propellers:

Air-Launched Missiles – A rapid reference which seeks not to duplicate the separate and vastly more detailed *Jane's Air-Launched Weapons*, indicating instead how the potential of aircraft described is augmented by the weapons they carry.

Aero-Engines – Arranged in alphabetical order of manufacturer, irrespective of their country of origin, within the classifications of piston, turboprop, turboshaft and jet engine.

Propellers – This lists some of the main airscrew manufacturers and provides explanations of their designation systems.

Images

Photographs are provided for each aircraft, and general arrangement ('three-view') drawings for most. Images are annotated with a seven digit number which uniquely identifies them in *Jane's* image database.

Other Information

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Climbing vertically over the Palm Jumeirah, Dubai, this Saab JAS 39C Gripen was caught in an impressive pose by the camera of Katsuhiko Tokunaga, one of the World's most accomplished aviation photographers

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Executive Overview: Aircraft

Like aerospace's Tweedledum and Tweedledee, Airbus and Boeing grow more alike as they proclaim their differences with increasing stridency. The see-saw of their annual and self-inflicted "orders and deliveries battle" continued its fickle gyrations during 2006, but with some added and most unwelcome jerks.

As recently as 2003 and 2004 this yearly *Jane's* essay discussed Boeing's woes in the forms of its blind alley pursuit of a transonic airliner and belated turn to the sounder venture of what is now the 787 Dreamliner; and its first ever double trouncing by Airbus in both annual order and delivery totals. Airbus, meanwhile was working on design of its forthcoming A350 challenger to Boeing and raising the stakes with construction of several prototypes of the mighty A380.

By 2006, the US company was building up the largest-ever pre-launch order book for an airliner and had claimed back the annual orders crown after six years; while, contrariwise, at Airbus, prospective customers' dissatisfaction with the A350 project forced it to be re-launched as the A350XWB; and actual customers vented their anger at mounting delivery delays with the A380.

Having been hailed upon its coalescence into a single company as a triumph for European integration, Airbus continued to reflect the political realities of the EU in February 2007 when CEO Louis Gallois attempted overdue restructuring, with the attendant economies, closures and loss of 10,000 jobs.

Seen as essential to increase efficiency, reduce costs and offset the effects of the weak US dollar, the restructuring plan (Power8) floundered at the first hurdle and had to be postponed because Airbus' national shareholders were paralysed by the vision of redundancies in their own countries and the consequent political backlash. The matter rapidly reached presidential level, with political commentators suggesting neither French nor German leader would be willing to compromise: the former with elections due in two months' time and the latter believing Germany was being disproportionately affected.

Eventually, on 28 February 2007, reality gained the upper hand, but with the redundancies spread over a four-year period. The advisability of that leisurely contraction was immediately brought into question by Gallois, who observed, "We should have done this many years ago [when] Boeing was in difficulties; the dollar was strong; and we were selling aeroplanes like bread." Former Airbus CEO Jean Pierson remarked before the job cuts, "The system we now have cannot last. EADS as a company is heading to the wall."

The EADS/Airbus strategy appears to be one in which it matches Boeing's Dreamliner manufacturing plan, whereby some 90 per cent of the aircraft's key items are designed and built by outside firms. The UK is also keen to participate in this process, despite the fact that BAE Systems disposed of its 20 per cent Airbus share in 2006. Divestment was to schedule, which resulted in it coming immediately after the share price plummet that accompanied the mid-year, management-related *contretemps*. A traditional supplier of Airbus wings, the UK division of the company, which will lose 1,600 jobs in the current reorganisation, is investing in composites technology and looking to bring in experienced partners to align itself with the parent firm's plans for diversification of development and supply.

More time was lost to Boeing during the course of 2006 when, having announced the A350XWB re-vamp at Farnborough in July, Airbus was distracted until December in making the launch announcement. That fact may not be entirely unconnected with Boeing's 70 per cent share of the widebody market that year, its 787 Dreamliner having had an almost clear run while the XWB remained in limbo.

Boeing has made full use of computer technology in its marketing endeavours, employing a popular, modern means of projecting a positive image of itself: the 'blog'. "Randy's Journal" has the framework of the informal 'web log' so popular with Internet habitués, and while steering clear of the more headline-grabbing blogs kept by some of society's less inhibited members, it combines in successful measure solid and useful facts about the airliner business with a steady drip of anti-Airbus contributions from both the blogger and his many correspondents.

While honestly labelled as a Boeing site, Randy's Journal evokes echoes of the *Gustav Siegfried Eins* radio station of the Second World War, which sowed despondency in German ranks through a carefully woven fabric of news, uncomfortable truth, criticism of inefficiency, and innuendo. Randy's more ambitious target would appear to be both Germany *and* France. That such web-based journals will be launched by more aerospace companies would seem to be certain—in the same way that the immediacy and intensity of discomfort when settling one's person upon a temporarily misplaced carpet tack is certain.

In assessing the tactical victories of airliner order, delivery and backlog numbers, sight may be lost of the strategic view. The bald figures for the past six years are in the adjacent table (No. 1).

TABLE 1: AIRBUS and BOEING ORDERS and DELIVERIES

	AIRBUS			BOEING		
YEAR	Orders	Deliveries	Backlog	Orders	Deliveries	Backlog
			1,679			1,610
2001	274	325	1,575	335	525	1,357
2002	233	303	1,505	619	424	1,152
2003	254	305	1,454	631	463	1,110
2004	366	320	1,500	272	285	1,097
2005	1,035	378	2,177	1,002	290	1,809
2006	790	434	2,533	1,047	398	2,455
TOTALS	**2,952**	**2,065**		**3,906**	**2,385**	

In view of the importance of backlog in determining a company's stock value, it is instructive to make a medium-check on the strength of these notes of promise. Between 2001 and 2006, Airbus took 2,952 orders which remained good at the end of their calendar year of placement, and delivered 2,065 airliners. Added to the opening backlog of 1,679, the positive difference of 887 between orders and deliveries would give a backlog at the beginning of 2007 of 2,566, whereas it is 2,533. In other words, 33 orders, some 1 per cent of those placed, have 'evaporated'.

Boeing tells a different story: 3,906 orders, 2,385 deliveries, an apparent increase of 1,521 in backlog, which should thus total 3,131. In fact, it is 2,455, showing an evaporation of 676 orders—17 per cent.

If these two major manufacturers take no more orders and suffer similar backlog evaporation until their last aircraft is built, Airbus will have delivered 4,573 aircraft since the dawn of the 21st Century and Boeing, a slightly lower 4,423. An unlikely, but interesting situation, mitigated by the fact that Boeing will have sold more higher-value airliners than its rival.

A more detailed breakdown of 2006 performance appears in Tables 2 and 3. These may be said also to summarise the World situation, save the trickle of airliners from Russia in the form of the traditional one or two Ilyushin Il-96s and a veritable flurry of Tupolev Tu-204s and 214s sufficient to warrant the first use for over a decade of the fingers of one's second hand to tally them.

Sukhoi continues with its plans to improve the Russian share of regional airliner manufacture, its RRJ gaining the hardly imaginative epithet, Superjet 100 (or SSJ) during 2006. Embraer's latest family was completed at the same time, when its largest member, the 195, entered service. Bombardier, meanwhile, waited until early in 2007 to announce a go-ahead for its challenge to the Embraer 190 with a further stretch of the CRJ family, known as the 1000. Still marking time, the Bombardier CSeries underwent further design refinements in 2006 and has been reconfirmed recently as still standing in the (theatrical) wings, if not in immediate prospect of taking to (aerodynamic) wings.

Now that the successors to Dornier have delivered the last Model 328, it is left to Bombardier and Embraer to define the regional jet market. Production continues its decline, although with the Brazilian company the clear market leader. Notable is the fact that the larger-capacity regionals are making a better showing than their smaller siblings, confirming the wisdom of Embraer's timing of its E series launch and giving hope to Bombardier's CRJ1000. The CSeries finds itself in the right size bracket of a shrinking market, facing an extremely tricky go/no-go decision—as might the shipyard building tea clippers at the same time that the maritime steam turbine caught on.

TABLE 2: AIRBUS ORDERS AND DELIVERIES
(at 1 January 2007)

	Orders Total	Deliveries Total	Orders in 2006	Deliveries in 2006	Backlog
A300	561	555	0	9	6
A310	260	255	0	0	5
Total 300-310	**821**	**810**	**0**	**9**	**11**
A318	90	36	minus 7	8	54
A319	1,497	930	258	137	567
A320	2,700	1,633	272	164	1,067
A321	649	371	130	30	278
Total 318-321	**4,936**	**2,970**	**653**	**339**	**1,966**
A330-200	395	243	74	39	152
A330-300	279	204	29	23	75
A340-200/300	246	241	2	2	5
A340-500	31	25	5	4	6
A340-600	121	71	5	18	50
Total 330-340	**1,072**	**784**	**115**	**86**	**288**
A350-800	71	0	4	0	71
A350-900	31	0	11	0	31
Total 350	**102**	**0**	**15**	**0**	**102**
A380	156	0	24	0	156
A380F	10	0	minus 17	0	10
Total 380	**166**	**0**	**7**	**0**	**166**
Total	**7,097**	**4,564**	**790**	**434**	**2,533**

TABLE 3: BOEING COMMERICIAL AIRPLANE GROUP ORDERS AND DELIVERIES
(at 1 January 2007)

	Orders Total	Deliveries Total	Orders in 2006	Deliveries in 2006	Backlog
707/720	1,010	1,010	0	0	0
Total 707/720	**1,010**	**1,010**	**0**	**0**	**0**
717-200	155	155	0	5	0
Total 717	**155**	**155**	**0**	**5**	**0**
727	1,831	1,831	0	0	0
Total 727	**1,831**	**1,831**	**0**	**0**	**0**
737-100	30	30	0	0	
737-200	1,114	1,114	0	0	
737-300	1,113	1,113	0	0	
737-400	486	486	0	0	
737-500	389	389	0	0	
737-600	69	69	–6	10	
737-700/C-40A	1,265	806	193	107	459
737-700BBJ	99	85	9	10	14
737-700C	12	11	1	1	2
737-800	2,082	1,100	461	172	982
737-800BBJ	15	13	2	2	2
737-900	52	52	–3	0	0
737-900BBJ	3	0	3	0	3
737-900ER	99	0	69	0	99
Total 737	**6,828**	**5,268**	**729**	**302**	**1,560**
747-100/SP	250	250	0	0	
747-200/E-4	393	393	0	0	
747-300	81	81	0	0	
747-400	446	442	0	0	4
747-400D	19	19	0	0	
747-400ER	6	6	0	0	
747-400ERF	40	20	8	6	20
747-400F	126	108	4	8	18
747-400M	61	61	0	0	24
747-8	24	0	24	0	24
747-8F	54	0	36	0	54
Total 747	**1,500**	**1,380**	**72**	**14**	**120**
757-200	913	913	0	2	
757-200M	1	1	0	0	
757-200PF	80	80	0	0	
757-300	55	55	0	0	
Total 757	**1,049**	**1,049**	**0**	**2**	**0**
767-200	128	128	0	0	0
767-200ER	121	118	0	2	3
767-300	104	104	0	0	0
767-300ER	534	514	10	7	20
767-300F	50	46	0	3	4
767-400ER	38	37	0	0	1
Total 767	**975**	**947**	**10**	**12**	**28**
777-200	88	87	0	0	1
777-200ER	426	386	0	23	40
777-200LR	36	2	6	2	34
777-300	60	60	0	1	0
777-300ER	237	69	37	39	168
777F	56	0	33	0	56
Total 777	**903**	**604**	**76**	**65**	**299**
767-3	43	0	0	0	43
787-8	330	0	99	0	330
787-9	75	0	61	0	75
Total 787	**448**	**0**	**160**	**0**	**448**
Grand Totals	**14,699**	**12,244**	**1,047**	**398**	**2,455**

Table does not include one each of 727-100, 747-100, 757-200, 767-200 and 777-200 owned by Boeing. Annual order total is net (after deduction of cancellations). Order total for Boeing 787 at 31 December 2005 was retrospectively reduced from 291 to 288, modifying 2006 data accordingly.

TABLE 4: REGIONAL JET ORDERS AND DELIVERIES

	Net Orders 2006	Deliveries 2006	Deliveries 2005	Deliveries 2004
Bombardier				
CRJ100/200	minus 16	1	35	75
CRJ440	nil	nil	12	33
CRJ700	minus 33	13	49	52
CRJ705	nil	nil	15	nil
CRJ900	98	50	14	15
Embraer				
ERJ-135	minus 15	nil	2	1
ERJ-140	minus 20	nil	nil	nil
ERJ-145	55	12	46	87
E 170	minus 41	32	46	46
E 175	77	11	14	nil
E 190	126	40	12	nil
E 195	17	3	nil	nil
Totals	**248**	**162**	**245**	**309**

At mid-year 2006, figures were even poorer, with both Bombardier and Embraer showing overall negative figures for orders. In contrast, regional turboprops have continued their revival, so much so that ATR has predicted an increase in its manufacturing rate to 44 in 2007 and 60 in 2008, returning its Toulouse factory to the prosperous days of the early 1990s. Only it and Bombardier remain active in the West, suggesting they are well placed to profit from a turning of the tide against regional jets. China's MA60 have had little success outside Africa and neighbouring Asian countries, while the Antonov An-140 has yet to make an impact on the market, despite its three production lines.

TABLE 5: REGIONAL TURBOPROP ORDERS AND DELIVERIES

	Net Orders 2006	Deliveries 2006	Deliveries 2005	Deliveries 2004
ATR 42	7	8	5	5
ATR 72	56	16	10	8
Dash 8Q-100/200	3	3	1	1
Dash 8Q-300	11	16	9	8
Dash 8Q-400	24	31	18	10
Totals	**101**	**74**	**43**	**32**

Established business jet manufacturers continue their cautious development of the market, while newcomers take a more radical—and more risky—approach. Hawker, which is now being transferred (with Beechcraft) from Raytheon to an independent, purpose-formed company, used the 2006 NBAA Convention to launch two derivatives of what some may remember as the 1962 de Havilland DH.125 Jet Dragon, while the same event saw Cessna launch the CJ4 and that treble superlative, but really only minor 'tweak', the Citation XLS+.

Spectrum, a 2005 launch with the SA-33, returned with the larger SA-40, despite having lost the prototype of the former in an accident a few months before. Grob's G.180 SP^{n} second prototype was a further sad loss of 2006, while Honda used the AirVenture show at Oshkosh in July to proclaim its intention of marketing the HondaJet, having in the past declared it to be only a technology testbed. Piaggio also entered the confessional and admitted paternity of the twin-jet concept which was touring the bazaars in artist's impression form a year before, promising that it will now proceed to the hardware stage.

At the increasingly blurred point at which business jets merge into personal jets, Piper launched the single-engine PA-47 PiperJet; Excel-Jet flew and crashed the Sport-Jet; and AIR had the Epic Elite jet ready to fly until a new wing had to be designed and built in order to de-conflict with the intellectual rights of its erstwhile partner, Farnborough Aircraft. After some niggling problems not all of its own making, Eclipse scraped home on its target of a 2006 first customer delivery with the symbolic hand-over of the initial production Model 500 on 31 December.

TABLE 6: BUSINESS JET DELIVERIES

	2006	2005	2004	2003
Airbus A319ACJ	10	9	15	5
Beechcraft Premier	23	30	37	29
Boeing BBJ	13	4	3	7
Bombardier Learjet 40	26	21	17	0
Learjet 45/XR	30	28	22	17
Learjet 60	15	18	9	12
Challenger 300	55	50	28	1
Challenger 604	29	36	29	24
Global Express/XRS	22	13	20	14
Global 5000	18	17	4	0
Challenger 850/870/890	18			
Total	**259**	**183**	**129**	**68**
Cessna Mustang	1	0	0	0
CitationJet 1	0	14	20	22
CitationJet 1+	25	4	0	0
CitationJet 2	1	23	27	56
CitationJet 2+	36	0	0	0
CitationJet 3	72	48	6	0
Citation Bravo	18	21	25	31
Citation Encore	14	13	24	21
Citation Excel	0	0	23	48
Citation XLS	73	64	32	0
Sovereign	57	46	9	0
Citation X	12	14	15	18
Total	**309**	**247**	**181**	**196**
Dassault Falcon 50EX	5	5	5	8
Falcon 900C	0	1	3	3
Falcon 900DX	4	2	0	0
Falcon 900EX	16	16	15	20
Falcon 2000	6	6	11	12
Falcon 2000EX	30	21	29	16
Total	**61**	**51**	**63**	**59**
Eclipse 500	1	0	0	0
Embraer Legacy	27	20	13	13
Gulfstream 100/150/200	42	26	22	24
350-550	71	63	56	50
Total	**113**	**89**	**78**	**74**
Hawker 400XP	53	53	28	24
800XP/850XP	64	58	50	47
Total	**117**	**111**	**78**	**71**
Grand total	**933**	**744**	**597**	**522**

A remarkable increase of 80 per cent over four years is likely to be exceeded as more personal jets are delivered and new types reach maturity, the latter category including offerings from Adam and Diamond.

Utility and turboprop business aircraft show more modest growth, although that does not appear to have acted as a deterrent to hopeful manufacturers. Aerocomp, AIR, ATI, Evektor, Extra, GAP (Farnborough), Ibis and Quest have prospective entrants at various stages short of production, suggesting disappointment ahead for several hopefuls.

TABLE 7: LIGHT TURBOPROP DELIVERIES

	2006	2005	2004	2003
Adam 500	4	2	0	0
Beechcraft King Air 90	52	35	27	18
King Air 200	42	37	39	38
King Air 350	48	42	36	24
Cessna 208 Caravan	8	11	13	8
208B Caravan	59	75	51	49
Piaggio Avanti	19	14	16	12
Pilatus PC-12	90	80	70	61
Piper Meridian	49	40	26	24
Socata TBM 700/850	42	31	31	34
Total	**413**	**367**	**309**	**268**

Light aviation's breadth and depth precludes detailed analysis of the kind which can be applied to types dealt with above, so it must suffice to judge trends by reference to some of the larger producers. The American Light Sport classification continues to expand and draw in ever larger numbers of approved designs, of which many are from Europe. In the past year, Cessna has made moves to acquire some of this action for itself and the LSA prototype unveiled at Oshkosh in July 2006 could be its means to enter the medium reaches of the recreational market. Such a step may not appeal to its fellow companies, but 're-badgeing' may be a less involved alternative for them (if Cessna has not already adopted that route).

Having celebrated 50 years of its Model 172 and 182, Cessna chose 2006 to fly the prototype of a possible successor, provisionally known as the NGP (Next Generation Piston). If the likes of Columbia and Cirrus have not already done so, the plethora of little Light Sports arriving from Europe will have awakened Cessna to the potential of composites construction for cost reduction and for grace of line. Uniquely in Cessna, the NGP relies on composites to no mean degree, and while a sizeable proportion of American owner-pilots is likely to remain faithful to 'tin' aeroplanes for decades to come, it would be wise to put a few eggs in the composites basket.

TABLE 8: SELECTED FACTORY-BUILT LIGHTPLANE DELIVERIES

	2006	2005	2004	2003
American Champion				
Model 7	25	41	38	23
Model 8	35	48	56	40
Beechcraft Bonanza	80	71	62	55
Baron	38	28	31	27
Cessna 172	409	351	236	349
182	467	359	329	165
206	129	112	89	74
Columbia 300*	0	0	0	19
350*	39	25	28	32
400*	146	89	50	5
Cirrus SRV*	6	9	3	2
SR20*	150	116	91	112
SR22*	565	475	459	355
Diamond DA20*	55	54	58	75
DA40*	220	207	203	153
DA42*	163	68	0	0
Gippsland Airvan	20	22	20	19
Liberty XL2*	29	2	0	0
Maule (all)	38	27	27	32
Mooney Bravo	5	20	9	5
Ovation	63	65	28	30
Eagle	0	0	0	1
Acclaim	7	0	0	0
Piper Warrior	19	37	18	31
Archer	29	16	19	49
Arrow	5	9	12	16
Saratoga	47	45	40	37
6X/6XT	21	34	38	21
Seneca	26	12	10	28
Seminole	11	29	11	16
Malibu Mirage	31	11	15	7
Socata TB (all)	0	9	5	40
Symphony SA 160*	5	10	0	0
Tiger AG-5B	3	15	19	18
Totals	**2,886**	**2,416**	**2,004**	**1,836**

* Composites construction

Changes of note during the past year have included launch of Mooney's Acclaim and cessation of manufacture by both Symphony and Tiger.

Meaningful analysis of the helicopter market has been complicated of late by the reluctance of Sikorsky and AgustaWestland to publish order and delivery figures on a calendar year basis. Bell's 2006 results remain elusive because of a long term problem affecting the company's entire website and defeating any attempts to initiate an e-mail dialogue. Only Eurocopter appears to have the will and means to produce a timely summary of its activities, which shows that deliveries in 2006 totalled 381.

For many years to come, the world of military aviation will refer to December 2006 as a time-marker for two events of strategic importance. In the West, Lockheed Martin flew the prototype F-35 Lightning II Joint Strike Fighter (JSF) and in the East, Russia's Air Forces (VVS) received the first two Sukhoi Su-34 interdictors from series production. The first event is significant for not only the USAF, Navy and Marines, but for the several nations expected to acquire the machine and operate it as the major—if not the sole—combat aircraft in their inventories until the 2040s.

'Fullback' is a name which will probably convey only an erroneous, sport-related message to most Western military personnel, which fact is a reflection of the diminished threat of conflict with a militarily weakened Russia since 1991. However dimly recalled, that is the reporting name assigned to Sukhoi's latest interdictor, the Su-34, which is earmarked to replace the Su-24 'Fencer'. After a long pause caused by financial instability, Russia is again receiving new military combat aircraft from what is planned to be a properly funded and productive assembly line. Even allied to a recent resurgence of political bullying from the Kremlin, several squadrons of 'Fullbacks'—a still distant prospect—will not signal a return to the Cold War, but the recent delivery does mark a turning point in the fortunes of the VVS which Western countries should note and monitor.

The present year will see the USAF tackle the thorny question of backing the Airbus A330 or Boeing KC-767 as its delayed next-generation tanker and have decided for it which turboprop twin (C-27J or C-295) should be the Joint Cargo Aircraft it will share with the US Army. In view of the importance of C3I on the modern battlefield, it is curious that the Northrop Grumman E-10 conversion of 767 is expected to expire in 2007 because of funding starvation.

In the realm of military helicopters, the US Army has also pursued off-the-shelf procurement of existing designs from around the world. In December 2006, the Eurocopter UH-72A Lakota was commissioned into service in satisfaction of a requirement announced in September 2004, for which the EC 145 was selected in June 2006. Also in December, the German Army became the first of several air arms to receive a NHIndustries NH90—20 years to the month after design began and 23 years from the initial draft specification.

Helicopters and tiltrotors now appear to be more in demand for the US forces than fixed-wing equipment, and while latest budgetary plans restrict procurement of the latter, they call for attrition replacement helicopters (Bell UH-1Ys and AH-1Zs, Sikorsky UH-60s and Boeing CH-47s) as well as extra purchases of Bell RAH-70s. In fact, in a significant reversal of recent trends RAH-70 requirements are increased by 154, from 358 to 512.

While it has never been determined with absolute accuracy just how many swallows do make a Summer, it is unlikely to be as few as 154. For the foreseeable future, therefore, Western military aircraft production is likely to remain a slow and only moderately rewarded business, seeking any icing for its cake from Iran's increasingly worried neighbours.

Notes and Acknowledgements

In very few of its almost 100 editions has *Jane's All the World's Aircraft* undergone such a fundamental revision as that presented in this volume. The compiling team of Susan Bushell, Mike Jerram, Kenneth Munson and Lindsay Peacock have again sorted, evaluated and incorporated a mass of sometimes conflicting information which seems to increase in size with each year

A redesign of the book has presented the opportunity to modify, update and, to some extent, standardise drawings produced over the years by three different technical artists. We hope that the new style strikes the correct balance between utility and size in a publication which last year broke the 1,000-page 'barrier' for the first time.

Readers with large collections of *Jane's* may contest that assertion. The 1969-70 "bonus edition" was, indeed, 1,072 pages, but this encompassed 492 pages of UAVs, sailplanes, missiles in detail, rockets and space, aero engines in detail, aviation books, ground equipment, airports, aircraft equipment, airlines and avionics. However, none of these is covered in the current volume, most having grown into sizeable subject publications in their own right. Comparing like with like, *All the World's Aircraft* has doubled the number of its pages since 1969....but the CAP.10, SF-260, HS 125 (Hawker), H-47 Chinook, Cessna 172, Cessna 182, Champion Citabria, PC-6 Porter, C-130 Hercules, Piper PA-28, Sikorsky H-53, and several others in that edition, remain with us to this day.

The burgeoning size of our paper edition is due in no small part to the additional 46 companies and 102 aircraft added in the past year. Others—but by no means as many—have fallen by the sky's wayside, so that the final tally for this edition is 1,011 aircraft and 565 companies, not including 13 separate divisions of some of the major manufacturers. With regard to the previously mentioned general arrangement drawings, 102 brand new ones have been added to this edition and 271 existing illustrations modified and updated. The total of new photographs is 1,175, in the main (aircraft) section of the book, plus a further 50 in the preliminaries.

In addition to the compiling team already mentioned, the editor is indebted to others for their work in this edition: James Goulding and Mike Badrocke for the line drawings; and to Bill Gunston for compilation of the Glossary and Aero Engines tables. At the Jane's offices, Tracy Johnson processed all this information—including the inevitable last-minute avalanche of urgent updates which was handled with impressive speed—ably assisted in the early stages by Carol Offer.

We also rely on the goodwill of many others who contribute to completeness of the book without thought of reward: Yefim Gordon, whose regular inputs enhance the Russian Federation entries; Robert Hewson, Jamie Hunter and Martin Streetly, considered together as fellow editors of *Jane's* publications, but also assisting over and above the call of duty; Rod Simpson, well-travelled editor of Air Britain's *Aviation World* and recorder of light and general aviation; and Gerard Frawley of *Australian Aviation*.

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Paul Jackson
Pulham Market, Norfolk, March 2007

Editor's Biography

Paul Jackson FRAeS, Editor-in-Chief, *Jane's All the World's Aircraft*

The chance gift of an aircraft book at the age of six was the Genesis of a passion for all matters aeronautical that has absorbed Paul Jackson for almost half a century. Editor of an aviation society newsletter in his native East Yorkshire shortly after leaving school, he contributed to amateur and professional aviation journals, on both historical and current matters, for a further decade before becoming a freelance aerospace writer and editor. In 1987, he was invited to join the compiling team of *Jane's All the World's Aircraft*, being appointed its editor in 1994. Inevitably, his hobbies are aviation related, including flying and maintaining a veteran Aeronca Chief lightplane; chairing a branch of the Popular Flying Association; sitting as a committe member of an Air Training Corps squadron; and aviation photography.

Paul Jackson 0567909

Aircraft Type Classifications

To assist comparison between different makes of aircraft undertaking broadly similar roles, the 'TYPE' classifications which introduce each aircraft description are standardised and arranged into 13 classes.

Classification is according to *Jane's* own criteria; in some instances this may differ from a manufacturer's description. Exact capacities and engine types and numbers for large aircraft are omitted in these shorthand descriptions. However, as size diminishes, such aspects assume greater importance and, accordingly, are quoted.

Except where the type description immediately and obviously precludes it (for example, 'Strategic transport'), aircraft are assumed to be monoplanes powered by a single piston engine and propeller. Multiple engines, turboprop and jet propulsion are specifically mentioned. In deference to common usage, 'jet' includes turbojets and turbofans, as more properly described in the 'POWER PLANT' paragraph.

All aircraft are Class A (or equivalent) certified/certifiable and factory-assembled; where clarification is necessary, the term 'lightplane' is employed. Ultralights and/or aircraft built from kits are specifically noted as such. However, in view of widely differing national legislation on ultralights, it must be noted that the term has several interpretations; the most liberal (in terms of permissible maximum weight) is used in this book.

The more versatile makes of aircraft cannot be given justice in deliberately short type descriptions. Readers should be aware that the ability to undertake surveillance, geological survey, VIP transport, water bombing and many other duties can be easily bestowed on medium transports and some other types of aircraft. Crop sprayers can be reconfigured in moments for firefighting and oil pollution dispersal. The full story will be found under the 'CURRENT VERSIONS' heading.

As an aid to analysis, totals for each category are given in parentheses.

Five years have passed since this annual summary first appeared, so it is now possible to discern with a measure of certainty the trends in the aerospace industry's perceived needs for different classes of aircraft.

Bomber and surveillance	+9%
Fighter and trainer	–22%
Miscellaneous and government	+71%
Transport	–28%
Airliner	+10%
Business	+60%
Utility	+22%
Amphibian	+100%
Lightplanes (factory built)	+11%
Utility kitbuilt	+24%
Kitplanes and Ultralights	+58%
Rotary wing	+7%
Lighter than air	–16%

Trends noted above refer to the number of designs currently offered in each category; for example 23 bomber and surveillance aircraft on the market in 2002, but 25 today. Most noticeable is the falling number of military aeroplanes such as fighter/trainer and transport, to which may be added a 26 per cent decline in the number of overtly military helicopters on the market. The civil field, by contrast, continues its expansion, with business jets and their closely related cousins, the light personal jets, in the ascendant. Single-engine, piston-powered machines, particularly for home assembly, are noticeably strong performers, while the rotary wing total increase reflects the fact that civil expansion has outstripped military contraction.

Of those 1,042 specific types of aircraft on the market, 63 per cent of 851 aeroplanes have a single piston engine for power; as do 46 per cent of 158 rotary-wing aircraft. Of contents as a whole, 10 per cent of aeroplanes and 17 per cent of helicopters were designed for military purposes, not counting several types of helicopters which are equally suitable for either purpose.

Class 1: Bomber and surveillance (25)

Boeing 737 AEW&C 1121673

These are military or paramilitary aircraft of widely differing size and performance.

Strategic bomber (2)
- XAC H-6 (China)
- Tupolev Tu-160 (Russian Federation)

Maritime reconnaissance four-jet (2)
- BAE Systems Nimrod MRA. Mk 4 (United Kingdom)
- Kawasaki MP-X (Japan)

Maritime surveillance twin-jet (1)
- Boeing P-8A (United States)

Maritime surveillance twin-turboprop (3)
- Airtech CN-235 MP Persuader and CN-235 MPA (International)
- ATR 42 Surveyor (International)
- CASA C-212 Patrullero (Spain)

Airborne early-warning and control system (3)
- Airbus AEW&C (International)
- Boeing 737 AEW&C (United States)
- Northrop Grumman E-2C Hawkeye (United States)

Airborne ground surveillance system (3)
- Airbus A321 AGS (International)
- Boeing 767 Military Versions (United States)
- Raytheon Sentinel (United States)

Airborne multisensor command and control system (1)
- Northrop Grumman E-10 (United States)

Multisensor surveillance twin-turboprop (1)
- BNG BN2T-4S Defender 4000 (United Kingdom)

Multisensor surveillance turboprop (1)
- Pilatus PC-12M and Spectre (Switzerland)

Multisensor surveillance twin-prop (1)
- Vulcanair P.68 Observer and P.68 Diesel (Italy)

Multisensor surveillance lightplane (7)
- ALMS Calao (France)
- BLA Dragonfly (Optica) (United Kingdom)
- Diamond HK36TTC-MPX (Austria)
- German Aircraft Sky-MAXX (Germany)
- Schweizer SA 2-37 (United States)
- Schweizer SA 2-38 (United States)
- Seabird Jordan SB7L-360 Seeker (Jordan)

Class 2: Fighter and trainer (61)

Saab JAS 39A Gripen 1047037

Air superiority fighter (3)
- SAC (Sukhoi Su-27) J-11 (China)
- Sukhoi Su-27 (Russian Federation)
- Sukhoi Su-30 (Su-27PU) (Russian Federation)

Multirole fighter (18)
- ADA Tejas (LCA) (India)
- Boeing F-15E Eagle (United States)
- Boeing F/A-18E/F Super Hornet (United States)
- CAC J-7 (China)
- CAC J-10 (China)
- Dassault Mirage 2000 (France)
- Dassault Rafale (France)
- Eurofighter Typhoon (International)
- Lockheed Martin F-16 Fighting Falcon (United States)
- Lockheed Martin (645) F-22 Raptor (United States)
- Lockheed Martin F-35 Joint Strike Fighter (United States)
- MiG-29 and MiG-35 (Russian Federation)
- Saab JAS 39 Gripen (Sweden)
- SAC J-8 (China)
- Sukhoi Su-30M (Russian Federation)
- Sukhoi Su-33UB (Su-27KUB) (Russian Federation)
- Sukhoi Su-35 and Su-37 (Su-27SM2) (Russian Federation)
- Sukhoi T-21 PAKFA (Russian Federation)

Attack fighter (8)
- Alenia/Aermacchi/Embraer AMX (International)
- CAC FC-1 Xiaolong (China)
- HAL (SEPECAT) Jaguar International (India)
- IRIAF (HESA) Azarakhsh (Iran)
- IRIAF Saeghe (Iran)
- Mitsubishi F-2 (Japan)
- Sukhoi Su-34 (Russian Federation)
- XAC JH-7 (China)

Light fighter/advanced jet trainer (1)
- Aero L 159 (Czech Republic)

Advanced jet trainer (3)
- Boeing/BAE Systems T-45 Goshawk (International)
- GAIC FTC-2000 and CY-1 (China)
- HAIC Q-5J (China)

Advanced jet trainer/light attack jet (9)
- Aermacchi M-346 (Italy)
- Avioane IAR-99 Soim (Romania)
- BAE Systems Hawk 50, 60 and 100 Series (United Kingdom)
- HAIC L-15 (China)
- HAL HTT-39 (India)
- IACI (SAHA) Shafagh (Iran)
- KAI T-50 and A-50 Golden Eagle (Korea, South)
- MiG-AT (Russian Federation)
- Yakovlev Yak-130 (Russian Federation)

Basic jet trainer (2)
- IRIAF Tazarve (Iran)
- MMZL Bielik and Fenix (Poland)

Basic jet trainer/light attack jet (5)
- Aermacchi MB-339 (Italy)
- Aermacchi M-311 (Italy)
- HAL HJT-36 Sitara (India)
- LMAASA AT-63 Pampa (Argentina)
- HAIC JL-8 (China)

Basic turboprop trainer/attack lightplane (2)
- Embraer EMB-314 Super Tucano (Brazil)
- Golden/US Aircraft A-67 Dragon (United States)

Basic turboprop trainer (7)
- Beechcraft (3000) T-6A Texan II (United States)
- Fuji T-7 (Japan)
- IAMI (HESA) HT-80 (Iran)
- KAI KT-1 Woong-Bee (Korea, South)
- Pilatus PC-7 Mk IIM Turbo Trainer (Switzerland)
- Pilatus PC-9M Advanced Turbo Trainer (Switzerland)
- Pilatus PC-21 (Switzerland)

Basic prop trainer/attack lightplane (1)
- Aermacchi SF-260 (Italy)

Basic prop trainer (2)
- ENAER (ECH-51) T-35 Pillan (Chile)
- HAIC CJ-6A (China)

Class 3: Miscellaneous and/or government (12)

Boeing AL-1A 1121775

Aircraft of diverse or multiple duties employed generally, but not exclusively, by the state.

Missile defence system (1)
- Boeing AL-1A (United States)

Multirole twin-jet (1)
KAC Hawker 800 (Japan)
High-altitude platform (2)
Grob HALE G 600 and 600 ER (Germany)
Scaled 318 White Knight (United States)
Technology demonstrator (7)
AMV 211 (United States)
FanWing Ultralight (United Kingdom)
Northrop Grumman OFW (United States)
Piccard Solar Impulse (Switzerland)
Scaled 311 Capricorn (United States)
Scaled 316 SpaceShipOne (United States)
Terrafugia Transition (United States)
Ornithopter (1)
UTIAS 'Big Flapper' (Canada)

Class 4: Transport (26)

Sukhoi Su-80 1133356

Generally of a military nature, often with rear loading ramps. The larger aircraft are usually, but not exclusively, jet-powered. Light transports are those not exceeding 5,670 kg (12,500 lb).

Tanker-transport (2)
Airbus MultiRole Tanker-Transport (MRTT) (International)
Boeing 767 Military Versions (United States)
Medium transport/multirole (8)
Airbus A400M (International)
Antonov An-70 (Ukraine)
Boeing C-17A Globemaster III (United States)
Ilyushin/Irkut/HAL IRTA-21 (International)
Kawasaki C-X (Japan)
Lockheed Martin 382U/V Hercules (United States)
SAC Y-8 (China)
SAC Y-9 (China)
Twin-turboprop transport (11)
Airtech CN-235 (International)
Alenia C-27J Spartan (Italy)
Antonov An-38 (Ukraine)
CASA C-212 Series 400 (Spain)
CASA C-295 (Spain)
CSIR Saras (India)
HAL (Dornier) 228 (India)
Ilyushin Il-112 (Russian Federation)
PZL M28 Skytruck (Poland)
PZL M28B Bryza (Poland)
Sukhoi Su-80 (Russian Federation)
Twin-turboprop light transport (5)
AII AVA-606 (Iran)
Dorna 12/19-seat transport (Iran)
HAI Y-12 (China)
Skydesign SB100 Skylander (France)
Viking DHC-6 Twin Otter (Canada)

Class 5: Airliner and freighter (56)

Embraer ERJ-135 1153715

Civilian passenger and cargo aircraft. Jet power is implied for all large airliners; number of engines given only for medium-size aircraft; regional jets are all twins.

Supersonic airliner (1)
EADS/JAXA NEXST-1 (International)
High-capacity airliner (1)
Airbus A380 (International)
Wide-bodied airliner (9)
Airbus A300-600 (International)
Airbus A330 (International)
Airbus A340 (International)
Airbus A350 (International)
Boeing 747 (United States)
Boeing 767 (United States)
Boeing 777 (United States)
Boeing 787 Dreamliner (United States)
Ilyushin Il-96-300 (Russian Federation)
New concept airliner (1)
Blended Wing Body (International)
Four-jet freighter (1)
Boeing 747-400F (United States)
Twin-jet airliner (9)
Airbus A318 (International)
Airbus A319 (International)
Airbus A320 (International)
Airbus A321 (International)
Boeing 717 (United States)
Boeing 737 (United States)
Bombardier CSeries (Canada)
Tupolev Tu-204 and Tu-214 (Russian Federation)
Tupolev Tu-334 (Russian Federation)
Twin-jet freighter (6)
Airbus A300-600 Convertible and A300-600 Freighter (International)
Antonov An-72 and An-74 (Ukraine)
Antonov An-74-300 and An-174 (Ukraine)
Boeing 767-300 General Market Freighter (United States)
Tupolev Tu-330 (Russian Federation)
XAC WJ (China)
Regional jet airliner (17)
ACAC ARJ21 (China)
Antonov An-128 (Ukraine)
Antonov An-148 (Ukraine)
Bombardier CRJ200 and Challenger 800 (Canada)
Bombardier CRJ700 Srs 701 (Canada)
Bombardier CRJ700 Srs 705 (Canada)
Bombardier CRJ900 (Canada)
Embraer ERJ-145 (Brazil)
Embraer ERJ-135 (Brazil)
Embraer ERJ-140 (Brazil)
Embraer 170 and 190 (Brazil)
JADC YSX (Japan)
Kawasaki YPX (Japan)
Mitsubishi NGRJ (Japan)
Sukhoi RRJ (Russian Federation)
Tupolev Tu-324 and Tu-414 (Russian Federation)
Yakovlev MS-21 (Russian Federation)
Twin-turboprop airliner (10)
Antonov An-128 (Ukraine)
Antonov An-140 (Ukraine)
ATR 42 (International)
ATR 72 (International)
Bombardier Dash 8 Q100 and Q200 (Canada)
Bombardier Dash 8 Q300 (Canada)
Bombardier Dash 8 Q400 (Canada)
IAMI (HESA) Ir.An-140 Faraz (Iran)
Ilyushin Il-114 (Russian Federation)
XAC MA60 (China)
Twin-turboprop freighter (1)
UAI FF-1080 Freight Feeder (United States)

Class 6: Business (83)

Dassault Falcon 7X 1151481

The established configuration of a business jet being a twin, only single- and tri-jet configurations are specifically noted. Detailed strata devised by participants in the business jet market are not reproduced here. Instead, the main category is subdivided into small business jets with accommodation for six or fewer passengers; long-range (sub-airliner size) business jets with the 4,000 n mile (7,400 km; 4,600 mile) range necessary to fly from the US eastern seaboard to Western Europe; and the central core of twin-jets with upwards of seven seats.

Supersonic business jet (4)
Aerion SBJ (United States)
Gulfstream SBJ (United States)
SAI QSBJ (United States)
Tupolev Tu-444 (Russian Federation)
Long-range business jet (5)
Bombardier BD-700 Global Express (Canada)
Bombardier Global 5000 (Canada)
Gulfstream G300 and G400 (United States)
Gulfstream G350 and G450 (United States)
Gulfstream G500 and G550 (United States)
Large business jet (3)
Boeing Business Jet (BBJ) (United States)
Boeing Business Jet 2 (BBJ 2) (United States)
Boeing Business Jet 3 (BBJ 3) (United States)
Long-range business tri-jet (2)
Dassault Falcon 900 (France)
Dassault Falcon 7X (France)
Business tri-jet (1)
Dassault Falcon 50 (France)
Business jet (28)
Bombardier BD-100 Challenger 300 (Canada)
Bombardier CL-600 Challenger (Canada)
Cessna Citation CJ4 (United States)
Cessna 550 Citation Bravo (United States)
Cessna 560 Citation Encore (United States)
Cessna 560XL Citation Excel and XLS (United States)
Cessna 560XLS+ Citation XLS Plus (United States)
Cessna 680 Citation Sovereign (United States)
Cessna 750 Citation X (United States)
Cessna LCC (United States)
Dassault Falcon 2000 (France)
Embraer EMB-135BJ Legacy 600 (Brazil)
Embraer Phenom 300 (Brazil)
Eviation EV-20 Vantage (United States)
Hawker 400 (United States)
Hawker 800 (United States)
Hawker 900XP and 750 (United States)
Hawker 4000 (United States)
Grob G 180 SP[n] Utility Jet (Germany)
Gulfstream G100 (United States)
Gulfstream G150 (United States)
Gulfstream G200 (United States)
Learjet 40 (United States)
Learjet 45 (United States)
Learjet 60 (United States)
Piaggio P.1XX (Italy)
Spectrum S-33 Independence (United States)
Spectrum S-40 Freedom (United States)
Light business jet (12)
Adam A700 AdamJet (United States)
Beechcraft Premier (United States)
Cessna 510 Citation Mustang (United States)
Cessna 525 Citation CJ1 and CJ1+ (United States)
Cessna 525A Citation CJ2 and CJ2+ (United States)
Cessna 525B Citation CJ3 (United States)
Dirgantara/Aeronimbus NMX (International)
Eclipse Eclipse 500 (United States)
Embraer Phenom 100 (Brazil)
Honda HA-420 HondaJet (United States)
Millennium Foxjet II (United States)
Sino Swearingen SJ30-2 (United States)
Private jet (9)
AIR Epic Elite (United States)
Cirrus Jet (United States)
Diamond D-Jet (Austria)
Excel-Jet Sport-Jet (United States)
Maverick Leader (United States)
Maverick Leader II (United States)
Maverick Cruiser Jet (United States)
Maverick SmartJet (United States)
Piper PiperJet (United States)
Two-seat jet sportplane (2)
ATG-1 Javelin (United States)
Messerschmitt Me 262 (United States)
Business mono-jet kitbuilt (1)
Aerocomp CA-J Comp Air Jet (United States)
Business twin-turboprop (2)
Beechcraft King Air 90 (United States)
Piaggio P.180 Avanti (Italy)
Business turboprop (9)
AIR Epic LT and Dynasty (United States)
Extra EA-500 (Germany)
GAP Kestrel JP100 (International)
Grob G 140TP (Germany)
Grob G 160 Ranger (Germany)
Piper PA-46-500TP Malibu Meridian (United States)
SAIC LE-800 (China)
Socata TBM 700 (France)
Socata TBM 850 (France)
Business twin-prop (3)
Adam A500 CarbonAero (United States)
ATI RT-700 (United States)
High Performance TT62 Baltic (Germany)
Business prop (2)
Extra EA-400 (Germany)
Piper PA-46-350P Malibu Mirage (United States)

Class 7: Utility (79)

Neiva Ipanema 1121629

Restricted to single- and twin-engine passenger or passenger/light freight aircraft with accommodation, typically, for four or six persons. An intermediate category bridging commercial and private ownership. Crop sprayers are included.

Utility turboprop twin (5)
- Beechcraft King Air 200 (United States)
- Beechcraft King Air 350 (United States)
- BNG BN2T Turbine Islander and Defender (United Kingdom)
- Evektor EV-55 Outback (Czech Republic)
- Reims F406 Caravan II (France)

Light utility twin-prop transport (7)
- Avia Accord-201 (Russian Federation)
- BNG BN2B Islander (United Kingdom)
- MiG-201 (Russian Federation)
- Tupolev Tu-44 (Russian Federation)
- VulcanAir P.68, Observer and P.68 Diesel (Italy)
- VulcanAir VA 300 (Italy)
- Wolfsberg Raven 257 (Czech Republic)

Six-seat utility twin (2)
- Beechcraft Baron 58 (United States)
- Piper PA-34-220T Seneca V (United States)

Five-seat utility twin (1)
- OMA Sud Skycar (Italy)

Four-seat utility twin (5)
- Aeropract-37 (Russian Federation)
- Diamond DA42 Twin Star (Austria)
- Piper PA-44-180 Seminole (United States)
- MMZL EM-11 Orka (Poland)
- Tecnam P2006T (Italy)

Light utility turboprop (20)
- Aeroprogress/ROKS-Aero T-101 Grach (Russian Federation)
- Aerotech (Intracom) SMG-92T Turbo Finist (Switzerland)
- Cessna 208 Caravan (United States)
- Comp Air 9 (United States)
- Ibis Ae 270 Spirit (International)
- Integrity Integrity (Australia)
- Intracom GM-17 Viper (Switzerland)
- Intracom DS-12 (Switzerland)
- Integrity Integrity (Australia)
- Khrunichev T-501 (Russian Federation)
- Khrunichev T-205 and T-207 (Russian Federation)
- Laplan L-551 (Russian Federation)
- Maule M-7 (United States)
- Myasishchev M-101T Sokol (Russian Federation)
- PAC 750XL (New Zealand)
- Pilatus PC-12 (Switzerland)
- Quest Kodiak (United States)
- Smolensk (Technoavia) SM-92T Turbo Finist (Russian Federation)
- Smolensk (Technoavia) SM-2000 (Russian Federation)
- VulcanAir VF 600W Mission (Italy)

Light utility transport (6)
- Gippsland GA-8 Airvan (Australia)
- Laplan L-451 (Russian Federation)
- Maule M-7 and M-9 (United States)
- Pilatus PC-6 Turbo Porter (Switzerland)
- RAA Voyager E-7 (Russian Federation)
- Sherpa Sherpa (United States)

Utility biplane (1)
- SAMC Y-5 (China)

Six-seat utility transport (6)
- Beechcraft Bonanza 36 (United States)
- Cessna 206 Stationair and T206 Turbo Stationair (United States)
- Piper PA-32R-301 Saratoga II HP (United States)
- Piper PA-32R-301FT 6X (United States)
- Piper PA-32R-301T Saratoga II TC (United States)
- Piper PA-32R-301XTC 6XT (United States)

Five-seat utility transport (1)
- Found FBA-2C Bush Hawk (Canada)

Agricultural sprayer twin (1)
- VSTOL SST 2000 Paradigm (United States)

Agricultural sprayer (23)
- AII AVA-303 (Iran)
- Air Tractor AT-401 Air Tractor (United States)
- Air Tractor AT-402 Turbo Air Tractor (United States)
- Air Tractor AT-502 Turbo (United States)
- Air Tractor AT-602 (United States)
- Air Tractor AT-802 (United States)
- Avantazh A-31 Spectrum (Russian Federation)
- CZAW (Zenair) CH 701-AG STOL (Czech Republic)
- Gippsland GA200 Fatman (Australia)
- HAIC N-5 (China)
- IPE-010 (Brazil)
- Ikar Ai-70 (Ukraine)
- Istra Ezhik (Russian Federation)
- Khrunichev T-419 Strekoza (Russian Federation)
- Kulon-2 SKhS (Russian Federation)
- MVEN Fermer (Russian Federation)
- NEIVA EMB-202 Ipanema (Brazil)
- PAC Cresco (New Zealand)
- PZL M18 Dromader (Poland)
- Sukhoi Su-38L (Russian Federation)
- Thrush Turbo-Thrush S2R (United States)
- Thrush 660 Turbo-Thrush (United States)
- Weatherly 620 (United States)

Agricultural sprayer ultralight (1)
- Aerolites Aeromaster (United States)

Class 8: Amphibian (36)

Beriev Be-103 Bekas 1042996

All such aircraft (including the occasional flying boat) are included here for ease of reference, even those assembled from kits or classified as ultralights.

Four-turboprop amphibian (1)
- ShinMaywa US-1A and US-2 (Japan)

Twin-turboprop amphibian (3)
- Beriev Be-112 (Russian Federation)
- Bombardier 415 (Canada)
- Laplan L-572 (Russian Federation)

Twin-jet amphibian (1)
- Beriev (Betair) Be-200 Altair (Russian Federation)

Twin-engine amphibian biplane (1)
- Hensley H-2 (United States)

Utility amphibian (2)
- Aero-Volga LA-8 Flagman (Russian Federation)
- RIDA 256 (Russian Federation)

Six seat amphibian (4)
- Beriev Be-103 Bekas (Russian Federation)
- Beriev (KnAAPO) SA-20P (Russian Federation)
- Rida Aleks-251 (Russian Federation)
- Warrior Centaur (United Kingdom)

Six-seat amphibian/kitbuilt (1)
- Seastar Seastar (United States)

Five-seat amphibian (3)
- Chernov Che-27 (Russian Federation)
- Laplan L-471 (Russian Federation)
- Seawind Seawind 300C (United States)

Four-seat amphibian (2)
- Beriev Be-101 (Russian Federation)
- Chernov Che-25 (Russian Federation)

Four-seat amphibian kitbuilt (3)
- Cobra Landseair (Australia)
- SG Sea Storm (Italy)
- Shearwater Shearwater (New Zealand)

Three-seat amphibian/kitbuilt (2)
- A-41 VNS-41 (Vietnam)
- Gidroplan Che-22 Korvet (Russian Federation)

Three-seat amphibian kitbuilt (1)
- Aeroprakt-24 (Ukraine)

Two-seat amphibian (2)
- Air Elite Storm Rally (United States)
- Chernov Che-23 (Russian Federation)

Two-seat amphibian kitbuilt (4)
- AirMax SeaMax (Brazil)
- Colyaer Freedom (Spain)
- SG Sea Storm (Italy)
- Quikkit Glass Goose (United States)

Two-seat amphibian /kitbuilt (2)
- EDRA Aéronautica Paturi (Brazil)
- Independent JB1 SeaDragon (United States)

Two-seat amphibian ultralight kitbuilt (2)
- Aerolites Aeroskiff (United States)
- WQS Seahawk (Germany)

Two-seat amphibian ultralight/kitbuilt (1)
- CZAW Mermaid (Czech Republic)

Two-seat flying boat kitbuilt (1)
- Colyear Gannet (Spain)

Class 9: Lightplane (factory built) (146)

Yakovlev Yak-54 1127941

Single-prop aircraft seating up to five persons and available only in complete form, unless otherwise stated. The US's LSA category includes some aircraft in Class 9 as well as others categorised as Ultralights, including homebuilts.

US Light Sport Aircraft

LSA rules for aircraft and Sport Pilot categorisation for pilots came into effect on 1 September 2004, affecting current and future aircraft with a gross weight of less than 598 kg (1,320 lb) only while flying in US territory. There are three sub-categories.

Sport Pilot – Experimental: Existing Experimental category aircraft (including amateur-builts, ultralights and flex-wings) which owners may, should they wish, transfer to Sport Pilot category registration before 31 January 2008.

Sport Pilot – Standard: Existing aircraft with a certificate of airworthiness specifying MTOW below 1,230 lb, including some versions of Aeronca, Luscombe, Piper Cub and Taylorcraft. These must continue to be maintained to FAA certification standards, but can be flown by Sport Pilots.

Special LSA: Factory-built, ready-to-fly aircraft designed and constructed in accordance with the ASTM (American Society of Testing and Materials) consensus standards for light-sport aircraft. S-LSA aircraft do not receive FAA type certification; once the first example in the US has been granted a certificate of airworthiness and that form (FAA 8130-7) lodged with the Experimental Aircraft Association, the design is taken as 'approved' and further machines are automatically accepted.

Those S-LSAs approved by January 2007 are given with their official US name, which may differ in some cases from the listing in *Jane's* because of marketing under the name of an American agent.
- Aeropro EuroFox
- Aerosport Ltd. Breezer
- Aerosport Ltd. C42 Ikarus
- Aerostar Festival
- Aircraft Manufacturing & Development CH601XL
- American Legend AL3C-100 Cub
- ATEC 321 Faeta
- B&F Technik Vertriebs FK-9 Mark IV
- Colyear S100 Freedom

Cub Crafters CC11-100 Sport Cub
Czech Aircraft Works Parrot
Czech Aircraft Works Mermaid
Czech Aircraft Works Sport Cruiser
DOVA DV-1 Skylark
Evektor SportStar
Fantasy Air Allegro 2000
Flight Design CT
Gryf Aircraft Spol MD 3 Rider
Indus Aviation T211 Thorpedo
Iniziative Industriali Italiane Sky Arrow 600 Sport
Jabiru USA Sport Aircraft J170-SP
Jabiru USA Sport Aircraft J250-SP
Jabiru USA Sport Aircraft Calypso-SP
Jihlavan Airplanes KP-5 Kappa
Just Aircraft Highlander
Luscombe Silvaire LSA-8
Rans S-7LS
Remos Aircraft G-3
Skykits USA Corp Savannah
Skykits USA Corp Savannah ADV
Storm Aircraft Rally LSA
Taylor Aviation Taylor Sport
Tecnam Bravo
Tecnam Echo Super
Tecnam Sierra
TL-Ultralight Sting Sport
Zlin Savage

Updates are available from www.sportpilot.org

Five-seat lightplane (2)
Diamond DA50 Super Star (Austria)
NLA AC-500 Air Car (China)

Four-seat lightplane (33)
Bellanca 17-30 Super Viking (United States)
Cessna 172 Skyhawk (United States)
Cessna 182 Skylane (United States)
Cessna T182T Turbo Skylane (United States)
Cessna NGP (United States)
Cirrus SR20 and SRV (United States)
Cirrus SR22 (United States)
Columbia Columbia (United States)
Diamond DA40D Diamond Star (Austria)
Diamond DA40-180 Diamond Star (Canada)
EADS PZL PZL-104M Wilga 2000 (Poland)
Evektor VUT 100 Cobra (Czech Republic)
FACI Fajr F-3 (Iran)
III Arrow F300 FSJ (Italy)
Ilyushin Il-103 (Russian Federation)
Mooney M20M Bravo (United States)
Mooney M20R Ovation 2 (United States)
Mooney M20TN Acclaim (United States)
Piper PA-28-161 Warrior III (United States)
Piper PA-28-181 Archer III (United States)
Piper PA-28-201 Arrow (United States)
QME 11E (United States)
Robin DR 400 Dauphin (France)
Robin DR 400/160 Major (France)
Robin DR 400/180 Régent (France)
Robin DR 500 Président (France)
SAIC LE-500 Little Eagle (China)
Solaris Sigma and Alpha (United States)
Socata TB 9 Tampico and TB10 and TB 200 Tobago (France)
Socata TB 20 and TB 21 Trinidad
Tiger AG-5B Tiger (United States)
UTVA-96 (Serbia & Montenegro)
Zlin Z 143 (Czech Republic)

Three-seat lightplane (3)
Aviaprom M-12 (Russian Federation)
Lilienthal X-34 Bekas (Ukraine)
PAC (AMF) Mushshak and Super Mushshak (Pakistan)

Three-seat biplane (1)
Waco Classic YMF Super (United States)

Primary prop trainer/sportplane (6)
Aerostar (Yakovlev) Iak-52 (Romania)
AII AVA-202 (Iran)
Alpha 120 (New Zealand)
NAL Hansa-3 (India)
PAC Airtrainer CT/4E (New Zealand)
PZL M26 Iskierka (Poland)
Zlin Z 242L (Czech Republic)

Aerobatic two-seat sportplane (10)
CAP 10 (France)
Extra EA-200 (Germany)
Extra EA-300 and EA-330 (Germany)
Interavia I-3 (Russian Federation)
MXR MX2 (United States)
Sukhoi Su-29 (Russian Federation)
Wingtip to Wingtip Panzl S-330 (United States)
Yakovlev/Strela Bear 360 (Russian Federation)
Yakovlev Yak-9U-M (Russian Federation)
Yakovlev Yak-54 (Russian Federation)

Aerobatic two-seat lightplane (4)
Aeromot AMT-600 Guri (Brazil)
Alpha 160 (New Zealand)
Grob G 120A (Germany)
LoPresti LP-1 Fury (United States)

Two-seat lightplane (68)
3Xtrim 3X55 Trener, 3X45 Ultra and 3X47 Ultra Plus (Poland)
Advanced Aero LSA-IVT (United States)
Aerostar Festival (Romania)
Aerostyle Breezer (Germany)
Air Elite Storm Rally (United States)
AMD Zenith CH 2000 Alarus (United States)
AMD Zenith CH601XL (United States)
American Champion 7EC Champ (United States)
American Champion 7ECA Citabria Aurora (United States)
American Champion 7GCAA Citabria Adventure (United States)
American Champion 7GCBC Citabria Explorer (United States)
American Champion 8GCBC Scout (United States)
American Champion 8KCAB Super Decathlon (United States)
American Legend Cub (United States)
Aquila A 210 (Germany)
ATAC Patriot II (United States)
Avantazh A-29 (Russian Federation)
Avantazh A-35 Scanner (Russian Federation)
Aviadesign A-16 Sport Falcon (United States)
Aviat Husky A-1 (United States)
Aviat Husky Pup (United States)
Aviatika-MAI-910 Interfly (Russian Federation)
Aviation Enterprises Magnum (United Kingdom)
CAG Toxo (Spain)
Cessna LSA (United States)
CLASS Kestrel (Canada)
Corvus Corone (Hungary)
CTRM Eagle 150 (Malaysia)
Cub Crafters CC18 Top Cub (United States)
Cub Crafters CC11 Sport Cub (United States)
Custom Flight Lite Star (Canada)
CZAW Parrot (Czech Republic)
Dean-Wilson Whitney Boomerang (Australia)
DF Alto (Czech Republic)
Diamond DA 20-C1 Katana (Canada)
Dorna D139-PT1 Blue Bird (Iran)
Dubna-2 Osa (Russian Federation)
Elitar 202 (Russian Federation)
Esqual VM-1 Esqual (Belgium)
Evektor Harmony (Czech Republic)
Flight Design CT (Germany)
Freebird Xtreme (United States)
Glass STOLGlass SG70 (Colombia)
Glass SpeedGlass (Colombia)
Griffon 100 (Russian Federation)
ICP SA2 Vimana (Italy)
III Sky Arrow (Italy)
III F-200 TSJ (Italy)
Impulse Impulse (Germany)
Interstate S-1B2 Arctic Tern (United States)
Ion Ion (United States)
IPE-06A (Brazil)
Issoire APM-20 Lionceau and APM-30 Lion (France)
Jihlavan KP 5 Rapid 500 (Czech Republic)
KLN VL-3 (Czech Republic)
Liberty XL-2 (United States)
Lightwing AC4 (Switzerland)
Luscombe Silvaire LSA-8 (United States)
MAI-217 (Russian Federation)
Maule M-4 (United States)
Nexaer LSI (United States)
Rans S-7LS Courier (United States)
Sauper Papango (France)
Scheibe SF-41 Zwergfalke (Germany)
Smith Piper PA-18 Super Cub (Canada)
SSVOBB Impuls (Netherlands)
Symphony SA 160 Symphony (Canada)
Taylorcraft F22 and Sport (United States)

Motor glider (9)
Aeromot Ximango (Brazil)
Diamond HK36 (Austria)
M+D AVo 68-R Samburo (Germany)
Paravar Pars Saba (Iran)
Scheibe SF25C Falke (Germany)
Stemme S10 and S15 (Germany)
Stemme S6, S8 and S15-8 (Germany)
Vans RV-11 (United States)
Whisper Whisper (South Africa)

Aerobatic two-seat biplane (2)
Aviat Pitts S-2C (United States)
SSH (Bücker) T-131 Jungmann (Poland)

Aerobatic single-seat sportplane (4)
CAP 232 (France)
Sukhoi Su-31 (Russian Federation)
Smolensk (Technoavia) SP-55M (Russian Federation)
Yakovlev Yak-3M (Russian Federation)

Aerobatic single-seat biplane (1)
SSH (Bücker) Jungmeister (Poland)

Glider tug (2)
Robin DR 400/180R Remo 180 (France)
Robin DR 400/200R Remo 200 (France)

Class 10: Utility kitbuilt (47)

Zenith Super STOL CH 801 0527136

This class reflects the growing number of kitbuilt aircraft intended for more than recreational use. The largest has 10 seats and turboprop power.

Private jet kitbuilt (1)
Comp Air CA-J Jet (United States)

Two-seat jet sportplane kitbuilt (1)
Viper ViperJet (United States)

Two-seat kitbuilt twin (2)
Lockwood AirCam (United States)
SlipStream Defiance (United States)

Utility turboprop kitbuilt (4)
Comp Air 7 (United States)
Comp Air 8 (United States)
Comp Air 10 (United States)
Comp Air 12 (United States)

Utility kitbuilt (1)
Khrunichev T-411 Aist (Russian Federation)

Six-seat turboprop kitbuilt (1)
Sreya Envoy (United States)

Six-seat kitbuilt (3)
ADI Super Stallion (United States)
Comp Air 6 (United States)
Murphy Super Rebel and Moose (Canada)

Four-seat kitbuilt twin (2)
Creative Flight Aerocat (Canada)
Hensley H-1 Wolf (United States)

Four-seat kitbuilt (27)
Aeronix Airelle (France)
Aviation Development Alaskan Bushmaster (United States)
AviPro Bearhawk (United States)
Avyron JG-803 (France)
CLASS Bush Caddy (Canada)
Comp Air 4 (United States)
Culp's Monoculp (United States)
Dream Tundra (Canada)
Dyn'Aero MCR4S (France)
Four Winds 210 and 250T (United States)
Hughes Australian Lightwing Speed 4000 (Australia)
Jabiru J Series (Australia)
KARI Firefly (Korea, South)
Lambert Mission M212 (Belgium)
Lancair Lancair IV, IVP and Sentry (United States)
Lancair Lancair ES and Super ES (United States)
Murphy Yukon (Canada)
Pulsar Cruiser and Super Cruiser (United States)
Ravin Ravin 500 (South Africa)
St Just Super Cyclone (Canada)
Tapanee Levitation 4 (Canada)
Team Tango Foxtrot (United States)
Vans RV-10 (United States)
Velocity XL-5 (United States)
Wag-Aero 2+2 Sportsman (United States)
Zenith Zodiac CH 640 (United States)
Zenith Super STOL CH 801 (United States)

Three-seat kitbuilt (4)
Comp Air 3 (United States)
Aviaprom M-12 (Russian Federation)
Murphy Rebel (Canada)
Skygear Albatros (Korea, South)

Aerobatic three-seat biplane/kitbuilt (1)
Culp's Special (United States)

Class 11: Kitplanes and/or ultralights (280)

Aeroprakt-20 Sky Cruiser 0525065

One- or two-seat, single-prop machines intended for private ownership. 'Kitbuilt' aircraft are in the lightplane category, unless described as ultralights (and flyable as such in at least some countries). Certain aircraft are available only in complete form, while kit manufacturers may offer the option of fly-away aircraft to those requiring the aeroplane, but not the assembly work. A forward slash (/) before the word 'kitbuilt' indicates that the aircraft is available complete *or* as a kit, as in 'ultralight/kitbuilt'; whereas an 'ultralight kitbuilt' is only available in pieces.

The upper weight limit is taken to be 544 kg (some 1,200 lb), although some national limits for ultralights are far lower. In the US, the new Light Sport Aircraft (LSA) category extends upwards to 598 kg (1,320 lb), meaning that several European ultralights, while well outside the US equivalent category, fall comfortably within the privileges of the Sport Pilot licence. Typical LSA aircraft appear in a separate list under Class 9, Lightplane (factory built).

Single-seat sportplane kitbuilt (4)
Bede BD-17 Nugget (United States)
Flug Werk FW 190 (Germany)
Loehle Spitfire Elite (United States)
MSW Votec 351 (Switzerland)

Single-seat sportplane/kitbuilt (1)
Zivko Edge 540 (United States)

Single-seat ultralight/motor glider (3)
J&AS J6 Fregata (Poland)
Noin Exel (France)
TeST TST-13 Junior 2005 (Czech Republic)

Single-seat ultralight (3)
ATEC 212 Solo (Czech Republic)
Just Plane Passions Vampire (Australia)
Kolb Firefly (United States)

Single-seat ultralight kitbuilt (14)
Aerolites Bearcat (United States)
Blue Yonder E-Z KingCobra (Canada)
Brand RB-1 (Australia)
Fisher Avenger (United States)
Flightstar Spyder (United States)
Flying Machines B612 (Czech Republic)
Fly Synthesis Wallaby (Italy)
Free Bird Sportlite 103 (United States)
Kolb Firefly (United States)
Mecklenburger Me-109 (Germany)
Murphy JDM-8 (Canada)
Sky Raider (United States)
Slipstream Scepter (United States)
Teknico Supa'Pup Mk 4 (Australia)

Single-seat ultralight/kitbuilt (2)
Sapphire LSA Mk II (Australia)
Silence Twister (Germany)

Single-seat ultralight biplane (1)
Aviatika-MAI-890 (Russian Federation)

Single-seat ultralight biplane kitbuilt (3)
Fisher Youngster and Youngster V (United States)
Great Plains Easy Eagle (United States)
Yesteryear MiFyter (United States)

Single-seat ultralight motor glider/kitbuilt (2)
Ekolot JK-01a Elf (Poland)
USA Cumulus (United States)

Single-seat motor glider ultralight (2)
AMS Carat A (Slovenia)
Dewald Melos 3000 (Germany)

Tandem-seat kitbuilt (11)
Aerolab Camp (Italy)
Airframes/Dakota Super 18 (United States)
Blue Yonder E-Z Flyer (Canada)
Custom Flight North Star (Canada)
Dalastek S45 Mystère (Canada)
LH-10 Ellipse (France)
Rans S-7S Courier (United States)
Rans S-19 (United States)
Van's RV-4 (United States)
Van's RV-8 and RV-8A (United States)
Wag-Aero Sport Trainer (United States)

Tandem-seat sportplane kitbuilt (11)
Kimball Model 15 Raptor A S (United States)
Kimball DR 109 (United States)
Legend Legend (United States)
MSW VOTEC 322 (Switzerland)
New Century Radial Rocket (United States)
Supermarine Spitfire (Australia)
Swiss Light Revolution (Germany)
Team Rocket F1 (United States)
Titan T51 Mustang (United States)
Warner Sportster (United States)
Zivko Edge 540T (United States)

Tandem-seat turboprop sportplane kitbuilt (2)
Algie LP-1 (United States)
Legend Turbine Legend (United States)

Tandem-seat turboprop sportplane/kitbuilt (1)
Cameron P-51G (United States)

Tandem-seat sportplane/kitbuilt (1)
Roland Bf 109G-2 (Germany)

Tandem-seat lightplane/kitbuilt (1)
US Light Aircraft Hornet (United States)

Tandem-seat ultralight (9)
Aeroprakt-30 (Ukraine)
Albatross AS-3A (Russian Federation)
DAR-21 Vector (Bulgaria)
III Sky Arrow (Italy)
Kolb Sling Shot (United States)
Podešva UL Piper (Czech Republic)
Lilienthal X-32 Bekas (Ukraine)
Mára Wing L-1 Malamut (Czech Republic)
VAM VAM-1 (Vietnam)

Tandem-seat ultralight kitbuilt (6)
Free Bird Sportlite 103 (United States)
Just Summit (United States)
Kolb Kolbra (United States)
Lockwood Drifter and Super Drifter (United States)
Rocky Mountain Ridge Runner (United States)
Sky Raider Sky Raider II (United States)

Tandem-seat ultralight/kitbuilt (7)
Aeroprakt-20R-912 Sky Cruiser (Ukraine)
HB Flugtechnik Cubby (Austria)
Hughes Pocket Rocket (Australia)
Podešva Trener Baby (Czech Republic)
Storch Storch SS Mk 4 (Serbia & Montenegro)
TL-232 Condor (Czech Republic)
Zlin Aviation (Russo) Savage (Czech Republic)

Tandem-seat biplane kitbuilt (3)
Aviat (Christen) Eagle II (United States)
Culp's Sopwith Pup (United States)
Steen Pitts 14 (United States)

Tandem-seat biplane/kitbuilt (1)
Kimball (Pitts) Model 12 (United States)

Tandem-seat ultralight motor glider (1)
Airsport Sonata (Czech Republic)

Tandem-seat ultralight biplane/kitbuilt (3)
B&F FK 12 Comet (Germany)
Podesva C104 (Czech Republic)
Hughes PR-Bipe (Australia)

Tandem-seat ultralight biplane kitbuilt (4)
Airlony Highlander (Czech Republic)
Fisher R-80 and RS-80 Tiger Moth (United States)
Murphy Renegade II (Canada)
Murphy Renegade Spirit (Canada)

Tandem-seat twin/kitbuilt (1)
Aeroprakt-36 (Ukraine)

Tandem-seat ultralight twin/kitbuilt (1)
Aeroprakt-26 (Ukraine)

Side-by-side kitbuilt (32)
Aerocomp Merlin GT (United States)
Aeronix Airelle (France)
Airdale Flyer (United States)
Airdale Magnum (United States)
AirStart Griffin (Canada)
Alpi Pioneer 200 (Italy)
Alpi Pioneer 300 (Italy)
Arion Lightning (United States)
Aviation Enterprises Magnum (United Kingdom)
Bushwhacker Air Bushwhacker (United States)
Creative Flight Aerocat (Canada)
Custom Flight Lite Star (Canada)
CZAW Parrot (Czech Republic)
DAC Ranger (Netherlands)
Dyn'Aero MCR01 (France)
Glasair Super II (United States)
Glasair III (United States)
GlaStar GlaStar (United States)
HB Flugtechnik HB 207 Alfa (Austria)
Helisota LAK-X (Lithuania)
HPA M1 Speedcruiser (United States)
Kitfox Kitfox (United States)
Lancair Legacy (United States)
Pulsar Super Pulsar 100 (United States)
Pulsar Sport 150 (United States)
Slipstream Genesis (United States)
Team Tango Tango 2 (United States)
Ultravia Pelican (Canada)
Van's RV-7 and RV-7A (United States)
Van's RV-9 and RV-9A (United States)
Van's RV-12 (United States)
Wag-Aero Wag-A-Bond (United States)

Side-by-side sportplane kitbuilt (4)
Algie LP-1 (United States)
Bede BD18 Nugget (United States)
Kimball McCullocoupe (United States)
Nemesis NXT (United States)

Side-by-side sportplane/kitbuilt (1)
Dyn'Aero CR100, CR110 and CR120 (France)

Side-by-side lightplane/kitbuilt (14)
Avantazh Aeropract-27 (Russian Federation)
Aero AT-3 (Poland)
Aeropract-33 (Russian Federation)
Brumby Brumby (Australia)
Bushwhacker Bushcub (United States)
CZAW Sport Cruiser (Czech Republic)
EG Voyager VR 202 (Italy)
Evektor SportStar (Czech Republic)
Indus Thorpedo and Sky Skooter (United States)
Sequoia Falco F.8L (United States)
SG Storm (Italy)
Tecnam P92 Echo (Italy)
Tecnam P2002 Sierra (Italy)
Tecnam P2004 Bravo (Italy)

Side-by-side lightplane/motor-glider kitbuilt (1)
Europa Europa (United Kingdom)

Side-by-side ultralight (44)
3Xtrim 3X55 Trainer, 3X45 Ultra and 3X47 Ultra Plus (Poland)
Aeroálcool Quasar Lite (Brazil)
Aeroandina MXP-1000 (Colombia)
AeroJames Isatis 01 (France)
Aeromoragón Stela (Spain)
Aero Services Guepard and Guepy (France)
Aerostar Festival (Romania)
Airsport Sonet (Czech Republic)
ALMS J.300 Series 4 Joker (France)
ALMS Papango (France)
Aviakit Vega 3000 (France)
B&F FK 9 (Germany)
B&F FK 14 Polaris (Germany)
Coavio DF 2000 (Italy)
Colyaer Martin 3 (Spain)
Corvus Corone (Hungary)
Danex Eurocub (Hungary)
DAR-23 Aksent (Bulgaria)
Ekolot JK-05 Junior (Poland)
Ekoflug MXP-740 (Slovakia)
Elitar Sigma-4 (Russian Federation)
Euroala Jet Fox 97 (Italy)
Eurofly FB5 Star Light (Italy)
Flight Design CT (Germany)
Flying Machines FM 250 Vampire (Czech Republic)
Fly Synthesis Texan (Italy)
Fly Synthesis Manthos (Italy)
Halley Apollo Fox (Hungary)
ICP Savannah (Italy)
Ikar Ai-10 Ikar (Ukraine)
Impulse Impulse (Germany)
Jihlavan KP 2U Rapid (Czech Republic)
Kieger AK3 (France)
KLN VL-3 (Czech Republic)
Lambert Mission M106 (Belgium)
Larus Larus (Czech Republic)
LD Aviation MFI 9UL1 (Czech Republic)
MB Avio C26 (Italy)
Medway SLA 100 Executive (United Kingdom)
Pipistrel Virus (Slovenia)
SG Rally (Italy)
Tecnam P96 Golf (Italy)

TL-96 Star and TL-200 Sting Carbon (Czech Republic)
Yak Aero Benelos (France)

Side-by-side ultralight kitbuilt (35)
Alisport Yuma (Italy)
Airdale Avid Flyer Mark IV (United States)
Airlony Skylane (Czech Republic)
Best Off Sky Ranger (France)
CAG Toxo (Spain)
Cobra Arrow (Australia)
Cobra Explorer (Australia)
Dart Dragonfly (South Africa)
Dyn'Aero MCR01 (France)
Euro Pingouin 152 (France)
Fisher Dakota Hawk (United States)
Flightstar IISL and IISC (United States)
Flyitalia MD3 Rider (Czech Republic)
Fly Synthesis New Wallaby (Italy)
FMP Qualt (Czech Republic)
Foxcon Terrier 2000 (Australia)
Free Bird Litesport Classic (United States)
German Aircraft Sky-MAXX (Germany)
Kolb Laser 2 (United States)
Kolb Mark III Xtra (United States)
Lobb Falco 95 (Slovakia)
Murphy Maverick (Canada)
Noin Choucas (France)
Nordic 8 Mini Explorer (Canada)
Raj Hamsa X-Air (India)
Rans S-6 Coyote II (United States)
Rans S-12XL Airaile and S-12S Super Airaile (United States)
Reality (Just Plane) Escapade (United Kingdom)
Skygear Bikini (Korea, South)
SlipStream Revelation (United States)
Sonex Sonex (United States)
Teknico AeroPup (Australia)
Zenith Zodiac CH 601HD (United States)
Zenith Zodiac CH 601XL (United States)
Zenith STOL CH 701 (United States)

Side-by-side ultralight/kitbuilt (41)
Aerodynos JA-177 Evolution (Colombia)
Aeronix Airelle (France)
Aeroprakt-22 (Ukraine)
Aeropro Eurofox (Slovakia)
Aerospool WT-9 Dynamic (Slovakia)
Aerostyle Breezer (Germany)
ALMS Jodel D 20 (France)
ATEC Zephyr and Faeta (Czech Republic)
AveoTech Aveo X, XT and XTC (United States)
Brumby Brumby (Australia)
CLASS Kestrel (Canada)
DF Alto (Czech Republic)
EG Voyager VR 202 (Italy)
Esqual VM-1 Esqual (Belgium)
Evektor teamEurostar (Czech Republic)
Fantasy Air Allegro and Arius (Czech Republic)
Fläming Air FSU Smaragd (Germany)
Fly Synthesis Storch (Italy)
G1 Aerospace Guérin G1 (France)
GM+T Pretty Flight (Romania)
Hughes Australian LightWing GR-912 (Australia)
Hughes Australian LightWing Sport 2000 (Australia)
Hughes Australian LightWing Speed (Australia)
Humbert Tétras (France)
Ikarus C42 (Germany)
Interplane Skyboy (Czech Republic)
Jabiru Jabiru (Australia)
Jabiru J160 Series (Australia)
Jihlavan KP 5 ASA Rapid 500 (Czech Republic)
Opus ARV Super2 (United States)
OSKBES MAI-223 Kityonok (Russian Federation)
Podesva UL Tulák (Czech Republic)
Protoplane Ultra (France)
Raj Hamsa Hanuman (India)
Remos G-3 Mirage (Germany)
Swiss Light D4 BK Fascination (Germany)
Swiss Light D5 Evolution (Germany)
ULBI Wild Thing (Germany)
Urban UFM-10 Samba (Czech Republic)
Urban UFM-13 Lambáda (Czech Republic)

Side-by-side ultralight biplane (1)
Aviatika-MAI-890 (Russian Federation)

Side-by-side ultralight biplane kitbuilt (1)
Yesteryear Bifyter (United States)

Side-by-side ultralight motor glider kitbuilt (2)
Flaming Air FA 03 Smaragd TMG (Germany)
Sonex Xenos (United States)

Side-by-side motor glider kitbuilt (1)
Cobra Arrow (Australia)

Side-by-side motor glider ultralight (1)
AMS Magnus (Slovenia)

Side-by-side ultralight/motor glider/kitbuilt (3)
Noin Excel (France)
Pipistrel Sinus (Slovenia)
Protoplane Massai (France)

Side-by-side ultralight twin (1)
Airox F-31 (Czech Republic)

Class 12: Rotary wing (153)

Kawasaki OH-1 1121801

Includes tiltrotors, autogyros and lifting platforms. Light utility helicopters are those not exceeding 5,000 kg (11,023 lb) maximum take-off weight.

Attack helicopter (8)
Bell 449 SuperCobra (United States)
Boeing AH-64 Apache (United States)
Denel AH-2 Rooivalk (South Africa)
Eurocopter 665 Tiger/Tigre (International)
Fuji (Boeing) AH-64D (Japan)
Kamov Ka-50 Chernaya Akula (Russian Federation)
Kamov Ka-52 Alligator (Russian Federation)
Mil Mi-28 (Russian Federation)

Armed observation helicopter (3)
Bell RAH-70 (United States)
HAL Lancer (India)
Kawasaki OH-1 (Japan)

Naval combat helicopter (4)
CHAIG Z-8 (China)
Kaman (K894) SH-2G Super Seasprite (United States)
Mitsubishi (Sikorsky) SH-60 (Japan)
Sikorsky S-70B (United States)

Heavy lift helicopter (3)
Eurocopter HTH (International)
Mil Mi-26 (Russian Federation)
Sikorsky CH-53X (United States)

Medium lift helicopter (2)
Boeing 114 and 414 Chinook (United States)
Kawasaki (Boeing) CH-47J Chinook (Japan)

Light lift helicopter (1)
Kaman K-1200 K-MAX (United States)

Medium transport helicopter (7)
Kamov Ka-29 (Russian Federation)
Kamov Ka-60 Kasatka (Russian Federation)
Kazan Ansat-3 Maksimum (Russian Federation)
Kazan/Mil Mi-17 (Russian Federation)
Mil Mi-38 (Russian Federation)
Mitsubishi (Sikorsky) UH-60 (Japan)
Sikorsky S/H-92 (United States)

Multirole medium helicopter (20)
Agusta-Bell 412 and Griffon (International)
AgustaWestland A139 (International)
AgustaWestland A149 (International)
AgustaWestland EH101 (International)
Bell 412 (Canada)
Bell UH-1Y (United States)
CHRDI Z-10 (China)
Dirgantara (Eurocopter) NAS-332 Super Puma (Indonesia)
Eurocopter Super Puma Mk I and Cougar Mk I (International)
Eurocopter Super Puma Mk II and Cougar Mk II (International)
HAL LCH (India)
Kamov Ka-32 (Russian Federation)
Kamov Ka-62 (Russian Federation)
Kawasaki (AgustaWestland EH101) KHI-01 (Japan)
Mil Mi-17 (Mi-8M), Mi-19, Mi-171 and Mi-172 (Russian Federation)
Mil Mi-54 (Russian Federation)
NHIndustries NH90 (International)
PZL W-3 Sokół (Poland)
Sikorsky S-70A (United States)
Sikorsky S-76 (United States)

Light utility helicopter (40)
AgustaWestland A 109 (International)
AgustaWestland A 109S Grand (International)
AgustaWestland A 119 Koala (International)
AgustaWestland Lynx (International)
Bell 206B-3 JetRanger III (Canada)
Bell 206L-4 LongRanger IV (Canada)
Bell 407 (Canada)
Bell 417 (Canada)
Bell 427 (Canada)
Bell 429 Globalranger (Canada)
Bell 430 (Canada)
CHAIG Z-11 (China)
Enstrom 480 and TH-28 (United States)
Eurocopter AS 350 Ecureuil/AStar and AS 550 Fennec (International)
Eurocopter AS 355 Ecureuil 2/TwinStar and AS 555 Fennec (International)
Eurocopter AS 365N Dauphin 2 and AS 565 Panther (France)
Eurocopter EC 130B (International)
Eurocopter EC 135 and EC 635 (France)
Eurocopter EC 155B (International)
Eurocopter EC 120 B Colibri (International)
Eurocopter BK 117 (International)
Eurocopter EC 145 (International)
Eurocopter UH-72A Lakota (International)
FH-1100 FHoenix (United States)
HAI (Eurocopter) Z-9 Haitun (China)
HAI Z-X (China)
HAL Dhruv (India)
HAL Cheetah and Cheetal (India)
HAL Chetak and Chetan (India)
IAMI (HESA) Shahed 278 (Iran)
IRGC Shahed 274 (Iran)
KAI (Bell) 429 (Korea, South)
KAI KUH (Korea, South)
Kamov Ka-226A Sergei (Russian Federation)
Kazan Ansat (Russian Federation)
MD 500 and MD 530 (United States)
MD 520N (United States)
MD 600N (United States)
MD Explorer (United States)
PZL SW-4 (Poland)

AEW helicopter (1)
Kamov Ka-31 and Ka-35 (Russian Federation)

Four-seat helicopter (3)
Mil Mi-34 (Russian Federation)
Robinson R44 (United States)
Schweizer 330 and 333 (United States)

Three-seat helicopter (5)
Enstrom F28 and 280 (United States)
Kazan Aktai (Russian Federation)
MK Helicopter MK 3 (Germany)
Mil Mi-60 (Russian Federation)
Schweizer 300C (United States)

Three-seat helicopter kitbuilt (1)
Pawnee Chief (United States)

Two-seat helicopter (5)
Aerocopter AK1-3 (Ukraine)
DFH Dragon 334 (Italy)
Guimbal Cabri G2 (France)
Istra Istra (Russian Federation)
Robinson R22 (United States)

Four-seat helicopter kitbuilt (1)
VAT Hummingbird (United States)

Two-seat helicopter kitbuilt (3)
Aviotecnica ES-101 Raven (Italy)
Dynali H2 (Belgium)
Rotorway Exec 162F (United States)

Two-seat helicopter/kitbuilt (1)
Aerokopter AK1-3 (Ukraine)

Two-seat ultralight helicopter (1)
NA Design NA 40 Bongo (Czech Republic)

Two-seat ultralight helicopter kitbuilt (4)
ASII Ultrasport 496 (United States)
Aviotecnica ES-101 Raven (Italy
Helisport CH-7 Kompress (Italy)
Helo Werks HX-1 Wasp (United States)

Single-seat ultralight helicopter (1)
Winner M500 (Belgium)

Single-seat ultralight helicopter kitbuilt (4)
ASII Ultrasport 254 and 331 (United States)
Eagle Helicycle (United States)
Innovator Mosquito (Canada)
Yoshine EzyCopter (Taiwan)

Four-seat autogyro (1)
Groen Hawk 4 (United States)

Three-seat autogyro (2)
Aero-Astra Okhotnik (Russian Federation)
Irkut A-002 (Russian Federation)

Two-seat autogyro kitbuilt (1)
Butterfly Golden Butterfly (United States)

Two-seat autogyro ultralight (4)
- Aerocopter Futura (Spain)
- Autogyro Europe MT-03 (Germany)
- ELA-07 (Spain)
- NewGen CARLA (United Kingdom)
- Proair Skywalk (Czech Republic)

Two-seat autogyro ultralight kitbuilt (4)
- ABS Xenon (France)
- Air Command Commander Elite (United States)
- Little Wing Roto-Pup (United States)
- RAF 2000 (Canada)

Two-seat autogyro ultralight (4)
- American Autogyro SparrowHawk (United States)
- Magni M 16 Tandem Trainer (Italy)
- Magni M 22 (Italy)
- Chayair Sycamore (South Africa)

Single-seat autogyro (1)
- Ustinov Adel' (Russian Federation)

Single-seat autogyro ultralight (3)
- Gyrotec DF 02 (Germany)
- Magni M 20 Talon (Italy)
- MAI 205 (Russian Federation)

Single-seat autogyro ultralight kitbuilt (4)
- Air Command Commander Elite (United States)
- Butterfly Super Sky Cycle (United States)
- Layzell AV-18 (United Kingdom)
- Little Wing Roto-Pup (United States)

New-concept rotorcraft (3)
- Bell Modular Affordable Product Line (Canada)
- Piasecki Vectored Thrust Ducted Propeller (United States)
- Sikorsky X2 (United States)

Lifting vehicle (5)
- Liftium HAL (France)
- PAM 100B Individual Lifting Vehicle (United States)
- Trek Dragonfly UMR-1 (United States)
- Urban Aero CityHawk (Israel)
- Urban Aero X-Hawk (Israel)

Exoskelitor flying vehicle (2)
- Gen H-4 (Japan)
- Trek Springtail EFV-4 (United States)

Light utility tiltrotor (1)
- Bell/Agusta BA609 (International)

Multimission tiltrotor (3)
- Bell Quad Tiltrotor (United States)
- Bell Boeing V-22 Osprey (United States)
- Eurotilt (International)

Convertiplane (3)
- Carter CarterCopter CC1 (United States)
- Carter PAV 2+2 (United States)
- Groen Gyrolifter (United States)

Class 13: Lighter than air (32)

Lightship A-60+ 0558597

All are (at least broadly) cylindrical dirigibles, unless otherwise specified.

Helium rigid (1)
- Nagy High-Speed Airship (United States)

Helium semi-rigid (3)
- Liftium Liftium series (France)
- TAG AG (Malaysia)
- Zeppelin NT (Germany)

Helium non-rigid (15)
- ABC Lightship A-60+ (United States)
- ABC Lightship/Spector Series (United States)
- Aeros 40 Sky Dragon (United States)
- Evolution FS 200 Friendship 200 (Germany)
- RosAeroSystems Au-11 (Russian Federation)
- RosAeroSystems Au-12 (Russian Federation)
- SkyCat AT-10 (United Kingdom)
- Skycruiser Skyship 500HL (United States)
- Skycruiser Skyship 600 (United States)
- Skycruiser Skyship 1000 (United States)
- SVAM CA-80 Vantageship (China)
- SVAM CA-120 Vantageship (China)
- USAI UL1 and UL2 (United States)
- Voliris 900 (France)
- Winderafter CA 108 (United States)

Helium non-rigid special shape (3)
- 21st Century SPAS-R1 (Canada)
- TSI SA-60 (United States)
- TSI SA-90 (United States)

Hybrid rigid air vehicle (2)
- DARPA Walrus (United States)
- Ohio Dynalifter (United States)

Hybrid semi-rigid air vehicle (1)
- JP Aerospace Ascender (United States)

Hybrid non-rigid air vehicle (1)
- SkyCat SkyCat (United States)

Hybrid buoyant aircraft (2)
- Aeros Aeroscraft (United States)
- Lockheed-Martin P-791 (United States)

Hot air non-rigid (4)
- Avgur Au-29 Zyablik (Russian Federation)
- Avgur Au-35 (Russian Federation)
- Gefa-Flug AS 105 GD (Germany)
- Kubicek AV-2 (Czech Republic)

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First Flights

Some of the first flights made during 2006

The present trend for longevity in military aircraft will make the closing days of 2006 significant until the middle of the 21st Century. Lockheed Martin's F-35 Lightning II Joint Strike Fighter climbs skyward at Fort Worth on 15 December 1154709

Argentina

LMAASA AT-63 Pampa NG, first to production standard (E-816; converted prototype EX-02) 13 Feb

Australia

Dean-Wilson Whitney Boomerang (VH-AAV) 1154713

Dean-Wilson Whitney Boomerang (VH-AAV) 6 Jul

Austria

Diamond D-Jet 1154710

Diamond Aircraft D-Jet (C-GVLJ) 18 Apr

Canada

Bombardier Challenger 605 1154714

Bombardier Challenger 605 (C-FGYM) 22 Jan

Big Flapper ornithopter 1154711

UTIAS Big Flapper (C-GPTR) 8 Jul

China

HAIC L-15 advanced trainer 1154715

HAIC L-15 (01) 13 Mar
CAC FC-1/JF-17 Xiaolong, third prototype (04) 28 Apr
CAC FC-1/JF-17 Xiaolong, fourth prototype (06) 10 Sep
Hafei FY550 18 Oct

Czech Republic

Wolfsberg Corvus 1F 1154712

Wolfsberg-Letov Corvus 1F (OK-WLT) 6 Jun

Evektor Super Cobra 1154716

Evektor VUT100-131i Super Cobra (OK-RAF) 24 Oct

France

Socata TBM 850, first production (F-WWRE/N850TB) 23 Jan
Balaskovic Alizé airship (W17-OD) *(first untethered flight)* 6 Sep
Best Off Sky Ranger Swift 912S (G-UPHI) **Oct

Germany

Impulse Xtreme 1154717

Impulse Xtreme 3000 (D-EYKS) 19 May
Grob SP[n] second prototype (D-CGSP) 29 Sep
(destroyed 29 November 2006)

India

Tejas fifth prototype 1154721

ADA LCA Tejas, fifth prototype (PV3/KH2005)	1 Dec

International

AgustaWestland KH-101, first assembled by Kawasaki (8651)	15 Feb
Airbus A310-300, Advanced Refuelling Boom System testbed (EC-HLA)	16 Mar
Airbus A330-200 MRTT, first for RAAF (F-WWYI)	30 Mar

South African Lynx 1154718

AgustaWestland Super Lynx 300, first for South African Navy (ZK115/191)	24 Apr
Eurocopter EC 145 Advanced Technology Rotor testbed (D-HMBK)	26 Apr
Airbus A380-800, third prototype (MSN003/F-WWSA/9V-SKA)	7 May
Eurocopter AS 532AL Cougar Mk I, first for Bulgarian Air Force (F-ZKBL/701)	9 May
NH Industries NH 90, first NFH for French Navy (F-ZWTO)	12 May
Airbus A319ACJ, first for Czech Air Force (D-AVWU/2801)	3 Jul
Airbus A380-800, fourth prototype (F-WWSB)	19 Jul

GAP (Farnborough) Kestrel 1154722

GAP Kestrel JP100/FACL F1 (N352F)	29 Jul
Airbus A380-800, first flight with passengers (MSN002/F-WXXL)	4 Sep

EH101 with BERP blades 1154719

AgustaWestland EH101, first flight in BERP IV upgrade configuration (G-17-510)	26 Sep
Airbus A318-100 Elite (D-AUAA/F-WWIB/HB-IPP)	10 Oct
Airbus A380-800, fifth prototype, first with GP7200 engines (MSN009/F-WWEA)	25 Aug

Second BA609 1154723

Bell/Agusta BA609, second prototype (N609AG)	9 Nov
Airbus A380-800, sixth prototype (MSN006/F-WWSC)	17 Nov
NH Industries NH 90, first NFH for Royal Norwegian Air Force (013)	20 Dec

Italy

Initial AMI C-27J 1154720

Alenia C-27J Spartan, first for Italian Air Force (MM62215)	24 Jul

Japan

Fuji/Boeing Apache 1154724

Boeing AH-64DJP Apache, first Fuji-assembled aircraft for JGSDF (N3216N/02-0004/745011)	25 Jan
Tokyo Institute of Technology experimental aircraft flew for 59 seconds powered solely by 160 AA-size batteries	16 Jul

Netherlands

DAC RangeR prototype (PH-DAC)	15 Sep

New Zealand

Alpha 160A, first New Zealand-built (ZK-FXY)	12 Apr

Russian Federation

Tupolev Tu-204-120CE, first for Air China Cargo (RA-64030)	14 May

Sukhoi Su-80GP 1154725

Sukhoi Su-80GP, first pre-production (unmarked; c/n 01-05)	29 Jun
Sukhoi Su-34, first production (01)	12 Oct

Switzerland

MSW Aviation Votec 351 (HB-YMV)	23 Sep

Taiwan

Prototype AIDC F-CK-1C 1154729

AIDC F-CK-1C Shiang-Seng IDF (converted F-CK-1A 95-8136)	9 Oct

United Kingdom

BAE Systems Hawk Mk 132, first for Indian Air Force (ZK121/HT001)	13 Dec

United States

Advanced Aero Vortex (N101VX)	6 Jan

Spectrum S-33 Independence 1154726

Spectrum Aeronautical Spectrum S-33 Independence (N322LA) *(crashed 25 July)*	7 Jan
Cessna 510 Citation Mustang, second production (N510KS)	27 Jan
Lockheed Martin P-791 airship (N791LM)	31 Jan
Carter 002 CGD-T (N899CC)	** Jan

AdamJet first production 1154730

Adam Aircraft A700 AdamJet, first production (N700LJ)	6 Feb
Arion Lightning (N233AL)	3 Mar

First F-16 for Poland 1154727

Lockheed Martin F-16C Block 52, first for Polish Air Force (03-0040/4040)	14 Mar
Mooney M20TN Acclaim (N311TN)	16 Mar
Cessna 560 Citation Encore+, first production (N560CC)	22 Mar
Bombardier Learjet 60^{XR} (N50163)	3 Apr
Boeing/DARPA X-37, first air-launched flight	7 Apr

Excel-Jet Sport-Jet 1154731

Excel-Jet Sport-Jet (N350SJ) *(crashed 22 June)*	13 May

Gulfstream G550, first Nachshon conformal AEW version for Israel (N637GA/637)	20 May
Tri-State Aviation P-51A Mustang replica (N8082U)	7 Jun
Cessna Citation Mustang, third (first Independence-built) production (N403CM)	15 Jun

Cessna NGP 1154732

Cessna Next Generation Piston (NGP) (N99110)	23 Jun
Bell 445 ARH-70A, first for US Army (N44515)	20 Jul
Boeing EA-18G Growler (166641)	15 Aug

Seawind 300C 1154733

Seawind Seawind 300C, first production (C-GDBS)	31 Aug
Boeing 737-900ER (N900ER/PK-LAG)	1 Sep
Boeing 747-400 Dreamlifter (Large Cargo Freighter) (N747BC)	9 Sep

Golden A-67 Dragon 1154736

Golden Aviation/US Aircraft A-67 Dragon (N906US)	6 Oct

Cessna LSA 1154734

Cessna Light Sport Aircraft (N158CS)	13 Oct

Nexaer LS-1 1154737

Nexaer LS1 (N103XR) *(runway hop only)*	16 Oct
Boeing CH-47F Chinook, first production	23 Oct

Skyacht Personal Blimp 1154735

Skyacht Aircraft Personal Blimp *Alberto* (N111SY, registered as Nachbar SY-1) *(first untethered flight)*	27 Oct
Boeing C-17A Globemaster III, first for Royal Australian Air Force (A41-206)	7 Nov
Van's RV-12 (N912VA)	9 Nov
Boeing EA-18G Growler, second production (166642)	10 Nov
Lockheed Martin F-35A Lightning II, first prototype (AA-1)	15 Dec
Boeing KC-767, first for Japan Air Self-Defence Force (N763TT)	21 Dec

Gulfstream Nachshon 1154762

Aerospace Calendar

Some significant aerospace events in 2006

2006 was the year in which Embraer completed the introduction to service of its four-member E-jet family, the last being the Embraer 195, delivered to Flybe on 1 September

1154743

2006	Military aviation	Civil aviation
3 Jan	Sikorsky awarded system development and demonstration (SDD) contract for CH-53K heavy lift helicopter	Sikorsky Aircraft announced that it had received FAA certification for the S-76C++
12 Jan	US Army cancelled contract with Lockheed Martin for Aerial Common Sensor replacement for the Beechcraft RC-12 Guardrail	
23 Jan		First production EADS Socata TBM 850 turboprop made initial flight on same day as award of FAA certification
Jan		First flight of Carter PACV 2+2 convertiplane
1 Feb		First flight of 5,000th Boeing 737; delivery accomplished 13 Feb to Southwest Airlines
17 Feb	Critical design reviews of F-35A and F-35B versions of Lockheed Martin Joint Strike Fighter successfully concluded	
19 Feb	First SDD Lockheed Martin F-35 Joint Strike Fighter rolled off production line at Fort Worth, Texas	
23 Feb		Mooney Airplane Company delivered its 11,000th production aircraft; the milestone machine was an Ovation2 GX, which was accepted by Dennis Strigl of New Jersey
Feb	Production of first wing assembly for Airbus Military A400M began at Filton, UK	

First operational F-22A Raptor

1154739

3 Mar	USAF 94th FS receives the first Lockheed Martin F-22A Raptor destined for an operational squadron	First flight of prototype Arion Lightning kitbuilt aircraft

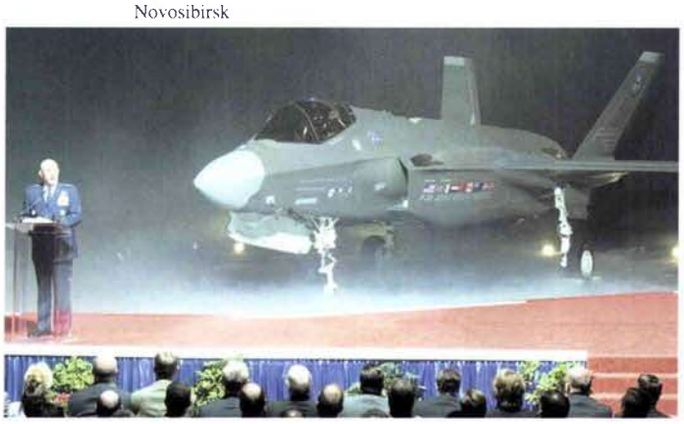
2006	Military aviation	Civil aviation
	First (UK-built) AgustaWestland KHI-01 (EH101) handed over to Japan Maritime Self-Defence Force	
14 Mar		Delivery of 250th Bombardier CRJ700 regional jet (to SkyWest)
21 Mar	Hungarian Air Force accepted delivery of its first five Saab JAS 39 Gripen multirole fighters at Kecskémet	Last Dornier airliner, a 328JET, delivered to Iceland for Nordic Wings (leased to City Star)
22 Mar		First flight of Cessna Citation Encore+ at Cedar Rapids, Iowa
23 Mar	First production HC-144A (CN-235) for US Coast Guard rolled out by EADS CASA at San Pablo, Seville	
Mar	Algeria placed order for 28 Sukhoi Su-30MKA multirole fighters	
4 Apr		Arion Lightning kitbuilt aircraft made public debut at Sun 'n' Fun, Lakeland, Florida, along with Aviadesign A-16 Sport Falcon, HeloWerks HX-1 Wasp ultralight kitbuilt helicopter, Aerolab Lo-Camp and several Light Sport versions of existing designs

The 4,000th F-16 Fighting Falcon

1154740

20 Apr	Hand-over of 4,000th Lockheed Martin Fighting Falcon, an F-16C for Oman	
28 Apr		Pilatus delivered 600th PC-12 business turboprop aircraft
13 May		First flight of prototype Excel-Jet Sport-Jet
23 May		Manufacture of commercial aircraft at Long Beach, California, ended with delivery of the last two Boeing 717 jetliners

2006	Military aviation	Civil aviation
30 May	Rostvertol announced delivery of first series production Mil Mi-28N Night Hunter attack helicopter to Russian Air Force	
2 Jun	First Airbus A330 tanker for Royal Australian Air Force delivered to CASA of Spain for modifications	
29 Jun	Contract covering supply of additional 34 NHIndustries MRH90 helicopters for service with Army and Navy signed by Australia	
30 Jun	Eurocopter EC-145 announced as winning contender in US Army Light Utility Helicopter competition; subsequently designated UH-72A Lakota	Brazilian ANAC certification awarded to Embraer 195 regional jet airliner
1 Jul	Raytheon Sentinel R. Mk 1 made its public debut at RAF Waddington air show	
6 Jul	First production Sukhoi Su-34 'Fullback' rolled out at Novosibirsk	



F-35 Lightning II naming ceremony 1154744

7 Jul	Formal unveiling of Lockheed Martin F-35 at Fort Worth accompanied by announcement that Lightning II name had been chosen for the Joint Strike Fighter	
17 Jul		Mockup of the joint Bell-Urban Aeronautics X-Hawk 'flying car' shown at Farnborough International. 'XWB' re-draft of Airbus A350 design is revealed; Sukhoi RRJ is renamed Superjet 100
19 Jul	AgustaWestland released details of proposed AW149 medium multirole battlefield helicopter at Farnborough Air Show	
21 Jul	Sukhoi announced that it had received a contract from Venezuela covering supply of 30 Su-30MK multirole fighters	
24 Jul	Start of integrated fuselage assembly process for first Airbus Military A400M at Bremen, Germany	Opening of EAA AirVenture '06 at Oshkosh. Cessna unveiled LSA (Light Sport Aircraft) and made surprise fly-by of NGP (Next Generation Piston) prototypes. Other debuts included Vans Aircraft RV-12 proof-of-concept prototype. Cessna celebrated 50 years of Model 172/182 and production of 65,000 of this family; Honda announces decision to market the HondaJet
25 Jul	Final assembly of first Airbus Military A400M wing began at Filton, UK	

2006	Military aviation	Civil aviation
26 Jul		First production Mooney Ovation3 handed over to customer, Andre Kulaga, at EAA AirVenture, Oshkosh
31 Jul	First new production Sikorsky UH-60M Black Hawk utility helicopter rolled out	

First EA-18G Growler *(Marv Lynchard, USAF)* 1154741

3 Aug	Roll-out of first EMD Boeing EA-18 Growler at St Louis	
15 Aug	First flight of Boeing EA-18G Growler electronic warfare aircraft	
1 Sep		Flybe became the first customer to take delivery of an Embraer 195 regional jet airliner First flight of Boeing Next Generation 737-900ER at Seattle

The 700th of the ATR 42/72 family 1154745

8 Sep		Air Deccan takes delivery of the 700th ATR turboprop airliner
12 Sep	Last of 11 AgustaWestland A109 light observation helicopters handed over to Royal Malaysian Army at Vergiate, Italy	
13 Sep		Eurocopter handed over 400th production example of the EC120 since deliveries began in 1998 (to Sacramento County Sheriff's Department)
15 Sep	First engine run accomplished by Lockheed Martin F-35 Lightning II	
19 Sep	Gulfstream Aerospace handed over its first Conformal Airborne Early Warning (CAEW) special-mission aircraft to Israel	
27 Sep	First production examples of the UH-1Y and AH-1Z handed over to US Marine Corps at Bell's Amarillo, Texas, facility	

2006	Military aviation	Civil aviation

Last of the Bombardier CL-604 line 1154742

3 Oct		Bombardier announced roll-out of 365th and last production Challenger 604 business jet at Montreal-Dorval; delivery to customer was expected in early 2007
13 Oct		BAE Systems' 20 per cent share in Airbus was acquired by EADS for EUR2.75 billion, making EADS now the sole owner of Airbus
16 Oct		Announcements on the eve of the NBAA Convention in Orlando, Florida, included Hawker 750 and 900XP, Spectrum S-40 Freedom
17 Oct		Aircraft unveiled at NBAA Convention were Cessna Citation CJ4, Cessna XLS+, Cessna LCC and Piper PA-47 PiperJet

First autonomous aerial refuelling 1154746

25 Oct	Omega Boeing KC-707 tanker and NASA Boeing F/A-18 Hornet receiver make the first autonomous aerial refuelling contact	
26 Oct		Airbus signed a framework agreement with a Chinese consortium concerning creation of a final assembly line in China for the A320 family of airliners
Oct		Cessna Aircraft Company completed production of the 7,000th single-engined piston aircraft to be manufactured at Independence, Kansas; the milestone aircraft was a Cessna 182 Skylane

Chinese-built Diamond Star 1154747

Oct		Diamond Aircraft's Chinese factory rolled out its first DA40 Diamond Star

2006	Military aviation	Civil aviation
3 Nov	Singapore became first customer for Pilatus PC-21 turboprop trainer, ordering a total of 19 aircraft	
7 Nov		Cessna delivered the 100th production Citation Sovereign business jet
9 Nov		Cirrus Design Corporation announced that it had produced its 3,000th aircraft since the first delivery in 1999
14 Nov	Netherlands became first country to commit to production, sustainment and follow-on development (PSFD) phase of Lockheed Martin F-35 Lightning II programme with signature of MoU	
16 Nov	First two PZL-Świdnik SW-4 training helicopters delivered to Polish Air Force	
22 Nov		First Cessna Citation Mustang business jet delivered
28 Nov	First of four Boeing C-17A Globemaster III strategic transport aircraft handed over to the Royal Australian Air Force at Long Beach, California	

Lockheed's 2,300th Hercules is rolled out 1154751

29 Nov	The 2,300th production example of the Lockheed Martin C-130 Hercules was delivered, this being a KC-130J Super Hercules tanker for the US Marine Corps rolled out on 4 October	
1 Dec		Airbus received authorisation to proceed with industrial launch of the A350 XWB Family
6 Dec	EADS CASA delivered the first HC-144A (CN-235) to Lockheed Martin for final fitting out and eventual hand-over to the US Coast Guard	
7 Dec	Lockheed Martin F-35 Lightning II moved under own power for first time and accomplished low-speed taxi test at Fort Worth, Texas	

Eurocopter UH-72A Lakota hand-over and naming 1154748

11 Dec	Hand-over and naming ceremony for US Army's first Eurocopter UH-72A Lakota	

2006	Military aviation	Civil aviation
	Canada confirmed involvement in PSFD for Lockheed Martin F-35 Lightning II by signing MoU	
12 Dec		AgustaWestland delivered the first US-asssembled AW 139 (to Seacor Holdings) from its Philadelphia plant, accompanied by an A 109 Power and an A 119 Koala
13 Dec	The German Army became the first customer to receive production examples of the NH90 TTH (Tactical Transport Helicopter) with delivery of the first two at Donauwörth	
15 Dec	First flight of first SDD Lockheed Martin F-35A Lightning II at Fort Worth, Texas	
	First two production examples of the Sukhoi Su-34 'Fullback' delivered to Russian Air Force	
21 Dec		FAA certification awarded to Cessna Citation Encore+
29 Dec	China officially admits to existence of CAC J-10 multirole fighter, nearly three years after it entered service with the PLAAF	
31 Dec		The first customer Eclipse 500 was delivered to co-owners David Crowe, a private owner, and Jet-Alliance, a shared jet ownership company in Westlake Village, California

Delayed deliveries of the NHIndustries NH90 began on 13 December 2006 with two helicopters to the German Army 1154752

Official Records

(Corrected to 1 January 2007)

For a second edition in succession, the Scaled Composites 311 Capricorn *Virgin Atlantic GlobalFlyer* heads this section, having bettered its earlier achievements during 2006, again flown by Steve Fossett *(Paul Jackson)* 1164937

The Fédération Aéronautique Internationale (FAI) is the world authority for verification of aviation records. Each category is further broken down by type of power plant, weight band and sex of pilot, while time-to-height and height-with-payload records are subdivided into further bands. Additionally, point-to-point records can be set between an almost unlimited number of city pairs. Consequently, only the more significant records are quoted here.

The full range of categories is:

Class A	Free balloons	Class F	Aeromodelling	Class N	STOL aeroplanes
Class B	Airships	Class G	Parachuting	Class O	Hang gliders and paragliders
Class C	Aeroplanes	Class H	VTOL aeroplanes	Class P	Aerospacecraft
Class D	Gliders and motor gliders	Class I	Human-powered aircraft	Class R	Microlights
Class E	Rotorcraft	Class K	Spacecraft	Class S	Space models
		Class M	Tilting wing/engine aircraft	Class U	Unmanned Aerial Vehicles

ABSOLUTE WORLD RECORDS

CLASS A (Free Balloons)

Four records are classed as Absolute World Records for free balloons by the FAI, as follows:

Duration (Switzerland)
Bertrand Piccard (Switzerland) and Brian Jones (UK) in the Cameron R-650 combination hot air/helium balloon HB-BRA *Breitling Orbiter 3*, from Château d'Oex, Switzerland, to near Dâkhla, Egypt, between 1 and 21 March 1999. 477 hours 47 minutes.

Distance (Switzerland)
Bertrand Piccard (Switzerland) and Brian Jones (UK) in the Cameron R-650 combination hot air/helium balloon HB-BRA *Breitling Orbiter 3*, from Château d'Oex, Switzerland to near Dâkhla, Egypt, between 1 and 21 March 1999. 22,037.8 n miles (40,814.0 km; 25,361.34 miles).

Altitude (US)
Cdr M D Ross and Lt Cdr V A Prather in Winzen Research ONXR290WRP-1 *Lee Lewis Memorial*, from USS *Antietam*, Gulf of Mexico, on 4 May 1961. 34,668 m (113,740 ft).

Shortest time around the world (US)
Steve Fossett (USA) in Cameron/Cole R-550 combination hot air/helium balloon N277SF *Bud Light Spirit of Freedom* from Northam, Australia to meridian 116° 42' 16" East, over Australia, between 19 June and 2 July 2002. 320 hours 33 minutes.

CLASS B (Airships)

In 2006, the Avgur Au-35 bettered the airship altitude record set two years earlier by the Boland Rover 1164938

Four records are classed as Absolute World Records for airships by the FAI, as follows:

Duration (Germany)
Kapt Hugo Eckener and crew in Zeppelin D-LZ127 *Graf Zeppelin* from Lakehurst, New Jersey, to Friedrichshafen, Germany, between 29 October and 1 November 1928. 71 hours 7 minutes.

Distance in a straight line (Germany)
Kapt Hugo Eckener and crew in Zeppelin D-LZ127 *Graf Zeppelin* from Lakehurst, New Jersey, to Friedrichshafen, Germany, between 29 October and 1 November 1928. 3,447.35 n miles (6,384.50 km; 3,967.14 miles).

Altitude (Russian Federation)
Stanislav Fiodorov in Avgur Au-35 RA-0337G *Snow Goose* at Moscow, Russian Federation, 17 August 2006. 8,180 m (26,837 ft).

Speed in a straight line (UK)
Steve Fossett and Hans-Paul Ströhle in Zeppelin NT N07-100 D-LZFN at Friedrichshafen, Germany, 27 October 2004. 62.1 kt (115 km/h; 71.5 mph).

CLASS C (Aeroplanes)

Seven records are classed as Absolute World Records for aeroplanes by the FAI, as follows:

Distance without landing (US), and **Distance over a closed circuit without landing**
Steve Fossett in Scaled Composites 311 Capricorn *Virgin Atlantic GlobalFlyer* N277SF, 8 to 11 February 2006 from Salina, Kansas, to Shannon, Ireland. 22,390.67 n miles (41,467.53 km; 25,766.67 miles).

Distance over a closed circuit without landing (US)
Steve Fossett in Scaled Composites 311 Capricorn *Virgin Atlantic GlobalFlyer* N277SF, 14 to 17 March 2006 from and to Salina, Kansas. 21,979.77 n miles (40,706.53 km; 25,293.88 miles).

Altitude (USSR)
Alexander Fedotov in an E-266M (MiG-25) on 31 August 1977. 37,650 m (123,523 ft).

Altitude in sustained horizontal flight (US)
Captain Robert C Helt and Major Larry A Elliott, USAF, in an unidentified Lockheed SR-71A on 28 July 1976 at Beale AFB, California. 25,929.031 m (85,069 ft).

Altitude, after launch from a 'mother-plane' (US)
Major R White, USAF, in the North American X-15A-3 (56-6672) on 17 July 1962, at Edwards AFB, California. 95,935.99 m (314,750 ft).

Speed on a straight course (US)
Captain Eldon W Joersz and Major George T Morgan Jr, USAF, in an unidentified Lockheed SR-71A on 28 July 1976 over a 15/25 km course at Beale AFB, California. 1,905.81 kt (3,529.56 km/h; 2,193.17 mph).

Speed in a closed circuit (US)
Major Adolphus H Bledsoe Jr and Major John T Fuller, USAF, in Lockheed SR-71A 64-17958, on 27 July 1976, over a 1,000 km closed circuit from Beale AFB, California. 1,818.154 kt (3,367.221 km/h; 2,092.294 mph).

WORLD CLASS RECORDS

Following are details of some of the more important world class records confirmed by the FAI:

CLASS C, GROUP 1 (Landplanes with piston engines)

Mario Pezzi, in pressure suit, seated in his Caproni Ca 161bis in 1938 1151671

Distance in a straight line (US), and **Distance in a closed circuit** (US)
Richard 'Dick' Rutan and Jeana Yeager in the Voyager (N269VA), between 14 and 23 December 1986. Circumnavigation of the World, starting and finishing at Edwards AFB, California. 21,712.816 n miles (40,212.139 km; 24,986.664 miles).

Altitude (Italy)
Mario Pezzi, in a Caproni Ca 161*bis*, on 22 October 1938 at Montecelio, Italy. 17,083 m (56,046 ft).

Speed in a straight line (US)
Lyle Shelton in the modified Grumman F8F Bearcat *Rare Bear* (N777L), with a 2,833 kW (3,800 hp) Wright R-3350 engine, on 21 August 1989, over a 3 km course at Las Vegas, New Mexico. 459.09 kt (850.24 km/h; 528.31 mph).

CLASS C, GROUP 2 (Landplanes with turboprop engines)

Great circle distance without landing (US)
Lt Col E L Allison and crew in a Lockheed HC-130H Hercules (65-0972), on 20 February 1972. 7,587.99 n miles (14,052.95 km; 8,732.098 miles).

Distance in a closed circuit (US)
Cdr Philip R Hite and crew in the Lockheed RP-3D Orion (158227), on 4 November 1972. 5,455.46 n miles (10,103.51 km; 6,278.03 miles).

Altitude (US)
Einar Enevoldson in Grob Egrett-1, N14ES, on 1 September 1988, at Majors Field, Greenville, Texas. 16,329 m (53,573 ft).

Speed on a straight course (US)
Cdr Donald H Lilienthal and crew in a Lockheed P-3C Orion, over a 15/25 km course on 27 January 1971. 435.26 kt (806.10 km/h; 500.89 mph).

Speed in a closed circuit (USSR)
Ivan Sukhomlin and crew in Tupolev Tu-114 SSSR-76459, on 9 April 1960, carrying a 25,000 kg payload over a 5,000 km circuit. 473.66 kt (877.212 km/h; 545.07 mph).

CLASS C, GROUP 3 (Landplanes with jet engines)

The FAI has ratified the Class C-1b Group 4 (landplanes 500 to 1,000 kg; rocket engine) distance claim of 3 December 2005 by Richard G Rutan and the XCOR Aerospace EZ-Rocket (modified Rutan EZ) N132EZ for 8.64 n miles (16 km; 9.94 miles) without landing. This "shortest long-distance record flight" received the National Aeronautic Association's 2005 award for Most Memorable Aviation Record and paves the way for establishment of a Rocket Racing League 1164941

Distance without landing and **distance over a closed circuit without landing (US)**
See absolute World Records.

Altitude, speed on straight course and **speed in 1,000 km closed circuit**
See Absolute World Records.

Speed over a 3 km course at restricted altitude (US)
Darryl Greenamyer in the modified Red Baron F-104RB Starfighter (N104RB), on 24 October 1977, at Mud Lake, Tonopah, Nevada. 858.77 kt (1,590.45 km/h; 988.26 mph).

Speed in a 100 km closed circuit (USSR)
Alexander Fedotov in an unidentified Mikoyan E-266 (MiG-25) on 8 April 1973. 1,406.641 kt (2,605.1 km/h; 1,618.734 mph).

Speed in a 500 km closed circuit (USSR)
M Komarov in a Mikoyan E-266 (MiG-25), on 5 October 1967, near Moscow. 1,609.88 kt (2,981.5 km/h; 1,852.62 mph).

Speed around the world (Eastbound; without aerial refuelling) (France)
Michel Dupont and Claude Hetru in Concorde F-BTSD on 16 August 1995, 704.68 kt (1,305.93 km/h; 811.46 mph). (**Note**. Exceeds record for circumnavigation with aerial refuelling and speed Westbound).

Speed around the world, non-stop and non-refuelled (US)
Steve Fossett in Scaled Composites 311 Capricorn *Virgin Atlantic GlobalFlyer* N277SF, 1 to 3 March 2005 from and to Salina, Kansas. 297.40 kt (550.78 km/h; 342.24 mph).

Greatest payload carried to a height of 2,000 m (Ukraine)
Aleksandr V Galunenko in Antonov An-225 Mriya UR-82060, on 11 September 2001. 253,820 kg (559,577 lb).

CLASS C.2, ALL GROUPS (Seaplanes)

Great circle distance without landing (UK)
Capt D C T Bennett and First Officer I Harvey, in the Short-Mayo S.20 *Mercury*, G-ADHJ, between 6 and 8 October 1938, from Dundee, Scotland, to the Port Nolloth, South Africa. 5,211.66 n miles (9,652 km; 5,997.5 miles).

Altitude (USSR)
Georgi Buryanov and crew of two in Beriev M-10 '40', on 9 September 1961, over the Sea of Azov. 14,962 m (49,088 ft).

Speed on a straight course (USSR)
Nikolai Andrievsky and crew of two in Beriev M-10 '40', on 7 August 1961, at Joukovski-Petrovskoe, over a 15/25 km course. 492.44 kt (912 km/h; 566.69 mph).
[1]Class C.3 Amphibians record is held by Sergei Andreev and Nikolay Shlykov in Beriev M-12 Tchaika '05' on 30 October 1987. 309.54 kt (573.27 km/h; 356.21 mph).

CLASS E.1 (Helicopters)

Great circle distance without landing (US)
R G Ferry in a Hughes YOH-6A, between 6 and 7 April 1966, from Culver City, California, to Ormond Beach, Florida. 1,923.08 n miles (3,561.55 km; 2,213 miles).

Altitude (France)
Jean Boulet in an Aerospatiale SA 315B Lama on 21 June 1972, at Istres, France. 12,442 m (40,820 ft).

Speed on a straight course (UK)
Trevor Egginton and Derek Clews in Westland Lynx G-LYNX, on 11 August 1986, over a 15/25 km course, at Glastonbury, Somerset. 216.45 kt (400.87 km/h; 249.09 mph).

Speed over a closed circuit (US)
Thomas F Doyle Jr in Sikorsky S-76A N5445J, over a 500 km circuit at West Palm Beach, Florida, on 8 February 1982. 186.68 kt (345.74 km/h; 214.83 mph).

Beriev Be-10 (M-10) '40' holds altitude and speed records for seaplanes, plus 10 more of lesser importance — most remaining unbeaten 1164939

CLASS E.3 (Autogyros)

Altitude without payload (US)
Andrew C Keech, in Little Wing LW-5 N100MK on 20 April 2004 at Frederick, Maryland, 8,049 m (26,407 ft).

Distance without landing (US)
Andrew C Keech, in Little Wing LW-5 N100MK from Little Rock, Arkansas, to Statesville, North Carolina, on 14 February 2006, 584.72 n miles (1,082.91 km; 672.89 miles). Claim of 763 n miles (1,414 km; 879 miles) lodged by same pilot and aircraft on 3 February 2007.

Distance over a closed circuit without landing (US)
Andrew C Keech in Little Wing LW-5 N100MK at Little Rock, Arkansas, 9 February 2006, 550.26 n miles (1,019.09 km; 633.23 miles). Claim of 610 n miles (1,130 km; 702 miles) lodged by same pilot and aircraft on 31 January 2007.

Speed on a straight course (UK)
Wing Cdr K H Wallis, in a Wallis WA-121/Mc G-BAHH, over a 3 km course, at Shipdam, Norfolk, on 16 November 2002, 112.1 kt (207.7 km/h; 129.1 mph).

Autogyro records formerly held by Wg Cdr Ken Wallis are now being taken over by the Little Wing LW-5 of Andrew Keech
1154650

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International Aircraft Registration Prefixes

F-WWOW! An appropriately awesome registration for the prototype Airbus A380 (accompanied by the Red Arrows at Farnborough in 2006) was facilitated by regulations requiring 'W' to be the first variable letter of registration for uncertified aircraft in France *(Paul Jackson)* 1164934

Registration Requirements

An international system for the identification of civil aircraft was devised in 1919 and enshrined (with much else concerning aerial transport) in the Convention Relating to the Regulation of Air Navigation, which was signed in Paris on 13 October that year. This built upon embryo national systems, most notably that of the UK which had adopted the letter "G" as a national prefix in May 1919 following the issue, on 30 April, of what are believed to have been the world's first airworthiness and registration requirements.

Further conferences and conventions built upon this basis, the allocation of marks passing to the International Commission for Air Navigation (CINA). Today, Annex 7 of the International Civil Aviation Organisation regulations describes the application of aircraft registrations in broad terms. National prefixes have changed through the years, not only as the consequence of the birth of new countries, but for other reasons. Examples from the 1920s include CH- (for Switzerland); R- (Argentina); and UL- (Luxembourg). Lithuania, when recently returned to autonomy, was assigned LY- and not the RY- previously used.

Implementation of Annex 7 is by national governments, whose aviation authorities often have slightly different interpretations. Variations might include the wearing of Italic characters (not exceeding 30° slope) and dispensation for helicopters to carry smaller registrations. In addition, New Zealand allows serifed, variable thickness letters similar to Helvetica typeface and the omission of the national prefix for aircraft not intending to leave the islands.

The 'regulations' which follow must be taken, therefore, as only a guide.

(A) Permanent marking of aircraft nationality and registration shall (a) have no ornamentation; (b) contrast in colour with the background; and (c) be legible.

(B) Display of Marks: Each aircraft shall display marks consisting of the Roman capital letter denoting nationality, followed by the registration letters or number of the aircraft in Arabic numerals or Roman capital letters.

All new UK sailplanes are now required to have a British civil registration, this usually coinciding with the British Gliding Association trigraph, as with this Glaser-Dirks DG-505/20 Elan 'KHC' *(Paul Jackson)* 1164936

(C) Size of Marks: The character marks on vertical surfaces shall be at least 30 centimetres high (25 cm on helicopters in some countries, with dispensations down to 15 cm where space is unavailable); and 50 centimetres on lighter than air craft. When required to be carried, underside registrations (port wing of aeroplanes; beneath helicopter cabins) should be 50 cm in height.

Characters shall be formed by solid lines one-sixth as thick as the character is high. Characters must be two-thirds as wide as they are high, except the number "1", which must be one-sixth as wide as it is high, and the letters "M" and "W" which may be as wide as they are high. The space between each character may not be less than one quarter of the character width.

(D) Location of marks: These shall be on either the vertical tail surfaces or the sides of the fuselage between wing and empennage. Rotorcraft shall display marks horizontally on both surfaces of the cabin, fuselage, boom, or tail.

Airship marks are to be located lengthwise on each side of the hull and on its upper surface on the line of symmetry; or on the horizontal and vertical stabilisers. For the horizontal stabiliser, located on the right half of the upper surface and on the left half of the lower surface, with the tops of the letters and numbers toward the leading edge; and for the vertical stabiliser, located on each side of the bottom half stabiliser, with the letters and numbers placed horizontally.

The following two tables list (by alphanumeric order of prefix and alphabetical order of country, respectively) the markings which identify the national registrations of civil aircraft. The tables include some *de facto* prefixes which do not conform to ICAO rules. Mongolia, for example, has standardised on JU-, replacing both MT- and BNMAU-. Not all allocated markings are in current use, examples including Gibraltar and Vatican City. Brazil used only PP- and PT- from its allocation until PR- was brought into use in April 1999. In an unprecedented move in early 2002, Liberia responded to widespread abuse of its register by uncertified aircraft carrying illegal identities and revoked all EL- registrations. The new prefix A8- was introduced in 2003. At the same time, the first use was recorded in the Russian autonomous region of Karelia of the prefix KT-, while the Russian Federation began issuing privately owned aircraft with new registrations comprising four numbers and one letter, replacing five numbers.

Letter/number prefixes were introduced in 1948, while some countries which follow the national identifier with numbers omit the hyphen. In the case of some small members of the British Commonwealth, one or two letters after the hyphen are required to complete the national identity, leaving scope for as few as 26 aircraft on the national register.

Within national authorities, rules for allocation vary considerably. Not all letters of the alphabet need be employed. Owners may be permitted to request personal suffixes outside the strict alphabetical progression of the register, or certain classes of aircraft (by weight band or number of engines, for example) might be assigned specific groups of registrations. Civil aircraft flown under permit,

Russia's Avia Register forbids use of the RA- nationality prefix before individual aircraft receive their certificate of airworthiness. This Antonov An-140 (RA-)41250 flew to Farnborough for display without satisfying the legal requirement to indicate its country of registry *(Paul Jackson)* 1164935

sailplanes, ultralights, microlights and aircraft undergoing manufacturer's testing are in some countries allocated registration suffixes of an entirely different character (for example, numbers instead of letters).

It should be borne in mind that what are regarded as civil aircraft registrations are but part of a worldwide system of radio call-signs. Perhaps the best known of these is the range WAA to WZZ for the United States, often quoted in reference to commercial stations; for example WWFM. Likewise, there is a gap in aircraft registrations between CN- (Morocco) and CP- (Bolivia) because COA- to COZ- are assigned to Cuban ground stations. Amateur radio stations are large scale users of the system, a typical UK call-sign being GB2ATC (compared with G-AAAA to G-ZZZZ for civil aircraft).

A peculiarity in France is that although ultralight aircraft have an internal registration system comprising the local post code prefix plus two or three letters (for example 91-YC), those choosing to install a radio require a radio call-sign in the FJ range (such as FJPGW) which is often—although not compulsorily— applied externally in the form of a civil registration with a hyphen following the F. Similarly, some air forces apply military aircraft call-signs externally, most notably in Africa.

While new forms of flying machine have often found a home on civil aircraft registers until a special form of registration has been devised for them (air cushion vehicles, for example), UAVs have been slow to follow that convention. However 2005 was notable for the appearance on the US, Austrian and Italian registers of unmanned aircraft, with the promise of more to come.

More rapid expansion of the UK civil register is taking place in 2006 because of a change of regulations, retrospectively effective from 28 September 2003, requiring new sailplanes to adopt regular markings in place of the system administered by the British Gliding Association (BGA). All sailplanes imported into the UK after that date are being registered, preference being given to incorporation of the three letters of the trigraph previously allocated by the BGA.

The first such known is Schempp-Hirth Ventus 2CT BGA5071 'KGB' registered on 8 September 2003 (but not flown in the UK until after the 28 September deadline) and transferred to the civil register as G-CKGB on 3 January 2006. The G-CK** series will be used except where registrations have already been assigned to powered machines, in which case the final three letters will receive a non-conflicting prefix, such as G-D** or G-E**. Sailplanes registered with the BGA before September 2003 have a permanent exemption and out-of-sequence registrations are permitted on payment of the usual fee.

Registration prefixes: by prefix

AP-	Pakistan
A2-	Botswana
A3-	Tonga
A4O-	Oman
A5-	Bhutan
A6-	United Arab Emirates
A7-	Qatar
A8-	Liberia
A9C-	Bahrain
B-	China
B-H	Hong Kong
B-M	Macao
B-	Taiwan
C-, CF-	Canada
CC-	Chile
CN-	Morocco
CP-	Bolivia
CR-, CS-	Portugal
CU-	Cuba
CX-	Uruguay
C2-	Nauru
C3-	Andorra
C5-	Gambia
C6-	Bahamas
C9-	Mozambique
D-	Germany
DQ-	Fiji
D2-	Angola
D4-	Cape Verde
D6-	Comoros
EC-	Spain
EI-, EJ-	Ireland
EK-	Armenia
EL-	revoked 2002 (was Liberia)
EP-	Iran
ER-	Moldova
ES-	Estonia
ET-	Ethiopia
EW-	Belarus
EX-	Kyrgyzstan
EY-	Tajikistan
EZ-	Turkmenistan
E3-	Eritrea
E5-	Cook Islands
F-	France and colonies
G-	United Kingdom
HA-	Hungary
HB-	Switzerland & Liechtenstein
HC-	Ecuador
HE-	Greece (ultralights)
HH-	Haiti
HI-	Dominican Republic
HK-	Colombia
HL-	Korea, South
HP-	Panama
HR-	Honduras
HS-	Thailand
HV-	Vatican City
HZ-	Saudi Arabia
H4-	Solomon Islands
I-	Italy
JA-	Japan
JU-	Mongolia
JY-	Jordan
J2-	Djibouti
J3-	Grenada
J5-	Guinea-Bissau
J6-	St Lucia
J7-	Dominica
J8-	St Vincent & Grenadines
LN-	Norway
LQ-, LV-	Argentina
LX-	Luxembourg
LY-	Lithuania
LZ-	Bulgaria
N	USA
OB-	Peru
OD-	Lebanon
OE-	Austria
OH-	Finland
OK-	Czech Republic
OM-	Slovak Republic
OO-, OQ-	Belgium
OY-	Denmark
P-	Korea, North
PH-	Netherlands
PJ-	Netherlands Antilles
PK	Indonesia
PP- to PU-	Brazil
PZ-	Suriname
P2-	Papua New Guinea
P4-	Aruba
RA-, RF-	Russia
RDPL-	Laos
RP-	Philippines
SE-	Sweden
SP-	Poland
ST	Sudan
SU-	Egypt
SU-YA	Palestine
SX-	Greece
S2-	Bangladesh
S5-	Slovenia
S7-	Seychelles
S9-	São Tomé e Principé
TC-	Turkey
TF-	Iceland
TG-	Guatemala
TI-	Costa Rica
TJ-	Cameroon
TL-	Central African Republic
TN-	Congo (Republic)
TR-	Gabon
TS-	Tunisia
TT-	Chad
TU-	Côte d'Ivoire
TY-	Benin
TZ-	Mali
T2-	Tuvalu
T3-	Kiribati
T7-	San Marino
T8A-	Palau
T9-	Bosnia-Herzegovina
UK-	Uzbekistan
UN-	Kazakhstan
UR-	Ukraine
VH-	Australia
VN-	Vietnam
VP-A	Anguila
VP-B	Bermuda
VP-C	Cayman Islands
VP-F	Falkland Islands
VP-G	Gibraltar
VP-I	Isle of Man
VP-LM	Montserrat
VP-LV	British Virgin Islands
VQ-H	St Helena & Ascension
VQ-T	Turks & Caicos Islands
VT-	India
V2-	Antigua & Barbuda
V3-	Belize
V4-	St Kitts & Nevis
V5-	Namibia
V6-	Micronesia
V7-	Marshall Islands
V8-	Brunei
XA- to XC-	Mexico
XT	Burkina Faso
XU-	Cambodia
XY-, XZ-	Myanmar
YA-	Afghanistan
YI-	Iraq
YJ-	Vanuatu
YK-	Syria
YL-	Latvia
YN-	Nicaragua
YR-	Romania
YS-	El Salvador
YU-	Yugoslavia
YV-	Venezuela
Z-	Zimbabwe
ZA-	Albania
ZK- to ZM-	New Zealand
ZP-	Paraguay
ZS- to ZU-	South Africa
Z3-	Macedonia
3A-	Monaco
3B-	Mauritius
3C-	Equatorial Guinea
3D-	Swaziland
3X-	Guinea
4K-	Azerbaijan
4L-	Georgia
4R-	Sri Lanka
4X-	Israel
5A-	Libya
5B-	Cyprus
5H-	Tanzania
5N-	Nigeria
5R-	Madagascar
5T-	Mauritania
5U-	Niger
5V-	Togo
5W-	Samoa
5X-	Uganda
5Y-	Kenya
6O-	Somalia
6V-, 6W-	Senegal
6Y-	Jamaica
7O-	Yemen
7P-	Lesotho
7Q-	Malawi
7T-	Algeria
8P-	Barbados
8Q-	Maldives
8R-	Guyana
9A-	Croatia
9G-	Ghana
9H-	Malta
9J-	Zambia
9K-	Kuwait
9L-	Sierra Leone
9M-	Malaysia
9N-	Nepal
9Q-	Congo (Democratic Republic)
9U-	Burundi
9V-	Singapore
9XR-	Rwanda
9Y-	Trinidad & Tobago

Registration prefixes: by country

Afghanistan	YA-	Germany	D-	Oman	A4O-
Albania	ZA-	Ghana	9G-	Pakistan	AP-
Algeria	7T-	Gibraltar	VP-G	Palau	T8A-
Andorra	C3-	Greece	SX-	Palestine	SU-YA
Angola	D2-	(ultralights)	HE-	Panama	HP-
Anguilla	VP-LA	Grenada	J3-	Papua New Guinea	P2-
Antigua & Barbuda	V2-	Guatemala	TG-	Paraguay	ZP-
Argentina	LQ-, LV-	Guinea	3X-	Peru	OB-
Armenia	EK-	Guinea-Bissau	J5-	Philippines	RP-
Aruba	P4-	Guyana	8R-	Poland	SP-
Australia	VH-	Haiti	HH-	Portugal	CR-, CS-
Austria	OE-	Honduras	HR-	Qatar	A7-
Azerbaijan	4K-	Hungary	HA-	Romania	YR-
Bahamas	C6-	Iceland	TF-	Russian Federation	RA-, RF-
Bahrain	A9C-	India	VT-	Rwanda	9XR-
Bangladesh	S2-	Indonesia	PK-	El Salvador	YS-
Barbados	8P-	Iran	EP-	Samoa	5W-
Belarus	EW-	Iraq	YI-	San Marino	T7-
Belgium	OO-, OQ-	Ireland	EI-, EJ-	São Tomé ePrincipé	S9-
Belize	V3-	Isle of Man	VP-I	Saudi Arabia	HZ-
Benin	TY-	Israel	4X-	Senegal	6V-, 6W-
Bermuda	VP-B	Italy	I-	Seychelles	S7-
Bhutan	A5-	Jamaica	6Y-	Sierra Leone	9L-
Bolivia	CP-	Japan	JA	Singapore	9V-
Bosnia-Herzegovina	T9-	Jordan	JY-	Slovak Republic	OM-
Botswana	A2-	Kazakhstan	UN-	Slovenia	S5-
Brazil	PP- to PU-	Kenya	5Y-	Solomon Islands	H4-
Brunei	V8-	Kiribati	T3-	Somalia	6O-
Bulgaria	LZ-	Korea, North	P-	South Africa	ZS- to ZU-
Burkina Faso	XT-	Korea, South	HL-	Spain	EC-
Burundi	9U-	Kuwait	9K-	Sri Lanka	4R-
Cambodia	XU-	Kyrgyzstan	EX-	St Helena & Ascension	VQ-H
Cameroon	TJ-	Laos	RDPL-	St Kitts & Nevis	V4-
Canada	C-, CF-	Latvia	YL-	St Lucia	J6-
Cape Verde	D4-	Lebanon	OD-	St Vincent & Grenadines	J8-
Cayman Islands	VP-C	Lesotho	7P-	Sudan	ST-
Central African Republic	TL-	Liberia	A8-	Suriname	PZ-
Chad	TT-	Libya	5A-	Swaziland	3D-
Chile	CC-	Liechtenstein	HB-	Sweden	SE-
China	B-	Lithuania	LY-	Switzerland	HB-
(Hong Kong	B-H)	Luxembourg	LX-	Syria	YK-
(Macao	B-M)	Macedonia	Z3-	Taiwan	B-
Colombia	HK-	Madagascar	5R-	Tajikistan	EY-
Comoros	D6-	Malawi	7Q-	Tanzania	5H-
Congo (Democratic Republic)	9Q-	Malaysia	9M-	Thailand	HS-
Congo (Republic)	TN-	Maldives	8Q-	Togo	5V-
Cook Islands	E5-	Mali	TZ-	Tonga	A3-
Costa Rica	TI-	Malta	9H-	Trinidad & Tobago	9Y-
Côte d'Ivoire	TU-	Marshall Islands	V7-	Tunisia	TS-
Croatia	9A-	Mauritania	5T-	Turkey	TC-
Cuba	CU-	Mauritius	3B-	Turkmenistan	EZ-
Cyprus	5B-	Mexico	XA- to XC-	Turks & Caicos	VQ-T
Czech Republic	OK-	Micronesia	V6-	Tuvalu	T2-
Denmark	OY-	Moldova	ER-	Uganda	5X-
Djibouti	J2-	Monaco	3A-	Ukraine	UR-
Dominica	J7-	Mongolia	JU-	United Arab Emirates	A6-
Dominican Republic	HI-	Montserrat	VP-LM	United Kingdom	G-
Ecuador	HC-	Morocco	CN-	United States	N
Egypt	SU-	Mozambique	C9-	Uruguay	CX-
Equatorial Guinea	3C-	Myanmar	XY-, XZ-	Uzbekistan	UK-
Eritrea	E3-	Namibia	V5-	Vanuatu	YJ-
Estonia	ES-	Nauru	C2-	Vatican City	HV-
Ethiopia	ET-	Nepal	9N-	Venezuela	YV-
Falkland Islands	VP-F	Netherlands	PH-	Vietnam	VN-
Fiji	DQ-	Netherlands Antilles	PJ-	Virgin Islands	VP-L
Finland	OH-	New Zealand	ZK- to ZM-	Yemen	7O-
France and colonies	F-	Nicaragua	YN-	Yugoslavia	YU-
Gabon	TR-	Niger	5U-	Zambia	9J-
Gambia	C5-	Nigeria	5N	Zimbabwe	Z-
Georgia	4L-	Norway	LN-		

United Kingdom 'B Conditions' Markings

Many countries' registration systems include provision for aircraft undergoing special testing, or being prepared for export, to have temporary markings in a reserved area of the register. In the UK, the system takes the form of the national identifying letter (G-) followed by a number to indicate the authorised manufacturer or modification centre, followed by an individual number, usually beginning at one (for example G-90-2). The last-mentioned numbers were frequently re-used, but reallocation is now rare. Authorised users had reached 94 by 2006, current users being included in the CAA's CAP 475 listing of approved organisations.

In recent years, aircraft capable of carrying armament, which would have used B Conditions, have been required to carry a military serial number issued by the Ministry of Defence in the normal sequence of allocations.

Markings currently authorised (although not necessarily used on a regular basis) are detailed in the following table. These are not 'registrations' in the strict sense of the term, as there is no central record of allocations.

G-08	BAE Systems (Prestwick)	G-68	Medway Microlights	G-89	Cosmik Aviation
G-17	AgustaWestland	G-71	FR Aviation	G-90	Aerosport
G-36	Cranfield Aerospace	G-76	Police Aviation Services	G-94	RotorSport*
G-51	Britten-Norman Aircraft	G-77	Thruster Air Services		
G-52	Marshall Aerospace	G-78	Bristow Helicopters		
G-61	Aviation Enterprises	G-79	McAlpine Helicopters		
G-67	Tenencia	G-80	British Microlight Aircraft Association		

* Rotorsport's authority had lapsed by December 2006

Glossary of Aerospace Terms in Jane's All the World's Aircraft

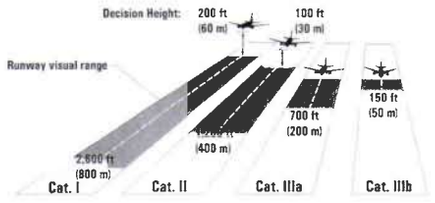
Chord: distance between leading and trailing edges, demonstrated by the Supermarine Spitfire LF. Mk XVI's elliptical wing *(Paul Jackson)* 1164925

AAM Air-to-air missile.
AAR Air-to-air refuelling.
AB Aktiebolag (Swedish company constitution).
absolute ceiling Greatest altitude attainable by aircraft in level flight. Compare service ceiling and certified altitude.
AC Alternating current.
ACC Air Combat Command (US).
ACLS Automatic carrier landing system.
ACMI Air combat manoeuvring instrumentation.
ACN Aircraft classification number (ICAO system for aircraft pavements).
ADC Air data computer.
ADF Medium-frequency automatic direction-finding (equipment).
ADI Attitude/director indicator.
aerofoil (N America, airfoil) Any solid body so shaped that, as a fluid medium (air or hot gas) moves past it, it experiences a useful force perpendicular to the direction of relative motion; thus, a wing generates lift, while a turbine blade generates torque on a shaft.
aeroplane (N America, airplane) Heavier-than-air aircraft with propulsion and a wing that does not rotate in order to generate lift.
AEW Airborne early warning.
AFB Air Force Base (USAF).
AFCS Automatic flight control system.
AFRP Aramid fibre-reinforced plastics.
afterburning Temporarily augmenting the thrust of a turbofan or turbojet by burning additional fuel in the jetpipe.
AGM Air-to-ground missile.
Ah Ampère-hours.
AHRS Attitude/heading reference system.
airbrake Passive device extended from aircraft to increase drag. Most common form is hinged flap(s) or plate(s), mounted in locations where operation causes no significant deterioration in stability and control at any attainable airspeed.
aircraft All manmade vehicles for off-surface navigation within the atmosphere, including helicopters and balloons. For practical purposes, air-cushion vehicles and wing-in-ground-effect vehicles are excluded from the classification.
airship Power-driven lighter-than-air aircraft. Traditional classes are: blimp, a small non-rigid; non-rigid, in which envelope is essentially devoid of rigid members and maintains shape by inflation pressure; semi-rigid, non rigid with strong axial keel acting as beam to support load; and rigid, in which envelope is itself stiff in local bending or supported within or around rigid framework.
airstair Retractable stairway built into aircraft.
ALARM Air-launched anti-radiation missile.
ALCM Air-launched cruise missile.
Allithium Aluminium-lithium alloy.
ALLTV All-light level television.
AM Amplitude modulation.
AMC Air Mobility Command (US).
amphibian Aerodyne capable of routinely operating from land or water, whether flying boat or floatplane.
AMRAAM Advanced Medium-Range AAM.
ANG Air National Guard (US).
anhedral Downward slope of wing or tailplane from root to tip.
anti-balance tab Hinged surface on trailing-edge of stabilator and operating in same direction, so as to dampen its movement.
ANVIS Aviator's night vision system.
AO Aktsionernoye Obshchestvo (Co Ltd; Russian company constitution).
AoA Angle of attack (see 'attack' below).
AOOT Aktsionernoye Obshchestvo Oktrytogo Tipa (Russian company constitution).
approach noise Measured 1 n mile from downwind end of runway with aircraft passing overhead at 113 m (370 ft).
APR Auxiliary power reserve.
APU Auxiliary power unit (part of aircraft).
ARINC Aeronautical Radio Inc, US company whose electronic box sizes (racking sizes) are the international standard.
ARM Anti-radiation missile.
ArNG Army National Guard (US).
ASE (1) Automatic stabilisation equipment; (2) Aircraft survivability equipment.
ASI Airspeed indicator.
ASM Air-to-surface missile.
aspect ratio Measure of wing (or other aerofoil) slenderness seen in plan view, usually defined as the square of the span divided by gross area.
AST Air Staff Target (UK).
ASTOVL Advanced STOVL.
ASUW Anti-surface unit warfare.
ASV Anti-surface vessel.
ASW Anti-submarine warfare.
ATC Air traffic control.
ATR Airline Transport Radio ARINC 404 black box racking standards.
attack, angle of (alpha) Angle at which airstream meets aerofoil (angle between mean chord and free-stream direction). Not to be confused with angle of incidence (which see).
augmented Boosted by afterburning (turbofan).
autogyro Rotary-wing aircraft propelled by a propeller (or other thrusting device) and lifted by a freely running autorotating rotor. Compare gyroplane.
AUW All-up weight (term meaning total weight of aircraft under defined conditions, or at a specific time during flight). Not to be confused with MTOW (which see).
avionics Aviation electronics.
AWACS Airborne warning and control system (aircraft category).
axisymmetric intakes Twin, circular engine air intakes mounted astride the spinner of New Piper light aircraft.
axisymmetric nozzle Circular jet-engine nozzle capable of unrestricted vectoring movement (within a cone specified by mechanical limitation) to enhance aircraft manoeuvrability.

ballistic parachute Emergency recovery parachute installed in (generally light) aircraft and capable of supporting both machine and occupants.
band See radar frequency.
bar Non-SI unit of pressure adopted by this yearbook pending wider acceptance of Pa. 1 bar = 10^5 Pa. ISA pressure at S/L is 1013.2 mb or just over 1 bar. ICAO has standardised hectopascal for atmospheric pressure, in which ISA S/L pressure is 101.32 hPa.
basic operating weight MTOW minus payload (thus, including crew, fuel and oil, bar stocks, cutlery and so on).
bearingless rotor Rotor in which flapping, lead/lag and pitch change movements are provided by the flexibility of the structural material and not by bearings. No rotor is truly rigid.
BITE Built-in test equipment.
bladder tank Fuel (or other fluid) tank of flexible material.
BLC Boundary-layer control.
bleed air Hot high-pressure air extracted from gas turbine engine compressor or combustor and taken through valves and pipes to perform useful work such as pressurisation, driving machinery or anti-icing by heating surfaces.
blown flap Flap across which bleed air is discharged at high (often supersonic) speed to prevent flow breakaway.
BOW Basic operating weight (which see).
BPR Bypass ratio.
BTU Non-SI energy unit (British Thermal Unit) = 0.9478 J.
bulk cargo All cargo not packed in containers or on pallets.
bus Busbar, main terminal in electrical system to which battery or generator power is supplied.
BV Besloten Vennootschap (Netherlands company constitution).
BVR Beyond visual range.
BWB Blended wing/body.
bypass ratio Air flow through fan duct (not passing through core) divided by airflow through core.
byte Group of bits of information forming unit in computer processing.

C^3 Command, control and communications.
CAA Civil Aviation Authority (UK).

cabane Structure, usually of braced struts, to support load above fuselage or wing. May carry parasol wing, engine nacelle or upper wing of most biplanes.
cabin altitude Height above S/L at which ambient pressure is same as inside cabin.
CAD/CAM Computer-assisted design/computer-assisted manufacture.
CAHI Central Aero and Hydrodynamics Institute of the Russian Federation; also transliterated as TsAGI.
canards Foreplanes, fixed or controllable aerodynamic surfaces ahead of CG.
capacity The volume swept out on each stroke by the pistons of a piston engine. It is expressed in cc (cubic centimetres) for small engines and in litres (1 litre = 1,000 cc) for larger ones. Also known as displacement or swept volume.
carangifoil Profile resembling a symmetrical, streamlined, fast-swimming fish (aerostats).
carbon fibre Fine filament of carbon/graphite used as strength element in composites.
CAS (1) Calibrated airspeed, ASI calibrated to allow for air compressibility according to ISA S/L; (2) close air support.
casevac Casualty evacuation.



Categories of ILS minima 0131472

Cat Category. Meanings include runway visibility and decision height minima for ILS. See diagram.
CATIA Computer-aided three-dimensional interactive analysis; Anglicised form of French CAD proprietary system *(Conception assistée tridimensionelle interactive d'applications)*.
CBU Cluster bomb unit.
CEAM Centre d'Expériences Aériennes Militaires.
CEAT Centre d'Essais Aéronautiques de Toulouse.
Ceconite Manmade covering material for light aircraft; trade name.
CEO Chief executive officer.
certified altitude Maximum flight altitude permitted by an aircraft's type certificate. Compare service ceiling and absolute ceiling.
CEV Centre d'Essais en Vol.
CFE Conventional Forces in Europe.
CFRP Carbon fibre-reinforced plastics.
CG Centre of gravity.
chaff Thin slivers of radar-reflective material cut to length appropriate to wavelengths of hostile radars and scattered in bundles to protect friendly aircraft.
chord Distance from leading-edge to trailing-edge measured parallel to longitudinal axis.
CIS Commonwealth of Independent [ex-USSR] States. See also RFAS.
CKD Component knocked down, for assembly elsewhere.
clean (1) In flight configuration with landing gear, flaps, slats and so on retracted; (2) Without any optional external stores.

Beechcraft manufacturer's plate including c/n 1164926

c/n Constructor's number; manufacturer's serial number.
C of A Certificate of Airworthiness; awarded to each individual aircraft (compare Type Certificate).
COIN Counter-insurgency.
collective pitch Controls pitch of all blades of helicopter main rotor in unison.
combi Civil aircraft carrying both freight and passengers on main deck.
comint Communications intelligence.
composite Material made of two constituents, such as filaments or short whiskers plus adhesive forming binding matrix.
constant-speed Variable-pitch propeller governed by a CSU so that its rotational speed is held constant.
contrarotating Propellers on same axis turning in opposite directions (compare C/R).
conventional and manual Aeroplane manoeuvring surfaces mechanically linked to pilot's hand and foot controls, unassisted (except, optionally, by aerodynamic or mass balances) and comprising ailerons on the outboard wing, rudder(s) to the rear of fixed tailfin(s) and elevators to the rear of a fixed (but optionally, incidence angle trimmable) tailplane. The description optionally includes leading-edge slats, flaps on inboard trailing-edges and trim tabs, all of which are mentioned separately, if installed. Ailerons which droop in unison with flaps (and thus are not the primary means of lowering stalling speed) are regarded as conventional. Control systems not conforming to the above — in that they have foreplanes, one or more all-moving tail surfaces, or flaperons, and those with mechanical/electronic assistance or interception of the pilot's movements— are described in appropriate detail.
convertible Transport aircraft able to be equipped to carry passengers or cargo, but not both simultaneously.
COO Chief operating officer.
core Gas generator portion of turbofan comprising compressor(s), combustion chamber and turbine(s).
C/R Counter-rotating; propellers of multi-engined aircraft turning in opposite directions on different axes (compare contrarotating).
CRT Cathode-ray tube.
cruising speed Flight speed on less than full engine power; maximum is normally at 75%, if not otherwise specified, but some manufacturers use higher throttle settings.
CSAS Command and stability augmentation system (part of AFCS).
CTOL Conventional take-off and landing (compare V/STOL).
CV Cheval vapeur (Germany, ps: pferdestarke) metric horsepower, equivalent to 0.7355 kW or 0.98632 hp and often translated erroneously as 'hp'.
CVR Cockpit voice recorder.
CY Calendar year; 1 January to 31 December. Compare FY.
cyclic pitch Controls variation of pitch as helicopter rotor blade makes each revolution.

Dacron Artificial fabric for light aircraft covering; trade name.
DADC Digital air data computer.
DADS Digital air data system.
DARPA Defense Advanced Research Projects Agency (US) (briefly ARPA before February 1996).
databus Electronic highway for passing digital data between aircraft sensors and system processors, usually MIL-STD-1553B or ARINC 419 (one-way) and 619 (two-way) systems.
dB Decibel.
DC Direct current.
DECU Digital engine (or electronic) control unit.
dem/val Demonstration/validation.
derated Engine restricted to power less than potential maximum (usually such engine is flat rated, which see).
design weight Different authorities have different definitions; weight chosen as typical of mission but usually much less than MTOW.
DF Direction-finder, or direction-finding.
DGAC Direction Générale à l'Aviation Civile, French certification authority.
dihedral Upward slope of wing from root (or intermediate point) to tip.
disposable load Sum of masses that can be loaded or unloaded, including payload, crew, removable equipment, usable fuel and other consumables; MTOW minus OWE.
DME UHF distance-measuring equipment; gives slant distance to a beacon; DME element of Tacan.
DoD Department of Defense.
dog-tooth A sharp discontinuity in the leading-edge of a wing or tail surface resulting from an increase in chord (see also sawtooth).
Doppler Short for Doppler radar — radar using fact that received frequency is a function of relative velocity between transmitter or reflecting surface and receiver; used for measuring speed over ground or for detecting aircraft or moving vehicles against static ground or sea.
double-slotted flap One having an auxiliary aerofoil ahead of main surface to increase maximum lift.

EAA Experimental Aircraft Association (divided into local branches called Chapters).
EAS Equivalent airspeed, RAS minus correction for compressibility.
EASA European Aviation Safety Agency.
ECCM Electronic counter-countermeasures.
ECM Electronic countermeasures.
ECS Environmental control system.
EEZ Economic exclusion (or exclusive-economic) zone.
EFIS Electronic flight instrument(ation) system, in which large multifunction CRT displays replace traditional instruments.
EGPWS Enhanced ground proximity warning system
EGT Exhaust gas temperature.
ehp Equivalent horsepower, measure of propulsive power of turboprop made up of shp plus addition due to residual thrust from jet.
EICAS Engine indication (and) crew alerting system.
ekW Equivalent kilowatts, SI measure of propulsive power of turboprop (see ehp).
elevon Wing trailing-edge control surface combining functions of aileron and elevator.
elint electronic intelligence.
ELT Emergency locator transmitter, to help rescuers home on to a disabled or crashed aircraft.
EMD Engineering and manufacturing development.
EO Electro-optical.
EPNdB Effective perceived noise decibel, SI unit of EPNL.
ERU Ejector release unit.
ESM (1) Electronic surveillance (or support) measures; (2) Electronic signal monitoring.
ETOPS Extended-range twin (engine) operations (thus sometimes given as EROPS), routeing not more than a given flight time (120, 180 or 240 minutes) from a usable alternative airfield.
EW Electronic warfare.

FAA Federal Aviation Administration.
FAC Forward air control (or controller).
factored Multiplied by an agreed number to take account of extreme adverse conditions, errors, design deficiencies or other inaccuracies.
FADEC Full-authority digital engine (or electronic) control.
FAI Fédération Aéronautique Internationale.
fail-operational System which continues to function after any single fault has occurred.
fail-safe Structure or system which survives failure (in case of system, may no longer function normally).
FAR Federal Aviation Regulations.
FAR Pt 23 Defines the airworthiness of private and air taxi aeroplanes of 5,670 kg (12,500 lb) MTOW and below.
FAR Pt 25 Defines the airworthiness of public transport aeroplanes exceeding 5,670 kg (12,500 lb) MTOW.
FBL Fly-by-light (which see).
FBW Fly-by-wire (which see).
FCS Flight control system.
FDR Flight data recorder (which see).
FDS Flight director system.
feathering Setting propeller blades at pitch aligned with slipstream to minimise drag.
fence A chordwise projection on the surface of a wing, used to modify the distribution of pressure.
Fenestron Helicopter tail rotor with many slender blades rotating in short duct (registered name).
ferry range Extreme safe range with zero payload.
FFAR Folding-fin (or free-flight) aircraft rocket.
field length Measure of distance needed to land and/or take off; many different measures for particular purposes, each precisely defined.
fixed-pitch Propeller with blades fixed to the hub.
FL Flight level. Notional altitude for air traffic control purposes which assumes ISA pressure (1013.25 mb; 29.92 in Hg) at S/L. Expressed in hundreds of feet; thus FL255 indicates approximately 25,500 ft
flap A surface carried on the leading- or trailing-edge of a wing and able to move relative to it. The simplest leading-edge flap and so-called plain (trailing-edge) flap is formed by hinging the entire edge of the wing. The Krueger is a leading-edge flap forming part of the wing undersurface, swung down and forwards on arms to give a bluff leading-edge. A split flap is formed by hinging only the undersurface of the trailing-edge. A slotted flap is a hinged trailing-edge which moves aft as well as down on tracks to leave a narrow slot ahead of it; hence double- and triple-slotted. A Fowler flap is a complete auxiliary aerofoil mounted on tracks under a fixed trailing-edge; initially it moves aft, to emerge behind the fixed part of the wing, and at the end of its travel it rotates down. A Gouge flap has an upper surface forming part of a cylinder, and rotates (on rails or brackets) about that cylinder's centre.
flaperon Wing trailing-edge surface combining functions of flap and aileron.
FLAR Federatsii Lyubitelei Aviatsii Rossii, Russian PFA.
flat-four Piston engine having four horizontally opposed cylinders; thus, flat-twin, flat-six and so on.
flight-adjustable pitch Propeller with blades that can be changed in pitch during flight to a limited extent (eg one way only). Compare variable pitch.
flat rated Propulsion engine capable of giving full thrust or power for take-off at an airfield well above S/L and/or at high ambient temperature (thus, probably derated at S/L).
flight data recorder Crash-protected recorder of dynamic/static pressure, air temperature, control-surface

and slat/flap positions, 3-axis accelerations, engine parameters and possibly other variables.
FLIR Forward-looking infra-red.
floatplane Aeroplane with one or more floats in place of land wheels, although, optionally, with retractable wheels as part of floats. Compare flying boat and seaplane.
fly-by-light Flight control system in which signals pass between computers and actuators along fibre-optic leads.
fly-by-wire Flight control system with electrical signalling, without mechanical interconnection between cockpit flying controls and control surfaces.

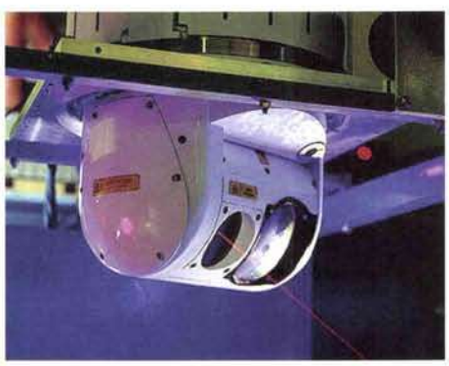
Flying boat: Lake Renegade *(Paul Jackson)* 1164927

flying boat Aircraft whose main body is a hull with planning bottom. Compare floatplane and seaplane.
FM Frequency modulation.
FMS (1) Foreign military sales (US DoD); (2) Flight management system.
footprint (1) A precisely delineated boundary on the surface around an airfield, inside which the perceived noise of an aircraft exceeds a specified level during take-off and/or landing; (2) Dispersion of weapon or submunition impact points.
foreplanes Pivoted canard surfaces forming part of the primary flight control system with authority in pitch and possibly also in roll. See also canards.
FOV Field of view.
Fowler flap See flap.
frequency See radar frequency.
frequency agile (frequency hopping) Making a transmission harder to detect by switching automatically to a succession of frequencies.
FSD Full-scale development.
FSED Full-scale engineering development.
FY Fiscal year; in US government affairs, runs from 1 October to 30 September (FY08 begins 1 October 2007); in Japan, from 1 April (FY19 or FY07 began 1 April 2007).

g Acceleration due to mean Earth gravity, that is of a body in free-fall; or acceleration due to rapid change of direction of flight path.
gallons Non-SI measure; 1 Imp gallon (UK) = 4.546 litres, 1 US gallon = 3.785 litres.
GFRP Glass fibre-reinforced plastics.
'glass cockpit' Cockpit in which dial instruments are replaced by multifunction electronic displays.
glass fibre Spun molten glass; see GFRP.
glideslope Element giving vertical (height) guidance in ILS.
glove (1) Fixed portion of wing inboard of variable sweep wing; (2) additional aerofoil profile added around normal wing for test purposes.
GmbH Gesellschaft mit beschränkter Haftpflicht (or Haftung) (German company constitution).
GPS Global Positioning System. US military/civil satellite-based precision navaid.
GPSS GPS Steering; integration of GPS with aircraft's autopilot to provide active navigation and smoother course changes.
GPU Ground power unit (not part of aircraft).
GPWS Ground-proximity warning system.
green aircraft Aircraft flyable but unpainted, unfurnished and basically equipped.
gross wing area See wing area.
ground-adjustable pitch Propeller with blades that can be adjusted in pitch by an engineer on the ground. Compare flight adjustable and variable pitch.
GS See glideslope.
gunship Aircraft designed for battlefield attack; helicopter gunships normally with slim body carrying pilot and weapon operator only.
GUP Gosudarstvennoye Unitarnoye Predpriyatie (Russian State Unitary Enterprise).
gyroplane Alternative term for autogyro favoured by some certification authorities, including FAA.

h Hour(s).
handed Rotating in opposite directions.
hardened Protected as far as possible against nuclear explosion.
hardpoint Reinforced part of aircraft to which external load can be attached, for example weapon or tank pylon.
HDU Hose-drum unit.
head-down display On the cockpit instrument panel (as distinct from a HUD).
head-level display Immediately below HUD.
helicopter Rotary-wing aircraft both lifted and propelled by one or more power-driven rotors turning about substantially vertical axes.
HF High frequency.
HIFR Helicopter in-flight refuelling.
HIRF High-intensity radiated field(s).
HMD Helmet-mounted display; hence HMS = sight.
HOCAC Hands on cyclic and collective.
homebuilt Aircraft built/assembled from plans or kits.
hot-and-high Adverse combination of airfield height and high ambient temperature, which lengthens required take-off distance.
HOTAS Hands on throttle and stick.
hot refuelling Replenishment of fuel while engine(s) running.
hovering ceiling Ceiling of helicopter (corresponding to air density at which maximum rate of climb is zero), either IGE or OGE.
HP High pressure (HPC, compressor; HPT, turbine).
hp Horsepower, non-SI unit of power. Compare cv.
HSI Horizontal situation indicator.
HUD Head-up display (bright numbers and symbols projected on pilot's aiming sight glass and focused on infinity so that pilot can simultaneously read display and look ahead). The term is increasingly rendered in the USA as "heads up", which is incorrect.
Hz Hertz; cycles per second.

IAS Indicated airspeed, airspeed indicator reading corrected for instrument error.
IATA International Air Transport Association.
ICAO International Civil Aviation Organisation.
IFF Identification friend or foe.
IFR (1) Instrument flight rules (compare VFR); (2) in-flight refuelling.
IGE In ground effect; helicopter performance with theoretical flat horizontal surface just below it (for example mountain).
IIR Imaging infra-red.
ILS Instrument landing system. See Cat.
Imperial gallon 1.20095 US gallons; 4.546 litres.
INAS Integrated nav/attack system.
Inc Incorporated (company constitution).
incidence The angle at which the wing is set in relation to the fore/aft axis. Often wrongly used to mean angle of attack (which see).
inertial navigation Measuring all accelerations imparted to a vehicle and, by integrating these with respect to time, calculating speed at every instant (in all three planes) and, by integrating a second time, calculating total change of position in relation to starting point.
INS Inertial navigation system.
integral construction Machined from solid instead of assembled from separate parts.
integral tank Fuel (or other liquid) tank formed by sealing part of structure.
intercom Wired telephone system for communication within aircraft.
inverter Electric or electronic device for inverting (reversing polarity of) alternate waves in AC power to produce DC.
IOC Initial operational capability.
IR Infra-red.



Nemesis IRCM 1164933

IRCM Infra-red countermeasures.
IRLS Infra-red linescan (builds TV-type picture showing cool and hot regions as contrasting shades).
IRS Inertial reference system.
IRST Infra-red search and track.
ISA International Standard Atmosphere (1013.25 mb, 1.225 g/m^3 and 15°C at mean sea level; lapse rate 1.98°C per 1,000 ft up to −56.5°C at 36,090 ft).

JAA Joint Aviation Authorities. Replaced by EASA.
JAR Joint Aviation Requirements, agreed by all major EC countries (JAR 25 equivalent to FAR Pt 25).
JAR-VLA JAR classification for Very Light Aircraft (MTOW limit of 750 kg; 1,653 lb).
JASDF Japan Air Self-Defence Force.
JATO Jet-assisted take-off (actually means rocket-assisted).
JCAB Japan Civil Airworthiness Board.
JDA Japan Defence Agency.
JGSDF Japan Ground Self-Defence Force.
JMSA Japan Maritime Safety Agency.
JMSDF Japan Maritime Self-Defence Force.
joined wing Tandem wing layout in which forward and aft wings are swept so that the outer sections meet.
JPATS Joint Primary Aircraft Training System (Beech T-6A Texan II).
JSC Joint stock company.
JSF Joint Strike Fighter.
JTIDS Joint Tactical Information Distribution System (NATO Link 16).
Junkers aileron Control surface (sometimes flaperon) suspended from mountings to the rear of wing trailing edge.

kbit One thousand bits of memory.
Kevlar Aramid fibre used as basis of high-strength composites material.
kg Kilogramme (2.20462 lb).
kitbuilt Prefabricated aircraft for amateur assembly.
KK Kabushiki Kaisha (Japanese company constitution).
km/h Kilometres per hour.
kN KiloNewtons (N×10^3). See N.
knot 1 n mile per hour (1.852 km/h; 1.15078 mph).
Krueger flap Hinges down and then forward from below the leading-edge.
kVA Kilovolt-ampères.
kW Kilowatt, SI measure of all forms of power (not just electrical).

LAMPS Light airborne multipurpose system.
LANTIRN Low-altitude navigation and targeting infra-red, night.
LAPES Low-altitude parachute extraction system.
LBA Luftfahrtbundesamt (German civil aviation authority).
lb Pound, non-SI unit of weight; 0.453592 kg.
lb st Pounds of static thrust.
LCD Liquid crystal display, used for showing instrument information.
LCN Load classification number, measure of 'flotation' of aircraft landing gear linking aircraft weight, weight distribution, tyre numbers, pressures and disposition.
LED Light-emitting diode.
lenticular Lens-shaped in profile, especially when low fineness ratio, although not necessarily symmetrical (aerostats).
lift dumper Spoiler designed to open on landing to reduce lift and thus increase effectiveness of wheel braking.
LINS Laser inertial navigation system.
litre SI unit of volume (0.264177 US gallon; 0.219975 Imp gallon).
LLC Limited liability company.
LLTV Low-light TV (thus, LLLTV, low-light level); see ALLTV.
LO Low-observables, which see (stealth).
load factor (1) Percentage of maximum payload; (2) design factor (g limit) for airframe.
LOC Localiser (which see).
localiser Element giving steering guidance in ILS.
LOH Light observation helicopter.
loiter Fly for maximum endurance, at much less than normal cruise speed.
longerons Principal fore-and-aft structural members (for example in fuselage).
Loran Long-range navigation; family of hyperbolic navaids based on ground radio emissions, now mainly Loran C.
LOROP Long-range oblique photography.
LOS Line of sight.
low-observables Materials, structures and techniques designed to minimise aircraft signatures of all kinds.
lox Liquid oxygen.
LP Low pressure (LPC, compressor; LPT, turbine).
LRIP Low-rate initial production.
LRMTS Laser ranger and marked-target seeker.
LRU Line-replaceable unit.

LSA: Flight Design CT *(Paul Jackson)* 1164928

LSA Light Sport Aircraft; US private/sport aircraft category. See Aircraft Type Classifications for explanation and examples. (Note: Official classification is *not* 'airplane').
Ltd Limited (company constitution).

m Metre(s), SI unit of length (3.28084 feet).
M or Mach number The ratio of the speed of a body to the speed of sound (340 m; 1,116 ft/s in air at 15°C) under the same ambient conditions.
MAD Magnetic anomaly detector.
mass balance Mass attached to flight control surface, typically ahead of hinge axis, internally or externally, to reduce or eliminate coupling with airframe flutter modes.
mass flow Mass of air passing per second (usually at T-O, S/L).
MAWS Missile-approach warning system.
mb Millibar, bar × 10^{-3}.
medevac Medical evacuation.
MFD Multifunction (electronic) display.
MHz Megahertz; 1 million (10^6) Hertz.
microlight See ultralight.
MIDS Multifunction information distribution system.
MKR Marker beacon receiver.
MLS Microwave landing system.
MLU Mid-life update.
MLW Maximum landing weight.
mm Millimetres, metres × 10^{-3}.
M mo Maximum operating Mach number.
MMS Mast-mounted sight.
MoD Ministry of Defence.
monocoque Structure with strength in outer shell, devoid of internal bracing (semi-monocoque, with some internal supporting structure).
MoU Memorandum of Understanding.
MPA Maritime patrol aircraft.
mph Miles per hour.
MSIP Multistaged improvement program (US).
MTBF Mean time between failures.
MTI Moving-target indication (radar).
MTOW Maximum take-off weight (minus taxi/run-up fuel).
MYP Multiyear procurement (US).
MZFW Maximum zero-fuel weight.

N Newton, SI unit of force, = 0.22480455 lb force.
NACES Navy aircrew common ejection seat (US).
NAS Naval Air Station (US).
NASA National Aeronautics and Space Administration (US).
NASC Naval Air Systems Command (also several other aerospace meanings) (US).
NATC Naval Air Training Command or Test Center (also several other aerospace meanings) (US).
NATO North Atlantic Treaty Organisation.
nav/com Navigation and communications receiver.
NBAA National Business Aircraft Association (US).
NBC Nuclear, biological, chemical (warfare).
NDT Non-destructive testing.
Newton See N.
NFO Naval flight officer; second crew member in US Navy aircraft; compare WSO.
Ni/Cd Nickel/cadmium.
nib Forward-pointing extension at inner end of fixed glove on VG aircraft or leading-edge root extension on light aircraft.
n mile nautical mile, 1,852 km, 1.15078 miles.
NOE Nap-of-the-Earth (low flying in military aircraft, using natural cover of hills, trees and so on).
NV Naamloze Vennootschap (Belgian/Netherlands company constitution).

AN/AVS-9 NVG *(SGB Enterprises)* 1151662

NVG Night vision goggles.
NVS Noise vibration suppression.

OAO Otkrytolye Aktsionernoye Obshchestvo (JSC; Russian company constitution).
OAT Outside air temperature.
OBIGGS Onboard inert gas generating system.
OBOGS Onboard oxygen generating system.
OCU (1) Operational Conversion Unit; (2) operational capabilities upgrade.
OEI One engine inoperative.
OEU Operational Evaluation Unit.
offset Workshare granted to a customer nation to offset the cost of an imported system.
OGE Out of ground effect; helicopter hovering, far above nearest surface.
OKB Opytnyi Konstruktorskoye Byuro (Russian experimental design bureau)
Omega Long-range hyperbolic radio navaid.
OOO Obshchestvo Ogranichennoye Otvetstvennostyu (Russian company constitution).
opeval Operational evaluation.
OTH Over-the-horizon (OTHT adds targeting).
OTPI On-top position indicator (indicates overhead of submarine in ASW).
OWE Operating weight empty. MTOW minus payload, usable fuel and oil and other consumables (thus, includes crew).

pallet (1) for freight, rigid platform for handling by forklift or conveyor; (2) for missile, interface mounting and electronics box outside aircraft.
Pascal SI unit of pressure =1 Nm^{-2} (one Newton per square metre).
payload Disposable load generating revenue (passengers, cargo, mail and other paid items); in military aircraft, loosely used to mean total load carried of weapons, cargo or other mission equipment.
performance Aircraft capabilities after S/L take-off at MTOW in ISA with normal full tankage, except as otherwise specified, and with landing data at MLW (where different).
PFA Popular Flying Association (UK).
PGM Precision-guided munition.
phased array Radar in which the beam is scanned electronically in one or both axes without moving the antenna.
Pirate Passive infra-red airborne tracking equipment.
PLA Prelaunch activities.
plane A lifting surface (for example wing, tailplane).
plc Public limited company (company constitution).
plug door Door larger than its frame in pressurised fuselage, either opening inwards or arranged to retract parts before opening outwards.
plume The region of hot air and gas emitted by a helicopter jetpipe.
ply Indication (ply rating) of tyre strength in a specific application; not necessarily the actual number of carcass plies in the tyre.
pneumatic de-icing Covered with flexible surfaces alternately pumped up and deflated to throw off ice.
port Left side, looking forward.
power-by-wire Using electric power alone (not electro-hydraulic) to drive control surfaces and perform other mechanical tasks.
power loading Aircraft weight (usually MTOW) divided by total propulsive power or thrust at T-O. For helicopters, based on transmission rating rather than total engine power.
power train A complete mechanical drive system, for example the sequence of gearwheels, clutches and shafts transmitting power from one or more engines to the rotors of a helicopter.
PPV Pre-production verification.
prepreg Glass fibre cloth or rovings pre-impregnated with resin to simplify layup.
pressure fuelling Fuelling via a leakproof connection through which fuel passes at high rate under pressure.
primary flight controls Those used to control trajectory of aircraft (thus, not trimmers, tabs, flaps, slats, airbrakes or lift dumpers, and so on).
primary flight display Single screen bearing all data for aircraft flight-path control.
propfan A family of new-technology propellers characterised by multiple scimitar-shaped blades with thin sharp-edged profile. Single and contrarotating examples promise to extend propeller efficiency up to an aircraft Mach number of about 0.8.
proprotor Large propeller, tilting for forward or vertical flight.
PT Perusahaan Terbatas (Indonesian company constitution).
Pty Proprietary (company constitution).
pulse Doppler Radar sending out pulses and measuring frequency-shift to detect returns only from moving target (s) seen against background clutter.
pylon Structure linking aircraft to external load (engine nacelle, drop tank, bomb, and so on).

Radar frequency Operating bands of airborne radars are given according to frequency. That part of the electromagnetic spectrum appropriate to above-surface short-range communication and radar (but not OTH) used in aviation is given in the adjacent table with an approximate cross-reference to previously used wavelength bands.
radius The approximate distance an aircraft can fly from base and return without intermediate landing.
RAI Registro Aeronautico Italiano (Italian civil aviation authority).
RAM Radar absorbent material.
ramp weight Maximum weight at start of flight (MTOW plus taxi/run-up fuel).
range Too many definitions to list, but essentially the distance an aircraft can fly (or is permitted to fly) with specified load and usually while making allowance for specified additional manoeuvres (diversions, standoff, go-around and so on).
RAS Rectified airspeed, IAS corrected for position error.
raster Generation of large-area display, for example TV screen, by close-spaced horizontal lines scanned either alternately or in sequence.
RAT Ram air turbine.

The Electromagnetic Spectrum

Frequency	Wavelength	General Designation	NATO Band	US Band
30–3 kHz	10,000–100 km	ELF		
3–30 kHz	100–10 km	VLF		
30–300 kHz	10–1 km	LF		
300 kHz–3 MHz	1,000–100 m	MF		
3–30 MHz	100–10 m	HF	A	
30–230 MHz	10–1.3 m	VHF	A	
230–250 MHz	1.3–1.2 m	VHF	A	P
250–300 MHz	1.2–1 m	VHF	B	P
300–500 MHz	100–60 cm	UHF	B	P
500–1,000 MHz	60–30 cm	UHF	C	P
1–2 GHz	30–13 cm	UHF	D	L
2–3 GHz	15–10 cm	UHF	E	S
3–4 GHz	10–7.5 cm	SHF	F	S
4–6 GHz	7–5.5 cm	SHF	G	C
6–8 GHz	5–7.5 cm	SHF	H	C
8–10 GHz	3.75–3 cm	SHF	I	X
10–12.5 GHz	3–2.5 cm	SHF	J	X
12.5–18 GHz	2.5–1.6 cm	SHF	J	Ku
18–20 GHz	1.6–1.5 cm	SHF	J	K
20–26.5 GHz	1.5–1.1 cm	SHF	K	K
26.5–30 GHz	1.1–1 cm	SHF	K	Ka
30–40 GHz	10–7.5 mm	EHF	K	Ka
40–60 GHz	7.5–5 mm	EHF	L	mm
60–100 GHz	5–3 mm	EHF	M	mm
100–300 GHz	3–1 mm	EHF		

Notes: Three overlapping descriptive systems are used in the West. General designations are Extremely Low, Very Low, Low, Medium, High, Very High, Ultra High, Super High and Extremely High Frequency. Frequencies are measured in kilo (1,000), mega (1,000,000) and giga (1,000,000,000) cycles per second (Hertz); wavelengths measured in kilometres, metres, centimetres and millimetres. 'NATO' bands describe radar and electronic warfare equipment; 'US' bands are used for radar and satellite communications. The latter's bounds are slightly 'elastic'. Aircraft-to-ground voice communications for air traffic control and similar purposes (including ground ration beacons) uses 108–136 MHz in the VHF band and 225–400 MHz in the V/UHF bands, the latter principally military, and not entirely accurately termed 'UHF'.

rating Any of several values of thrust or shaft power which an engine is qualified (usually also guaranteed) to develop under specified conditions.
RCS Radar cross-section; apparent size of echo.
redundant Provided with spare capacity or data channels and thus able to survive failures.
reversion Ability to switch to manual control following failure of a powered system.
RFAS Russian Federation and Associated States (CIS).
RFP Request(s) for proposals.
rigid rotor See bearingless rotor.
RMI Radio magnetic indicator; combines compass and navaid bearings.
R/Nav Calculates position, distance and time from groups of airways beacons.
RON Research octane number of fuel.
roving Multiple strands of fibre, as in a rope (but usually not twisted).
rpm Revolutions per minute.

RPV and ruddervators combined on BAE Systems Herti (J&AS J6 Fregate) 1151661

RPV Remotely piloted vehicle (pilot in other aircraft or on ground); contrast UAV.
RSA Réseau du Sport de l'Air. French PFA.
ruddervators Flying control surfaces, usually a V tail, that control both yaw and pitch attitude.
RVSM Reduced vertical separation minimum. Halved (1,000 ft) air traffic control separation between FL290 and FL410.
RWR Radar warning receiver.

s Second(s)
SA Société Anonyme (France, Romania), Sociedad Anónima (Brazil, Spain) or Spółka Akcyjna (Poland) (company constitution).
safe-life A term denoting that a component has proved by testing that it can be expected to continue to function safely for a precisely defined period before replacement.
SAM Surface-to-air missile.
SAR (1) Search and rescue; (2) synthetic aperture radar.
SAS Stability augmentation system.
satcom Satellite communications.
sawtooth Same as dog-tooth.
Sdn Bhd Sendirian Berhad (Malaysian company constitution).
SEAD Suppression of enemy air defence(s).
seaplane Floatplane with implied – but rarely actual – ability to operate outside sheltered waters. Compare floatplane; contrast flying boat.
semi-active Homing on to radiation reflected from target illuminated by radar or laser energy beamed from elsewhere (for example, from launch aircraft).
sensitive altimeter Altitude indicator of mechanical type, having acute sensitivity.
service ceiling Usually height equivalent to air density at which maximum attainable rate of climb is 100 ft/min. Compare absolute ceiling and certified altitude.
servo A device which acts as a relay, usually augmenting the pilot's efforts to move a control surface, or the like.
sfc Specific fuel consumption (which see).
shaft Connection between gas-turbine and compressor or other driven unit. Two-shaft engine has second shaft, rotating at different speed, surrounding the first (thus, HP surrounds inner LP or fanshaft).
shipment One item or consignment delivered (by any means of transport) to customer.
shp Shaft horsepower, measure of power transmitted via rotating shaft.
shroud Many meanings, including: (1) a fixed circular duct surrounding a fan or propfan; (2) a ring formed by lateral projections on a rotor (for example fan) blade (part-span or at the tip); (3) a portion of a wing or other fixed aerofoil projecting aft over the leading-edge of a hinged or otherwise movable surface such as a flap, aileron or elevator.
sideline noise EPNdB measure of aircraft landing and taking off, at point 0.25 n mile (2- or 3-engined) or 0.35 n mile (4-engined) from runway centreline.
sidestick Control column in the form of a short handgrip beside the pilot.
sigint Signals intelligence.
signature Characteristic 'fingerprint' of all acoustic or electromagnetic radiation (radar, IR, and so on).
single-aisle Passenger cabin has seats on each side of a single aisle along or near the centre.
single-shaft Gas-turbine in which all compressors and turbines are fixed to common shaft.
S/L Sea level.
SLAR Side-looking airborne radar.
slat Auxiliary curved or mini-aerofoil surface designed to prevent flow breakaway from a wing or tail. On a tail leading-edge it may be fixed, leaving a narrow slot. On a wing it is almost always retractable, normally flush with the wing profile but extended (under power or by aerodynamic lift) to leave a narrow slot for take-off, low-speed loiter or landing.
slot, slotted See slat.
S-LSA Special (factory-built) Light Sport Aircraft. See LSA.
snap-down Air-to-air interception of low-flying aircraft by AAM fired from fighter at a higher altitude.
SONAR, sonar Sound navigation and ranging.
SpA Società per Azioni (Italian company constitution).
specific fuel consumption Rate at which fuel is consumed divided by power or thrust developed, and thus a measure of engine efficiency. For jet engines (air-breathing, not rockets) unit is mg/Ns, milligrams per Newton-second; for shaft engines unit is μg/J, micrograms (millionths of a gram) per Joule (SI unit of work or energy).
spoiler Plank-like surface normally recessed into top of wing, hinged up under power to reduce (spoil) lift and increase drag. Used asymmetrically for lateral control.
spoileron Small spoiler augmenting ailerons.
sportplane Light aircraft design in which performance takes precedence over utility.
Sp. z o.o Spółka z ograniczoną odpowiedzialnoblaheią (Polish company constitution)
Srl Società Reponsibilita Limitata (Italian company constitution).
SSB Single-sideband (radio).
SSR Secondary surveillance radar.
SST Supersonic transport.
st Static thrust.
stabilator One-piece, all-moving horizontal taill, combining functions of horizontal stabiliser and elevator.
stabilizer Tailplane (US); vertical stabilizer = fin.
stall Sudden near-total loss of lift of a wing because AoA has exceeded a critical value.
stall strips Sharp-edged strips on wing leading-edge to induce stall to initiate at that point.
stalling speed Airspeed at which aircraft stalls at 1g.
starboard Right side, looking forward.
static inverter Solid-state (not rotary machine) inverter of alternating wave-form to produce DC from AC.
STC Supplementary Type Certificate.
stealth See low-observables.
stick-pusher Stall-protection device that forces pilot's control column forward as stalling angle of attack is neared.
stick-shaker Stall-warning device that noisily shakes pilot's control column as stalling angle of attack is neared.
STOL Short take-off and landing. (Several definitions, stipulating allowable horizontal distance to clear screen height of 35 or 50 ft or various SI measures.)
store Object carried as part of payload on external attachment (for example bomb, drop tank).
STOVL Short take-off, vertical landing.
strobe light High-intensity flashing beacon.
supercritical wing Wing of relatively deep, flat-topped profile generating lift right across upper surface instead of concentrated close behind leading-edge.

Sweepback: early example demonstrated by NAA F-86 Sabre *(Paul Jackson)* 1164929

sweepback Backwards inclination of wing or other aerofoil, seen from above, measured relative to fuselage or other reference axis, usually measured at quarter-chord (25 per cent) or at leading-edge.

t Tonne, 1 Megagram, 1,000 kg.
tab Small auxiliary surface hinged (flight-adjustable) or attached in a fixed position (ground-adjustable) to trailing-edge of control surface for trimming, balancing (reducing hinge moment: force needed to operate main surface) or in other way assisting pilot. Compare anti-balance tab.
tabbed flap Fitted with narrow-chord tab along trailing-edge which deflects to greater angle than main surface.
Tacan Tactical air navigation, UHF navaid giving bearing and distance to ground beacons; distance element (see DME) can be paired with civil VOR.
taileron Left and right tailplanes used as primary control surfaces in both pitch and roll.
tailplane Horizontal stabiliser; main horizontal tail surface, originally fixed and carrying hinged elevator(s) but today often a single 'slab' serving as control surface (see stabiliser, stabilator).
TANS Tactical air navigation system; Decca Navigator or Doppler-based computer, control and display unit.
TAS True airspeed, EAS corrected for density (often very large factor) appropriate to aircraft altitude.
TBO Time between overhauls.
t/c ratio Ratio of the thickness (aerodynamic depth) of a wing or other surface to its chord, both measured at the same place parallel to the fore-and-aft axis.
TCAS Traffic-alert and collision-avoidance system.
Tercom Terrain-comparison (or contour-matching), navigation aid which compares relief of terrain with profile stored in memory.
TFR Terrain-following radar (for low-level attack).
thickness Depth of wing or other aerofoil; maximum perpendicular distance between upper and lower surfaces.
thrust vectoring Rotation of a vehicle's thrust axis to control its trajectory or support its weight.
TIALD Thermal imaging and laser designation (pod).
tiltrotor Aircraft with fixed wing and rotors that tilt up for hovering and forward for fast flight.
T-O Take-off.
T-O noise EPNdB measure of aircraft taking off, at point directly under flight path 3.5 n miles from brakes-release.
TOGW Take-off gross weight (not necessarily MTOW)
ton Imperial (long) ton = 1.016 t or 2,240 lb, US (short) ton = 0.9072 t or 2,000 lb.
track Distance between centres of contact areas of main landing wheels measured left/right across aircraft (with bogies, distance between centres of contact areas of each bogie).
transceiver Radio transmitter/receiver.
transformer-rectifier Device for converting AC to DC at a different voltage.
transponder Radio transmitter triggered automatically by a particular received signal, as in secondary surveillance radar (SSR).

Eurocopter Bö 105 of TsENTROSPAS *(Paul Jackson)* 1164930

TsENTROSPAS (in Russian Federation) Ministry for Civil Defence, Emergencies and Elimination of the Consequences of Natural Disasters.
turbofan Gas-turbine jet engine generating most thrust by a large-diameter cowled fan, with small part added by jet from core.
turbojet Simplest form of gas turbine comprising compressor, combustion chamber, turbine and propulsive nozzle.
turboprop Gas turbine in which as much energy as possible is taken from gas jet and used to drive reduction gearbox and propeller.

Tyre classification systems

Classification name	Example	Nominal diameter	Nominal section width	Nominal rim diameter
Type III	8.50–10		8½ in	10 in
Type VII	49×17	49 in	17 in	
Three Part	49×19.0 -20	49 in	19.0 in	20 in
Radial	32×8.8R16	32 in	8.8 in	16 in
Metric	670×210-12	670 mm	210 mm	12 in

Example microlight/ultralight maxima

Country	Name	Seat(s)	Empty weight	MTOW	Fuel	V so
Australia	Ultralight	1–2		544 kg		
France	ULM[1]	1		300 kg[2]		35 kt[3]
	ULM[1]	2		450 kg[2]		35 kt[3]
Germany	Ultralicht	1–2		472.5 kg		
UK	Microlight	1–2		450 kg[2]		35 kt
USA	Ultralight (Pt 103)	1	254 lb[4]		5 USg	24 kt
	LSA	1–2		1,320 lb[5]		

[1] *Ultra leger motorise*; criteria accepted by several European countries
[2] Plus 10 per cent for seaplanes and amphibians
[3] Plus 5 per cent for seaplanes and amphibians
[4] Not including floats and deployable emergency devices
[5] Plus 8.3 per cent for seaplanes and amphibians

turboshaft Gas turbine in which as much energy as possible is taken from gas jet and used to drive high-speed shaft (which in turn drives external load such as helicopter transmission).
twist Progressive change of angle of incidence of a wing, rotor blade or other aerofoil from root to tip.
Type Certificate Airworthiness licence granted to enable a manufacturer to produce and market a specified type of aircraft (compare C of A).
tyre sizes Five systems of classification are in current use; Type I, consisting of a single figure indicating nominal diameter in inches, is obsolete. See adjacent table and also 'ply'

UAV Unmanned (or uninhabited) aerial vehicle; contrast RPV.
UHCA Ultra-high capacity airliner.
UHF Ultra-high frequency.
ultralight Light aircraft with parameters below specified national limits, qualifying for less rigorous licensing; also known as microlight. See table at top of page.
upper surface blowing Turbofan jet expelled over upper surface of wing to increase lift.
usable fuel Total mass of fuel consumable in flight, usually 95 to 98 per cent of system capacity.
useful load Usable fuel and other consumables plus payload.
US gallon 0.83267 Imperial gallon; 3.785 litres.
UV Ultra-violet.

'V-speeds' Shorthand notation of significant speeds within an aircraft's flight envelope (see table).

Variable geometry wings, on the laughing gull
(Paul Jackson) 1164931

variable geometry Capable of grossly changing shape in flight, especially by varying sweep of wings.
variable pitch Propeller with its blades held in rotary bearings in the hub, so that pitch (of all blades in unison) can be altered in flight. See constant speed; compare ground- and flight-adjustable pitch.
VDU Video (or visual) display unit.
vectored Capable of being pointed in different directions.
vertrep Vertical replenishment.
VFR Visual flight rules.
VHF Very high frequency.
VLF Very low frequency (area-coverage navaid).
VMS Vehicle management system.
VOR VHF omnidirectional range (network of VHF radio beacons each providing to/from bearing).
vortex generators Small blades attached to wing and tail surfaces to energise local airflow and improve control.
vortillon Short-chord fence (particularly on MD-80 series) ahead of and below leading-edge.
VSI Vertical speed (climb/descent) indicator.
V/STOL Vertical/short take-off and landing.

washout Inbuilt twist of wing or rotor blade reducing angle of incidence towards the tip.
watt SI unit of power, equal to 1 Js^{-1} (one Joule per second).
WDNS Weapon delivery and navigation system.
wet Housing fuel; wet wing often has extra connotation of integral tankage. Wet pylon can accommodate external fuel tank.
wheelbase Minimum distance from nosewheel or tailwheel (centre of contact area) to line joining mainwheels (centres of contact areas).
white tail Aircraft completed but unsold, thus not bearing any operator's insignia.
wide-body Passenger aircraft with cabin wide enough to have two longitudinal aisles between seats.
wing area Total projected area of clean wing (no projecting flaps, slats and so on) including all control surfaces and area of fuselage bounded by leading- and trailing-edges projected to centreline (inapplicable to slender-delta aircraft with extremely large leading-edge sweep angle). Described in *Jane's* as gross wing area; net area excludes projected areas of fuselage, nacelles, and so on.
wing loading Aircraft weight (usually MTOW) divided by wing area.
winglet Small auxiliary aerofoil, usually sharply upturned and often sweptback, at tip of wing.
WSO Weapon(s) system(s) officer.

yoke Pilot's flight control interface for pitch and roll axes in the form of a stick (control column) to the top of which is laterally pivoted a pair of handgrips in the form of a Y.

ZAO Zakrytoe Aktsionernoye Obshchestvo (Russian company constitution).
zero-fuel weight MTOW minus usable fuel and other consumables, in most aircraft imposing severest stress on wing and defining limit on payload.
zero/zero seat Ejection seat designed for use even at zero speed on ground.
ZFW Zero-fuel weight.

V-speeds definitions

V_1 Decision speed, up to which it should be possible to abort a take-off after failure of the critical engine and stop safely within the remaining runway length. After reaching V_1 the take-off must be continued.
V_2 Minimum take-off safety speed.
V_A Design manoeuvring speed. The speed below which abrupt and extreme control movements are possible (though not advised) without exceeding the airframe's limiting load factors.
V_B Design speed for maximum gust intensity.
V_C Design cruising speed.
V_D Design diving speed.
V_{DF} Maximum demonstrated diving speed. Also M_{DF}, maximum demonstrated Mach No. in a dive.
V_E Maximum speed at which landing gear (or other item) may be extended or retracted (cycled).
V_{FE} Maximum flap extension speed (top of white arc on ASI).
V_H Maximum level-flight speed with maximum continuous power.
V_{LE} Maximum speed with landing gear extended.
V_{MCA} Minimum control speed (air). Minimum speed at which directional control of a multi-engined aircraft can be maintained after failure of critical engine (in effect, the lowest speed at which the aircraft possesses sufficient rudder authority to counteract the yaw induced by asymmetric thrust).
V_{MO} Maximum operating speed. Also M_{MO}, maximum operating Mach No.
V_{MU} Minimum unstick speed.
V_{NE} Never-exceed speed.
V_{NO} Normal operating speed. The maximum structural cruising speed allowable for normal operating conditions.
V_R Rotation speed, at which to raise the nose for take-off.
V_{RA} Rough-air speed. Maximum recommended airspeed for penetrating turbulent air.
V_{REF} Any reference or 'bug' speed, typically quoted for approach speeds.
V_{S0} Stalling speed at maximum take-off weight, in landing configuration with flaps and landing gear down, at sea level, ISA conditions (bottom of white arc on ASI). Also V_S, stalling speed 'clean', and V_{S1}, stalling speed for a given configuration other than 'clean'.
V_{SSE} Minimum speed for deliberate shutting down of one engine for purposes of asymmetric flight training.
V_X Best angle of climb speed on all engines. Sometimes (UK usage) V_{α}.
V_{XSE} Best engine-out angle of climb speed.
V_Y Best rate of climb speed on all engines.
V_{YSE} Best engine-out rate of climb speed. Sometimes $V_{\alpha SE}$.
V_{ZRC} Zero rate of climb speed (on one engine, where drag of inoperative engine reduces climb gradient to zero).

AIRCRAFT

Argentina

LMAASA

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Original FMA (Military Aircraft Factory) came into operation 10 October 1927 as central organisation for aeronautical research and production; underwent several name changes before reverting, in 1968, to original title as component of Aérea de Material Córdoba (AMC) of Argentine Air Force. FMA converted into a joint stock company from April 1992, Air Force buying 30 per cent of the shares to establish itself as holding and management authority; control of FMA handed over to Planning Secretary of MoD on 20 December 1993. MoD and Lockheed Aircraft Argentina SA signed concession agreement on 15 December 1994, allocating management of FMA to Lockheed Martin, now Lockheed Martin Aircraft Argentina SA, from 1 July 1995.

Principal activities are divided into three market segments: current tasks (1) aircraft maintenance, modification and upgrade, including A-4AR Fighting Hawk C-130 Hercules, Fokker F.27 and F.28, IA 58 Pucará, T-34 Mentor, Boeing 737 and AT-63 Pampa; (2) manufacturing of parts, subassemblies, assemblies and composites components; and (3) engine maintenance for T56, Atar 09C, TFE731, J52, T53 and JT8D power plants. Argentine Air Force maintenance contract renewed in January 2001 for five years at estimated value of USD230 million, but national financial crisis severely curtailed military contracts; however, new, five-year FAA maintenance contract secured on 5 February 2004, plus others for Bolivia and Colombia, and parts manufacture for Chile and Lockheed Martin USA.

Laboratories, factories and other aeronautical division buildings occupy total covered area of 220,000 m² (2,368,075 sq ft); had workforce of approximately 1,000 in 2006. Córdoba facility also accommodates Centro de Ensayos en Vuelo (Flight Test Centre), a separate division also controlled by Argentine Air Force, at which all aircraft produced in Argentina undergo certification testing. Hiatus in AT-63 programme resolved with reactivation of contracts in February 2004.

LMAASA AT-63 PAMPA

TYPE: Basic jet trainer/light attack jet.

PROGRAMME: First-generation IA 63 Pampa initiated by Fuerza Aérea Argentina (FAA; Argentine Air Force) 1979, eventual configuration being selected over six other designs early 1980, with Dornier of Germany providing technical assistance (including manufacture of prototypes' wings and tailplanes); two static/fatigue test airframes and three flying prototypes built (first flight, by EX-01, 6 October 1984); first flight of production Pampa October 1987; 14 of initial batch of 18 (including three prototypes) delivered to FAA (10 survivors currently serving I Escuadron of 4 Grupo de Caza at El Plumerillo, Mendoza) from 1988; expected follow-on order for 46 did not materialise, and Argentine Navy requirement for 12 long remained in abeyance, but one new aircraft (E-816), assembled from existing and new components, delivered to FAA on 28 September 1999.

'New-generation' Pampa NG revealed late 1997 and offered to Argentine Air Force and Navy.

Resumption of activity announced 29 June 2000 to upgrade 12 Pampas to new AT-63 (with hyphen) configuration; deliveries then scheduled to begin in 2003 and end in June 2005; USD230 million contract (2001) included option for further 12 from new production (six for FAA and six for export). This reaffirmed in January 2001 to be part of five-year FAA support contract placed with LMAASA. Argentine Navy interest renewed in 2000; initial batch of eight then in prospect.

Work was suspended in 2002 because of national financial crisis; contracts reactivated in February 2004, covering six for Argentina and six for export, resulting in roll-out of first upgraded AT-63 (former IA 63 prototype EX-03, renumbered AT-03) on 15 December 2004, at which time first flight was scheduled for June 2005 — duly achieved on 23 June — and delivery in December 2005. By March 2005, manufacturer was discussing funding options with Argentine government for demonstrator with TFE731-40 engine, as envisaged for upgraded AT-63.

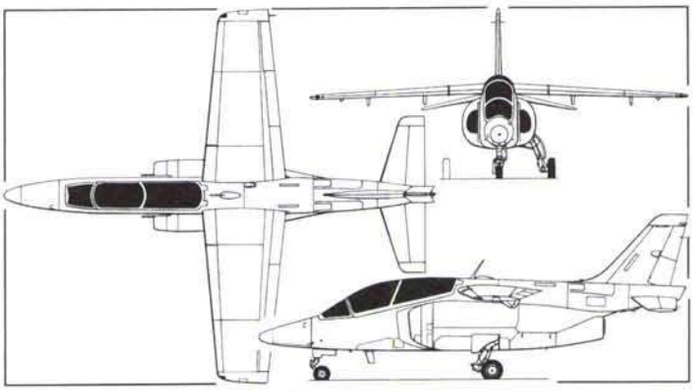
CURRENT VERSIONS: **IA 63 Pampa:** Standard Argentine Air Force version. Production complete.

Naval version: Would have strengthened landing gear, uprated engine and some changed avionics.

Pampa 2000 International: Not proceeded with.

Pampa NG A: Proposed advanced trainer with updated avionics. Essentially became AT-63 (initial version).

LMAASA AT-63 Pampa Phase II 1158854



LMAASA AT-63 Pampa two-seat basic and advanced jet trainer *(Dennis Punnett)* 1158782

Pampa NG B: Proposed combat-capable version; uprated engine and avionics. Features to be incorporated in later upgrade of AT-63.

AT-63: Attack/trainer. Announced 2001 as new standard version for Argentine Air Force and potential export. Two prototypes modified from existing IA 63s in 2001–02; first flight planned for November 2002, but delayed following funding problems of FAA; rescheduled for mid-2005 following 15 December 2004 roll-out. Initial version (Pampa Phase II) features new processor for DECU, Elbit avionics suite (MIL-STD-1553B databus, mission computer, RLG INS/GPS, integrated weapons system, liquid crystal MFD in each cockpit, and front cockpit HUD).

Customised advanced version (Pampa Phase III) proposed (originally for 2005) with structurally enhanced (+7/−3 g) wing, 18.7 kN (4,200 lb st) TFE731-40 engine and 390 kt (722 km/h; 489 mph) max level speed, missionised avionics with enhanced tactical capabilities, nose-mounted laser range-finder, fin-mounted RWR, conformal chaff/flare dispensers, two additional hardpoints (total seven) for AAMs and strengthened landing gear for increased MTOW.

AT-63 version also proposed with Lockheed Martin AN/APG-67(V)4 multimode radar in response to Colombian interest; announced at FIDAE, Chile, April 2002 that Lockheed Martin Naval Electronics& Surveillance Systems (now Lockheed Martin Maritime Systems and Sensors) selected to integrate APG-67 in Pampa. Also reported that Singapore evaluated AT-63 in early 2003 as S.211 replacement.

Description applies to Phase II Pampa.

CUSTOMERS: Argentine Air Force 18 AT-63 (12 upgraded Phase II and six new-build Phase III). Six of later also to be produced for export, possibly to Colombia, which reported (mid-2002) to have potential interest in up to 24.

COSTS: USD8 million to USD9 million, including radar (estimated, 2002).

DESIGN FEATURES: Intended for cost-effective pilot training in mission management techniques, advanced fighter lead-in training and extended-range anti-drug patrol missions. High degree of commonality with the original IA 63 Pampa, providing a customised low life-cycle cost fleet. Fail-safe service life 8,000 hours.

Non-swept shoulder-mounted wings and anhedral tailplane, sweptback fin and rudder; single engine with twin lateral air intakes. Wing section Dornier DoA-7/-8 advanced transonic; leading-edge sweep 5° 24'; thickness/chord ratio 14.5 per cent at root, 12.5 per cent at tip; anhedral 3°.

FLYING CONTROLS: Conventional hydraulically powered ailerons, rudder, all-moving tailplane, single-slotted Fowler flaps, and door-type airbrake, deployable at all speeds, on each side of upper rear fuselage; primary surfaces have Liebherr tandem actuators and electromechanical trim.

STRUCTURE: Conventional all-metal semi-monocoque/stressed skin; two-spar wing box forms integral fuel tank. Modified fuselage nosecone, tailcone and fintip in AT-63.

LANDING GEAR: SHL (Israel) retractable tricycle type, with hydraulic extension/retraction and emergency free-fall extension. Oleo-pneumatic shock-absorbers. Single Messier-Bugatti wheel on each unit with Goodrich (main) or Continental (nose) low-pressure tyre; nosewheel offset 10 cm (3.9 in) to starboard. Tyre sizes 6.50-10 (10 ply) on mainwheels, 380×150 (4/6 ply) on nosewheel, with respective pressures of 6.55 bar (95 lb/sq in) and 4.00 bar (58 lb/sq in). Nosewheel retracts rearward, mainwheels inward into underside of engine air intake trunks. Messier-Bugatti mainwheel hydraulic disc brakes incorporate anti-skid device; nosewheel steering (±47°). Gear designed for operation from unprepared surfaces.

POWER PLANT: One 15.57 kN (3,500 lb st) Honeywell TFE731-2C turbofan installed in rear fuselage. Single-point pressure refuelling, plus gravity point in upper surface of each wing. Standard internal fuel capacity of 968 litres (255 US gallons; 213 Imp gallons) in integral wing tank of 550 litres (145 US gallons; 121 Imp gallons) and 418 litre (110 US gallon; 92.0 Imp gallon) flexible fuselage tank with a negative g chamber permitting up to 10 seconds of inverted flight. Additional 415 litres (109 US gallons; 91.0 Imp gallons) can be carried in auxiliary tanks inside outer wing panels, to give a maximum internal capacity of 1,383 litres (364 US gallons; 304 Imp gallons). Provision on centre underwing stations for two external drop tanks, each of 317 litres (83.7 US gallons; 69.7 Imp gallons). Total fuel capacity 2,017 litres (533 US gallons; 444 Imp gallons).

ACCOMMODATION: Crew of two in tandem, rear seat elevated, on UPC (Stencel) S-III-S3IA63 zero/zero ejection seats. Ejection procedure can be preselected for separate single ejections, or for both seats to be fired from front or rear cockpit. HOTAS operation; dual controls standard. One-piece wraparound windscreen. One-piece canopy, with internal screen, is hinged at rear and opens upward. Entire accommodation pressurised and air conditioned.

SYSTEMS: Honeywell environmental control system, maximum differential 0.30 bar (4.4 lb/sq in), supplied by high- or low-pressure engine bleed air, provides a 1,980 m (6,500 ft) cockpit environment up to flight level 5,730 m (18,800 ft) and also provides ram air for negative g system and canopy seal. Oxygen system supplied by 10 litre (0.35 cu ft) lox converter. Engine air intakes anti-iced by engine bleed air.

Two independent hydraulic systems, each at pressure of 207 bar (3,000 lb/sq in), each supplied by engine-driven pump. Each system incorporates a bootstrap reservoir pressurised at 4 bar (58 lb/sq in). No.1 system, with flow rate of 16 litres (4.2 US gallons; 3.5 Imp

gallons)/min, actuates primary flight controls, airbrakes, landing gear and wheel brakes; No. 2 system, with flow rate of 8 litres (2.1 US gallons; 1.75 Imp gallons)/min, actuates primary flight controls, wing flaps, emergency and parking brakes, and nosewheel steering. Honeywell ram air turbine provides emergency hydraulic power for No. 2 system if engine shuts down in flight and pressure in this system drops below minimum.

Electrical system (28 V DC) supplied by Lear Siegler 400 A 11.5 kW engine-driven starter/generator; secondary supply (115/26 V AC power at 400 Hz) from two Flite-Tronics 450 VA static inverters and two SAFT 27 Ah sealed lead batteries. Thirty minutes of emergency electrical power available in case of in-flight engine shutdown.

AVIONICS: *Comms:* Two VHF/UHF transceivers and direction-finder, intercom and IFF or ATC transponder.

Radar: Lockheed Martin AN/APG-67(V)4 multimode radar optional (not fitted in Argentine Air Force aircraft).

Flight: VOR/ILS with marker beacon receiver; DME or Tacan optional; autonomous ESIS/air data computer, HSI, ADF, ADI; Honeywell HG 764 laser INS with GPS; radar altimeter; air data computer.

Instrumentation: Single 127 mm (5 in) HUD (multimode: UFCP, PDU, PSVS and camera); colour HUD camera/airborne videotape recorder; video repeater; 12.7 × 17.8 cm (5 × 7 in) liquid crystal MFD in each cockpit for Argentine Air Force; second, similar MFD in each cockpit (for EICAS) for export version; Multirole central computer and MIL-STD-1553B digital databus.

Mission: New integrated weapon delivery system. Mission computer/symbol generator/integrated comms; weapon management system/data transfer unit; steerable laser ring finder optional; radar warning receiver optional; chaff/flare dispenser.

ARMAMENT: Five stations for external stores, stressed for 440 kg (970 lb) on centre fuselage and each inboard underwing station, 290 kg (639 lb) on each outboard underwing station, all at +5.5/−2 *g*. Phase III aircraft will have further pair of pylons further outboard, each rated at 170 kg (375 lb), for total of seven, plus uprated inboard wing pylons. Several external stores configurations including Mk 81 and Mk 82 bombs; LAU-32, LAU-51 and LAU-10 rocket pods; 30 mm gun pod (centreline), twin machine gun pods; and CBLS 200 practice bomb carriers.

DIMENSIONS, EXTERNAL:

Wing span	9.69 m (31 ft 9½ in)
Wing aspect ratio	6.0
Length overall	10.93 m (35 ft 10¼ in)
Height overall	4.29 m (14 ft 1 in)
Tailplane span	4.58 m (15 ft 0 ¼ in)
Wheel track	2.66 m (8 ft 8¾ in)
Wheelbase	4.42 m (14 ft 6 in)

AREAS:

Wings, gross	15.63 m² (168.3 sq ft)
Ailerons (total)	0.89 m² (9.58 sq ft)
Trailing-edge flaps (total)	2.93 m² (31.54 sq ft)
Fin	1.86 m² (20.02 sq ft)
Rudder	0.655 m² (7.05 sq ft)
Tailplane	4.35 m² (46.87 sq ft)

WEIGHTS AND LOADINGS (estimated):

Weight empty	2,820 kg (6,217 lb)
Max fuel weight:	
fuselage	327 kg (721 lb)
wings, internal inboard	430 kg (948 lb)
wings, internal outboard	325 kg (717 lb)
underwing drop tanks	496 kg (1,093 lb)
Max external stores load	1,900 kg (4,189 lb)
Max T-O weight	5,000 kg (11,023 lb)
Max wing loading	319.9 kg/m² (65.52 lb/sq ft)
Max power loading	321 kg/kN (3.15 lb/lb st)

PERFORMANCE (estimated at 3,764 kg; 8,300 lb clean T-O weight with normal internal fuel, except where indicated):

Max level speed at 7,985 m (25,900 ft)	440 kt (814 km/h; 506 mph)
Max operating speed (VMO)	M0.8
Econ cruising speed at 9,145 m (30,000 ft)	350 kt (648 km/h; 402 mph)
Stalling speed at S/L, 50% normal internal fuel:	
flaps up	104 kt (193 km/h; 120 mph)
flaps down	82 kt (152 km/h; 95 mph)
Max rate of climb at S/L	1,560 m (5,118 ft)/min
Service ceiling	12,900 m (42,320 ft)
T-O run	430 m (1,410 ft)
Landing run at 3,497 kg (7,710 lb)	460 m (1,510 ft)
Radius of action:	
air-to-air (hi-hi), T-O weight of 4,300 kg (9,480 lb) with 254 kg (560 lb) external load, 5 min allowance for dogfight, normal internal fuel, 30 min reserves	380 n miles (703 km, 437 miles)
air-to-ground (hi-lo-lo-hi), 30 n mile dash out/in, T-O weight of 5,000 kg (11,023 lb) with 1,000 kg (2,205 lb) external load, max internal fuel, 5 min allowance for weapon delivery, plus 30 min reserves	236 n miles (127 km, 205 miles)
Ferry range 9,145 m (30,000 ft), ISA with 15 min reserves	1,140 n miles (2,111 km; 1,311 miles)
g limits	+6/−3

Australia

BRAND

BEST BRAND AUSSIE-AERO P/L

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DIRECTOR: Rolf Brand

In 1985, Dr Brand produced the Leaders AM-JB1 light aircraft (22.7 kW; 30 hp Cuyuna 430R), registered N212RB, and AM-DS1 which was offered to the US Department of Defense. Dr Brand is now concentrating his efforts on promoting the current RB-1 and its associated Enviro propeller. The latter is another of Rolf Brand's inventions and is marketed by his subsidiary company, Best Brand Propeller. Efficiency tests have shown it able to produce 210 kg (463 lb) of thrust from a 44.5 kW (60 hp) input when rotating at 2,000 rpm, an improvement of some 15 to 20 per cent over existing units.

Brand RB-1 prototype and example of Enviro propeller *(Paul Jackson)* 1151702

BRAND RB-1

TYPE: Single-seat ultralight kitbuilt.

PROGRAMME: Demonstrator (10-1450) built and flown in early 1990s. Original composites wings judged to be too heavy and replaced by current units; reflown as such in July 2004.

Funding sought for further development and marketing, to which end aircraft shown statically at Australian International Air Show, Avalon, March 2005. Intention is Chinese manufacturer for sale in Australia as kitplane.

COSTS: Kit USD18,500 (2005).

DESIGN FEATURES: Unconventional, modular ultralight structure, resembling pod-and-boom layout but with 'half length' boom attached to centre rear of tubular metal pod framework and pusher propeller rotating around intact (thus, structurally unimpaired) boom at approximate CG.

High-mounted wing of constant chord; cruciform empennage attached to rear of boom. Empennage efficiency increased by central prop-wash. Wings braced to pod by metal tube struts; empennage braced to wing by wires.

FLYING CONTROLS: Manual. Half-span Junkers ailerons outboard.

STRUCTURE: Aluminium boom (may be reinforced by composites for later versions with increased engine power). Wing of aluminium tube and ribs, with fabric covering; composites ailerons and empennage. Steel tube pod structure clad in composites.

LANDING GEAR: Tailwheel type; fixed. Axle type, steel tube main gear on prototype; cantilever spring type envisaged for production version.

POWER PLANT: Brand compact axial thrust (CAT) system comprising 48.0 kW (64.4 hp) Rotax 582 two-cylinder piston engine mounted at CG, below boom, turning propeller on a flexible mount, cancelling torque. Propeller hub rotates around boom; three advanced technology Enviro propeller blades bolted to hub, each blade of hollow construction. Blade material according to application; typically glass fibre and Kevlar. Composites fuel tank of spherical shape between cockpit and engine; capacity 45 litres (11.9 US gallons; 9.9 Imp gallons).

DIMENSIONS, EXTERNAL:

Wing span	8.50 m (27 ft 10¾ in)
Length overall	6.00 m (19 ft 8¼ in)

Brand RB-1 prototype fitted with replacement wings *(Paul Jackson)* 1121761

DIMENSIONS, INTERNAL:

Cockpit max width	0.68 m (2 ft 2¾ in)

AREAS:

Wings, gross	10.75 m² (115.7 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	185 kg (408 lb)
Max T-O weight	300 kg (661 lb)

PERFORMANCE:

Max level speed	92 kt (170 km/h; 106 mph)
Cruising speed	59 kt (110 km/h; 68 mph)
Stalling speed	27 kt (50 km/h; 32 mph)
Max rate of climb at S/L	122 m (400 ft)/min
T-O run	60 m (200 ft)
Landing run	100 m (330 ft)
Range	189 n miles (350 km; 217 miles)

BRUMBY

BRUMBY AIRCRAFT AUSTRALIA

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MANAGING DIRECTOR: Phil Goard

Having designed and built a prototype of the Goair Products GT-1 Trainer at Bankstown Airport, Sydney, Mr Goard transferred to Cowra under a new company name in 2004 to build a development, the Brumby. PG Aviation offers a variety of aircraft services, including material supplies, repair, manufacture, sales and issue of airworthiness certificates.

BRUMBY BRUMBY

TYPE: Side-by-side lightplane/kitbuilt.

PROGRAMME: Development of Goair GT-1 Trainer, which first flown (VH-BBR) July 1995 and followed by second machine in 2001. No further production known. Brumby (an Australian wild horse) first demonstrated (19-4462) at RA-Aus Natfly exhibition, Narromine, in April 2006. Pre-production batch of five under assembly in 2006, being registered in Ultralight or Experimental category.

COSTS: Kit AUD43,500, plus tax, excluding engine (2006).

DESIGN FEATURES: Optimised for Australian RAA (544 kg; 1,200 lb) or US LSA category. Design aims included short-field performance, good visibility and docile stall characteristics. Low wing of trapezoidal planform, apart from small constant-cord centre section. Trapezoidal empennage surfaces incorporate balanced, full-height rudder and horn-balanced elevators.

FLYING CONTROLS: Conventional and manual. Frise ailerons and slotted flaps. Actuation by pushrods or (rudder) cables; flaps electrically operated.

STRUCTURE: Generally of aluminium alloy.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring cantilever mainwheel legs; telescoping, steerable nosewheel. Hydraulic brakes. Fairings on all wheels.

POWER PLANT: One piston engine driving a two-blade, wooden propeller. Option of 59.6 kW (59.6 hp) Rotax 912 UL, 73.5 kW (98.6 hp) Rotax 912 ULS, 59.7 kW (80 hp) Jabiru 2200, 89 kW (120 hp) Jabiru 3300 (as prototype) or approx 82.0 kW (110 hp) Corvair 2700. Fuel in wing tanks; combined capacity 120 litres (31.7 US gallons; 26.4 Imp gallons).

ACCOMMODATION: Two persons, side-by-side, under forward-sliding canopy/windscreen; large fixed transparency covering baggage area to rear of seats. Optional gull wing canopy.

AVIONICS: To customer's specification.

DIMENSIONS, EXTERNAL:

Wing span	8.53 m (28 ft 0 in)
Wing chord at root	1.52 m (5 ft 0 in)
Wing aspect ratio	7.5
Length overall	6.25 m (20 ft 6 in)
Height overall	2.13 m (7 ft 0 in)

DIMENSIONS, INTERNAL:

Baggage area volume	0.17 m^2 (6.0 cu ft)

AREAS:

Wings, gross	9.75 m^2 (105.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	312 kg (688 lb)
Max T-O weight	600 kg (1,322 lb)
Max wing loading	61.5 kg/m^2 (12.59 lb/sq ft)

PERFORMANCE (Jabiru 3300 engine):

Never-exceed speed (VNE)	140 kt (259 km/h; 161 mph)
Max level speed	125 kt (232 km/h; 144 mph)
Normal cruising speed	115 kt (213 km/h; 132 mph)
Stalling speed, flaps down	38 kt (71 km/h; 44 mph)
Max rate of climb at S/L	305 m (1,000 ft)/min
T-O run	198 m (650 ft)
Landing run	183 m (600 ft)
Endurance	5 h

Brumby Aircraft Australia Brumby two-seat lightplane or ultralight 1158060

COBRA

COBRA AVIATION

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MANAGING DIRECTOR: Tom Wickers

Company founded in 2000 as Tomair Aircraft Sales; subsequently formed Cobra Aviation, for marketing of Arrow, Explorer and Landseair.

First Cobra Arrow built by an Australian constructor 1037912

COBRA ARROW

TYPE: Side-by-side ultralight kitbuilt; side-by-side motor glider kitbuilt.

PROGRAMME: Non-flying exhibition airframe, then incomplete, displayed at Avalon Air Show, February 2001; prototype (19-3700) was removed from its moulds in August 2001 and was fitted out in late 2001/early 2002. First flight 18 May 2002. Conventional tailplane and elevators replaced in July 2002 by stabilator. First tailwheel version (19-3988) under construction (Kim Penglaze, Victoria), in mid-2003; was complete by 2005.

CURRENT VERSIONS: **Arrow:** Standard version, *as described*. Available to Ultralight or Certified rules.

Arrow M/G: Motor glider version with 3.66 m (12 ft) increase in wing span.

Explorer: *Described separately.*

CUSTOMERS: Total of 30 kits sold by January 2006; first production kit shipped to New Zealand customer in March 2003.

COSTS: Arrow Sport kit, less engine, instruments and retractable landing gear, AUD42,850, plus tax. Quick-build AUD11,000 extra, reduces build time by 100 hours (2006).

DESIGN FEATURES: Derived from US Polliwagen homebuilt, described in 1983–84 and earlier editions. Designed to meet AUF 51 per cent amateur-built rules. Conventional low-wing monoplane; sweptback T tail. Kit comprises prejoined fuselage mouldings with cowling, canopy and main spar carry-through installed; tail surfaces; wing skins with main spar installed; laser-cut profiles for rib shapes; carbon fibre instrument panel; plus seats, fuel cells, control columns, rudder pedals and hardware. Wings detach for storage and transportation. Quoted average build time 350 hours.

FLYING CONTROLS: Manual. Ailerons, rudder and stabilator. Flaps.

STRUCTURE: Mostly of pre-moulded composites.

LANDING GEAR: Option of tailwheel type, fixed; or tricycle type, fixed or retractable. From mid-2003, wheel sizes 6.00×6 main; 5.00×6 nose.

POWER PLANT: Prototype has one 74.6 kW (100 hp) Subaru EA81 and Bolly Optima three-blade propeller. Other suitable engines include JPX 4TX75, Rotax 582, 912 and 914,

Jabiru 2200 and 3300, Mazda rotary and Textron Lycoming O-200 and O-360. Fuel capacity 71.9 litres (19.0 US gallons; 15.8 Imp gallons); optionally 130 litres (34.3 US gallons; 28.6 Imp gallons).

ACCOMMODATION: Two persons side by side under enclosed canopy. Dual controls (sticks) standard. Baggage door on starboard side of fuselage aft of cockpit.

DIMENSIONS, EXTERNAL:

Wing span: Arrow	8.53 m (28 ft 0 in)
Arrow M/G	12.19 m (40 ft 0 in)
Length overall	5.79 m (19 ft 0 in)
Height overall (nosewheel)	1.83 m (6 ft 0 in)
Wheelbase	1.83 m (6 ft 0 in)
Propeller diameter	1.83 m (6 ft 0 in)

WEIGHTS AND LOADINGS:

Weight empty, typical	280 kg (617 lb)
Max T-O weight: Ultralight	544 kg (1,200 lb)
Certified	700 kg (1,543 lb)
Max power loading (prototype)	6.63 kg/kW (10.90 lb/hp)

PERFORMANCE (Subaru engine):

Max level speed	more than 200 kt (370 km/h; 230 mph)
Cruising speed at FL85	132 kt (244 km/h; 152 mph)
Stalling speed, flaps down	38 kt (71 km/h; 44 mph)
T-O and landing run	122 m (400 ft)
Range	782 n miles (1,448 km; 900 miles)
g limits	+10/–6

COBRA EXPLORER

TYPE: Side-by-side ultralight kitbuilt.

PROGRAMME: In February 2003, Cobra revealed it was building a prototype of a high-wing version of the Arrow, due to fly in the middle of that year. Strut-braced wings save 40 kg (88 lb) of structural weight. No further details revealed, although prototype structurally complete by mid-2003, and first flew on 16 August 2004. Data released in 2004 were identical to those for the Cobra Arrow.

COBRA LANDSEAIR

TYPE: Four-seat amphibian kitbuilt.

PROGRAMME: Designed by Martin Gischus; announced by Cobra in May 2003. Manufacture of tooling for prototype began in 2000. By early 2006 it was reported that the fuselage was complete and work on the wings was progressing.

Artist's impression of Cobra Landseair 0554412

COSTS: Kit AUD58,000 (2003).

POWER PLANT: One pusher piston engine. Options include 96.9 kW (130 hp) Subaru EA82, Rotax 914 and Jabiru 3300. Fuel capacity 100 litres (26.4 US gallons; 22.0 Imp gallons).

DIMENSIONS, EXTERNAL:

Wing span	10.06 m (33 ft 0 in)
Length overall	6.10 m (20 ft 0 in)

DIMENSIONS, INTERNAL:

Cabin max width	1.12 m (3 ft 8 in)

AREAS:

Wings, gross	15.79 m² (171.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	350 kg (772 lb)
Max T-O weight	620 kg (1,366 lb)

PERFORMANCE:

Cruising speed	105 kt (194 km/h; 120 mph)
Stalling speed	40 kt (75 km/h; 46 mph)
Max rate of climb at S/L	244 m (800 ft)/min
T-O run on water	213 m (700 ft)
Landing run on water	244 m (800 ft)

DEAN-WILSON

DEAN-WILSON AVIATION LTD

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CHAIRMAN: Steve Wilson
VICE-CHAIRMAN: Gary Dean

Company was established in 2004 as an offshoot of the Dean-Wilson metal foundry. In the same year it announced that construction had begun of a new basic trainer designed by Bill Whitney, who had previously been responsible for refining the production version of Hughes Australian Lightwing; designing the Seabird Seeker; and 16 other projects. Dean-Wilson Aviation became a public listed company on 1 December 2005.

The new trainer, known as the Whitney Boomerang, is undergoing flight trials conducted by Arena Aviation at Kingaroy, north-west of Brisbane, and is being manufactured in series at the same location. Official opening of the 1,100 m² (11,850 sq ft) Kingaroy production facility was on 2 September 2006.

Dean-Wilson Whitney Boomerang 1154756

DEAN-WILSON WHITNEY BOOMERANG

TYPE: Two-seat lightplane.

PROGRAMME: Announced 2004, when construction of prototype was under way; this exhibited, partly complete, at Australian International Air Show at Avalon, 15 to 20 March 2005. First flight (VH-AAV) 6 July 2006. Delivery of first two production aircraft scheduled for March and April 2007 to launch customer, Arena Aviation.

CUSTOMERS: By January 2007, contracts received from training schools, Arena Aviation at Kingaroy and Minovation Flying School at Jandakot, Western Australia.

COSTS: USD129,000 basically equipped (2007).

Dean-Wilson Whitney Boomerang 1154687

DESIGN FEATURES: Low-cost, all-metal, basic trainer intended to replace Cessna 150/152, Piper PA-38 Tomahawk and similar aircraft. Design goals included strength, durability, comfort, good visibility for pilots, good performance and handling and incorporation of advanced technology.

Modular design for ease of production and maintenance; low-mounted, constant-chord wing; mid-mounted tailplane and sweptback fin with fillet.

Fatigue life 19,500 hours. Intended for CASA Type 23 certification.

FLYING CONTROLS: Conventional and manual. Balanced ailerons; horn/mass-balanced elevator and rudder. Slotted flaps; max deflection 45°. Control actuation by cables; pushrods for flaps.

STRUCTURE: Metal. Tubular 4130 steel cockpit cage with 6061-T6 aluminium cladding. Aluminium monocoque rear fuselage, except for steel tube framework anchorage for tailplane and single-piece elevator. Single-spar metal wing and control surfaces.

LANDING GEAR: Tricycle type; fixed. Wing-mounted spring cantilever mainwheel legs; oleo-pneumatic nosewheel leg. Mainwheels and nosewheel 5.00-5; hydraulic disc brakes on mainwheels. Parking brake. Nosewheel steerable.

POWER PLANT: One 85.8 kW (115 hp) Textron Lycoming O-235-N2C flat-four driving a metal, two-blade, fixed-pitch propeller. Optionally, one 119 kW (160 hp) Textron Lycoming O-320 flat-four. Fuel in two wing tanks, combined capacity 140 litres (37.0 US gallons; 30.8 Imp gallons).

ACCOMMODATION: Two persons, side by side, with baggage area at rear. Fixed windscreen; forward-hinged door each side; rear quarterlights for all-round vision. Dual controls.

SYSTEMS: Electric system, 12 V 60 A DC.

AVIONICS: Option of VFR, night VFR and IFR, including ADF and transponder.

Comms: Garmin GMA 340 intercom; GTX 327 transponder; GNS 430 COM/NAV/GPS.

Flight: Bendix/King KR 87 ADF and KI 227 indicator.

DIMENSIONS, EXTERNAL:

Wing span	9.80 m (32 ft 1¾ in)
Wing chord, constant	1.40 m (4 ft 7 in)
Wing aspect ratio	7.0
Length overall	6.46 m (21 ft 2¼ in)

Height overall ..... 2.49 m (8 ft 2 in)
Tailplane span ..... 2.95 m (9 ft 8 in)
Doors (each): Height ..... 0.91 m (3 ft 0 in)
Width ..... 0.65 m (2 ft 1¾ in)
Propeller diameter ..... 1.83 m (6 ft 0 in)
DIMENSIONS, INTERNAL:
Cockpit max width ..... 1.12 m (3 ft 8 in)
AREAS:
Wings, gross ..... 13.72 m² (147.7 sq ft)
Ailerons (total) ..... 1.22 m² (13.09 sq ft)
Flaps (total) ..... 1.83 m² (19.74 sq ft)
Tailplane ..... 1.31 m² (14.10 sq ft)
Elevator ..... 0.90 m² (9.67 sq ft)
WEIGHTS AND LOADINGS:
Max baggage weight ..... 35 kg (77 lb)
Max T-O weight ..... 750 kg (1,653 lb)
Max wing loading ..... 54.7 kg/m² (11.20 lb/sq ft)
Max power loading ..... 8.75 kg/kW (14.37 lb/hp)
PERFORMANCE:
Never-exceed speed (VNE) ..... 142 kt (263 km/h; 163 mph)
Cruising speed ..... 95 kt (176 km/h; 109 mph)
Stalling speed: flaps up ..... 49 kt (91 km/h; 57 mph)
flaps down ..... 43 kt (80 km/h; 50 mph)
Endurance, absolute ..... 5 h
g limits ..... +4.0/–2.2

FOXCON

FOXCON AVIATION AND RESEARCH PTY LTD

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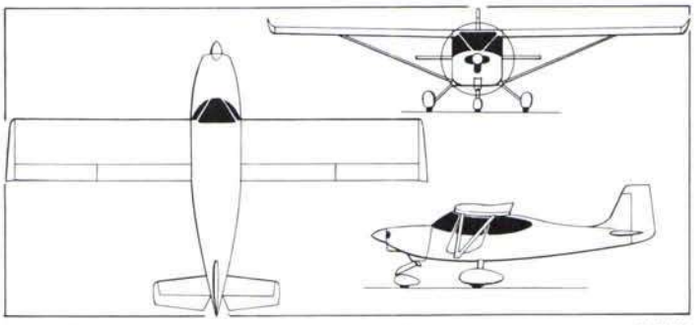
DIRECTOR: Helmut Kley

Mr Kley redesigned the original Terrier lightplane and returned it to production in composites form, manufactured by his company, Foxcon, formed in 1995. Builders are able to participate in a factory-assistance programme.

FOXCON TERRIER 200

TYPE: Side-by-side ultralight kitbuilt.
PROGRAMME: Composites version of 1980s tailwheel design, re-engineered, via Terrier 100, by Foxcon.
CURRENT VERSIONS: **Terrier 200:** *As described.*
Terrier 200C: Camper version; reconfigurable interior, with bench seat foldable to accommodate two recumbent occupants.
CUSTOMERS: Following some six of original version, 48 built by early 2005 including 30 in Australia, 10 in New Zealand (six currently registered) and one in Russia.
COSTS: Kit AUD55,000, including engine and tax (2005).
DESIGN FEATURES: High, constant-chord wing with streamlined V-strut bracing and upturned tips. Low tailplane and sweptback fin.
Quoted build time 300 hours, including builder-assistance programme.
Wing section Chris Mk 4. Dihedral 1° 30'.
FLYING CONTROLS: Conventional and manual. Frise ailerons with external hinge; horn-balanced elevators and rudder. Slotted flaps. Trim tabs on rudder and port ailerons; flight-adjustable tabs in both elevators. Control surface movements: ailerons +24/–12°; elevators +30/–20°.

Foxcon Terrier 200C camper version *(Paul Jackson)* 1151730


Foxcon Terrier two-seat ultralight *(James Goulding)* 1121715

STRUCTURE: Generally of vacuum-moulded composites with epoxy foam sandwich and steel fittings and firewall. Aluminium wing bracing struts.
LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring chromoly steel tube mainwheel legs with folded composites sheet streamlining; trailing link nosewheel. Hydraulic mainwheel brakes. Mainwheel size 16-inch; nosewheel 15-inch; composites wheel fairings on all.
POWER PLANT: One 74.6 kW (100 hp) Subaru EA 81 flat-four driving a Polyprop three-blade, ground-adjustable pitch, carbon fibre propeller via a Foxcon 2.2:1 belt drive with fore and aft bearings on each spindle. Optional Foxcon independent ignition system for each cylinder. Fuel tanks in wings, total usable capacity 80 litres (21.1 US gallons; 17.6 Imp gallons).
DIMENSIONS, EXTERNAL:
Wing span ..... 8.82 m (28 ft 11¼ in)
Length overall ..... 6.10 m (20 ft 0¼ in)
Height overall ..... 2.38 m (7 ft 9¾ in)
WEIGHTS AND LOADINGS:
Weight empty ..... 334 kg (736 lb)
Max baggage weight ..... 30 kg (66 lb)
Max T-O weight ..... 544 kg (1,200 lb)
PERFORMANCE:
Max level speed ..... 120 kt (222 km/h; 138 mph)
Cruising speed ..... 110 kt (204 km/h; 127 mph)
Stalling speed, flaps down ..... 30 kt (56 km/h; 35 mph)
Max rate of climb at S/L ..... 457 m (1,500 ft)/min
T-O and landing run ..... 100 m (330 ft)
Range ..... 600 n miles (1,111 km; 690 miles)
g limits ..... +6/–4

GIPPSLAND

GIPPSLAND AERONAUTICS PTY LTD

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Web: www.gippsaero.com
DIRECTORS:
George Morgan
Peter Furlong
SALES CO-ORDINATOR: Marguerite Morgan

Involved since 1971 in design and modification programmes for a wide range of aircraft, from wooden homebuilts to pressurised turboprops. Conversion of five Piper Pawnees to two-seat configuration in second half of 1980s led eventually to a totally new design, the GA200 crop-sprayer. Second Gippsland aircraft, GA8 Airvan, first flew in 1995 and was delivered to customers from December 2000 onwards. First export Airvan flew in 2001.

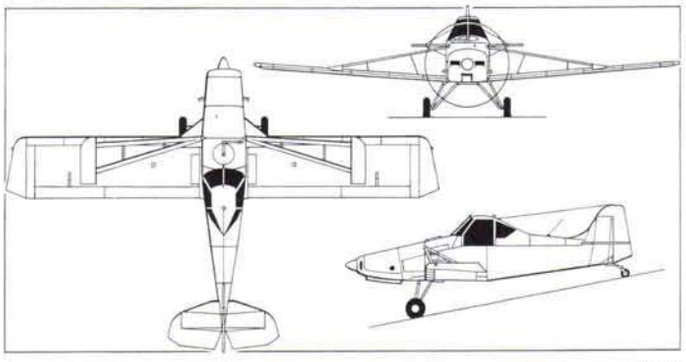
Other activities include main spar life extension of Piper Navajo/Chieftain, of which 83 had been refurbished by February 2006.

In early 2006, Gippsland occupied 6,000 m² (64,575 sq ft) of factory area; personnel totalled 115.

GIPPSLAND GA200 FATMAN

TYPE: Agricultural sprayer.
PROGRAMME: Precursor was two-seat conversion of five Piper PA-25–235 Pawnees to -235/A8 or -235/A9 Fatman standard in 1986–90. Prototype GA200 (VH-BCE) registered 1991; this and second aircraft used airframes from damaged Pawnees; No 3 (VH-SKG) was first new-build, in 1992. Designation derived from hopper capacity in US gallons. Full Australian CAA certification in both Normal and Agricultural categories (to CAO 101.16 and 101.22 and FAR Pt 23 Amendment 23.36) awarded 1 March 1991; FAR Pt 23 certification awarded 15 October 1997 in Restricted category. Certification also achieved in Brazil, Canada, China, New Zealand, South Africa and the US. Production at Traralgon, Victoria, since 1993, but now available to special order only. Is promoted in Middle East by Seabird Aviation Jordan, which offered new-build aircraft to Kurdistan government in 2005 under manufacturing licence granted by Gippsland.
CURRENT VERSIONS: **GA200:** Initial version; 194 kW (260 hp) Textron Lycoming O-540-H2A5 engine. Hopper capacity 776 litres (205 US gallons; 170 Imp gallons). Replaced by GA200C.
GA200 Ag-trainer: Training version, with dual controls, dual rudder pedals and smaller hopper. Total of three built, plus unspecified number of conversions from GA200s.
GA200B: Unofficial designation of GA200 with extended wingtips. Most built up to 1998 were to this standard.
GA200C: *As described.* Uprated (224 kW; 300 hp IO-540-K1A5) engine beneath cowling of revised shape; constant-speed propeller; 1,050 litre (277.4 US gallon; 231 Imp gallon) hopper capacity. In early 1998, 21st production (23rd overall) aircraft completed as prototype GA200C; all subsequent aircraft to this standard. Textron Lycoming AEIO-580 of 246 kW (330 hp) installed in new-built 45th aircraft and first flown 11 February 2003 for engine evaluation.
CUSTOMERS: Delivery of 44th (including prototypes) effected in November 2001; 45th flown February 2003; none further by end of that year. Exports to Brazil (one), Canada (one), China (nine), New Zealand (eight, beginning 1994), South Africa (two) and USA (five).
COSTS: USD470,483 ex-Jordan (2005).
DESIGN FEATURES: Purpose-designed agricultural aircraft. Braced low wing, with large integral hopper forward of cockpit; leading-edges are not handed to minimise replacement time in the event of birdstrike or other minor damage; crash-resistant, corrosion-proofed structure; gap-sealed ailerons; detachable wingtips. Although initially based on Piper Pawnee, GA200 in current form is substantially different. Wing dihedral 7° from roots. Flaps and ailerons non-handed. Horn-balanced elevators and rudder.

Gippsland GA200 Fatman agricultural sprayer 1151718



Gippsland GA200C Fatman sprayer *(Mike Keep)* 0110575

FLYING CONTROLS: Conventional and manual, cable actuated. Single-slotted trailing-edge wing flaps can be deployed to tighten turning radius during agricultural operations; T-O setting 15°, maximum 38°. Interconnect system applies bias to elevator trim spring when flaps extended, to avoid pitch trim changes. Fixed tab on rudder. Gap-sealed ailerons to prevent chemical ingress.

STRUCTURE: Fuselage of welded SAE 4130 chromoly steel tube with removable metal side and top panels; wings (braced by overwing inverted V strut of aluminium each side) and wire-braced tail surfaces conventional all-metal, but wing spars constructed from sheet metal to expedite repairs; wingtips detachable. Rear fuselage and tail surfaces are fabric covered. Initial fatigue life of 15,000 hours set by CASA, subject to extension pending ongoing tests.

LANDING GEAR: Non-retractable, with 6 in diameter Cleveland P/N 40-84A mainwheels mounted on tubular steel side Vs, hinged to lower longerons, plus half-axles under centreline, each with bungee cord shock-absorber, and hydraulic dampers; wire-cutter on leading tube of landing gear legs; Cleveland heavy duty hydraulic disc brakes. Mainwheel tyres size 8.50×6 (6 ply). Scott 3200 steerable/castoring tailwheel, size 5.00–5 (4 ply) mounted on multileaf flat springs.

POWER PLANT: One 224 kW (300 hp) Textron Lycoming IO-540-K1A5 flat-six engine, driving a Hartzell HC-C2YR-1BF/F8475R constant-speed, two-blade metal propeller. AEIO-580 installation under test in 2003, offering additional 22 kW (30 hp). Fuel in integral tank in each wing, combined usable capacity 200 litres (52.8 US gallons; 44.0 Imp gallons), plus small 14 litre (3.7 US gallon; 3.1 Imp gallon) header tank in upper front fuselage. Oil capacity 11.4 litres (3.0 US gallons; 2.5 Imp gallons).

ACCOMMODATION: Two energy-absorbing seats, side by side (smaller, right-hand seat for loader/driver); dual controls and second set of rudder pedals for right-hand seat in Ag-trainer. Four-point 25 *g* restraint harness(es). Cockpit doors open upward, each with bulged window to improve shoulder room and outward view. Pressurisation system minimises dust and chemical ingress.

SYSTEMS: 14 V 95 A automotive alternator and automotive or R-35 aviation battery for electrical power; 50 A circuit breaker switch serves as master switch.

AVIONICS: *Instrumentation:* ASI, electric turn-and-bank indicator, altimeter, tachometer, oil temperature and pressure gauges, CHT gauge, ammeter, fuel flow gauge and totaliser, and EGT gauge, all standard. VHF com only.

EQUIPMENT: One 1,070 litre (283 US gallon; 235 Imp gallon) capacity glass fibre/vinyl ester hopper in forward fuselage (approximately 76 litres; 20.0 US gallons; 16.7 Imp gallons less in Ag-trainer), with minimum load dump time of five seconds. Multirole door/hopper outlet, eliminating need to change outlet when changing between solids and liquids, can also be used for fire bombing or laying of fire retardants. Spreader vanes can be added to increase swath width. Cable cutters on landing gear legs and windscreen. 100 W landing light in each wingtip; 28 V night working lights system (two retractable underwing 600 W lights, powered by separate 28 V 55 A alternator) also available.

DIMENSIONS, EXTERNAL:

Wing span, standard version	11.985 m (39 ft 3¾ in)
Wing chord, constant	1.60 m (5 ft 3 in)
Wing aspect ratio	7.3
Length overall (flying attitude)	7.48 m (24 ft 6½ in)
Height (static) over cockpit canopy	2.33 m (7 ft 7¾ in)
Tailplane span	2.90 m (9 ft 6¼ in)
Wheel track	2.335 m (7 ft 8 in)
Propeller diameter	2.13 m (7 ft 0 in)

AREAS:

Wings, gross	19.59 m² (210.9 sq ft)
Ailerons (total)	0.79 m² (8.49 sq ft)
Flaps (total)	0.71 m² (7.63 sq ft)
Fin	0.48 m² (5.155 sq ft)
Rudder, incl tab	0.63 m² (6.76 sq ft)
Tailplane	1.295 m² (13.92 sq ft)
Elevators (total)	1.37 m² (14.725 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	758 kg (1,671 lb)
Operating weight empty	868 kg (1,914 lb)
Max hopper capacity, Normal category	544 kg (1,199 lb)
Max T-O weight: Normal category	1,524 kg (3,359 lb)
Agricultural category	1,996 kg (4,400 lb)
Max landing weight	1,448 kg (3,192 lb)
Max wing loading	101.8 kg/m² (20.86 lb/sq ft)
Max power loading	8.91 kg/kW (14.64 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	144 kt (266 km/h; 165 mph)
Max cruising speed at 75% power	115 kt (213 km/h; 132 mph)
Ferry speed	110 kt (204 km/h; 127 mph)
Econ cruising speed	100 kt (185 km/h; 115 mph)
Stalling speed: flaps up	57 kt (106 km/h; 66 mph)
flaps down	51 kt (95 km/h; 59 mph)
Max rate of climb at S/L	149 m (490 ft)/min
T-O run, normal category	350 m (1,148 ft)
T-O to 15 m (50 ft), normal category	475 m (1,558 ft)
Landing from 15 m (50 ft)	360 m (1,181 ft)
Landing run	200 m (656 ft)
Max range	400 n miles (740 km; 460 miles)
g limits	+3.8/−1.52

GIPPSLAND GA8 AIRVAN

TYPE: Light utility transport.

PROGRAMME: Design completed and proof of concept prototype construction started early 1994; first flight 3 March 1995 (aircraft then marked only as 'GA-8' on the fin but allocated company test registrations VH-GAV and later VH-PTR); 186 kW (250 hp) Textron Lycoming O-540; prototype destroyed 7 February 1996 during spinning trials; second airframe completed to major component stage for static testing; third airframe (initially flown without test registration VH-ZGI but with 'AIRVAN' on fin was second flying prototype, first flown in August 1996 with an interim 224 kW (300 hp) Textron Lycoming IO-540K-1A5 engine and three-blade propeller, pending installation of intended (but temporarily discontinued) production standard IO-580 in 1997; total of 350 hours flight testing completed by two prototypes by November 1998; second prototype re-registered VH-XGA in January 1999.

Provisional type certification obtained 10 March 1999, with full CASA certification to FAR Pt 23 Amendment 48 achieved 10 October 2000; subsequently upgraded to FAR Pt23 Amendment 54 on 14 March 2003; this applicable to c/n 026 (VH-HQE) and upwards, but earlier aircraft are upgradable. First delivery (VH-RYT) to Air Fraser Island Air 22 December 2000. Initial export aircraft (seventh overall, c/n 008/V3-HGI) first flew 24 November 2001, and delivered to Maya Island Air of Belize in following month. International debut (VH-BJY) at Asian Aerospace show in Singapore February 2002 before delivery to distributor PT Airvan Dirgantara of Indonesia. Transport Canada certification achieved in April 2003, followed by FAA FAR Pt23 Amendment 54 approval 30 May 2003; UK certification (for EASA) achieved 29 July 2005.

Various upgrades under development by 2005, principal being turbocharged TIO-540 engine (initial customer Mission Aviation Fellowship); trial installation in converted early production aircraft (VH-TBU) first flown November 2004; available in 2006. Turbine engine test programme to follow, but Diesel project awaiting certification of suitable engine. Other upgrades include enlarged nosewheel option; 'winterisation' with engine-powered heaters and door seal; Wipaire 4000 float option in conjunction with TIO-540 engine; skis; and Honeywell autopilot (available 2006); medical evacuation interior. Airvan VH-FGN used as testbed for outstanding upgrades in 2005-06; certification of these was expected in late 2006.

CUSTOMERS: Total of 84 production aircraft completed by February 2006. Deliveries included four in 2001; 12 in 2002; 19 in 2003; 23 in 2004; and 26 in 2005. Exports include aircraft for Belize (Maya Island Air, two), Botswana (three), Canada (two), Costa Rica (three), Germany (one, Ostfriesiche Luft Transport), Indonesia (six), Lesotho Defence Force (one c/n 03-038/LDF-54 delivered 19 March 2004), Mozambique (two), New Zealand (six), New Caledonia (one), Papua New Guinea (one), South Africa (eight), United Kingdom (two, including Boogie Club Skydive Centre), and US (22). Australian customers include Air Fraser Island (three), Alligator Airways (two), Lanya Air (three), Kakadu AirServices (two), Latrobe Air (one), Missionary Aviation Fellowship Australia (one), Shine Aviation Services (one), Skydive Oz (one), TGS Air Charter (two), and Wrightsair (three). In January 2003, the US Civil Air Patrol appointed Gippsland to supply Airvans on an Indefinite Quantity Indefinite Delivery (IQID) basis over a three-year period. The first CAP Airvan, c/n 030 (VH-AUP/N605CP), was delivered in August 2003 for SAR and Homeland Security missions; total 16 supplied by late 2005.

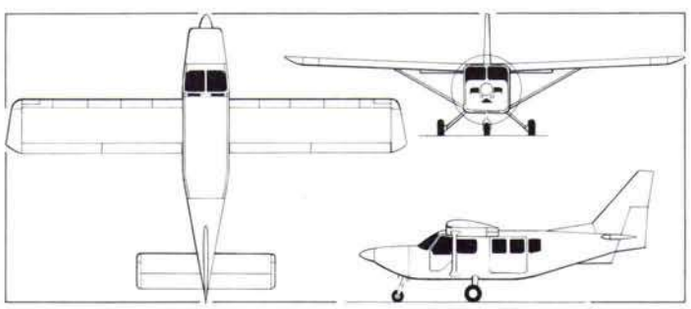
COSTS: USD450,000, VFR equipped (2006).

DESIGN FEATURES: Strut-braced, high-wing monoplane with sweptback vertical tail and fixed tricycle landing gear; designed to operate from unprepared strips. Fin and rudder modified, and ventral finlet added on second prototype, late 1996.

Wing aerofoil modified US 35B; dihedral 2° 30'; incidence 2°; twist 1.6°.

FLYING CONTROLS: Conventional and manual. Trimmable tailplane, deflections +2°/−5°; slotted flaps, deflections 14 and 38°. Elevator deflections +15°/−19°; ailerons +17°/−16°; rudder ±21°.

STRUCTURE: Light alloy; two-spar wing based on GA200 Fatman unit; composites cowlings and fairings; entire structure designed for easy manufacture, maintenance and repair.



Gippsland GA8 Airvan (Textron Lycoming IO-540 engine) *(James Goulding)* 0110574

Gippsland Airvan Australian owned *(Paul Jackson)* 1151694

Gippsland Airvan delivered to Mission Aviation Fellowship in early 2005, complete with new ventral pannier *(Paul Jackson)* 1121704

LANDING GEAR: Non-retractable tricycle type; single-piece tubular spring main gear, steerable steel spring/oleo nose leg; Parker heavy duty hydraulic disc brakes; high flotation mainwheels 8.50-6 (6 ply); nosewheel 6.00-6 (6 ply). Wipline float installation under development in US.

POWER PLANT: One 224 kW (300 hp) Textron Lycoming IO-540-K1A5 flat-six engine driving a two-blade Hartzell HC-2YR-1BF/F8475R constant-speed propeller. Fuel capacity 340 litres (89.8 US gallons; 74.8 Imp gallons) in two wing tanks, of which 332 litres (87.7 US gallons; 73.0 Imp gallons) usable. Oil capacity 11 litres (3.0 US gallons; 2.5 Imp gallons).

ACCOMMODATION: Pilot and up to seven passengers or equivalent cargo; full FAR Pt 23.562 compliant crashworthy seats. Amsafe seatbelt airbags under development in early 2003. Crew door each side of flight deck; flight openable forward-sliding cargo door on port side aft of wing. Cabin is heated and ventilated. Baggage compartment, with security net, at rear of cabin. Optional ventral cargo pod certified October 2004 and first fitted to VH-MFE (c/n 065), flown 21 December 2004.

SYSTEMS: Split bus electrical system powered by 14 V 95 A engine-driven alternator. Maintenance-free sealed battery and external power receptacle with overvolt protection standard.

AVIONICS: Standard Bendix/King avionics suite.

Comms: Dual KY 97A-61 VHF; KT 76A-12 transponder; KMA 24H audio panel and TX4400 intercom; pilot's yoke-mounted PTT switch; pilot's and co-pilot's headsets and microphone jacks.

Flight: KR 87 digital ADF; altitude encoder.

Instrumentation: KMD 150 moving map with 102 × 76 mm (4 × 3 in) multifunction display, airspeed indicator, artificial horizon, altimeter with hectoPascal subscale, electric turn co-ordinator, directional gyro, vertical speed indicator, OAT gauge, internally lit magnetic compass, electronic digital fuel flow and totaliser gauge, EGT gauge, recording tachometer, fuel supply gauge, fuel gauges with low fuel warning lights, oil temperature/pressure gauges, CHT gauge, and manifold pressure gauge.

EQUIPMENT: Standard equipment includes automatic fuel management system, windscreen demisting, instrument panel lighting, avionics dimming, map and cabin reading lights, navigation lights, dual landing/taxying lights, dual wingtip strobe lights; external power receptacle; pilot's and co-pilot's five-point inertia reel shoulder harnesses; six three-point inertia reel harnesses for passengers; cabin soundproofing; and entrance step.

DIMENSIONS, EXTERNAL:

Wing span	12.41 m (40 ft 8¾ in)
Wing chord, constant	1.60 m (5 ft 3 in)
Wing aspect ratio	7.9
Length overall	8.95 m (29 ft 4¼ in)
Fuselage max width	1.37 m (4 ft 6 in)
Height overall	3.89 m (12 ft 9 in)
Tailplane span	4.17 m (13 ft 8 in)
Wheel track	2.79 m (9 ft 2 in)
Wheelbase	2.30 m (7 ft 6½ in)
Cargo/passenger door: Height	1.08 m (3 ft 6½ in)
Width	1.07 m (3 ft 6 in)
Height to sill	0.85 m (2 ft 9½ in)
Propeller diameter	2.13 m (7 ft 0 in)

DIMENSIONS, INTERNAL:

Cabin: Length, incl flight deck	3.96 m (13 ft 0 in)
Max width	1.27 m (4 ft 2 in)
Max height	1.19 m (3 ft 11 in)
Max headroom, seat to ceiling	0.84 m (2 ft 9 in)
Floor area: incl flight deck	5.02 m² (54.0 sq ft)
excl flight deck	3.44 m² (37.0 sq ft)
Volume, incl flight deck	5.1 m³ (180 cu ft)
Cargo pod volume	0.51 m³ (18.0 cu ft)

AREAS:

Wings, gross	19.32 m² (208.0 sq ft)
Ailerons (total)	1.60 m² (17.20 sq ft)
Trailing-edge flaps (total)	1.60 m² (17.20 sq ft)
Fin	1.90 m² (20.50 sq ft)
Rudder	0.77 m² (8.30 sq ft)
Tailplane	4.40 m² (47.40 sq ft)
Elevators (total)	1.76 m² (18.90 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	997 kg (2,198 lb)
Baggage capacity: shelf	113 kg (250 lb)
aft bin	23 kg (50 lb)
Cargo pod capacity	200 kg (441 lb)
Max fuel	248 kg (547 lb)
Max T-O and landing weight:	
initial certification	1,814 kg (4,000 lb)
target	1,905 kg (4,200 lb)

Max wing loading:
initial certification ..... 93.9 kg/m² (19.23 lb/sq ft)
target ..... 98.6 kg/m² (20.19 lb/sq ft)
Max power loading:
first prototype ..... 9.74 kg/kW (16.00 lb/hp)
initial certification ..... 8.12 kg/kW (13.33 lb/hp)
target ..... 8.52 kg/kW (14.00 lb/hp)
PERFORMANCE:
Never-exceed speed (VNE) ..... 185 kt (342 km/h; 212 mph)
Normal cruising speed at 3,048 m (10,000 ft) ..... 120 kt (222 km/h; 138 mph)
Econ cruising speed ..... 104 kt (193 km/h; 120 mph)
Stalling speed: flaps up ..... 60 kt (112 km/h; 69 mph)
flaps down ..... 52 kt (97 km/h; 60 mph)
Max rate of climb at S/L ..... 240 m (787 ft)/min
Service ceiling, estimated ..... 6,100 m (20,000 ft)
T-O run ..... 347 m (1,138 ft)
T-O to 15 m (50 ft) ..... 457 m (1,500 ft)
Landing from 15 m (50 ft) ..... 396 m (1,300 ft)
Landing run ..... 155 m (509 ft)
Range with max fuel:
normal cruise ..... 730 n miles (1,352 km; 840 miles)
econ cruise ..... 933 n miles (1,727 km; 1,073 miles)
Endurance, no reserves:
at normal cruising speed ..... 6 h
at econ cruising speed ..... 9 h

GOAIR

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MANAGING DIRECTOR: Phil Goard

Company machines, welds and manufactures aircraft components. During the 1990s it designed, built and flight-tested the Goair Trainer, production of which was begun, although does not appear to have progressed.

In 2001, Goair completed a replica of the 1920s Westland Widgeon. Company re-formed as PG Aviation Pty Ltd.

HUGHES

HOWARD HUGHES ENGINEERING PTY LTD

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Web: www.lightwing.com.au
MANAGING DIRECTOR: Howie Hughes
SECRETARY: Jenny Hughes
PRODUCTION MANAGER: Nick Hughes
PUBLIC RELATIONS MANAGER: Shelly Hughes

Company formed 1984 to design and produce the Australian LightWing series which has developed from GR-582 via GA-55 to GR-912 and the associated Sport 2000. Most production, undertaken in a 2,000 m² (21,525 sq ft) factory at Ballina Airport, is for local use and either full certification or registry under AUF rules; around 10 aircraft per year are built. Aircraft for export are issued with Australian certificates of airworthiness. In 2003, the company announced the LightWing Speed, a low-wing development of the GR-912 family. By end 2004, over 160 aircraft had been produced, while the new Lightwing Speed made its first flight in 2005. In early 2005, the workforce numbered seven.

HUGHES AUSTRALIAN LIGHTWING GR-912

TYPE: Side-by-side ultralight/kitbuilt.
PROGRAMME: Prototype Australian LightWing (ALW) (25-0032) made first flight June 1986; initially with 47.8 kW (64.1 hp) Rotax 582 UL; many sold conforming to CAO 95 Pt 25 requirements; also produced under homebuilt or CAO 101 Pt 28 regulations in non-retractable tailwheel and twin-float configurations; first amphibian model delivered in 1990. Type certificate issued 25 September 1998.
CURRENT VERSIONS: **GR-912:** Tailwheel version. *As described.*
GR-912-T: Tricycle landing gear version; marketing designation Sport 2000; *described separately.*
LightWing Truck: Added to range in 2002; uses same wing married to 45 cm (1 ft 5¾ in) longer fuselage with extra space behind seats able to accommodate two further seats; reinforcing has obviated need for wire bracing on tail unit. Cabin width increased by 15 cm (6 in). Powered by 84.6 kW (113.4 hp) Rotax 914; will accept eight-cylinder 149 kW (200 hp) Jabiru once engine development completed. Initially offered in tailwheel configuration, with nosewheel version offered from 2003.
CUSTOMERS: More than 160 aircraft (all versions) delivered by end 2004; over 90 per cent registered under AUF rules. Claimed 29 per cent share of Australian two-seat light trainer market with GR-912.
COSTS: GR-912 AUD85,900 factory built; flaps AUD2,000 extra (2006).
DESIGN FEATURES: Modified Clark Y wing section. Quoted build time 500 hours, which reduces to 300 hours with quick-build versions.
FLYING CONTROLS: Conventional and manual. Optional flaps.
STRUCTURE: Strut-braced metal wings; welded 4130 steel tube fuselage and tail; tail surfaces are wire-braced; composites and polyfibre covering.
LANDING GEAR: Tailwheel type; fixed. Optional amphibious floats with retractable mainwheels and non-retractable tailwheels (latter doubling as water rudders).
POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS flat-four driving a two- or three-blade propeller via 2.27:1 gear reduction; Aerofiber wooden two-blade fixed-pitch propeller recommended; can also be fitted with 59.6 kW (79.9 hp) Rotax 912UL. Fuel capacity 60 litres (15.8 US gallons; 13.2 Imp gallons) of which 57 litres (15.1 US gallons; 12.5 Imp gallons) are usable. Oil capacity 3.0 litres (0.8 US gallon; 0.7 Imp gallon).

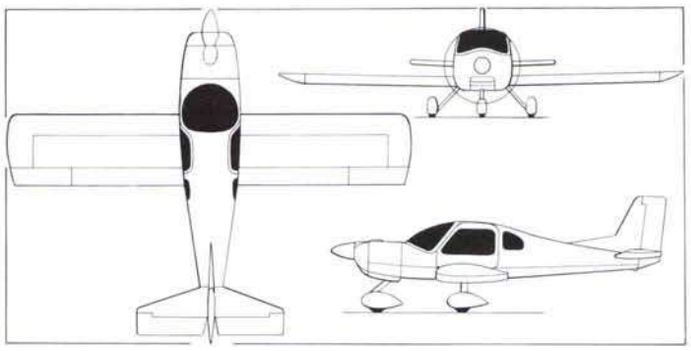
DIMENSIONS, EXTERNAL:
Wing span ..... 9.50 m (31 ft 2 in)
Length overall ..... 5.68 m (18 ft 7½ in)
Height overall ..... 1.90 m (6 ft 2¼ in)
AREAS:
Wings, gross ..... 15.35 m² (165.2 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 295 kg (650 lb)
Max T-O weight: on wheels ..... 544 kg (1,199 lb)
on floats ..... 620 kg (1,366 lb)
certified ..... 480 kg (1,058 lb)
PERFORMANCE:
Max level speed ..... 95 kt (176 km/h; 109 mph)
Max cruising speed ..... 80 kt (148 km/h; 92 mph)
Loiter speed ..... 50 kt (93 km/h; 58 mph)
Stalling speed, full flaps, power off ..... 40 kt (74 km/h; 46 mph)
Max rate of climb at S/L ..... 244 m (800 ft)/min
T-O run ..... 100 m (330 ft)
Landing run ..... 80 m (263 ft)
Range with max fuel ..... 216 n miles (400 km; 248 miles)

HUGHES AUSTRALIAN LIGHTWING SPEED

TYPE: Side-by-side ultralight/kitbuilt; four-seat kitbuilt.
PROGRAMME: Design began in 2002; construction started in 2003. Prototype (19-4353) first flew 19 July 2005, powered by Rotax 912S engine and Bolly propeller. Available as a kit for RAA or experimental categories from 2005 and factory-built from 2006.
CURRENT VERSIONS: **Speed 2000-S:** Two-seat Sport version; Rotax engine standard. Available only as kit; RAA (Australian) Ultralight category.
Speed 3000: Two-seat; Superior XP-360 engine. Kit only; experimental category.
Speed 4000: Four-seat version; larger wing; lowered 18 cm (7 in) cockpit floor at rear; Superior engine; Experimental category.
Speed GT: Glider Tug. Two-seat; large wing; Light Sport engine.
COSTS: Kit: Speed 2000-S AUD74,900 including Rotax 912S engine; Speed 3000 kit AUD79,000 and Speed 4000 AUD82,000, both with XP-360 engine; all plus tax (2006) and including 'glass' cockpit.
DESIGN FEATURES: Based on company's existing LightWing GR-912 family, including large fin fillet, but of low wing layout. Retains welded steel cockpit frame. Quoted build time 500 hours.
FLYING CONTROLS: Conventional and manual. Mass-balanced ailerons, plus horns on elevator and rudder. Ailerons and rudder actuated by pushrods; elevator by cables;. three-position manual flaps as standard.
STRUCTURE: Fuselage of 4130 welded steel tube with glass fibre, semi-structural external shell, although Speed 2000 has fabric-covered lower rear fuselage to limit weight. Wings have aluminium spar; glass fibre ribs, leading-edge and tips; aluminium centre and rear skin. Control surfaces are mixture of glass fibre and 6061-T6 tube with fabric covering.
LANDING GEAR: Fixed; tricycle type standard; tailwheel type optional, but all aircraft have interchangeable fittings. Fuselage-mounted, spring tubular steel cantilever mainwheel legs with composites streamline fairings; nosewheel similar; optional wheel fairings. Mainwheels 6.00-6; nosewheel 5.00-5. Floats optional.
POWER PLANT: Options include Light Sport Power 220 (Subaru EJ22) turbocharged, geared flat-four rated at 164 kW (220 hp); Subaru EJ20 of 149 kW (200 hp) as converted by Hughes and with MOTEC engine management system. 134 kW (180 hp) Superior XP-360; 73.5 kW (98.6 hp) Rotax 912S or 84.6 kW (113.4 hp) Rotax 914 flat-four. LW 230

Hughes GR-582 operating from Yarrawonga 1037908

Hughes Australian Lightwing 2000-S prototype 1037913



Hughes Australian Lightwing Speed 2000-S *(James Goulding)* 1121596

liquid-cooled engine and 2.1:1 gearbox planned for later versions. Two- or three-blade propeller; fixed- or flight-adjustable pitch. Fuel capacity 180 litres (47.5 US gallons; 39.6 Imp gallons) in four integral wing tanks.

ACCOMMODATION: Gull-wing doors each side of fuselage. Sidestick controllers.

AVIONICS: *Instrumentation:* 'Glass cockpit' of Hughes design and integration as standard, including one 254 mm (10 in) touch-screen (optionally two) Lawrance Airmap GPS and Fugawie mapping software. Optional internet access system.

EQUIPMENT: Optional ballistic recovery parachute.

All data are provisional.

DIMENSIONS, EXTERNAL:

Wing span: 2000, 3000	7.87 m (25 ft 9¾ in)
4000, GT	8.30 m (27 ft 2¾ in)
Length overall	6.42 m (21 ft 0¾ in)
Height overall	2.52 m (8 ft 3¼ in)

DIMENSIONS, INTERNAL:

Cockpit max width	1.18 m (3 ft 10½ in)

AREAS:

Wings, gross: 2000, 3000	11.81 m² (127.1 sq ft)
4000, GT	13.15 m² (141.5 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: 2000	400 kg (882 lb)
3000, GT	500 kg (1,102 lb)
4000	600 kg (1,323 lb)
Max T-O weight: 2000	600 kg (1,322 lb)
3000, GT	800 kg (1,763 lb)
4000	1,100 kg (2,425 lb)

PERFORMANCE:

Normal cruising speed: 2000	115 kt (213 km/h; 132 mph)
3000	165 kt (306 km/h; 190 mph)
Stalling speed, flaps down	45 kt (84 km/h; 52 mph)
Service ceiling	3,050 m (10,000 ft)

HUGHES AUSTRALIAN LIGHTWING SPORT 2000

TYPE: Side-by-side ultralight/kitbuilt.

PROGRAMME: Developed version of GR-912 (which see); certified in Australian Primary category. Uses original LightWing type certificate.

CUSTOMERS: 10 built by end 2002.

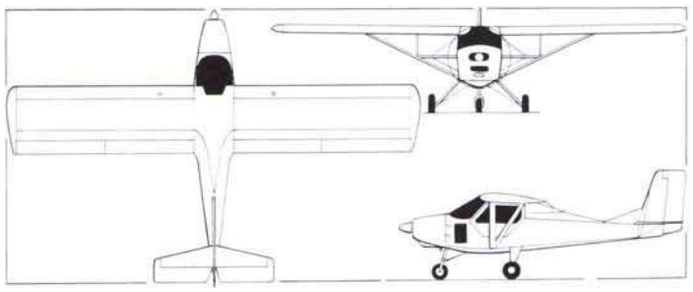
COSTS: AUD88,900 factory built; AUD45,900 kit, including alternative 59.6 kW (79.9 hp) Werner engine (2005).

FLYING CONTROLS: Conventional and manual. Horn-balanced tail surfaces; elevator pushrod-operated; aileron and rudder cable-operated. Three-position flaps.

STRUCTURE: Welded steel tube fuselage; riveted aluminium alloy two-spar wings; mainly fabric covered, with non-structural glass fibre fairings.

LANDING GEAR: Tricycle type; fixed; steerable nosewheel. Two faired-in side Vs hinged to lower longerons, plus half-axles sprung under centreline. Mainwheels 152 mm (6 in); nosewheel 127 mm (5 in).

Hughes Australian LightWing Sport 2000 *(Paul Jackson)* 1121613



Hughes Australian LightWing Sport 2000, showing optional 'Heliview' cockpit with side window at floor height (Rotax 912 UL flat-four) *(James Goulding)* 0010201

POWER PLANT: One 59.6 kW (79.9 hp) Rotax 912 UL flat-four driving an Aerofiber two-blade fixed-pitch wooden propeller. Fuel capacity 62 litres (16.4 US gallons; 13.6 Imp gallons) in two wing tanks.

DIMENSIONS, EXTERNAL:

Wing span	9.50 m (31 ft 2 in)
Length overall	5.68 m (18 ft 7½ in)
Height overall	2.20 m (7 ft 2½ in)

AREAS:

Wings, gross	15.14 m² (163.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	300 kg (661 lb)
Max T-O weight	480 kg (1,058 lb)

PERFORMANCE:

Cruising speed at 75% power	72 kt (133 km/h; 83 mph)
Stalling speed	35 kt (65 km/h; 41 mph)
T-O to and landing from 15 m (50 ft)	300 m (985 ft)
Range with max fuel	300 n miles (555 km; 345 miles)
g limits	+6/–4

HUGHES POCKET ROCKET

TYPE: Tandem seat-ultralight/kitbuilt.

PROGRAMME: Launched in 2000.

CURRENT VERSIONS: **PR-582:** Rotax 582 engine; *as described.*

PR-Breeze: Single-seat Rotax 503 engine.

PR-Bipe: Biplane version, *described separately.*

CUSTOMERS: Some 20 sold by early 2005.

COSTS: PR Breeze: Kit AUD29,900, including engine, propeller, altimeter, ASI, fabric covering and white paint (2004).

DESIGN FEATURES: Narrow-fuselage version of earlier ALW designs. Quoted kit build time 400 hours.

FLYING CONTROLS: Conventional and manual.

STRUCTURE: Fabric-covered tubular steel fuselage and wings. Main spar constructed from 10 cm (4 in) diameter tubular steel.

LANDING GEAR: Tailwheel type; fixed. Two faired-in side Vs hinged to lower longerons, plus half-axles sprung under centreline. Optional wheel fairings on PR-582.

POWER PLANT: PR-582 has one 47.8 kW (64.1 hp) Rotax 582 liquid-cooled two-cylinder engine driving two-blade wooden propeller. PR-Breeze has one air-cooled, two-cylinder, 34.0 kW (45.6 hp) Rotax 503, also driving two-blade wooden propeller. Fuel capacity (both) 80 litres (21.1 US gallons; 17.6 Imp gallons) in two integral wing tanks.

ACCOMMODATION: Pilot and passenger in tandem; PR-Breeze accommodates pilot only, in open cockpit.

DIMENSIONS, EXTERNAL:

Wing span	7.30 m (23 ft 11½ in)
Length overall	5.60 m (18 ft 4½ in)

AREAS:

Wings, gross	9.29 m² (100.0 sq ft)

PERFORMANCE:

Never-exceed speed (VNE)	105 kt (194 km/h; 120 mph)
Normal cruising speed	75 kt (139 km/h; 86 mph)
Stalling speed, flaps down	40 kt (74 km/h; 46 mph)

Hughes PR-582 tandem-seat ultralight 1042706

HUGHES PR-BIPE

TYPE: Tandem-seat, ultralight biplane/kitbuilt.

PROGRAMME: Name reflects biplane version of Hughes Pocket Rocket; wing span 6.00 m (19 ft 8¼ in). Offered from 2003. Prototype (19-4080) made first flight 10 July 2004. Further two under construction in 2005. Quoted build time 500 hours.

COSTS: Kit AUD34,990 (2005).

Hughes PR-Bipe tandem-seat ultralight 1042709

INTEGRITY

INTEGRITY AIRCRAFT

PO Box 77, West Lindfield, New South Wales 2070
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OWNER AND MANAGER: Lance H Watson

In May 2003, Mr Watson gave evidence to the Australian House of Representatives Transport & Regional Services Committee hearings, which included details of his company's intention to develop a single-turboprop version of Britten-Norman Trislander able to serve remote communities at "bus fare prices".

Construction of a prototype was to have begun in 2006.

INTEGRITY INTEGRITY

TYPE: Light utility turboprop.

PROGRAMME: Under development since 1999. Manufacture due to have begun in early 2005, but final details for funding were only being negotiated in January 2006, following which production of two prototypes was to begin.

To assist in launching the programme, Integrity obtained what was understood to be 12 uncompleted Trislander fuselages and eight sets of wings, more detailed examination revealing the totals to be 10 and six, respectively. One of these will become the second prototype, the first to be produced from a completed Trislander, the former demonstrator G-BEDO, first flown on 15 October 1976. Both prototypes to be converted by long-term Islander manufacturer, Romaero of Romania, which also responsible for technical drawings; certification in UK, supported by local Integrity design office. Configuration patented in USA.

CUSTOMERS: Potential sales of 1,500.

COSTS: USD1.7 million (estimated 2003).

DESIGN FEATURES: Single-engine version of BNG Trislander, itself basically a BNG Islander with third piston engine mounted at the intersection of cruciform empennage. Integrity changes restricted to installation of rear-mounted turboprop; fairing-over of wing engine/main landing gear attachments; forward fuselage extended 76 cm (30 in) to maintain C of G within limits and accommodate extra two seats; nose profile and avionics from current BNG Defender 4000.

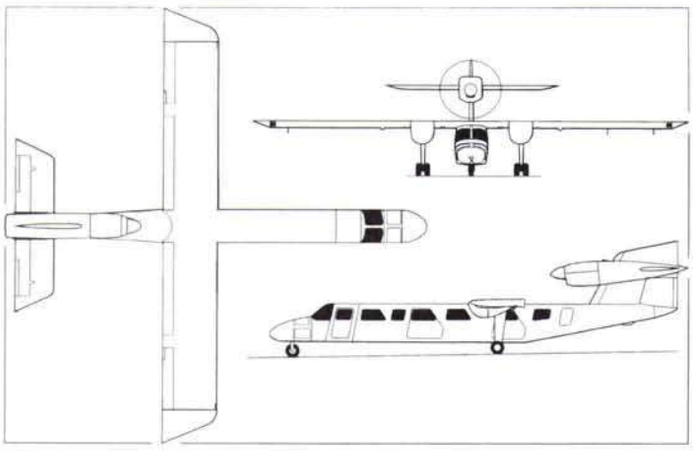
Low risk development of proven airframe and engine, suitable for regional commuter services where ability to land on rough fields and (dis)embark passengers with engine running is an advantage.

FLYING CONTROLS: Conventional and manual. Slotted ailerons and electrically-actuated slotted flaps with permanent droop; ground-adjustable tab in starboard aileron; flight-adjustable trim tabs in rudder and each elevator.

STRUCTURE: Generally of rivited aluminium. Two-spar torsion-box wing in single piece; four-longeron, semi-monocoque fuselage of pressed frames and stringers and metal skin; local strengthening of rear fuselage, compared with Islander.

LANDING GEAR: Tricycle type; fixed. Wing-mounted cantilever main legs with integral oleo-pneumatic shock-absorbers. Single, steerable nosewheel; twin mainwheels; all tyres 7.00-6. Hydraulic and parking brakes.

Integrity single-turboprop adaptation of BNG Trislander 1151509



Integrity Integrity 18-passenger turboprop *(Paul Jackson)* 1151508

POWER PLANT: One 820 kW 1,100 shp Honeywell TPE331-12 turboprop driving a McCauley five-blade propeller. Fuel tanks in wings, outboard of landing gear attachments; total capacity 1,128 litres (298 US gallons; 248 Imp gallons).

ACCOMMODATION: Total 20 (or 13 to FAR Pt 23 certification) including one or two pilots. Internal noise suppression system.

SYSTEMS: Pop-out emergency generator and standby battery.

AVIONICS: *Flight:* TAWS, EGPWS, GPS.
Instrumentation: EFIS.

EQUIPMENT: Tail monitoring camera.

DIMENSIONS, EXTERNAL:

Wing span	16.15 m (53 ft 0 in)
Wing chord, constant	2.03 m (6 ft 8 in)
Wing aspect ratio	8.3
Length overall	15.77 m (51 ft 8¾ in)
Fuselage: Max width	1.21 m (3 ft 11½ in)
Max depth	1.46 m (4 ft 9¾ in)
Height overall	4.32 m (14 ft 2 in)
Tailplane span	6.44 m (21 ft 1½ in)
Wheel track (c/l shock-absorbers)	3.61 m (11 ft 10 in)
Wheelbase	7.88 m (25 ft 10¼ in)
Propeller diameter	2.21 m (7 ft 3 in)

DIMENSIONS, INTERNAL:

Cabin (rear of pilot's seat) volume	10.2 m^3 (360 cu ft)

AREAS:

Wings, gross	31.31 m^2 (337.0 sq ft)
Ailerons (total)	2.38 m^2 (25.60 sq ft)
Trailing edge flaps (total)	3.62 m^2 (39.00 sq ft)
Fin	5.83 m^2 (62.70 sq ft)
Rudder, incl tab	1.13 m^2 (12.20 sq ft)
Tailpane	8.36 m^2 (90.0 sq ft)
Elevators (total)	2.42 m^2 (26.00 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	2,359 kg (5,200 lb)
Max T-O weight	4,535 kg (10,000 lb)
Max wing loading	144.8 kg/m^2 (29.67 lb/sq ft)
Max power loading	5.53 kg/kW (9.09 lb/shp)

PERFORMANCE:

Cruising speed at 3,050 m (10,000 ft)	170 kt (315 km/h; 196 mph)
Stalling speed, flaps down	50 kt (93 km/h; 58 mph)
Max rate of climb at S/L	305 m (1,000 ft)/min
T-O run	412 m (1,350 ft)
Landing from 15 m (50 ft)	436 m (1,430 ft)
Landing run	258 m (845 ft)
Range	1,000 n miles (1,852 km; 1,150 miles)
Endurance: at cruising speed	6 h 30 min
at long-range speed	7 h 30 min

JABIRU

JABIRU AIRCRAFT PTY LTD

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MANAGING DIRECTOR: Kevin Pearce

Jabiru formed 1988 by Rodney Stiff and Phil Ainsworth to produce Jabiru LSA 55/2K, but branched into engine design and manufacture when Italian-built KFM engine, which powered this variant, was withdrawn from market. Now produces 1,600 and 2,200 cc flat-four and 3,300 cc flat-six engines for its own and other manufacturers' aircraft. A factory-built SLA version of Jabiru, the UL 450, was launched in 2000. The company and aircraft are named for Australia's sole indigenous stork. Production averages 100 aircraft and 360 engines per year and by late 2004 had sold kits to 16 countries. A prototype of a four-seat Jabiru, the J400, first flew in March 2001 and customer deliveries began almost immediately. By January 2006, 52 Jabirus were registered under Australian CAA regulations and in December 2005 the 1,000th Jabiru, a J160, was delivered to an Australian customer.

In late 2004, company held discussions with Seabird Aviation Jordan regarding assembly and support of Jabiru aircraft in the Middle East and North Africa which resulted in SAJ offering two Jabiru versions as the Yamamah Y-160 and Y-430. Jabiru is also the parent company of Microair Avionics.

The various Jabiru versions are summarised in the table for ease of reference.

JABIRU JABIRU

TYPE: Side-by-side ultralight/kitbuilt.

PROGRAMME: Design of original Jabiru LSA, started 1987; prototype (first of two, VH-JCX and VH-JQX) made first flight August 1989; first customer delivery April 1991; factory-built version certified to CAO 101 Pt 55 on 1 October 1991; 20 built with KFM engine as LSA 55/2K before change to 44.7 kW (60 hp) Jabiru 1600 flat-four as LSA 55/2J, many of these subsequently re-engined; kitplane construction certification achieved in Australia, New Zealand, South Korea, UK and USA by early 1997; marketed in US as amateur-built kit, achieving FAR Pt 21.191 (g) certification on 8 February 1996 (as well as Australian CAO 19 equivalent); marketing office opened at Aiken, South Carolina, in anticipation of substantial US sales of at least 100 per year but later closed in favour of network of dealerships. Total of 54 factory-built and 18 kitbuilt with 1600 engine between April 1993 and March 1996. More powerful ST version introduced in 1994; Jabiru 2200-powered LSA 55/3J received certification on 6 January 1998.

Joint venture announced in 1998 with CDE Aviation Company of Sri Lanka, subsidiary of Lionair, to establish Jabiru Asia for manufacture of Jabiru ST3 for Asian markets,

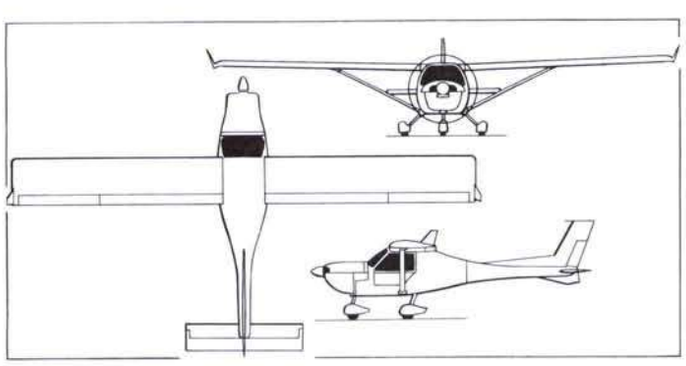
JABIRU LIGHTPLANE VARIANTS

Version	Fuselage	Wing	Engine	Gear	Fuel	Built	Rudder	Winglets
ST-3 (Certified)	Short	Short, Foam	2200	Nose	Fuselage	Factory	Inset	No
LSA (Certified)	Short	Short, Foam	2200	Nose	Fuselage	Factory	Inset	No
SP Series:								
SP	Long	Short, F or H	2200/3300	Nose	F/Wing	Kit	Inset	No
SP-T	Long	Short, F or H	2200/3300	Tail	F/Wing	Kit	Inset	No
UL Series:								
UL	Long	Long, F or H	2200/3300	Nose	F/Wing	Kit	Inset	No
UL-T	Long	Long, F or H	2200/3300	Tail	F/Wing	Kit	Inset	No
UL-C (Certified)	Long	Long, Foam	2200	Nose	Fuselage	Factory	Inset	No
J-Series:								
J200	J400	Short, Hollow	3300	Nose	Wing	Kit	Inset	No
J230	J400	Long, Hollow	3300	Nose	Wing	Kit	Horn	Yes
J230-C (Certified)	J400	Long, Hollow	3300	Nose	Wing	Factory	Horn	Yes
J250	J400	J250/J450	3300	Nose	Wing	Kit	Horn	Yes
J400 (4-seat)	J400	Short, Hollow	3300	Nose	Wing	Kit	Horn	Yes
J430 (4-seat)	J400	Long, Hollow	3300	Nose	Wing	Kit	Horn	Yes
J450 (4-seat)	J400	J250/J450	3300	Nose	Wing	Kit	Horn	Yes
J160 Series:								
J160	J160	Short, Hollow	2200	Nose	F/Wing	Kit	Horn	Yes
J160-C (Certified)	J160	Short, Hollow	2200	Nose	F/Wing	Factory	Horn	Yes
J170	J160	J250/J450	2200	Nose	F/Wing	Kit	Horn	Yes

Notes: F is foam; H is hollow wing type

Jabiru UL two-seat ultralight *(Paul Jackson)* 1037933

Winglet-equipped Jabiru UL 450 built by Kev Bream *(Paul Jackson)* 1037934



Jabiru Calypso two-seat ultralight with short rudder *(James Goulding)* 1159095

especially India. Jabiru factory at Koggala, in southern Sri Lanka; intended to have production capacity for 40 aircraft per year, using engines and avionics imported from Australia, and airframes manufactured locally. Nothing further had been heard of this by 2003.

CURRENT VERSIONS: **Jabiru LSA**: Light Sport Aircraft; factory-built; registered under AUF (Australian Ultralight Federation) rules (Pt 101.55); certified under CASA Pt 21.13A 6 June 2002. 'Short span; short fuselage' version: span 8.03 m (26 ft 4 in), length 5.03 m (16 ft 6 in), wing area 7.90 m² (85.0 sq ft).

Jabiru ST: Certified version of LSA; in factory production from mid-1994 and certificate awarded 1 July 1994; first was 50th production Jabiru. In mid-1998, the 17th production ST was registered VH-JRU to Jabiru Aircraft as the first **ST-3** short span and fuselage.

Jabiru SK: Quick-build kit version of ST (components are manufactured alongside production aircraft); first was 66th production Jabiru; quoted home-build time is 600 hours.

Jabiru SP4: Kit, combining longer fuselage of UL 450 with Jabiru 2200 engine and short-span wings of SK; originally designated SP. MTOW 470 kg (1,036 lb); stalling speed 39 kt (73 km/h; 45 mph); optimised for Canadian, Chilean and South African markets, among others. Fuel capacity 70 litres (18.5 US gallons; 15.4 Imp gallons).

Jabiru SP6: Company designation of SP4 kit with 89.5 kW (120 hp) Jabiru 3300 engine. Also known as **Jabiru SP 3300**. MTOW 500 kg (1,102 lb). Cruising speed 117 kt (217 km/h; 135 mph). Fuel capacity as SP4, or 85 litres (22.5 US gallons; 18.7 Imp gallons) optional.

Jabiru SP-T: Tailwheel version of SP; both four- and six-cylinder versions available. Enlarged rudder; mainwheel legs moved forward; steerable tailwheel and differential braking. Prototype built by Peter Kayne of Narrogin, Western Australia.

Jabiru SP 480: Proposed version of SP for JAR-VLA certification, with maximum take-off weight of 480 kg (1,058 lb); under development in late 1999.

Jabiru Calypso: Initially factory-built; now available only as kit; previously known as **UL 450**; SLA (Small Light Aeroplane to UK's now-replaced BCAR Section S), first aircraft was built in Ireland in 1998. Launched in UK in 2000 and meeting 35 kt (65 km/h; 41 mph) stalling speed requirement. Differences from SK include wing span increased by 1.37 m (4 ft 6 in); fuselage by 0.61 m (2 ft 0 in); flaps by total of 1.83 m (6 ft 0 in); and reduced ventral fin. Also available with tailwheel as **Calypso T**. Meets FAA LSA. More than 200 sold by end 2004.

Jabiru UL-C and UL-D: Factory-built version of Calypso, designed to meet CAO 101.55; CASA approval received 2 December 2004 (UL-C) and 11 February 2005 (UL-D). Powered by Jabiru 2200B; first aircraft was c/n 610.

J200, J400 and J160: Developed versions; *described separately*.

CUSTOMERS: Production of complete and kit aircraft totalled over 660 by mid-2006.

COSTS: Calypso: USD25,000; minus engine, USD35,900 with Jabiru 2200 and USD39,900 with Jabiru 3300 engine (2006). Flyaway Calypso 2200 USD59,995 (April 2002).

DESIGN FEATURES: Designed to Australian AUF Pt 101.55 and British BCAR Section S, with reference to FAR Pt 21 and JAR-VLA. Ultralight or certified aircraft, suitable for factory or amateur assembly. Unswept wing (braced) and tailplane, swept fin; dorsal and ventral fins; all flying surfaces square-tipped; wings detachable for storage and transportation. Quoted build time 600 hours.

Wing section NASA 4412; drooped wingtips; dihedral 1° 15'; incidence 2° 30'; no twist.

FLYING CONTROLS: Conventional and manual. In-flight adjustable pitch trim; wide-span slotted flaps. Original short rudder supplanted by full-height rudder (also available as retrofit) on all versions. From 2002, enlarged fin version (¾ height rudder) adopted, entire vertical tail being moved further forward.

STRUCTURE: All-GFRP except metal wing struts, nosewheel assembly and engine mount.

LANDING GEAR: Tricycle type, fixed. Fuselage-mounted spring GFRP cantilever mainwheel legs with speed fairings. Nosewheel steerable ±15°, coupled to rudder and with compressed rubber shock-absorber. Mainwheels 4.00–6 or 5.00–6; Bigfoot 6.00–6 tyres optional. Nosewheel 2.60–4, 4.00–4 or 5.00–6; tailwheel 250×50.

POWER PLANT: One 59.7 kW (80 hp) Jabiru 2200A/J flat-four engine, driving a two-blade, fixed-pitch, wood/composites propeller. Fuel capacity 65 litres (17.2 US gallons; 14.3 Imp gallons).

SYSTEMS: 12 V DC electrical system with 100 W capacity; 20 Ah battery.

AVIONICS: *Comms:* VHF antenna (inside fin) and intercom standard.

Instrumentation: Basic VFR; vacuum instruments optional.

Data below refer to Jabiru Calypso with Jabiru 2200 engine.

DIMENSIONS, EXTERNAL:

Wing span: normal	9.40 m (30 ft 10 in)
with winglets	9.56 m (31 ft 4½ in)
Length overall	5.64 m (18 ft 6 in)
Height overall	2.01 m (6 ft 7 in)

DIMENSIONS, INTERNAL:

Cockpit max width at shoulder	1.07 m (3 ft 6 in)

AREAS:

Wings, gross	9.29 m² (100.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, equipped	242 kg (534 lb)
Max T-O weight	450 kg (992 lb)

PERFORMANCE:

Never-exceed speed (VNE)	120 kt (222 km/h; 138 mph)
Max level speed	110 kt (204 km/h; 127 mph)
Cruising speed at 75% power	100 kt (185 km/h; 115 mph)
Stalling speed, flaps down	35 kt (65 km/h; 41 mph)
Max rate of climb at S/L	305 m (1,000 ft)/min
T-O run	100 m (330 ft)
Landing run	168 m (555 ft)
Range with max fuel	430 n miles (796 km; 494 miles)

JABIRU J SERIES

TYPE: Four-seat kitbuilt.

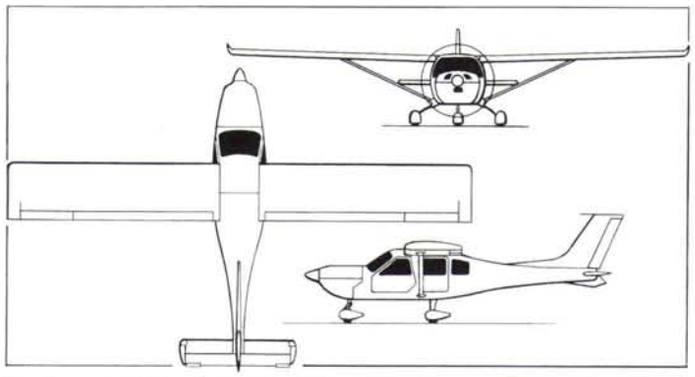
PROGRAMME: Developed as four-seat version of Jabiru, although with option of installing only two seats in enlarged cabin. Prototype (19-3512), in ultralight configuration, first flew 16 March 2001. Maiden flight of first customer-built J200, 13 December 2001. Meets FAA 51% rule.

CURRENT VERSIONS: **J200**: Two-seat ultralight with same dimensions as J400. **200A** has maximum allowable T-O weight; **200B** limited to 544 kg (1,200 lb) to meet AUF ultralight rules.

Jabiru J250 registered in US *(Paul Jackson)* 1037935

Jabiru J400 on Australian register *(Paul Jackson)* 1037936

Australian ultralight category Jabiru J200 *(Paul Jackson)* 1037940



Two/four-seat Jabiru J200/J400 *(James Goulding)* 1159099

J230: Two-seat version combining J200 fuselage with Jabiru Calypso wing. Factory-built, certified J230-C was under development in 2006.

J250: Announced at Sun 'n' Fun, April 2002; meets FAA LSA kitbuilt rules. Wing span and area increased to meet stall requirements of 44 kt (82 km/h; 51 mph) 'clean' and 39 kt (73 km/h; 45 mph) flaps down.

J400: Four-seat lightplane.

J430: Four-seat version of J230.

J450: US market version (also sold in South Africa). Increased wing span (9.14 m; 30 ft 0 in) and area (11.15 m²; 120.0 sq ft); fuel 139 litres (36.8 US gallons; 30.7 Imp gallons).

J450A: As J450, but higher max T-O weight.

CUSTOMERS: Total 300 kits produced by mid-2006 for customers in Australia, Brazil, Canada, France, Namibia, New Zealand, South Africa and US.

COSTS: J200 kit USD34,000, without engine (USD48,400 with engine); J250 kit USD36,000 (USD50,400); J400 kit USD38,000 (USD52,400); J450 kit USD40,000 (USD54,400) (all 2006).

Data generally as for Jabiru Jabiru, except that below.

DESIGN FEATURES: Stretched fuselage with second pair of side windows. Wings of Jabiru LSA, with fuel in wings. Horn-balanced rudder. Quoted build time 600 hours.

LANDING GEAR: Generally as Jabiru. Larger 5.00–6 wheels standard on J400 with 4.00–4 wheels optional.

POWER PLANT: One 89.5 kW (120 hp) Jabiru 3300 flat-six, driving Sensenich W64ZK-49 two-blade fixed-pitch propeller. Fuel capacity 137 litres (36.2 US gallons; 30.1 Imp gallons) in wings, of which 130 litres (34.3 US gallons; 28.6 Imp gallons) is usable. Oil capacity 2.3 litres (0.61 US gallons; 0.51 Imp gallons).

ACCOMMODATION: Four persons; or two, if flown to ultralight regulations. Three doors on J400; rear port door operable only when flaps retracted.

DIMENSIONS, EXTERNAL:

Wing span: J200A, J200B, J400	8.10 m (26 ft 7 in)
J230, J430	9.58 m (31 ft 5 in)
J250, J450	9.14 m (30 ft 0 in)
Wing chord: J200A, J200B, J400	0.99 m (3 ft 3 in)
Wing aspect ratio: J200A, J200B, J400	8.2
J230, J430	9.7
J250, J450	7.5
Length overall	6.55 m (21 ft 5¾ in)
Height overall: J200A, J200B, J400	2.20 m (7 ft 2½ in)
J230, J250, J430, J450	2.40 m (7 ft 10½ in)
Tailplane span	2.66 m (8 ft 8¾ in)
Wheel track: J200A, J200B, J400	1.88 m (6 ft 2 in)
J230, J250, J430, J450	1.82 m (5 ft 11½ in)
Propeller diameter: all	1.52 m (5 ft 0 in)

DIMENSIONS, INTERNAL:

Cabin: Max width	1.12 m (3 ft 8 in)
Max height	1.09 m (3 ft 7 in)

AREAS:

Wings, gross: J200A, J200B, J400	8.00 m² (86.1 sq ft)
J230, J430	9.48 m² (102.0 sq ft)
J250, J450	11.15 m² (120.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: J200A, J400	315 kg (694 lb)
J200B	310 kg (683 lb)
J230, J250, J430, J450	340 kg (750 lb)
Max T-O weight: J200B, J450	544 kg (1,200 lb)
J200A, J230, J400, J430, J450A	700 kg (1,543 lb)
J250	558 kg (1,232 lb)
Max wing loading: J200A, J400	87.5 kg/m² (17.92 lb/sq ft)
J200B	68.0 kg/m² (13.94 lb/sq ft)
J230, J430	73.8 kg/m² (15.12 lb/sq ft)
J250	50.1 kg/m² (10.27 lb/sq ft)
J450	48.8 kg/m² (10.00 lb/sq ft)
J450A	62.8 kg/m² (12.86 lb/sq ft)
Max power loading: J200A, J230, J400, J430, J450A	7.82 kg/kW (12.86 lb/hp)
J200B, J450	6.08 kg/kW (10.00 lb/hp)
J250	6.25 kg/kW (10.27 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE):	
J200A, J200B, J400	138 kt (255 km/h; 159 mph)
J230, J430	135 kt (250 km/h; 155 mph)
Manoeuvring speed: J200A, J200B, J400	130 kt (241 km/h; 150 mph)
J230, J430	115 kt (213 km/h; 132 mph)
J250, J450	125 kt (232 km/h; 144 mph)
Normal cruising speed	120 kt (222 km/h; 138 mph)
Stalling speed, power off:	
flaps up:	
J200A, J400	60 kt (111 km/h; 69 mph)
J200B	51 kt (95 km/h; 59 mph)
J230, J430	50 kt (93 km/h; 58 mph)
J250, J450	44 kt (82 km/h; 51 mph)
flaps down:	
J200A, J400	48 kt (89 km/h; 56 mph)
J200B, J230, J430	45 kt (84 km/h; 52 mph)
J250, J450	39 kt (73 km/h; 45 mph)
Max rate of climb at S/L:	
J200A, J200B, J230, J400, J430	305 m (1,000 ft)/min
J250, J450	457 m (1,500 ft)/min
Service ceiling: all	4,570 m (15,000 ft)
T-O run: J200B	200 m (660 ft)
J200A, J400	300 m (985 ft)
J230, J430	150 m (495 ft)
J250, J450	100 m (330 ft)

Landing run:
J200A, J200B, J250, J400, J450 ..... 200 m (660 ft)
J230, J430 ..... 250 m (820 ft)
Range: J200A, J200B, J400 ..... 720 n miles (1,333 km; 828 miles)
J230, J430 ..... 800 n miles (1,481 km; 920 miles)
J250, J450 ..... 690 n miles (1,277 km; 794 miles)
Endurance: J200A, J250, J450 ..... 6 h 0 min
J230, J430 ..... 6 h 42 min
g limits: all ..... +3.8/–2.0

JABIRU J160 SERIES

TYPE: Side-by-side ultralight/kitbuilt.

PROGRAMME: Further development of two-seat Jabiru, based on wider fuselage and horn-balanced rudder of J200/J400 series. Prototype J160 first flew April 2004 and made public debut at Natfly air show, Narrowmine, later that month. Initially marketed as kitbuilt, but J160-C certified by Australian CASA on 21 December 2005, beginning with 29th aircraft. J170 offered to US LSA category.

CURRENT VERSIONS: **J160:** Basic version; kitbuilt.

J160-C: Certified, factory-built version of J160.

J170SP: Introduced in 2005. Optimised for Light Sport Aircraft category in US. Increased span wing with winglets, wider cockpit with Y-shape central control stick and horn-balanced rudder. All tyres 13×5.00-6. Kitbuilt.

CUSTOMERS: Total over 70 kits delivered by mid-2006 to Australia, New Zealand, Norway and US.

DESIGN FEATURES: Generally as earlier two-seat, 2200-powered Jabiru, but wider and higher cockpit; horn-balanced rudder; various wing options.

Jabiru J170SP being marketed in the US for the LSA category *(Paul Jackson)* 1037930

DIMENSIONS, EXTERNAL:
Wing span: J160 ..... 8.12 m (26 ft 7¾ in)
J170SP over winglets ..... 9.66 m (31 ft 8¼ in)
Wing chord ..... 0.99 m (3 ft 3 in)
Wing aspect ratio: J160 ..... 8.2
J170SP 9.3
Length overall ..... 5.78 m (18 ft 11½ in)
Height overall ..... 2.30 m (7 ft 6½ in)
Tailplane span ..... 2.35 m (7 ft 8½ in)
Wheel track ..... 1.90 m (6 ft 3 in)
DIMENSIONS, INTERNAL:
Cabin max width ..... 1.14 m (3 ft 9 in)
AREAS:
Wings, gross: J160 ..... 8.04 m² (86.5 sq ft)
J170SP ..... 9.29 m² (100.0 sq ft)
WEIGHTS AND LOADINGS:
Weight empty: J160 ..... 268 kg (591 lb)
J170SP ..... 290 kg (639 lb)
Max T-O weight ..... 544 kg (1,200 lb)
Max wing loading: J160 ..... 67.7 kg/m² (13.87 lb/sq ft)
J170SP ..... 58.6 kg/m² (12.00 lb/sq ft)
Max power loading ..... 8.58 kg/kW (14.12 lb/hp)
PERFORMANCE:
Never-exceed speed (VNE): J160 ..... 132 kt (244 km/h; 152 mph)
J170SP ..... 125 kt (231 km/h; 143 mph)
Manoeuvring speed ..... 105 kt (194 km/h; 121 mph)
Normal cruising speed ..... 100 kt (185 km/h; 115 mph)
Stalling speed, power off:
flaps up: J160 ..... 49 kt (91 km/h; 57 mph)
J170SP ..... 45 kt (84 km/h; 52 mph)
flaps down: J160 ..... 43 kt (80 km/h; 50 mph)
J170SP ..... 38 kt (71 km/h; 44 mph)
Max rate of climb at S/L: J160 ..... 152 m (500 ft)/min
J170SP ..... 213 m (700 ft)/min
Service ceiling ..... 4,570 m (15,000 ft)
T-O run: J160 ..... 200 m (660 ft)
J170SP ..... 140 m (459 ft)
Landing run: J160 ..... 165 m (545 ft)
J170SP ..... 150 m (495 ft)
Range: J160 ..... 500 n miles (926 km; 575 miles)
J170SP ..... 1,030 n miles (1,907 km; 1,185 miles)
Endurance: J160 ..... 5 h 0 min
J170SP ..... 10 h 18 min
g limits ..... +3.8/–2.0

JUST PLANE PASSIONS

AERO V AUSTRALIA PTY

Light Aeronautics Industry Cluster, Illawarra Regional Airport, Albion Park Rail, New South Wales 2527
e-mail: kgarland11@bigpond.com
DIRECTORS:
Kenneth Garland
Dianne Garland

Aero V established the Just Plane Passions division following its acquisition in 2004 of rights to build the Sadler Vampire in its civilian form, plus associated jigs and tools with which to restart production. Company headquarters transferred from Camden to Illawarra Regional Airport in August 2005.

JUST PLANE PASSIONS VAMPIRE SV-2

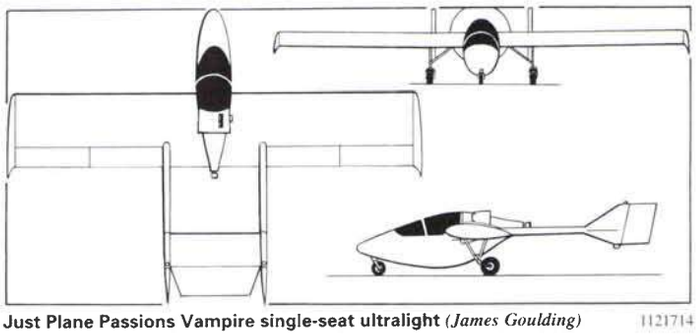
TYPE: Single-seat ultralight.

PROGRAMME: Designed by William G Sadler; American Microflight Vampire won Grand Champion Design at EAA Convention, Oshkosh, 1982. US production, as complete aircraft, begun in 1982, accounted for 36 in Part 103 Ultralight category; plus one in Experimental category (N7V); and one custom-built Ro-dair (with modified fins). Rights to civil version sold in Australia, but Mr Sadler continued to promote military applications, producing the Sadler Aircraft Corporation A-22 Piranha (N22AB) in 1989 and Turkish-built TAI TG-X1 Yarasa in 1997, both having been described in *Jane's All the World's Aircraft* in the late 1990s. Development continues (www.sadlerair.com).

Australian manufacture by Skywise Ultraflight Pty Ltd at Bankstown, Sydney, under ANO 95.25 ultralight regulations, initially as SV-1 with 22.4 kW (30 hp) KFM 107ER, but mostly in SV-2 form with Rotax 447. Total of 23 (plus two remanufactured) completed between 1998 and 1990, further three appearing in early 1990s after Skywise's bankruptcy. Additionally, one side-by-side seat aircraft built, but not flown; currently owned by Ronald M Fisher & Associates, Torquay, Victoria, and fitted with a 59.7 kW (80 hp) Jabiru 2200; unofficially named Kingfisher.

Manufacturing rights to Vampire transferred to Alan Daffy in 1990; Bryan Gabriel in 1991; John Hinton and Dave Bailey in 1995; Kirk Sutton in 1999; thence to Aero V. Rollout of initial new-built aircraft was intended in July 2005 but was not known to have taken place several months later. Changes from original include compressed rubber suspension, composites propeller and differential hydraulic brakes. Two-seat version may be introduced later.

First production Skywise Vampire promoting latest version built in Australia by Just Plane Passions *(Paul Jackson)* 1151729



Just Plane Passions Vampire single-seat ultralight *(James Goulding)* 1121714

CURRENT VERSIONS: **Vampire S-2A:** Manufactured by Aero V/Just Plane Passions.

DESIGN FEATURES: Twin-boom pusher configuration with constant-chord wing at mid-fuselage, outer wing panels folding for storage.
Wing section NACA 63 3-A218.

FLYING CONTROLS: Conventional and manual, including single-piece elevator and twin rudders. Flaps.

STRUCTURE: Generally metal, with non-structural Kevlar/glass fibre pod skins; 6061-T6 aluminium alloy booms and empennage and 2024-T3 Alclad wings.

LANDING GEAR: Tricycle type; fixed. Wing-mounted, tube metal tripod mainwheel legs with compressed rubber shock-absorbers. Hydraulic brakes.

POWER PLANT: One 31.0 kW (41.6 hp) Rotax 447 UL two-cylinder, liquid-cooled two-stroke driving a three-blade Ultra-Prop composites propeller. Fuel in wingroots, total usable capacity 40 litres (10.6 US gallons; 8.8 Imp gallons).

DIMENSIONS, EXTERNAL:
Wing span ..... 6.78 m (22 ft 3 in)
Width, wings folded ..... 2.49 m (8 ft 2 in)
Length overall ..... 4.98 m (16 ft 4 in)
Height overall ..... 1.36 m (4 ft 5½ in)
AREAS:
Wings, gross ..... 8.55 m² (92.0 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 170 kg (348 lb)
Max T-O weight ..... 290 kg (639 lb)
PERFORMANCE:
Max level speed ..... 85 kt (157 km/h; 98 mph) IAS
Normal cruising speed ..... 75 kt (139 km/h; 86 mph) IAS
Stalling speed: flaps up ..... 38 kt (71 km/h; 44 mph) IAS
flaps down ..... 34 kt (63 km/h; 40 mph) IAS
Max rate of climb at S/L ..... 244 m (800 ft)/min
T-O run ..... 120 m (395 ft)
Landing run ..... 100 m (330 ft)
g limits (ultimate) ..... +6/–4

SEABIRD

SEABIRD AVIATION AUSTRALIA PTY LTD

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Fax:(+61 7) 41 25 31 23
e-mail: seabirdaust@optusnet.com.au
CHAIRMAN: Donald C Adams
MANAGING DIRECTOR: Peter Adams

Seabird Aviation was founded in 1983 to develop the Seeker observation aircraft. Despite having built Seekers for certification, Seabird's business plan was always to franchise Seeker production capability, rather than sell individual aircraft; entire manufacturing equipment for a Seeker production line can be forwarded in two standard-size ISO shipping containers.

On 25 July 2000, Seabird signed an agreement with Evektor-Aerotechnik (EV-AT) of the Czech Republic leading to the formation of a joint venture company, Evektor-Seabird Pty Ltd, to manufacture and market the Seeker. This is no longer in operation, having produced no aircraft by mid-2003, when Seabird reached a new agreement with KADDB of Jordan for local assembly in quantity; the joint venture is known as Seabird Aviation Jordan (SAJ). Accordingly, the aircraft is described in the Jordanian section of *Jane's All the World's Aircraft*. SAA retains ownership of the Type Certificate and has issued licences to SAJ and Seabird Aviation America (SAAM).

Of five seekers completed up to end of 2004, two prototypes had been withdrawn from use and the remaining three transferred to Jordan for resale or demonstration. Jordanian production has been delayed but was due to begin in 2006. At this time SAA was building first aircraft for SAAM at its Hervey Bay plant using components fabricated in India.

SAPPHIRE

SAPPHIRE AIRCRAFT AUSTRALIA PTY LTD

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Web: www.users.bigpond.com/stevendumesny/
SALES MANAGER: Steven Dumesny

Formed on 2 July 1998, Sapphire markets an updated version of the Winton Sapphire, designed to CAO 19 by Scott Winton. A two-seat version, nominally designated Sapphire Scenic, and a self-launching glider, were under development, but have been cancelled.

SAPPHIRE LSA Mk II

TYPE: Single-seat ultralight/kitbuilt.

PROGRAMME: Introduced in 1998. First kit delivered in May 1999 and flown in September 1999. Company aims to produce one factory-built aircraft per year to evaluate production methods and develop kit manual; remainder of production is of kit version.

CURRENT VERSIONS: **Sapphire LSA:** Available as factory-built version meeting Australian CAO 95 Pt 25 certification standards, or as kitbuilt to CAO 95 Pt 10. Three kits available: Basic, comprising main airframe components; Intermediate, with control systems completed; and Advanced, including engine, propeller and instruments. All kits qualify for 51 per cent amateur-built kit regulations.

Sapphire Scenic: Proposed two-seat version under development; MTOW of 500 kg (1,102 lb), 94 kt (174 km/h; 108 mph) cruise. Cost approximately AUD35,000, plus tax (2002); project cancelled late 2003.

CUSTOMERS: First kit sold May 1999. Total of 42 flying by January 2003, including two factory-built.

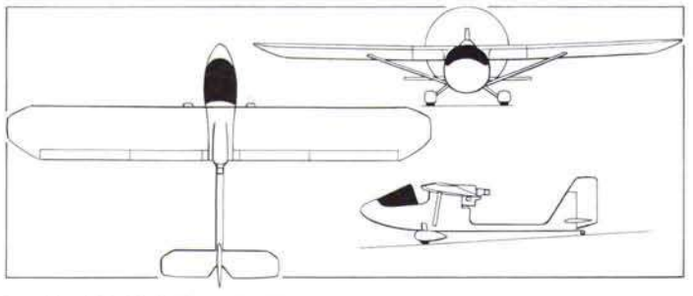
COSTS: Factory-built flyaway AUD35,266, kit AUD23,650 (2005). Estimated total cost of kit to flying condition AUD30,000 inclusive.

DESIGN FEATURES: Pod-and-boom fuselage with strut-braced shoulder-mounted wings; open cockpit with large windscreen. Baggage box, volume 25 litres (0.88 cu ft), in fuselage pod.

FLYING CONTROLS: Conventional and manual. Ailerons and trimmable all-flying tailplane operated by pushrods; rudder spring-coupled to tailwheel; quarter-span flaps; deflections 5° up (for fast cruising) and 20 and 40° down.

STRUCTURE: Mostly composites; GFRP fuselage pod reinforced with internal bulkheads; aluminium tailboom; wings of GFRP with foam ribs; fin is of GFRP; horizontal tail and rudder of aluminium tube with fabric covering. Wings and horizontal tail detach for storage or transport; quoted disassembly/assembly times 10 minutes and 5 minutes respectively.

Sapphire LSA single-seat ultralight *(Paul Jackson)* 1037937



Sapphire LSA Mk II *(James Goulding)* 0561622

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted spring laminated GFRP cantilever main legs. Mainwheel size 11–4.00×5. Cable-operated brakes. Wheel fairings optional. At least one nosewheel-equipped Sapphire conversion exists.

POWER PLANT: One 29.5 kW (39.6 hp) Rotax 447 UL-1V in kit-built aircraft; 34.0 kW (45.6 hp) Rotax 503 UL-1V two-cylinder two-stroke, driving a Sweetapple two- or three-blade wooden pusher propeller via 2.24:1 reduction gearing in factory-built aircraft. Integral fuel tanks in wings, standard capacity 38 litres (10.0 US gallons; 8.4 Imp gallons), optional 58 litres (15.3 US gallons; 12.8 Imp gallons).

EQUIPMENT: Fully enclosed canopy and strut fairings optional.

DIMENSIONS, EXTERNAL:

Wing span	8.84 m (29 ft 0 in)
Length overall	5.00 m (16 ft 4¾ in)
Height overall	1.25 m (4 ft 1¼ in)
Propeller diameter	1.27 m (4 ft 2 in)

DIMENSIONS, INTERNAL:

Cabin max width	0.61 m (2 ft 0 in)

AREAS:

Wings, gross	9.13 m² (98.3 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	158 kg (348 lb)
Max T-O weight	350 kg (771 lb)

PERFORMANCE:

Never-exceed speed (VNE)	98 kt (181 km/h; 112 mph)
Cruising speed at 75% power:	
without fairings	75 kt (139 km/h; 86 mph)
with fairings: two-blade propeller	75 to 85 kt (139 to 157 km/h; 86 to 98 mph)
three-blade propeller	87 to 89 kt (161 to 165 km/h; 100 to 102 mph)
Stalling speed: power on	34 kt (63 km/h; 40 mph)
power off	36 kt (67 km/h; 42 mph)
Max rate of climb at S/L	305 m (1,000 ft)/min
Service ceiling	3,660 m (12,000 ft)
T-O run	55 m (180 ft)
Landing run	100 m (330 ft)
Range	328 n miles (607 km; 377 miles)
Endurance	3 h 30 min
g limits	+8/–4

STORCH

STORCH AVIATION AUSTRALIA PTY LTD

Storch Aviation Australia Pty Ltd had transferred its operations to Serbia by 2005.

SUPERMARINE

SUPERMARINE AIRCRAFT PVT LTD

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Web: www.supermarineaircraft.com
MANAGER: Michael O'Sullivan
ASSISTANT MANAGER: Geoff Braddock

Michael (Mike) O'Sullivan founded Supermarine Aircraft Pty Ltd in 1992 to develop a kitbuilt scale replica of the Second World War Supermarine Spitfire. Local dealers have been appointed in New Zealand, South Africa, UK and US. Factory area 1,050 m² (11,300 sq ft); workforce stood at 10 in 2005.

SUPERMARINE SPITFIRE

TYPE: Tandem-seat sportplane kitbuilt.

PROGRAMME: Prototype Mk 25 first flew in November 1995. Designations follow from Mk 24 version produced by original Supermarine company. First UK-built aircraft flew 19 April 2005; conditional type approval granted by PFA on 21 September 2005. Isuzu V-6 engine first flown 2004 (VH-SFG) and adopted as recommended engine by Supermarine.

CURRENT VERSIONS: **Spitfire Mk 25:** Single-seat version to 75 per cent scale. Discontinued by 2003.

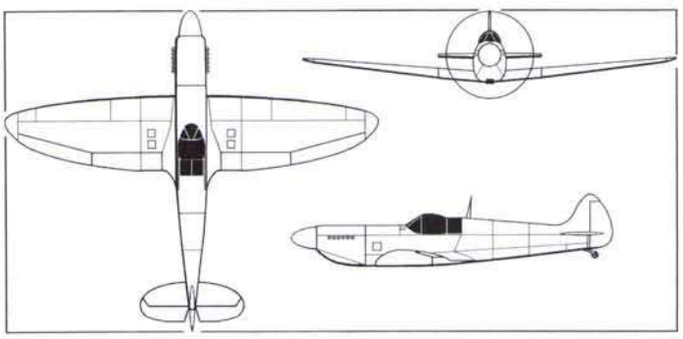
Spitfire Mk 26: Two-seat and sole production version, with accommodation for pilot and passenger in tandem under single canopy, or pilot and additional fuel or baggage.

CUSTOMERS: Total of 70 of both versions sold by late 2005. US marketing began at Sun 'n' Fun in April 2004. Customers in Australia, Canada, South Africa, UK, US and elsewhere; eight flying and nine more under construction in Australia by late 2005. UK had 14 under construction in 2005.

COSTS: Development AUD2.5 million. Complete basic kit from AUD118,250 not including engine, propeller, instruments, shipping or taxes (2005). Price, complete and flyaway, AUD325,000 (2005).

DESIGN FEATURES: Scale replica of Supermarine Spitfire. Wings de-rig for storage or road transport. Supplied as complete kit; main airframe components are jig-assembled at factory for completion by customer; quoted build time 1,000 to 1,200 hours. Complies with FAA

Supermarine Spitfire Mk 26 two-seat kitplane 1151709



Authentic lines of the Supermarine Spitfire Mk 26 *(Paul Jackson)* 0569577

Australian amateur-built Supermarine Spitfire Mk 26 *(Paul Jackson)* 1121609

and other authorities' 51 per cent homebuilding rules. Can operate as Australian Ultralight under RAA rules with single seat.

Wing section similar to original; dihedral 5°; incidence 2° 10'; washout 2°.

FLYING CONTROLS: Conventional and manual; surfaces mass-balanced, with horn-balanced elevators; electric split flaps, max deflection 65°; pushrod actuation, except cable actuated rudder and pitch trim.

STRUCTURE: Aluminium throughout, except for glass fibre cowling and non-structural fairings. Two-spar wing. Flush riveting and etch primed throughout.

LANDING GEAR: Tailwheel type; electrically retractable mainwheels. Main tyres 6.00. Hydraulic disc brakes.

POWER PLANT: One 134 kW (180 hp) Jabiru 5100 eight-cylinder four-stroke, driving a two- or four-blade constant-speed propeller. Optionally 186 kW (250 hp) General Motors Isuzu V-6 motorcar engine driving an IVO two-, three- or four-blade propeller via 1.6:1 belt reduction gear. Fuel capacity: standard 115 litres (30.4 US gallons; 25.3 Imp gallons); 'wet wing' option adds further 160 litres (42.3 US gallons; 35.2 Imp gallons).

DIMENSIONS, EXTERNAL:

Wing span	8.44 m (27 ft 8¼ in)
Length overall	7.24 m (23 ft 9 in)
Height at spinner	2.06 m (6 ft 9 in)
Wheel track	1.68 m (5 ft 6¼ in)

AREAS:

Wings, gross	11.33 m² (122.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: normal	460 kg (1,014 lb)
RAA Ultralight	405 kg (893 lb)
Max T-O weight: normal	810 kg (1,785 lb)
RAA Ultralight	560 kg (1,234 lb)
Max wing loading	57.3 kg/m² (11.75 lb/sq ft)
Max power loading (Jabiru)	5.59 kg/kW (9.18 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	193 kt (357 km/h; 222 mph)
Cruising speed at 75% power	160 kt (296 km/h; 184 mph)
Manoeuvring speed	240 kt (232 km/h; 150 mph)
Stalling speed: flaps up	45 kt (84 km/h; 52 mph)
landing configuration	42 kt (78 km/h; 49 mph)
Max rate of climb at S/L	762 m (2,500 ft)/min
Service ceiling	5,490 m (18,000 ft)
T-O run	207 m (680 ft)
Landing run	445 m (1,460 ft)
Max range	434 n miles (804 km; 500 miles)
Endurance at econ cruising speed, with reserves	3 h 0 min
g limits	+6/−4

TEKNICO

TEKNICO PTY LTD

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Web (2): www.aeropup.com
MANAGING DIRECTOR: John Cotton

Company previously named Aerosport Pty Ltd and Supapup Aircraft. Early versions (Mks 1, 2 and 3) of SupaPup hand-built at Hahndorf, South Australia, until cost of compliance with local airworthiness directives forced closure of company. Aerosport redesigned aircraft as Mk 4 in 1992 and returned to business (as Teknico) with relaunched production line for kits. Most are operated under ultralight rules (homebuilt, uncertified). Two-seat AeroPup launched in 2002.

Company moved from Oakbank to current location in 2005 and concentrates on two-seat Aeropup.

TEKNICO AEROPUP

TYPE: Side-by-side ultralight kitbuilt.

PROGRAMME: First flown 2002; kit production under way by November 2002.

CUSTOMERS: Total of 17 built by December 2005 and further six then on order.

COSTS: Kit, less engine, instrument and covering AUD26,000 (2005).

The description for the Supa'Pup Mk IV applies also to the AeroPup except as follows:

Teknico Aeropup 1113689

DESIGN FEATURES: Two-seat version of Supa'Pup Mk IV. Quoted build time 350 hours.

FLYING CONTROLS: Dual controls standard, with centrally mounted control column. Flaps standard.

LANDING GEAR: Tailwheel type; fixed. Two faired-in side Vs hinged to lower longerons, plus half-axles, each with shock absorber, attached to compression frame. Steerable tailwheel.

POWER PLANT: Engines in 48.5 kW (65 hp) to 74.6 kW (100 hp) range according to customer choice; Jabiru, Rotax or Subaru recommended. Fuel capacity 90 litres (23.8 US gallons; 19.8 Imp gallons) in two wing tanks.

DIMENSIONS, EXTERNAL:

Wing span	8.20 m (26 ft 10¾ in)
Length overall	6.03 m (19 ft 9½ in)
Height	1.67 m (5 ft 5¾ in)

DIMENSIONS, INTERNAL:

Cabin max width:	
standard windows	1.07 m (3 ft 6 in)
bulged windows	1.14 m (3 ft 9 in)

AREAS:

Wings, gross	10.06 m² (108.3 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, typical	270 kg (595 lb)
Baggage capacity	40 kg (88 lb)
Max T-O weight	750 kg (1,653 lb)

PERFORMANCE:

Stalling speed	42 kt (78 km/h; 49 mph)
T-O to 15 m (50 ft)	100 m (330 ft)
Endurance with aux tank and 10% reserves	more than 4 h
g limits	+5/–3

TEKNICO SUPA'PUP MK IV

TYPE: Single-seat ultralight kitbuilt.

PROGRAMME: Original Aerosport company developed and produced three earlier versions of the Supa'Pup from the mid-1980s onwards; Supa'Pup Mk IV first flown in early 1998. Some registered as lightplanes; most as ultralights with 544 kg (1,200 lb) MTOW limitation under CAO 95 Pt 10.

CUSTOMERS: By November 2005, 28 Supa'Pup kits had been supplied.

COSTS: Kit, less engine, instruments and covering AUD19,000 (2005).

DESIGN FEATURES: Strut-braced, high-wing cabin monoplane; wings fold rearwards for storage or transportation without disconnection of fuel lines or control runs. Quoted build time 350 hours.

Wing dihedral 2°.

FLYING CONTROLS: Conventional and manual via torque tubes and cables. Optional flaps.

STRUCTURE: Welded steel tube fuselage covered in Stitts fabric; glass fibre engine cowling and wingtips. Three alloy wing spars.

LANDING GEAR: Tailwheel type; fixed. Two faired-in side Vs hinged to lower longerons, plus half-axles, each with shock absorber, attached to compression frame. Steerable tailwheel. Wheels 6.00-6; disc brakes on main wheels.

Teknico Supa'Pup Mk IV with Jabiru 2200 engine *(Paul Jackson)* 1037938

POWER PLANT: One 34.0 kW (45.6 hp) Rotax 503 UL-1V two-cylinder two-stroke. Jabiru 2200, Rotax 582 and Subaru engines also suitable. Fuel contained in wing tanks, combined capacity 54 litres (14.3 US gallons; 11.9 Imp gallons); optional 90 litre (23.8 US gallon; 19.8 Imp gallon) wing tanks.

EQUIPMENT: Optional cargo pod under development.

DIMENSIONS, EXTERNAL:

Wing span	7.74 m (25 ft 4¾ in)
Length overall	5.70 m (18 ft 8½ in)
Height	1.67 m (5 ft 5¾ in)

DIMENSIONS, INTERNAL:

Cabin max width	0.61 m (2 ft 0 in)

AREAS:

Wings, gross	9.50 m² (102.3 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	180 to 230 kg (397 to 507 lb)
Baggage capacity	20 kg (44 lb)
Max T-O weight	340 kg (750 lb)

PERFORMANCE:

Never-exceed speed (VNE)	130 kt (240 km/h; 149 mph)
Max level speed	100 kt (185 km/h; 115 mph)
Cruising speed	95 kt (176 km/h; 109 mph)
Stalling speed	36 kt (67 km/h; 42 mph)
Max rate of climb at S/L	335 m (1,100 ft)/min
T-O to 15 m (50 ft)	100 m (330 ft)
Endurance with 10% reserves, standard fuel	4 h 30 min

Austria

DIAMOND

DIAMOND AIRCRAFT INDUSTRIES GMBH

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Company formed 1981 in Friesach, Carinthia, southern Austria, as Hoffman Flugzeugbau GmbH; re-formed after August 1984 bankruptcy as Hoffman Aircraft Ltd, subsidiary of Simmering-Graz-Pauker AG; relocated to new facility at Wiener Neustadt 1987; name HOAC Austria Flugzeugwerk Wiener Neustadt GmbH adopted 1990 after 1989 management buyout; renamed Diamond Aircraft Industries GmbH March 1996 and achieved JAR 21 design approval in 2001.

Factory expanded to 5,200 m² (56,000 sq ft) of floor space in 1996 to accommodate wider model range, increase production levels and provide new research and maintenance facilities. Current products include refurbished DA20 Katana. Diamond Aircraft Corporation produces the two-seat DA20 in Canada; the four-seat DA40 Star became available in 2000 and deliveries of production aircraft accelerated in 2001. DA40D certified and DA42 Twin Star launched in 2002, and D-JET announced in 2003.

Having achieved sales of 1,700 aircraft up to the end of 2000, Diamond gained a further 176 (including Canada) in 2001, 201 in 2002, 263 in 2003, 272 in 2004, and 415 in 2005.

Diamond acquired UK rotary engine manufacturer MidWest Engines in 1994, but acquisition not announced until Aero '03 show at Friedrichshafen in April 2003, under new company name Diamond Engines. Manufacturer of AE 50R Wankel-type rotary engine, with development of IAE 75R continuing in 2006.

Diamond opened a new 10,900 m² (117,000 sq ft) composites production centre at Wiener Neustadt on 23 January 2004 where components are manufactured to supply assembly lines in Austria and Canada, with potential to increase production to up to 600 aircraft per year. Austrian employees totalled 508 in 2005.

In April 2005, Diamond announced imminent establishment of a Chinese joint-venture scheduled to produce its first DA40 Diamond Star in mid-2006 at Binzhou factory which was inaugurated early October 2005.

DIAMOND HK36

European marketing name: Super Dimona
North American marketing name: Katana Xtreme

TYPE: Motor glider.

PROGRAMME: Original Hoffman H-36 Dimona (Diamond) was designed by Austrian-German team, first flight by first of three prototypes taking place in Germany 9 October 1980; production, in Austria, started May 1981; Dimona Mk II introduced May 1985 (smaller wingtip fairings, modified cowling, better propeller pitch control, stronger main gear, sprung steerable tailwheel); production of H-36 totalled over 275 by 1989.

Development of HK36R Super Dimona (considerably redesigned by Dieter Kohler — hence K in designation) started March 1987; first flight, with 67.1 kW (90 hp) Limbach L 2400 engine, October 1989, and one or two more completed with Limbach engines, but Rotax 912 adopted as standard power plant. Production began April 1990 and Austrian certification to JAR 22 awarded 15 May 1990 to HK36 and 6 September 1990 to HK36R. Certification transferred to EASA on 21 December 2005. Manufacture totalled 114 by 1995, when supplanted by current versions. 'Short-wing' LF 2000 was proof-of-concept for DA20 Katana; TS and TTS versions introduced 1995 (certified 6 March 1996 and 20 December 1966, respectively), but discontinued two years later; these and current TC/TTC featured winglets; prototypes (OE-9415 and OE-9416) built 1995 certified 12 July and 20 December 1966, respectively. In 1997, export Dimonas for the North American market were renamed Katana Xtreme. Production temporarily halted in mid-2003; re-launched 2007 version has triangular window added each side, to rear of cockpit canopy.

Diamond Aircraft was selected in July 2003 to supply a Katana Xtreme airframe for the Boeing Fuel Cell Demonstrator project led by Boeing's Madrid-based Research and Technology Center. Work to integrate Proton Exchange Membrane fuel cells supplied by Intelligent Energy (UK) was scheduled to begin in the summer of 2003, with first flight expected in 2006.

CURRENT VERSIONS: **HK36TC 80:** Tricycle landing gear version of now discontinued HK 36TS. Some 20 TS/TC built in 1996, four in 1998 and eight for Indian Air Force in early 2000. No longer promoted.

HK36TC 100: As HK 36TC 80, but with Rotax 912S-3 engine.

HK36TTC 115: As HK 36TC 80 but with Rotax 914. Majority of production is this version. **Eco** version described separately.

HK36TTC-MPX: Described separately.

CUSTOMERS: Some 630 H/HK-36s built up to temporary closure of production line in mid-2003, including over 275 H-36s, 114 HK36Rs and 236 (including two prototypes) of T/TT series. Customers in Austria, Canada, Denmark, France (including five to air force in 2002), Germany, Netherlands, UK, US and elsewhere.

Prototype of re-started production version, OE-9510 (c/n 36800) exhibited at ILA, Berlin, May 2006, in advance of full launch in 2007.

COSTS: TC 80 EUR112,900; TC 100 EUR118,900; TTC 115 EUR123,700, ex-works, excluding taxes (all 2004).

DESIGN FEATURES: Conventional motor glider, with T tail and low/mid wing. Wings can be detached and, optionally, folded back alongside fuselage for transportation and storage. Improvements of T/TT series (from 1996) include carbon fibre main spar. Compared with H-36 Dimona, HK 36 has modified inboard leading-edge, sweptback wingtips and Schempp-Hirth (instead of DFS) type airbrakes; better access to engine and control system via completely removable cowlings; improved spin characteristics; stronger main landing gear and improved tailwheel springing; larger canopy with new mechanism; wingroot fairings and rear fuselage redesigned.

Wortmann wing section FX-63-137 at root.

FLYING CONTROLS: Conventional and manual. Longitudinal stability improved in Super Dimona over original by increasing elevator chord and adding trim tab; airbrakes in wing upper surface. Control surface deflections: ailerons +85 mm (3.35 in)/ –42 mm (1.65 in); tailplane +60 mm (2.36 in)/ –50 mm (1.97 in); rudder ±265 mm (10.43 in).

STRUCTURE: Mainly of GFRP; carbon fibre wing spar and main bulkhead. GFRP mainwheel legs and fairings.

Prototype '2007 Model' Diamond HK36 Super Dimona (a TC100 version) exhibited at Berlin in May 2006 *(Paul Jackson)* 1159368

LANDING GEAR: Non-retractable tricycle type, with free-castoring nosewheel, ±30°. Wheel fairings on all three legs.

POWER PLANT: *TC 80*: One 59.6 kW (79.9 hp) Rotax 912A-3 flat-four with 2.27:1 reduction drive to an MT-Propeller MTV-1-A/170-08 composites, two-blade, three-position constant-speed (hydraulic) and feathering propeller. Alternative fixed-pitch propellers (MT-170R-125-2A or Hoffman HO14-1705-123).

TC 100: One 73.5 kW (98.6 hp) Rotax 912S-3.

TTC 115: One 84.6 kW (113.4 hp) Rotax 914F-3.

Fuel tank in fuselage, capacity 80 litres (21.1 US gallons; 17.6 Imp gallons), of which 77 litres (20.3 US gallons; 16.9 Imp gallons) usable. Optionally, 55 litres (14.5 US gallons; 12.1 Imp gallons) gross.

ACCOMMODATION: Two seats side by side. Cockpit canopy hinged at rear to open upward. Baggage space aft of seats.

AVIONICS: Basic VFR as standard only. Optional avionics from Garmin.

Comms: Optional GMA 340 audio panel, SL 30 COM/NAV, SL 40 COM, GNC 250XL COM/NAV/GPS or GNS 430 with glideslope; GTX 327 (Mode C) or GTX 330 (Mode S) transponder.

EQUIPMENT: Optional landing, position and anti-collision lights; optional glider towing hook or banner towing winch.

DIMENSIONS, EXTERNAL:

Wing span	16.33 m (53 ft 7 in)
Wing aspect ratio	17.4
Length overall	7.28 m (23 ft 10½ in)
Width, wings folded	2.20 m (7 ft 2½ in)
Height over tail	2.40 m (7 ft 10½ in)
Propeller diameter	1.70 m (5 ft 7 in)

AREAS:

Wings, gross	15.30 m² (164.7 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: TC 80, TC 100	555 kg (1,224 lb)
TTC 115	563 kg (1,241 lb)
Max baggage weight: all	12 kg (26 lb)
Max T-O weight: all	770 kg (1,697 lb)
Max towing load: TC 80	370 kg (815 lb)
TC 100	500 kg (1,102 lb)
TTC 115	600 kg (1,322 lb)
Max wing loading: all	50.3 kg/m² (10.31 lb/sq ft)
Max power loading: TC 80	12.92 kg/kW (21.23 lb/hp)
TC 100	10.48 kg/kW (17.21 lb/hp)
TTC 115	9.10 kg/kW (14.95 lb/hp)

PERFORMANCE, POWERED:

Never-exceed speed (VNE):	
all	141 kt (261 km/h; 162 mph)
Max cruising speed: TC 80	108 kt (200 km/h; 124 mph)
TC 100	116 kt (215 km/h; 134 mph)
TTC 115	119 kt (220 km/h; 137 mph)
Cruising speed at 65% power:	
TC 80	90 kt (167 km/h; 104 mph)
TC 100	100 kt (185 km/h; 115 mph)
TTC 115	106 kt (196 km/h; 122 mph)
Max rate of climb at S/L: TC 80	246 m (807 ft)/min
TC 100	294 m (965 ft)/min
TTC 115	324 m (1,063 ft)/min
T-O run: TC 80	201 m (659 ft)
TC 100	193 m (633 ft)
TTC 115	182 m (600 ft)
T-O to 15 m (50 ft): TC 80	338 m (1,110 ft)
TC 100	308 m (1,010 ft)
TTC 115	274 m (900 ft)
g limits: all	+5.3/−2.65

PERFORMANCE, UNPOWERED:

Best glide ratio: all	27
Min sink rate: all	1.20 m (3.94 ft)/s

DIAMOND HK36TTC-MPX

TYPE: Multisensor surveillance lightplane.

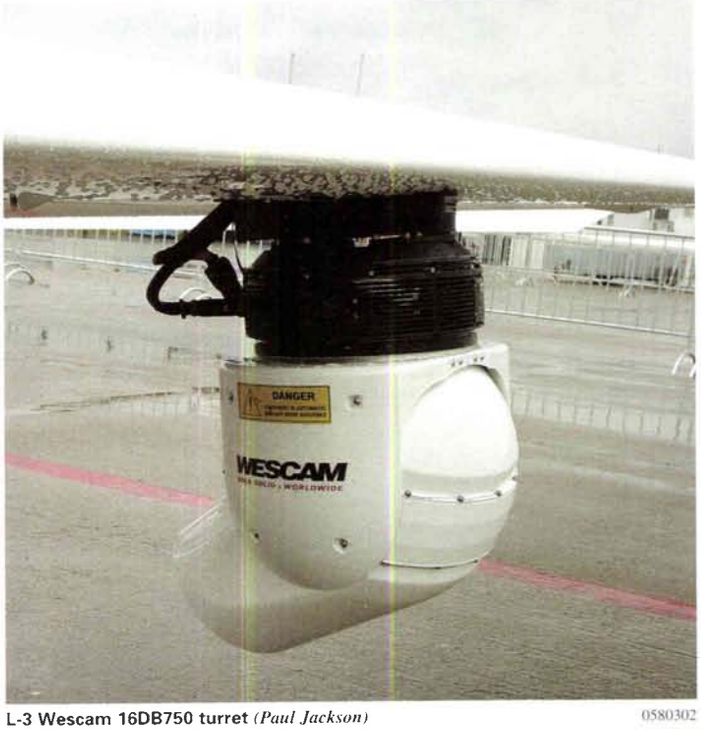
CURRENT VERSIONS: **HK36TTC-MPX**: Generic designation for sensor-equipped Dimona. Developed by Diamond Aircraft Corporation in association with L-3 Wescam Inc of Ontario; multimission utility aircraft version of Diamond HK 36TTC Katana Xtreme. MPX (Multi Purpose Xtreme) incorporates hardpoint under each wing at approximately mid-span for quick-release sensor pods. Each pod can accommodate up to 45 kg (100 lb) of equipment, including gyrostabilised video surveillance cameras (such as L-3 Wescam Model 16 ENG broadcast camera system) and IR sensors, with provision for onboard data and image collection, or downlink telemetry. An independent 28 V 40 A DC power supply is provided for surveillance equipment, and a cockpit equipment bay, capacity 0.4 m³ (14 cu ft) or 30 kg (66 lb), accommodates rack-mounted electronics or instruments for in-flight monitoring. Standard fuel capacity of 110 litres (29.1 US gallons; 24.2 Imp gallons) provides endurance up to 7 hours.

HK36TTC-Eco: Specific designation for aircraft currently in service. Certified by Austrian ACG on 19 January 1999 and in FAA Utility category 29 March 1999 and Restricted category (aerial photography only) 21 December 2000; latter permits increased MTOW of 929 kg (2,050 lb). EASA certification (reconfirming ACG) on 21 December 2005.

Prototype OE-9481 currently operated (since 1998) in Switzerland by Met Air atmospheric sampling company as HB-2335. Five conversions undertaken in Canada for US market: N842WS, N845WS and N846WS operated by Diamond Aircraft; and N843WS and N844WS of Wescam Air Operations, Van Nuys, California.

Of these, N844WS became OE-9437 in Diamond (Austria) ownership and exhibited at ILA, Berlin, May 2004 with a 55 kg (1,213 lb) L-3 Wescam 16DB750 turret.

Canadian-converted HK36TTC-MPX now operated in Austria *(Paul Jackson)* 0580303



L-3 Wescam 16DB750 turret *(Paul Jackson)* 0580302

DIAMOND DA40D DIAMOND STAR

TYPE: Four-seat lightplane.

PROGRAMME: Formally launched 23 April 1997 at the Aero 97 show at Friedrichshafen, Germany, when mockup displayed; initially retained name of Katana; proof-of-concept prototype DA40-V1 (OE-VPC) first flew on 5 November 1997, powered by a Rotax 914 engine; a Teledyne Continental IO-240-engined DA40-V2 (OE-VPE) followed shortly thereafter; neither event was publicised; a third prototype, DA40-V3, with Textron Lycoming IO-360 engine, flew in late 1998; fourth, near-production standard, prototype (OE-VPM) joined the test programme in mid-1999 followed by three more prototypes comprising DA40-P5 (c/n 40005/OE-VPQ), -P6 (40006/OE-VPB), -P7 (40007/OE-VPW), these having enlarged ventral strake and cutaway rudder.

First production aircraft (40008/OE-KPN) registered June 2000; second exhibited at Farnborough in following month. Lycoming-powered variant was initial production version, for which JAR 23 certification was achieved 24 October 2000; FAA certification, 9 April 2001, followed by JAA IFR certification on 27 April 2001, and FAA IFR certification on 23 August 2001. First deliveries to US customers (seven aircraft) took place during EAA AirVenture 2001 at Oshkosh in July 2001. Chinese CAAC certification granted 26 October 2004.

Austrian production temporarily halted in early 2002 upon transfer of Lycoming-engined variant to Canada. Thielert-engined version now sole European-built DA40. This gained EASA certification on 28 September 2005, for new Garmin G1000 avionics suite.

CURRENT VERSIONS: **DA40-180:** Original version with Lycoming IO-360 engine; now produced by Diamond Canada (which see).

DA40-FP: Version of DA40-180 with fixed pitch propeller. EASA certification achieved 14 April 2005, followed by FAA approval 27 July 2005.

DA40D: Marketed as DA40-TDI. Powered by Thielert Centurion 1.7 turbo diesel; converted prototype (OE-KPP) first flew 22 November 2001; JAR 23 N-VFR certification achieved 22 November 2002 followed by IFR approval on 18 June 2003. Development aircraft OE-VTA and -VTB (80th and 84th Austrian-built). Initial batch comprised 75 aircraft; some 229 produced by end of 2005 for operators in Armenia, Australia, Austria, China, Denmark, France, Germany, Japan, Malaysia, Netherlands, New Zealand, Norway, Sweden, Switzerland, Thailand and UK. *As described.*

CUSTOMERS: Total of 170 DA40Ds ordered by mid-2004; Cabair of UK ordered 16, of which 12 received by mid-2004. The Amaury de la Grange pilot school at l'Epag de Merville, France, ordered six DA40Ds. Beijing PanAm International Aviation Academy ordered 41 DA40Ds with Garmin G1000 avionics in November 2004 of which four were delivered immediately and a further six in January 2005, and HM Aerospace of Langkawi, Malaysia has taken delivery of 16 DA40Ds for its training operation. Total of 207 delivered in 2005.

COSTS: DA40-TDI standard N-VFR EUR199,100; IRF from EUR242,829; DA40-TDI G1000 N-VFR EUR239,500, IFR from EUR266,524 (all 2005, excluding tax).

DESIGN FEATURES: Four-seat development of DA20; to be certified to FAR/JAR 23 or equivalents in Europe, North America, Russian Federation, South Africa and Turkey. DA 20 wings attach to new, wider centre-section to increase span; downturned tips to horizontal tail; single strake/tail bumper. Enlarged cabin increases fuselage length by 0.67 m (2 ft 2¼ in).

Wing section is Diamond-modified Wortmann FX 63-144-4-20.

FLYING CONTROLS: Conventional and manual. Ailerons and elevators operated by pushrods with low-friction bearings, rudder by cables; manual pitch trim standard, electric pitch trim optional via control stick-mounted switch; ground-adjustable trim tab on rudder; electrically actuated slotted flaps.

STRUCTURE: Fuselage, with integral vertical fin, is mostly of GFRP construction with local CFRP reinforcement in high-stress areas, comprising two half-shells bonded together. Two-spar wings with GFRP/PVC foam/GFRP sandwich skins; horizontal tail and rudder surfaces similarly covered.

LANDING GEAR: Fixed tricycle type, with cantilever spring steel leg on each main unit and elastomeric suspension on nose leg. Mainwheel size 6.00–6; nosewheel 5.00–5. Steering is provided by differential braking of mainwheel and friction-damped castoring nosewheel. Speed fairings on all three wheels.

POWER PLANT: One 99 kW (133 hp) Thielert Centurion 1.7 turbo-diesel with FADEC, driving an MT-Propeller MTV-6-A/187-129 three-blade constant-speed propeller. Fuel in two wing tanks, standard capacity 114 litres (30.1 US gallons; 25.1 Imp gallons), of which 106 litres (28.0 US gallons; 23.3 Imp gallons) usable; optional long-range tank of 155 litres (40.9 US gallons; 34.1 Imp gallons) gross, 148 litres (39.1 US gallons; 32.6 Imp gallons) usable.

ACCOMMODATION: Four persons in two side-by-side pairs. Single-piece canopy lifts up and forwards for access to front seats; rear occupants board through an upward-opening door to port. Cabin has 26 *g* composites self-adapting comfort gel foam seats of leather with fabric inlays with three-point automatic safety harnesses and roll over bar. Baggage compartment behind rear seats includes tubular extension into rear fuselage for extra-long items. Premium leather interior and rigid baggage compartment extension compartment, and ski tube (not with baggage compartment extension), all optional.

SYSTEMS: 14 V electrical system includes 90 A alternator; 12 V 35 Ah battery.

AVIONICS:

Integrated Garmin G1000 glass panel suite as core system.

Comms: Dual Garmin GIA 63 com/nav/GPS; GMA 1347 digital audio system; GTX 33 Mode S transponder (replaced by GTX 330 in optional IFR package).

Flight: Garmin GRS 77 AHRS; GDC 74 air data computer; GMU 44 triaxial magnetometer; GEA 71 airframe/engine interface unit. IFR package adds Honeywell KAP 140 dual-axis autopilot with optional altitude preselect, and integrated KN 63 remote DME.

Instrumentation: Dual Garmin GDU 1040 254 mm (10 in) displays for PFD and MFD functions with backup/standby mechanical ASI, altimeter, artificial horizon and compass. Options include Becker 3500 remote ADF and WX 500 Stormscope.

EQUIPMENT: Landing light, taxying light, position lights, instrument lighting system, overhead cabin light, power socket for hand-held GPS and heated pitot/static system, lightning protection kit, gust lock, towbar, tools, pitot cover, fire extinguisher, and first aid kit, all standard. Noise reduction kit optional (mandatory in Austria, Germany and Switzerland).

DIMENSIONS, EXTERNAL:

Wing span ..... 11.94 m (39 ft 2 in)

Garmin G1000 twin-screen avionics certified for Diamond Star in 2005

1151722

Thielert engine installation in Diamond Star *(Jane's/Jamie Hunter)* 1151724

Diamond DA40D Diamond Star *(Jane's/Jamie Hunter)* 1151725

Diamond DA40D Diamond Star equipped with early version of Garmin IFR suite *(Jane's/Jamie Hunter)* 1151723

Wing aspect ratio	10.53
Length overall	8.00 m (26 ft 3 in)
Height overall	1.97 m (6 ft 6 in)
DIMENSIONS, INTERNAL:	
Baggage compartment: Length	1.08 m (3 ft 6½ in)
Max width	0.35 m (1 ft 1¾ in)
Max height	0.80 m (2 ft 7½ in)
AREAS:	
Wings, gross	13.54 m² (145.7 sq ft)
Ailerons	0.65 m² (7.00 sq ft)
Flaps	1.56 m² (16.79 sq ft)
Horizontal tail	2.34 m² (25.18 sq ft)
Elevator	0.58 m² (6.24 sq ft)
Fin	1.60 m² (17.22 sq ft)
Rudder	0.47 m² (5.06 sq ft)
WEIGHTS AND LOADINGS:	
Weight empty	735 kg (1,620 lb)
Baggage capacity	30 kg (66 lb)
Max T-O weight	1,150 kg (2,535 lb)
Max landing weight	1,092 kg (2,407 lb)
Max wing loading	84.9 kg/m² (17.40 lb/sq ft)
Max power loading	11.60 kg/kW (19.06 lb/hp)
PERFORMANCE (A: DA40-180; B: DA40FP; C: DA40D):	
Never-exceed speed (VNE), all	178 kt (329 km/h; 204 mph)
Max cruising speed, all	129 kt (239 km/h; 148 mph)
Cruising speed at FL100:	
A at 45% power	107 kt (198 km/h; 123 mph)
A at 55% power	120 kt (222 km/h; 138 mph)
C at 60% power	114 kt (211 km/h; 131 mph)
A at 65% power	131 kt (243 km/h; 151 mph)
B at 65% power	130 kt (240 km/h; 150 mph)
C at 70% power	125 kt (232 km/h; 144 mph)
B at 75% power	138 kt (256 km/h; 159 mph)
C at 80% power	132 kt (244 km/h; 152 mph)
Stalling speed, clean, all	52 kt (97 km/h; 60 mph)
Max rate of climb at S/L: A	262 m (860 ft)/min
B	297 m (974 ft)/min
C	169 m (554 ft)/min
T-O run: A	310 m (1,020 ft)
B	350 m (1,150 ft)
C	335 m (1,100 ft)
T-O to 15 m (50 ft): A	440 m (1,445 ft)
B	550 m (1,805 ft)
C	630 m (2,070 ft)
Landing from 15 m (50 ft): A	638 m (2,095 ft)
B	817 m (2,680 ft)
C	750 m (2,460 ft)
Landing ground roll: A	352 m (1,155 ft)
B	466 m (1,530 ft)
C	288 m (945 ft)
OPERATIONAL NOISE LEVELS (JAR 36):	
Standard exhaust	78.7 dB(A)
OAM 40-096 exhaust	69.5 dB(A)

Instrument panel of DA40D 0532054

DIAMOND DA42 TWIN STAR

TYPE: Four-seat utility twin.

PROGRAMME: Prototype (then wearing D-GENI but not officially registered as such) shown statically at ILA Berlin, 6 to 12 May 2002. Although long reported, company decision to build was only made in November 2001, and assembly began in March 2002; DA42-V1 first flight (as OE-VPS) 9 December 2002; second prototype DA42-V2, OE-VDA, flew October 2003, total of 288 flight hours logged by late September 2004; third (and sixth) used for static testing only; DA42-P4 OE-VDB, first flown 29 April 2004, and shown at ILA, Berlin, May 2004, with total of 235 flight hours logged by late September 2004. EASA certification 13 May 2004; FAA FAR Pt 23 approval granted 22 July 2005. North American debut (DA42-P4) at EAA AirVenture Oshkosh, 27 July 2004 after transatlantic ferry flight from Wiener Neustadt 20 to 23 July via Scotland, Iceland, Greenland, Nunavut, Kuujjuaq and London, Ontario, followed by nonstop 1,900 n miles (3,519 km; 2,186 mile) return ocean crossing from St John's, Newfoundland, to Porto, Portugal, in 12 hours, 30 minutes' flying time at average ground speed of 152 kt (282 km/h; 175 mph) and fuel burn of 10.86 litres (2.87 US gallons; 2.39 Imp gallons) per hour, per engine.

First delivery, of two aircraft (F-GJMT and F-GSIM) for French distributor Jacques Mattern, took place on 24 March 2005, followed by the first of 50 ordered by Diamond Aircraft UK.

CURRENT VERSIONS: **DA42-TDI Twin Star**: Thielert-powered version, *as described*. Manufacturing designation DA42D.

DA42-360 Twin Star: Conversion of DA42-V1 with 134 kW (180 hp) Textron Lycoming IO-360-M1A flat-sixes and Hartzell FC7495S two-blade propellers first flew on 16 April 2004. Also promoted as DA42L. Second prototype, newly-built OE-VDC, flew 18 December 2004; third (OE-VLC) shown at AirVenture, Oshkosh, July 2004. Production version with three-blade MT-Propeller composite propellers. Lycoming installation has air

Diamond DA42 Twin Stars in formation

1151708

Instrument panel of DA42 Twin Star with twin Garmin screens

1151707

intakes on each side of propeller hub. Fuel capacity 360 litres (95.0 US gallons; 79.2 Imp gallons) of which 340 litres (89.8 US gallons; 74.8 Imp gallons) usable. Max cruising speed 191 kt (354 km/h; 220 mph); max rate of climb at S/L 640 m (2,100 ft)/min; rate of climb at S/L, OEI 91 m (300 ft)/min; max range 1,000 n miles (1,852 km; 1,150 miles). No production planned.

DA42 OPALE: Multipurpose aerial sensor platform (OPALE: Optional Piloted Surveillance and Reconnaissance System) version developed in conjunction with Rheinmetall Defence Electronics GmbH for reconnaissance, surveillance, inland or coastal border control, power plant and agricultural monitoring. Designed to be flown piloted or as UAV from ground control station/section control centre. Features nose/chin-mounted gyro-stabilised UOMZ SON 112 observation system; microwave LOS Broadband downlink with range of up to 108 nm (200 km; 124 miles), satellite uplink for command, control and payload data, and HF narrowband datalink for redundant command and a variety of task-specific sensors. Airframe modifications include enlarged downturned tailplane tips. At loiter speed of 65 kt (120 km/h; 75 mph) on-station time is up to 18 hours. Prototype OE-FDA (fifth DA42 airframe) first flew 12 May 2005.

CUSTOMERS: Total of 571 orders by late 2005, of which 215 are from customers in Europe and 356 from North America, including 10 for North American launch customer Embry-Riddle Aeronautical University for its Aviation & Space Technology Academy (ASTA) graduate first-officer training programme, an unspecified number for CTC McAlpine of the UK; one for Atlantic Flight Training of the UK delivered 17 June 2005; EPAG France has ordered four; Beijing PanAm International Aviation Academy has ordered 19, of which the first three were delivered 28 September 2005 after a ferry light of 30 hours, 22 minutes duration.

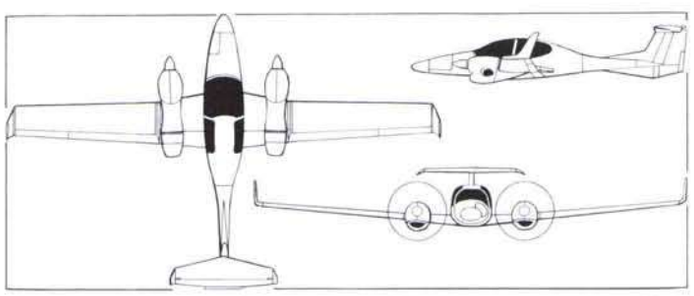
Total of 68 delivered in 2005, including aircraft for customers in France, the UK and US.

COSTS: EUR405,625 basically equipped (2005).

DESIGN FEATURES: Twin-engined version of DA40D Diamond Star; integral wing centre section replaced by a bolt-on centre section for wing of increased span; deeper floor provides increased headroom; front bulkhead (formerly firewall) moved forward. DA40 outboard wing panels with winglets; T tail; engine cowlings of large frontal area. Downturned tailplane tips. Enlarged rudder and fin dorsal fillet; underfin faired into rudder.

FLYING CONTROLS: Conventional and manual. Inset horn balance in ailerons. Flight-adjustable tabs on elevator (central) and rudder; ground-adjustable tab on port aileron Slotted flaps outboard of engines; split flaps inboard; both electrically actuated.

Diamond DA42 OPALE prototype/demonstrator 1151706



Diamond DA42-TDI Twin Star *(James Goulding)* 1047849

STRUCTURE: Composites throughout. Generally as for DA40, but with increased use of carbon fibre for additional strength. Airframe certified for unlimited life, with first structural maintenance required after 6,000 flight hours.

LANDING GEAR: Tricycle type; electrohydraulically retractable. Nosewheel, with 5.00-5 tyre, retracts rearward and covered by single, starboard-hinged door; mainwheels, with 15×6.00-6 tyres and trailing-link configuration, retract inboard, having single part-door on legs, leaving wheel exposed after retraction. Oleo-pneumatic shock-absorbers on all legs. Hydraulic brakes. Floatplane version planned.

POWER PLANT: Two 99 kW (133 hp) Thielert Centurion 1.7 turbocharged diesel engines, each driving an MT-Propeller MTV-6-A/187-129 three-blade, variable-pitch (hydraulic) propeller. Single-lever control, with FADEC. Fuel tanks in wings, capacity 197 litres (52.0 US gallons; 43.3 Imp gallons), of which 189 litres (49.9 US gallons; 41.6 Imp gallons) usable; optional long-range capacity 104 litres (27.4.0 US gallons; 22.9 Imp gallons), of which 100 litres (26.4 US gallons; 22.0 Imp gallons) usable.

ACCOMMODATION: Four persons in two side-by-side pairs. Single-piece canopy lifts up and forwards for access to front seats; rear occupants board through an upward-opening door to port. Cabin has deluxe leather interior with 26 g composites self-adapting seats with three-point inertia reel safety harnesses, and roll-over bar. Baggage compartment behind seats includes tubular extension into rear fuselage for extra-long items. Baggage compartment extension similar to that of Canadian-built DA40, optional. Forward baggage compartment in nose with doors both sides. Air conditioning optional for DA42-360 from 2006.

SYSTEMS: Optional oxygen system. Electrical system 28 V with dual paralleling alternators (one per engine), each providing up to 60 A. Battery in nose: 11 Ah. Optional TKS fluid de-icing system for wing, tailplane, propellers and windscreen with approval (granted 16 December 2005) for flight into forecast or known icing conditions; weight 54 kg (118 lb); typical effectiveness 2.5 hours. Bendix/King KAP 140 autopilot.

AVIONICS: Garmin G1000 integrated avionics system as standard.

Comms: Dual Garmin GIA 63 com/nav/GPS/ILS, single GMA 1347 digital audio selector panel with marker beacon receiver and GTX 33 Mode S transponder with traffic information system (where available).

Flight: Bendix/King GRS 77, GMU 44 AHRS and terrain awareness system. Options include Bendix/King KN 63 DME, Becker RA 3502 ADF and L-3 WX-500 Stormscope.

Instrumentation: Two 254 mm (10 in) GDU 1040A (1,024 × 768 resolution) flat panel, sunlight readable, landscape format colour TFT screens.

EQUIPMENT: Landing light, taxying light, position lights, instrument lighting system, overhead cabin light, heated pitot/static system, ANR headsets, gust lock, towbar, tools and pitot cover; fire extinguisher and first aid kit all standard.

DIMENSIONS, EXTERNAL:

Wing span	13.41 m (44 ft 0 in)
Wing aspect ratio	11.04
Length overall	8.53 m (28 ft 1 in)
Height overall	2.44 m (8 ft 2 in)
Propeller diameter	1.87 m (6 ft 1½ in)

AREAS:

Wings, gross	16.28 m² (175.3 sq ft)
Ailerons (total)	0.66 m² (7.10 sq ft)
Trailing edge flaps:	
slotted	1.34 m² (14.42 sq ft)
split	0.84 m² (9.04 sq ft)
Horizontal tail surfaces	2.35 m² (25.30 sq ft)
Elevators	0.66 m² (7.10 sq ft)
Vertical tail	2.43 m² (26.16 sq ft)
Rudder	0.78 m² (8.40 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	1,250 kg (2,756 lb)
Max baggage weight:	
Nose	30 kg (66 lb)
Cockpit	45 kg (99 lb)
Baggage extension	18 kg (40 lb)
Max T-O weight (Utility)	1,785 kg (3,935 lb)
Max landing weight	1,700 kg (2,748 lb)
Max zero-fuel weight	1,650 kg (3,638 lb)
Max wing loading	109.6 kg/m² (22.45 lb/sq ft)
Max power loading	9.00 kg/kW (14.79 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	194 kt (359 km/h; 223 mph)
Cruising speed: at FL100:	
at 50% power	127 kt (235 km/h; 146 mph)
at 60% power	138 kt (256 km/h; 159 mph)
at 70% power	148 kt (274 km/h; 170 mph)
at 80% power	156 kt (289 km/h; 179 mph)
at 90% power	163 kt (302 km/h; 188 mph)
at FL180:	
at 50% power	135 kt (250 km/h; 72 mph)
Stalling speed, flaps up	63 kt (117 km/h; 73 mph)
Max operating altitude	5,485 m (18,000 ft)
Max rate of climb at S/L	323 m (1,060 ft)/min
T-O run	427 m (1,400 ft)
T-O to 15 m (50 ft)	691 m (2,270 ft)
Landing from 15 m	710 m (2,330 ft)
Landing run	397 m (1,305 ft)
Range, 60% power at FL100:	
standard fuel	897 n miles (1,661 km; 1,032 miles)
with long range tank	1,275 n miles (2,361 km; 1,467 miles)

DIAMOND D-JET

TYPE: Private jet.

PROGRAMME: Development revealed in late 2002; initial details released 14 January 2003; first flight (C-GVLJ) at London, Canada, 18 April 2006; certification and deliveries planned for first quarter 2008. To be certified in standard and high maximum take-off weight versions for European and US markets, respectively. Final assembly of production aircraft to be in Canada. Seven-seat, twin-engine derivative under study in early 2003.

CUSTOMERS: Sales by July 2004 totalled more than 180.

Prototype Diamond D-Jet on its maiden flight 1158051

For details of the latest updates to ***Jane's All the World's Aircraft*** online and to discover the additional information available exclusively to online subscribers please visit
jawa.janes.com

Diamond D-Jet prototype 1158052

COSTS: Unit cost less than USD1 million (2005).

DESIGN FEATURES: Low-wing of laminar flow aerofoil section with moderate sweepback and small winglets; T tail; engine inlets in wingroots.

STRUCTURE: Composites throughout.

POWER PLANT: One 6.23 kN (1,400 lb st) Williams International FJ33-4 turbofan, with FADEC. Fuel capacity 792 litres (209 US gallons; 174 Imp gallons) in EASA-certified version; 1,100 litres (291 US gallons; 242 Imp gallons) in FAA-certified version.

ACCOMMODATION: Five, including pilot(s), in two-plus-three seating configuration; pressurised cabin. Two cabin windows per side.

SYSTEMS: Pressurisation system, maximum differential 0.38 bar (5.5 lb/sq in) maintaining 2,440 m (8,000 ft) cabin environment to 7,620 m (25,000 ft). De-icing system standard. Ballistic Recovery Systems emergency parachute recovery system will be offered as option, deployable at speeds up to 300 kt (556 km/h; 345 mph).

AVIONICS: Garmin G1000 integrated avionics system comprising three-tube EFIS display with dual 254 mm (10 in) PFDs and single centrally mounted 381 mm (15 in) MFD. FMS controller, dual com/nav, integrated GFC 700 autopilot, glareshield mounted autopilot controller, dual audio panels, dual AHRS/GPS/magnetometer sensor system, and Mode S transponder.

DIMENSIONS, EXTERNAL:

Wing span	11.43 m (37 ft 6 in)
Length overall	10.69 m (35 ft 0¾ in)
Height overall	3.53 m (11 ft 7 in)

DIMENSIONS, INTERNAL:

Cabin: Length	3.53 m (11 ft 7 in)
Max width	1.47 m (4 ft 10 in)
Max height	1.47 m (4 ft 10 in)

WEIGHTS AND LOADINGS (A: EASA certification; B: FAA certification):

Weight empty: A, B	1,175 kg (2,590 lb)
Max payload	499 kg (1,100 lb)
Max fuel weight	789 kg (1,739 lb)
Payload with max fuel: A	179 kg (395 lb)
B	229 kg (505 lb)
Max T-O weight: A	1,999 kg (4,407 lb)
B	2,300 kg (5,070 lb)

PERFORMANCE (estimated):

Max operating speed	295 kt (546 km/h; 339 mph)
Cruising speed: max at FL250	315 kt (583 km/h; 363 mph)
Long range cruising speed	240 kt (444 km/h; 276 mph)
Stalling speed: A	61 kt (113 km/h; 71 mph)
B	63 kt (117 km/h; 73 mph)
Time to FL250	15 min
Service ceiling	7,620 m (25,000 ft)
Max range: A	1,012 n miles (1,874 km; 1,164 miles)
B	1,351 n miles (2,502 km; 1,554 miles)

DIAMOND DA50 SUPER STAR

TYPE: Five-seat lightplane.

PROGRAMME: On 15 December 2006, Diamond allowed guests to its plant an 'unofficial' view of the DA50 Super Star, which appears to be a five-seat version of the DA40 Diamond Star.

Diamond noted only that the aircraft would employ "various gasoline and Diesel" engines up to 261 kW (350 hp). The prototype appears to have a Thielert 4.0 Diesel of that power and a four-blade, scimitar propeller by MT-Propeller. The T tailplane has the downturned tips found on the DA42.

First photograph released of the Diamond DA50 Super Star 1158905

HB FLUGTECHNIK

HB FLUGTECHNIK GMBH

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Company name indicates Heino Brditschka, designer of motor gliders, including the HB 23 and HB 202. Both had the unconventional mid-fuselage propeller, to which HB Flugtechnik has returned for some of its recent projects.

From its 2,400 m² (25,830 sq ft) factory, HB provides a wide variety of other aviation services, including overhaul and repair, aerial photography and advertising, flying training, aircraft charter and support of amateur constructors. In 1998, distribution of HB 207 kits was assigned to Aero-Service Thüringen of Erfurt, Germany, but this has now ceased.

In 2002, HB announced that it was working on more projects, including the **HB 401** high-wing pusher; **HB 402** high-wing design resembling Cessna 172; and **HB 403**, based around the company's Alfa; work was continuing during 2004, but nothing reported subsequently.

The company also markets the Amigo, Cubby and Dandy ultralights produced by Tomáš Podešva in the Czech Republic.

HB FLUGTECHNIK HB 207 ALFA

TYPE: Side-by-side kitbuilt.

PROGRAMME: First flight (HB 207RG OE-CHC) 14 March 1995. Second prototype (HB 207 OE-CAA) made public debut, unmarked and then unflown, at Aero '97 at Friedrichshafen, April 1997. Certified to JAR-VLA.

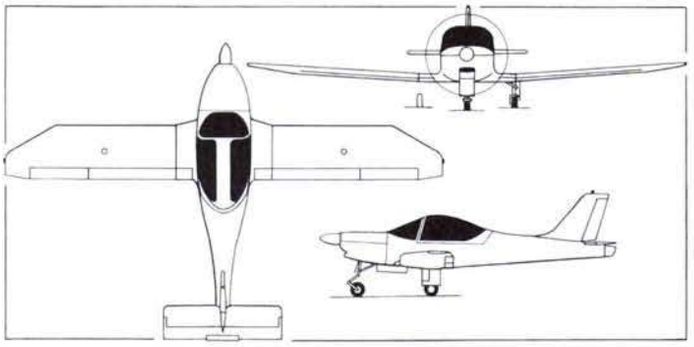
CURRENT VERSIONS: **HB 207:** Fixed landing gear version.

HB 207RG: Retractable landing gear version. Empty weight 498 kg (1,098 lb), MTOW 750 kg (1,653 lb); cruising speed at 75 per cent power 140 kt (259 km/h; 161 mph); service ceiling 4,570 m (15,000 ft); T-O run 340 m (1,115 ft), or 440 m (1,445 ft) to 15 m (50 ft); range 809 n miles (1,500 km; 932 miles).

CUSTOMERS: Total 85 sold in Austria, Brazil, Czech Republic, France, Germany, Lithuania, Sweden, Switzerland, United Kingdom and USA by April 2001; at least 70 completed by late 2005.

COSTS: Standard aircraft fast-build kit, no engine, propeller or avionics EUR22,500 (2005).

Rotax-engined version of fixed-gear HB 207 Alfa *(Paul Jackson)* 1158436



HB Flugtechnik HB-207RG Alfa (Volkswagen engine) *(Paul Jackson)* 1158442

DESIGN FEATURES: Quoted build time 1,000 hours. Constant chord low wings with raked tips; slightly sweptback fin and rudder; one-piece elevator aft of vertical tail. Airframe features derigging and rigging guide points for road transport or storage.

FLYING CONTROLS: Conventional and manual. Ailerons and elevator actuated by pushrods; rudder by cables. Large central trim tab in elevator. Manual (optionally electric) operation for flaps.

STRUCTURE: Mainly metal primary structure with GFRP skin; moving surfaces have Ceconite covering.

LANDING GEAR: HB 207RG has retractable tricycle type, with size 4.00-4 tyre on each unit. Main units have brakes and rubber-in-compression shock-absorption, and retract inward; nosewheel retracts rearward. HB 207 has fixed tricycle type with 5.00-5 tyres plus streamlined fairings and spats on each unit.

POWER PLANT: Standard engine is an 80.9 kW (108.5 hp) VW Porsche HB 2400 G/2 flat-four based on that of Porsche 911 sports car; alternatives include 59.6 kW (79.9 hp) Rotax 912 A, 73.5 kW (98.6 hp) Rotax 912S and 84.5 kW (113.3 hp) Rotax 914, or Limbach or Textron Lycoming engines up to 119 kW (160 hp). Rotax versions have elongated engine cowling. Geared drive to choice of propellers: two-blade wooden fixed pitch, three-blade adjustable- or variable-pitch, or (as on prototypes) five-blade adjustable- or variable-pitch. Fuel tank in each wing, combined capacity 100 litres (26.4 US gallons; 22.0 Imp gallons).

ACCOMMODATION: Rearward-sliding fully transparent canopy.

SYSTEMS: Electrical system: 200 A 15 Ah (optionally 20 Ah) battery; 14 V 75 A alternator.

AVIONICS: *Comms:* Honeywell 760-channel KX 155 transceiver, KT 76A transponder and ELT optional.

Flight: Honeywell KX 125 VOR with KI 208 indicator optional.

Instrumentation: VFR flight and engine transmission instrumentation standard.

DIMENSIONS, EXTERNAL:

Wing span	9.00 m (29 ft 6¼ in)
Wing aspect ratio	8.5
Length overall	5.95 m (19 ft 6¼ in)
Height overall	1.95 m (6 ft 4¾ in)

DIMENSIONS, INTERNAL:

Cabin: Length	1.94 m (6 ft 4½ in)
Max width	1.10 m (3 ft 7¼ in)
Max height	0.97 m (3 ft 2¼ in)

AREAS:

Wings, gross	9.50 m² (102.3 sq ft)
Vertical tail surfaces (total)	0.65 m² (7.00 sq ft)
Horizontal tail surfaces (total)	1.68 m² (18.08 sq ft)

WEIGHTS AND LOADINGS (U: Utility, N: Normal category):

Weight empty: U, N	450 kg (992 lb)
Max T-O weight: U	700 kg (1,543 lb)
N	750 kg (1,653 lb)
Max wing loading: U	67.4 kg/m² (13.80 lb/sq ft)
N	73.7 kg/m² (15.09 lb/sq ft)
Max power loading:	
VW-Porsche HB 2400 G/2	8.66 kg/kW (14.22 lb/hp)
Rotax 912 A	11.75 kg/kW (19.31 lb/hp)

PERFORMANCE (HB 2400 engine, U and N as above):

Never-exceed speed (VNE): U, N	166 kt (309 km/h; 192 mph)
Cruising speed: U	132 kt (245 km/h; 152 mph)
N	130 kt (240 km/h; 149 mph)
Stalling speed:	
flaps up: U	51 kt (93 km/h; 58 mph)
N	53 kt (98 km/h; 61 mph)
30° flap: U	46 kt (84 km/h; 53 mph)
N	47 kt (87 km/h; 55 mph)
Max rate of climb at S/L: U	330 m (1,082 ft)/min
N	300 m (984 ft)/min
Service ceiling	4,265 m (14,000 ft)
T-O run: U	190 m (625 ft)
N	210 m (690 ft)
T-O to 15 m (50 ft): U	300 m (985 ft)
N	320 m (1,050 ft)
Landing run: U	153 m (500 ft)
Range: U, N	647 n miles (1,200 km; 745 miles)
g limits: U	+4.4/−2.2
N	+3.8/−1.9

HB FLUGTECHNIK AMIGO, CUBBY AND DANDY

TYPE: Tandem-seat ultralight/kitbuilt; side-by-side ultralight/kitbuilt.

PROGRAMME: Introduced to HB range in 2002 as modular range, based on Podešva series of Piper Cub lookalikes produced in Czech Republic. Differences include the following:

CURRENT VERSIONS: **Amigo:** Side-by-side version of modern appearance, with nosewheel, short-span wings, square-topped fin and cut-down rear decking. Option of increased engine power. Manufacturer's designation **TUL 03**. Prototype (later D-MBHB) shown at Aero '03, Friedrichshafen, 24–27 April 2003.

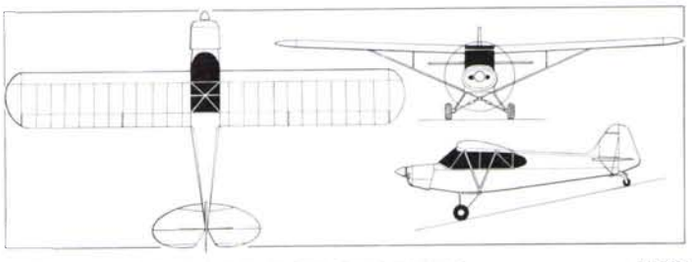
Cubby: Tandem-seat, tailwheel layout, most resembling classic J3 Cub. Manufacturer's designation **TUL 02**.

Dandy: As Cubby, but side-by-side seating.

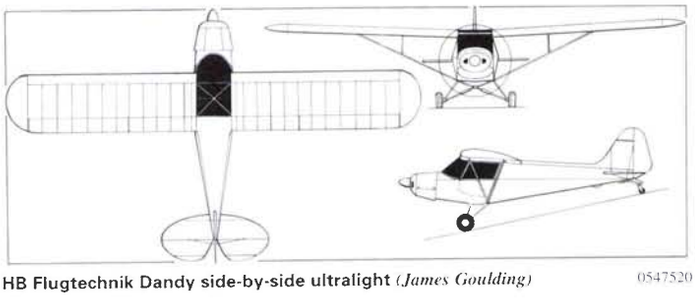
COSTS: Amigo kit EUR14,900 without engine; EUR41,500 flyaway with Rotax 912; Cubby kit EUR13,900 without engine; EUR39,900 flyaway with Rotax 912, all plus tax (2006).

HB Flugtechnik Cubby 1037915

HB Flugtecknik Dandy 1037916



Cubby representative of Piper J3 Cub *(James Goulding)* 0547521



HB Flugtechnik Dandy side-by-side ultralight *(James Goulding)* 0547520

FLYING CONTROLS: Conventional and manual. All models have plain flaps and flight-adjustable trimmer in each elevator.

STRUCTURE: Amigo has metal tube, fabric-covered lower fuselage and strut-braced wings, latter with composites tips and leading edge; metal fin fillet, braced tailplane. Cubby and Dandy have metal tube fuselage with fabric covering aft of cabin and metal sheet forward, fabric-covered wooden wings.

LANDING GEAR: *Amigo:* Nosewheel type; fixed. Fuselage-mounted, spring composites cantilever mainwheel legs, 4.00–6 mainwheels with cable-operated drum brakes; 4.00–4 nosewheel. Tail bumper.

Cubby/Dandy: Tailwheel type; fixed. Two faired-in side Vs hinged to lower longerons, plus half-axles, each with shock-absorber, attached to compression frame. 15×6.00–6 mainwheels and solid tailwheel.

POWER PLANT: One 59.6 kW (79.9 hp) Rotax 912 UL with two-blade propeller standard. Amigo option of 73.5 kW (98.6 hp) Rotax 912 ULS and two-blade ArPlast variable-pitch

HB Flugtechnik Amigo 1037911

propeller. Fuel tank behind cockpit; capacity 60 litres (15,8 US gallons; 13,2 Imp gallons) in all versions with option to increase to 90 litres (23,8 US gallons; 19,8 Imp gallons) in Cubby.

EQUIPMENT: Amigo has optional ballistic parachute.

DIMENSIONS, EXTERNAL (A: Amigo, C: Cubby, D: Dandy):

Wing span: A	9.00 m (29 ft 6¼ in)
C	9.90 m (32 ft 5¾ in)
D	9.60 m (31 ft 6 in)
Length overall: A	5.70 m (18 ft 8½ in)
C, D	5.60 m (18 ft 4½ in)
Height overall: A	2.20 m (7 ft 2½ in)
C, D	2.00 m (6 ft 6¾ in)

AREAS:

Wings, gross: A	11.80 m² (127,0 sq ft)
C	13.00 m² (139,9 sq ft)
D	12.80 m² (137,8 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: A, C	265 kg (584 lb)
D	260 kg (573 lb)
Max T-O weight: all	450 kg (992 lb)
where allowed	472,5 kg (1,041 lb)

PERFORMANCE:

Never-exceed speed (VNE): A	102 kt (190 km/h; 118 mph)
C, D	91 kt (170 km/h; 105 mph)
Normal cruising speed: A	86 kt (160 km/h; 99 mph)
C, D	81 kt (150 km/h; 93 mph)
Stalling speed: A	30 kt (55 km/h; 35 mph)
C, D, flaps down	27 kt (50 km/h; 31 mph)
Max rate of climb at S/L	300 m (984 ft)/min
T-O run: A	70 m (230 ft)
C, D	60 m (200 ft)
g limits	+6/−4

Belgium

DYNALI

DYNALI SA HELICOPTERES

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SALES MANAGER: M Michau

As well as supplying kits and flyaway helicopters, Dynali also offers builder assistance at its Nivelles factory. Distributors have been appointed in France, Spain and South Africa.

DYNALI H2

TYPE: Two-seat ultralight helicopter kitbuilt.

PROGRAMME: Prototype (registered in France as F-PHH) formally revealed 11 May 2004; flew later that year and exhibited at several trade shows; new design of main blade (replacing aluminium unit supplied by Air Copter) added in early 2005; testing satisfactory, but by May 2005 plans in hand for replacement of original Rotax 914 engine by higher-powered Subaru.

COSTS: Kit EUR90,000 (2006).

DESIGN FEATURES: Small, moderately-priced helicopter with option of home- or factory-assisted assembly to meet JAR 27 VLR regulations. Airframe designed for progressive deformation in the event of accident. Flight controls as for larger helicopters, allowing representative training. Safety features include oil contamination, and oil and water level warnings.

Prototype Dynali H2 two-seat helicopter *(Paul Jackson)*

1037942

Conventional layout with two-blade Vitech Aerospace main rotor and eight-blade Duc Helice Fenestron-type tail rotor. Main rotor 530 rpm. Fixed horizontal tailplane with end fins.

Main rotor blade section NACA 23015.

STRUCTURE: Welded stainless steel tube cabin structure with Kevlar skin; carbon fibre tailboom. Composites main rotor blades and aluminium tail rotor. Polyurethane foam fillings. Aluminium skids.

LANDING GEAR: Skid-type; fixed. Three attachment points each side.

POWER PLANT: One flat-four piston engine with belt drive to rotors. Initially 84.5 kW (113.3 hp) Rotax 914; to be replaced by Subaru EJ25 derated to 123 kW (165 hp). Fuel capacity 80 litres (21.1 US gallons; 17.6 Imp gallons).

DIMENSIONS, EXTERNAL:

No details announced

WEIGHTS AND LOADINGS:

Weight empty	420 kg (926 lb)
Max T-O weight	685 kg (1,510 lb)

PERFORMANCE:

Never-exceed speed (VNE)	102 kt (190 km/h; 118 mph)
Max operating speed	89 kt (165 km/h; 103 mph)
Endurance	4 h

ESQUAL.COM

ESQUAL.COM NV

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Esqual ultralight developed by Vol Mediterrani of Spain. Programme transferred in March 2006 to Belgium; new manufacturing facilities to be established at the former military air base of Brustem, near Saint-Truiden, subject to planning permission.

ESQUAL.COM VM-1 ESQUAL

English name: Shark

TYPE: Side-by-side ultralight/kitbuilt; two-seat lightplane.

PROGRAMME: Prototype EC-YZZ flown 2000 by designers, Vol Mediterrani at 'Les Umbertes' aerodrome, Moià. UK debut at PFA Rally, Cranfield, June 2002 (demonstrator EC-ZFF). Programme transferred to Belgium in 2006, coincident with adoption of AN (USA) hardware sizes and Mateo wheels and brakes.

CURRENT VERSIONS: **VM-1:** Original version. Initial 73 aircraft, built up to mid-2003. Wing span 9.25 m (30 ft 4¼ in); length 5.86 m (19 ft 2¾ in).

From 74th aircraft onwards, has wider chord ailerons and smaller wingtip fairings for slightly reduced span. Prototype was EC-ZFX fitted with new wing, including fixed landing gear.

VM-1C: 'Carbon' version of VM-1, adding carbon fibre main spar, electric elevator trim and dual controls.

VM-1P: At least two VM-1s registered in Portugal.

Esqual Sport: Marketed by Esqual North America LLC (www.esqualna.com) for LSA category; Jabiru 3300 engine and Sensenich W64ZK-51 propeller.

Fixed gear: Nosewheel landing gear. Fuselage-mounted spring composites mainwheel legs and trailing-link nosewheel, all with wheel fairings. Mainwheels 3.50–6; nose 4.00–4. *As described.*

Retractable gear: Tailwheel type. Retractable mainwheels; fixed tailwheel with speed fairing. Prototype EC-ZFX had flown by mid-2002. Max level speed (Jabiru 3300 engine) 200 kt (370 km/h; 230 mph). Wing span approx 8.23 m (27 ft 0 in); wing area 7.90 m² (85.0 sq ft). At least two built by 2005.

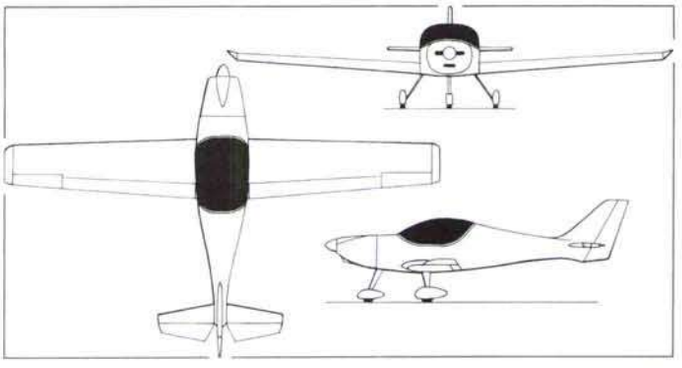
CUSTOMERS: More than 90 built and 100 sold by early 2005.

COSTS: Kit less engine and instruments: VM-1 EUR30,068, VM-1C EUR34,025. US kit delivery charge USD1,700. Rotax flyaway: VM-1 EUR61,387, VM-1C EUR65,344. Jabiru 2200 flyaway: EUR55,993 and EUR59,950; Jabiru 3300 flyaway: EUR61,387 and EUR65,344. All prices not including tax (2006).

DESIGN FEATURES: High-performance ultralight with low landing speed achieved by refinement of wing design. Low-mounted, tapered wing and mid-tailplane. Sweptback fin. No composites work required for assembly.

FLYING CONTROLS: Conventional and manual; ailerons and elevator pushrod actuated. Variable incidence (electric) tailplane for trim. Slotted flaps; maximum deflection 45°; flaps also deflect upwards to optimise cruising speed.

Esqual.com VM-1 Esqual flown in USA *(Paul Jackson)* 1159168



Vol Mediterrani VM-1 Esqual side-by-side kitbuilt *(Paul Jackson)* 1159131

STRUCTURE: Glass fibre monocoque fuselage with integral fin; cockpit area reinforced. Steel tube centre-section. Wing main spar of carbon fibre or glass fibre (according to customer's choice; latter with 10 kg; 22 lb weight saving), with secondary trailing-edge spar and glass fibre sandwich skin.

LANDING GEAR: As described under Current Versions. Hydraulic brakes.

POWER PLANT: Option of 73.5 kW (98.6 hp) Rotax 912 ULS (standard) or 59.7 kW (80 hp) Jabiru 2200 flat-four or 89 kW (120 hp) Jabiru 3300 flat-six; last-mentioned adds 8.5 kg (19 lb) to empty weight. Warp Drive three-blade ground-adjustable pitch propeller standard. Airmaster propeller optional. Fuel in two wing tanks, combined capacity 100 litres (26.4 US gallons; 22.0 Imp gallons).

EQUIPMENT: Optional Galaxy ballistic parachute.

DIMENSIONS, EXTERNAL:

Wing span	9.10 m (29 ft 10¼ in)
Length overall	6.08 m (19 ft 11½ in)
Height overall	1.94 m (6 ft 4½ in)

DIMENSIONS, INTERNAL:

Cabin max width	1.10 m (3 ft 7¼ in)

AREAS:

Wings, gross	9.20 m² (99.0 sq ft)

WEIGHTS AND LOADINGS (Rotax 912 ULS and glass fibre wing spar):

Weight empty	275 kg (606 lb)
Max T-O weight: Ultralight	450 kg (992 lb)
LSA	567 kg (1,250 lb)

PERFORMANCE (Ultralight: Rotax 912 ULS and three-blade propeller; J2200 and J3300, fixed-pitch, where different):

Max level speed: Rotax	146 kt (270 km/h; 168 mph)
J2200	124 kt (230 km/h; 143 mph)
J3300	148 kt (275 km/h; 171 mph)
Cruising speed at 75% power:	
Rotax	135 kt (250 km/h; 155 mph)
J2200	113 kt (210 km/h; 130 mph)
J3300	132 kt (245 km/h; 152 mph)
Stalling speed, flaps down	35 kt (64 km/h; 40 mph)
Max rate of climb at S/L: Rotax	549 m (1,800 ft)/min
J2200	305 m (1,000 ft)/min
J3300	457 m (1,500 ft)/min
T-O run: Rotax	95 m (315 ft)
J2200	130 m (430 ft)
J3300	105 m (345 ft)
Landing run	95 m (315 ft)
Range	567 n miles (1,050 km; 652 miles)
g limits	+9/−3 (ultimate)

LAMBERT

LAMBERT AIRCRAFT ENGINEERING BVBA

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DIRECTOR: Filip Lambert

In late 1995 Filip Lambert, a student at the College of Aeronautics, Cranfield, UK, was named one of three joint winners of the Royal Aeronautical Society Light Aircraft Design Competition with his Mission M212-100. Lambert Aircraft Engineering was formed in 1996 and the prototype mission M212-100 was fabricated in Belgium with the assistance of Steven Lambert and the original intention of undertaking test flying at Koksijde air force base, where the company planned to build a 3,000 m² (32,290 sq ft) production facility during the first half of 2004; production scheduled to start in the second half of 2004, when extra staff employed, although a maiden flight did not take place until mid-2004; factory facilities have been built at Wevelgem rather than Koksijde. In September 2003 the workforce numbered three.

LAMBERT MISSION M106

TYPE: Side-by-side ultralight.

PROGRAMME: Prototype built in Slovak Republic *circa* 2003, unannounced; registered OM-M666 and named Tucniak (penguin); based at Lambert company aerodrome at Wevelgem since early 2004; second prototype (59-COP/F-JPQX) with redesign and new engine made first flight from there 18 November 2005; prototype Tucniak moved to Moorsele, Belgium, but with French registration 59-COQ and call-sign FJPQS. Formally announced at PFA Flying for Fun, Kemble, UK, 1 July 2005. Production of initial batch of eight started December 2005 in Slovak Republic with final assembly in Belgium; type certificate awarded 3 April 2006 by Belgian CAA.

COSTS: EUR36,900 flyaway (2006).

DESIGN FEATURES: High, constant-chord wing braced to lower longerons by circular-section V struts and auxiliary strut each side; sweptback fin and mid-mounted tailplane. Original landing gear of side Vs and half-axles replaced prior to launch by cantilever type; Volkswagen and Rotax engines initially flown and found to be unsatisfactory; replaced by UL260i.

FLYING CONTROLS: Conventional and manual. Balanced ailerons and flaps, both operated by pushrods. Plain-hinged elevator and rudder; former cable-actuated; latter operated by pushrods and with flight-adjustable trim tab to port.

Views of second Lambert Mission M106 1158439

STRUCTURE: Welded steel alloy tube fuselage and empennage, both with fabric covering; fabric-covered wing built on dual tubular aluminium spars.

LANDING GEAR: Fixed; tailwheel type standard; nosewheel type optional. Fuselage-mounted, spring glass fibre cantilever mainwheel legs with optional fairings. Mainwheels 14×4 with hydraulic disc brakes; steerable tailwheel 200×50.

POWER PLANT: One 61.1 kW (82 hp), FADEC-controlled UL Power UL260i flat-four, directly driving a two-blade (optionally three-blade) wooden, fixed-pitch propeller. Option of 59.6 kW (79.9 hp) Rotax 912 or 73.5 kW (98.6 hp) Rotax 912S. Composites fuel tanks in wings and header tank in fuselage; total capacity 70 litres (18.5 US gallons; 15.4 Imp gallons) of which 64 litres (16.9 US gallons; 14.1 Imp gallons) usable.

AVIONICS: Dynon Avionics D-10A EFIS and EMS-D10 standard. Optional Avmap EKPIV moving map display

EQUIPMENT: Optional ballistic recovery parachute.

DIMENSIONS, EXTERNAL:

Wing span	9.32 m (30 ft 7 in)
Length	5.65 m (18 ft 6½ in)
Height overall: tailwheel	1.80 m (5 ft 10¾ in)
nosewheel	1.95 m (6 ft 4¾ in)

AREAS:

Wings, gross	11.80 m² (127.01 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	260 kg (573 lb)
Max T-O weight:	450 kg (992 lb)
where allowed	495 kg (1,091 lb)

PERFORMANCE:

Never-exceed speed (VNE)	113 kt (210 km/h; 130 mph)
Max operating speed	100 kt (185 km/h; 115 mph)
Normal cruising speed	85 kt (157 km/h; 98 mph)
Stalling speed, flaps down	35 kt (65 km/h; 41 mph)
Max rate of climb at S/L	305 m (1,000 ft)/min
T-O run	110 m (361 ft)
Range at 75% power	351 n miles (650 km; 403 miles)

LAMBERT MISSION M212

TYPE: Four-seat kitbuilt.

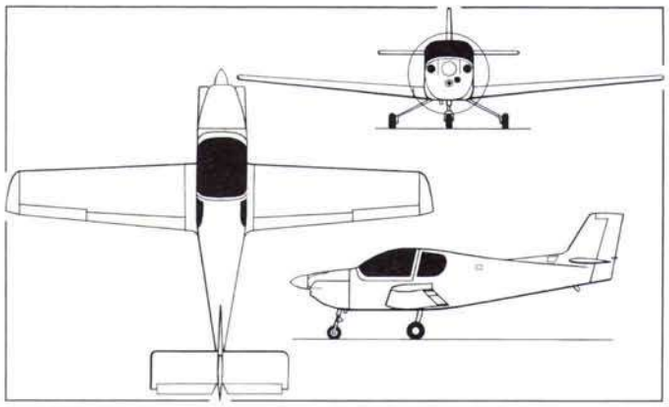
PROGRAMME: Design started November 1992; fuselage mockup completed July 1993; construction of proof-of-concept prototype began at Geluveld, Belgium, January 1996; structural test programme completed 23 December 1998; prototype, M212–100 registered G-XFLY in February 2000, was structurally complete by March 2001; all composites work and landing gear completed November 2001; power plant and fuel system work began March 2002 in UK. Public debut in UK at PFA Rally, Cranfield, 21–23 June 2002. First flight planned for December 2002, but not achieved until 13 July 2004 at Cranfield. Popular Flying Association approval achieved 13 April 2005. Kit production delayed by priority given to M106, but eventually launched in late 2006.

CURRENT VERSIONS: Family of aircraft planned around core four-seat version.

M212-100: Prototype. One only.

M212-200: Basic four-seat version; will be available factory-built or as kit; certification to JAR/FAR Pt 23 planned.

Prototype Lambert Mission M212 1037917



Lambert Mission M212 *(Paul Jackson)* 1159815

M212-300: Proposed two-seat aerobatic trainer; since discontinued.

M212-400: Four-seat tourer with increased fuel and baggage capacity, optional retractable landing gear, maximum take-off weight 1,100 kg (2,425 lb) and range of over 1,000 n miles (1,852 km; 1,151 miles).

M216: Proposed retractable landing gear version.

CUSTOMERS: Six orders for M212-200 and options on 20 M212-200 and -400 kits held in September 2003; customers in the Benelux countries, France and, mostly, the UK. By mid-2005, first batch of five aircraft under construction.

COSTS: Kit, excluding engine, propeller and VFR avionics, EUR59,900 (2006).

DESIGN FEATURES: Designed using CAD and wind tunnel research facilities; will meet FAR Pt 23 and JAR 23 certification criteria. Low-wing monoplane; wings, which have laminar flow, moderate taper and upturned tips. Wing dihedral 5°; incidence at root 2°; twist 2°. Quoted kit build time 800 hours.

FLYING CONTROLS: Conventional and manual. Cable and pushrod actuation. Electrically actuated single-slotted flaps.

STRUCTURE: All-composites, with extensive (95 per cent by weight) use of prepregs; glass and carbon in epoxy resin used for spars and longerons. Fuselage of monocoque construction; wing has dual main spars plus auxiliary spar for further strengthening.

LANDING GEAR: Fixed tricycle type. Mainwheels size 6.00–6, nosewheel 5.00–5 or 6.00–6; Cleveland brakes. Steerable nosewheel, maximum steering angle ±50°. Potential for development of retractable version (tailwheel option withdrawn).

POWER PLANT: Prototype fitted with second-hand 112 kW (150 hp) Textron Lycoming O-320-E2D flat-four; MT-Propeller MTV-18-C/175–17d three-blade, constant-speed (electric) propeller; and Gomolzig twin-muffler exhaust; other options include the 134 kW (180 hp) Superior XP-360 and DeltaHawk DH180A4 134 kW (180 hp) or DH200A4 149 kW (200 hp) liquid-cooled four-cylinder two-stroke Diesel engine, driving either fixed-pitch or constant-speed propeller. Fuel capacity 120 litres (31.7 US gallons; 26.4 Imp gallons) in single fuselage tank in M212–100 prototype; production examples will have two wing tanks and total capacity of 160 litres (42.3 US gallons; 35.2 Imp gallons), can be increased to 280 litres (74.0 US gallons; 61.6 Imp gallons). In developed form as four-seat tourer, suitable for engines in 172 to 194 kW (230 to 260 hp) power range.

ACCOMMODATION: Four persons in 2+2 configuration, under one-piece, forward-hinged canopy. Seats and rudder pedals adjustable; dual controls standard.

All data are provisional.

DIMENSIONS, EXTERNAL:

Wing span	9.80 m (32 ft 1¾ in)
Wing aspect ratio	8.0
Length overall	7.40 m (24 ft 3½ in)
Height overall	2.90 m (9 ft 6 in)
Tailplane span	3.20 m (10 ft 6 in)
Wheel track	2.80 m (9 ft 2¼ in)

DIMENSIONS, INTERNAL:

Cabin: Length	2.50 m (8 ft 2½ in)
Max width	1.12 m (3 ft 8 in)
Max height	1.25 m (4 ft 1¼ in)
Baggage compartment volume:	
M212–100	0.50 m³ (17.7 cu ft)

AREAS:

Wings, gross	12.00 m² (129.2 sq ft)
Ailerons (total)	0.60 m² (6.46 sq ft)
Flaps (total)	1.08 m² (11.62 sq ft)
Elevators (total)	2.65 m² (28.52 sq ft)

WEIGHTS AND LOADINGS (Superior XP-360):

Weight empty	722 kg (1,592 lb)
Max T-O weight	1,150 kg (2,535 lb)
Max wing loading	95.8 kg/m² (19.63 lb/sq ft)
Max power loading	6.39 kg/kW (10.50 lb/hp)

PERFORMANCE (Superior XP-360):

Never-exceed speed (VNE)	183 kt (338 km/h; 210 mph)
Max level speed at S/L	140 kt (259 km/h; 161 mph)
Max cruising speed at FL80:	
at 75% power	137 kt (254 km/h; 158 mph)
at 60% power	126 kt (233 km/h; 145 mph)
Stalling speed, flaps down	53 kt (99 km/h; 61 mph)
Max rate of climb at S/L	274 m (900 ft)/min
T-O run	280 m (920 ft)
Range with max fuel	
at 75% power	480 n miles (889 km; 552 miles)
at 60% power	550 n miles (1,018 km; 633 miles)

WINNER

WINNER M500

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Web: www.winner500.com
DIRECTORS: Jean Joordens
Jean-Yves Dantinne

Winner was formed on 12 July 2004 to manufacture and market the M500 ultralight helicopter, operating from a 250 m² (2,690 sq ft) factory. The workforce numbered three in December 2005.

WINNER M500

TYPE: Single-seat ultralight helicopter.
PROGRAMME: Resembles Mini 500 scale version of Hughes/MDH 500, but of original engineering. First flight (F-PJOO, registered as Joordens M-5JJ) 2004.
COSTS: Flyaway, EUR50,000, including tax (2006).
DESIGN FEATURES: Variable-incidence half-tailplane starboard, opposite tail rotor. Main rotor TBO 1,000 hours.
STRUCTURE: Welded 4041 steel frame and boom; composites pod; composites and metal main rotor; aluminium tail rotor.
LANDING GEAR: Skid type; metal tube with leg fairings.
POWER PLANT: One 74.0 kW (99 hp) Hirth 3701ES water-cooled, three-cylinder two-stroke with electronic injection. Fuel capacity 60 litres (15.85 US gallons; 13.2 Imp gallons).
DIMENSIONS, EXTERNAL:
Main rotor diameter ..... 5.79 m (19 ft 0 in)
Tail rotor diameter ..... 0.95 m (3 ft 1½ in)
Length: fuselage ..... 5.49 m (18 ft 0¼ in)
overall, rotors turning ..... 6.89 m (22 ft 7¼ in)
Height overall ..... 2.47 m (8 ft 1¼ in)

Winner M500 prototype 1037922

WEIGHTS AND LOADINGS:
Weight empty ..... 264 kg (582 lb)
Max T-O weight ..... 450 kg (992 lb)
PERFORMANCE:
Max operating speed ..... 94 kt (175 km/h; 109 mph)
Normal cruising speed ..... 76 kt (140 km/h; 87 mph)
Max rate of climb at S/L ..... 244 m (800 ft)/min
Max range ..... 189 n miles (350 km; 217 miles)

WOLFSBERG

WOLFSBERG AIRCRAFT CORPORATION NV

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MANAGING DIRECTOR: Alec N Clark

Formerly Triloader Aircraft Corporation NV, formed 1995, which at that time intended to develop the Clark-Norman Triloader. Name changed to Wolfsberg Aircraft Corporation NV and development started of a family of twin-boom aircraft in 1 tonne load category.

All manufacture by Wolfsberg Letecká Tovarna in Prague, Czech Republic. Prototype Raven 257 flew 28 July 2000; extensively redesigned and relaunched in 2005 as Corvus 1, new version first flew 6 June 2006. Belgian company is responsible for direction of its Czech subsidiary and for Corvus marketing and sales throughout the world.

Brazil

AEROALCOOL

AEROALCOOL TECNOLOGIA LTDA

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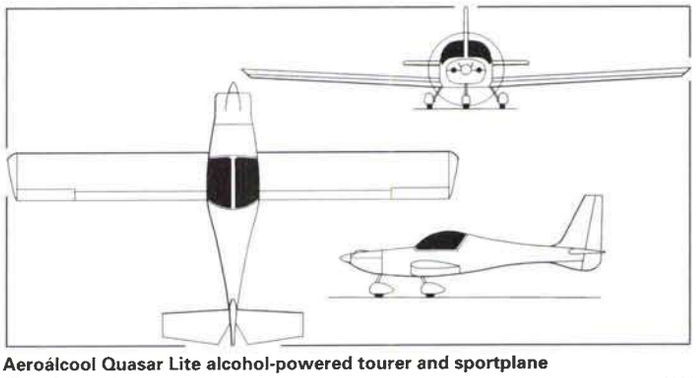
CO-FOUNDER: Omar J J Pugliesi

Formed in 2001, Aeroálcool specialises in converting aircraft engines to alcohol power. Its initial aircraft design is the Quasar Lite.

AEROÁLCOOL QUASAR LITE

TYPE: Side-by-side ultralight.
PROGRAMME: Prototype PU-ACX registered in January 2003; first flight announced February 2006. US promotion began at AirVenture, Oshkosh, in July 2006. US demonstrator N5QL.
DESIGN FEATURES: Economic, high speed tourer and sportplane powered by alcohol. Low, constant-chord wings of high aspect ratio with Hoerner tips. Tapered rear fuselage mounting tall, sweptback fin with underfin and trapezoidal tailplanes.
FLYING CONTROLS: Manual. All-moving tailplane, plus rudder and ailerons. Slotted flaps. Aileron and tailplane actuation by pushrods.
STRUCTURE: Fuselage of glass fibre and epoxy resin, with PVC foam, plus carbon fibre reinforcement. Aluminium rudder and tailplane structure with polyester fabric covering except for aluminium leading-edge D box. Acrylic canopy with carbon fibre frame. Stainless steel firewall. Wing of riveted 2024T3 aluminium attached to fuselage by titanium reinforcements.

Prototype Aeroálcool Quasar ultralight 1158507



Aeroálcool Quasar Lite alcohol-powered tourer and sportplane *(Paul Jackson)* 1159256

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring cantilever SAE 4130 steel mainwheel legs. Cantilever nosewheel leg of 7075 aluminium SAE T7351. Hydraulic mainwheel brakes.
POWER PLANT: One 41.7 kW (56 hp) Aeroálcool AA-1600 flat-four piston engine driving a two-blade wooden propeller. Integral fuel tanks in wings, combined capacity 80 litres (21.1 US gallons; 17.6 Imp gallons) of alcohol.
SYSTEMS: Electrical system 12 V with 16 Ah battery.
EQUIPMENT: Optional ballistic recovery parachute and occupant airbags.
DIMENSIONS, EXTERNAL:
Wing span ..... 9.25 m (30 ft 4¼ in)
Length overall ..... 5.60 m (18 ft 4½ in)
Height overall ..... 2.18 m (7 ft 1¾ in)
DIMENSIONS, INTERNAL:
Cabin max width ..... 1.06 m (3 ft 5¾ in)
AREAS:
Wings, gross ..... 9.20 m² (99.0 sq ft)
WEIGHTS AND LOADINGS:
Max baggage weight ..... 15 kg (33 lb)
Max fuel weight ..... 56 kg (124 lb)
Max T-O weight ..... 480 kg (1,058 lb)
PERFORMANCE:
Never-exceed speed (VNE) ..... 146 kt (270 km/h; 168 mph)
Cruising speed at 75% power ..... 103 kt (191 km/h; 119 mph)
Stalling speed, flaps down ..... 39 kt (72 km/h; 45 mph)
Max rate of climb at S/L ..... 168 m (550 ft)/min
Range with max fuel ..... 834 n miles (1,545 km; 960 miles)
Endurance ..... 8 h

AEROMOT

AEROMOT INDÚSTRIA MECÂNICO-METALÚRGICA LTDA

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MANAGING DIRECTOR: João Cláudio Jotz
MARKETING CONTACT: Fabiane Dorneles

Aeromot Indústria is part of Aeromot Group with Aeromot Aeronaves e Motores SA (parent company, founded 1967, which provides maintenance).

Aeromot Indústria initially designed, certified and built seats for aircraft built by Embraer; it later produced several structural parts for Embraer aircraft, and designed and certified seats for Airbus, Boeing, Fokker and McDonnell Douglas (now Boeing) commercial transports. In 1985 it purchased assets of Fournier motor glider factory in France, including sole manufacturing rights for RF-10; has since incorporated several improvements to basic model, including different engines and propellers. A lightplane version, the AMT-600 Guri, with reduced wing span, first flew in 1999 and was certified in December 2001.

Factory has shop floor area of 3,100 m² (33,375 sq ft) and workforce of approximately 150.

In late 2003, Aeromot was reported to be in the final stages of negotiation with GAIC of China with regard to the latter's licensed production of the Guri and, subject to a change of Chinese air licencing law, the Super Ximango. Joint development and production of a four-seat aircraft is also under consideration.

AEROMOT XIMANGO

US Air Force designation: TG-14

TYPE: Motor glider.

PROGRAMME: Brazilian production version of French Aérostructure (Fournier) RF-10; first flight (French prototype) 6 March 1981; see Sailplanes section of 1990–91 *Jane's* for French production history. All production rights sold to Aeromot July 1985; Brazilian CTA certification of AMT-100 granted 5 June 1986 and French (DGAC) 10 October 1990; AMT-200, developed by Aeromot, made first flight July 1992; was certified 3 February 1993 in Brazil, on 29 December 1993 in USA (to FAR Pt 22), during 1995 in UK and on 24 November 1998 in Canada. Certification of AMT-200 also achieved in Australia, Colombia, France, Germany, Japan, Netherlands and New Zealand.

CURRENT VERSIONS: **AMT-100 Ximango:** Initial production version; powered by one 59.7 kW (80 hp) Limbach L 2000 EO1 flat-four engine driving a Hoffmann HO-V62RL/160BT two-blade three-position variable-pitch propeller. Total 43 built, 1988–93.

AMT-100P Ximango: Military/police and observation version. Two side windows below canopy; underfuselage pod for 100 kg (220 lb) of weapons and avionics or surveillance equipment. In service with Brazilian military police and other law enforcement and environment protection agencies. Production ceased; replaced by AMT-200P, AMT-200SP and AMT-300P with similar optional equipment.

AMT-200 Super Ximango: Generally similar to AMT-100 except for Rotax 912A power plant. Main production variant between 1995 and 2000. Improvements introduced in 1997 include redesigned instrument panel; new canopy locking mechanism; fully enclosing main landing gear doors; tailwheel fairing; and metal fuel tanks.

AMT-200P: Military, police and observation version.

AMT-200S Super Ximango S: Version optimised for pilot training and soaring ('S' indicating 'sport'). Generally similar to AMT-200 except for Rotax 912 S4 engine and optional removable winglets (span as AMT-300). Prototype first flew in September 1999; deliveries from December 1999, to customers in Australia (one), Brazil (one), Dominican Republic (one), South Africa (two), UK (two) and USA (22). Main production variant from 2000.

Selected from at least 13 types evaluated for the USAF's Introductory Flight Training Program (IFTP), replacing grounded Slingsby T-3A Fireflies in flight screening/primary training role; initial order for 14 aircraft announced October 2001; first (01-0136/N136XS) delivered to 94th Flight Training Squadron of US Air Force Academy at Colorado Springs on 24 June 2002, all operating with civilian registrations.

AMT-200SP: Military, police and observation version.

Detailed description applies to the AMT-200 except where indicated.

AMT-300 Turbo Ximango Shark: Prototype (PT-ZAM, converted from an early AMT-100) flew July 1997; based on AMT-200, but with Rotax 914F turbocharged engine, redesigned cockpit, new engine cowling and winglets. Brazilian certification achieved 31 March 1999, followed by FAA approval 19 July 1999; deliveries began in May 1999 with two aircraft for US market to Ximango US at Spruce Creek, Florida; believed none further by late 2005, however.

AMT-300P: Military, police and observation version.

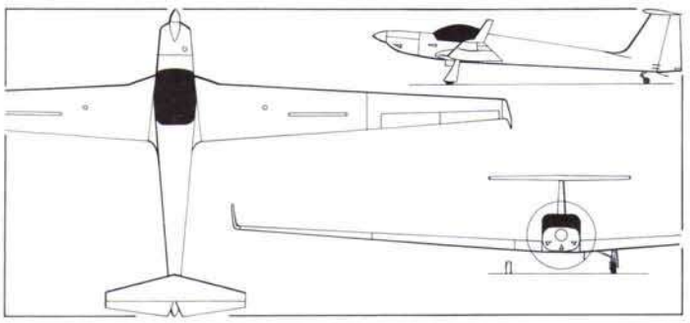
AMT-300R Reboque: Glider tug version of AMT-300.

AMT-600 Guri: Trainer and sport aerobatic version. Described separately.

CUSTOMERS: Initial order for 50 from Brazilian Civil Aeronautical Department; also produced for military/paramilitary roles such as observation, patrol and counter-insurgency. Total of 163 AMT-100s, AMT-200s, AMT-200Ss and AMT-300s produced by December 2004, including deliveries to customers in Argentina (two), Australia (seven), Belgium (one), Brazil (63), Canada (one), Colombia (one), Dominican Republic (one), France (seven), Germany (two), Japan (four), South Africa (two), Mexico, UK (six), USA (49) and undisclosed (5). Further airframe (c/n 112) completed as prototype Guri. AMT-300 production began at No. 106, but continues in parallel with AMT-200.

COSTS: USD135,000 basic for AMT-200; USD143,000 basic for AMT-200S; USD154,000 basic for AMT-300 (all 2004).

Aeromot AMT-200S Super Ximango S *(Paul Jackson)* 1151727



Aeromot AMT-200 Super Ximango S *(James Goulding)* 0589198

DESIGN FEATURES: Typical motor glider; low, tapered wing with fixed incidence T tail. Wings detachable for transportation and storage; outboard half of wing can be folded inward without disconnecting aileron controls.

Wing section NACA 64$_3$-618; dihedral 2° 30'.

FLYING CONTROLS: Conventional and manual; ailerons and elevators operated by pushrods, rudder by cables; trim tab actuated by cable on AMT-100/200; trim control on AMT-200S/300 effected by spring device on elevator pushrod. Schempp-Hirth airbrakes in wing upper surface.

STRUCTURE: All-GFRP/foam except for carbon fibre main spar and light alloy airbrakes.

LANDING GEAR: Mechanically retractable mainwheels (tyre size 330×130), with hydraulic suspension and Cleveland hydraulic disc brakes with differential action; steerable tailwheel with size 210×65 tyre.

POWER PLANT: One 59.6 kW (79.9 hp) Rotax 912A flat-four with Hoffmann HO-V62R/170FA propeller. Fuel in two main tanks in wings, combined capacity 90 litres (23.8 US gallons; 19.75 Imp gallons). AMT-200S has one 73.5 kW (98.6 hp) Rotax 914 S4, driving a three-position variable-pitch Hoffmann propeller. AMT-300 has one 84.6 kW (113.4 hp) Rotax 914 F3 turbocharged flat-four driving an MT/MTV-21 constant-speed feathering propeller; fuel capacity 90 litres (23.8 US gallons; 19.8 Imp gallons).

ACCOMMODATION: Two seats side by side. One-piece canopy hinged at rear to open upward. Dual controls standard.

SYSTEMS: Electric starter and 12 V 30 A alternator.

DIMENSIONS, EXTERNAL:

Wing span: 200, 200S	17.47 m (57 ft 3¼ in)
300	17.67 m (57 ft 11½ in)
Wing aspect ratio: 200, 200S	16.3
300	16.7
Width, wings folded	10.15 m (33 ft 3½ in)
Length overall	8.08 m (26 ft 6 in)
Height overall: 200, 200S, 300	1.93 m (6 ft 4 in)
Tailplane span	3.68 m (12 ft 0¾ in)
Wheel track	2.80 m (9 ft 2¼ in)
Wheelbase	5.03 m (16 ft 6 in)
Propeller diameter: 200, 200S	1.70 m (5 ft 7 in)
300	1.65 m (5 ft 5 in)

DIMENSIONS, INTERNAL:

Cockpit: Length	1.85 m (6 ft 0¾ in)
Max width	1.15 m (3 ft 9¼ in)
Max height	1.00 m (3 ft 3¼ in)

AREAS:

Wings, gross: 200, 200S	18.70 m² (201.3 sq ft)
300	18.75 m² (201.8 sq ft)
Ailerons (total)	2.72 m² (29.28 sq ft)
Airbrakes (total)	1.16 m² (12.49 sq ft)
Fin	1.44 m² (15.50 sq ft)
Rudder	0.69 m² (7.43 sq ft)
Tailplane	1.95 m² (20.99 sq ft)
Elevator	0.95 m² (10.23 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: 200	620 kg (1,367 lb)
200S	625 kg (1,378 lb)
300	630 kg (1,389 lb)
300R	620 kg (1,367 lb)
Max T-O weight: 200, 200S, 300	850 kg (1,874 lb)
Max baggage: 300	10 kg (22 lb)
Max wing loading: 200, 200S	45.5 kg/m² (9.31 lb/sq ft)
300	45.3 kg/m² (9.28 lb/sq ft)
Max power loading: 200	14.26 kg/kW (23.42 lb/hp)
200S	11.56 kg/kW (19.00 lb/hp)
300	9.92 kg/kW (16.29 lb/hp)

PERFORMANCE, POWERED:

Never-exceed speed (VNE):	
200, 200S, 300	133 kt (245 km/h; 153 mph)
Max cruising speed: 200	110 kt (205 km/h; 127 mph)
200S	119 kt (220 km/h; 137 mph)
300	124 kt (230 km/h; 143 mph)
Normal cruising speed: 300	122 kt (225 km/h; 140 mph)
Stalling speed: 300	42 kt (78 km/h; 48 mph)
Max rate of climb at S/L: 200	156 m (512 ft)/min
200S	180 m (591 ft)/min
300	198 m (650 ft)/min
Service ceiling: 200, 200S	more than 4,900 m (16,076 ft)
300	more than 8,700 m (28,543 ft)
T-O run, hard runway: 200	226 m (745 ft)
200S	210 m (689 ft)
300	174 m (570 ft)
T-O to 15 m (50 ft), hard runway:	
200	305 m (1,001 ft)
300	296 m (970 ft)
Landing from 15 m (50 ft)	less than 300 m (984 ft)
Landing run	less than 150 m (492 ft)
Range with max fuel:	
200: best power	594 n miles (1,100 km; 683 miles)
best economy	756 n miles (1,400 km; 870 miles)

200S: best power ..... 575 n miles (1,065 km; 661 miles)
best economy ..... 783 n miles (1,450 km; 901 miles)
300: best power ..... 548 n miles (1,015 km; 630 miles)
best economy ..... 810 n miles (1,500 km; 932 miles)
Max endurance:
200: best power ..... 5 h 30 min
best economy ..... 12 h
200S: best power ..... 4 h 54 min
best economy ..... 12 h
300: best power ..... 4 h 30 min
best economy ..... 12 h
g limits: 200, 200S, 300 ..... +5.3/−2.65
PERFORMANCE, UNPOWERED:
Best glide ratio at 58 kt (108 km/h; 67 mph):
200, 200S 31:1
300 ..... 32:1
Min rate of sink at 52 kt (97 km/h; 60 mph):
200, 200S ..... 0.93 m (3.05 ft)/s
300 ..... 0.96 m (3.15 ft)/s
Stalling speed: 200, 200S, 300 ..... 42 kt (78 km/h; 48 mph)

AEROMOT AMT-600 GURI

English name: Little Boy

TYPE: Aerobatic two-seat lightplane.

PROGRAMME: Design began July 1998; prototype (PP-XBS), employing a Ximango airframe first flown 13 July 1999; Brazilian CTA certification was achieved 12 December 2001. First production aircraft (PR-AMT) registered in August 2003 and second (PR-LCB) in January 2004.

Negotiations under way in late 2004 for a retractable landing gear version to be built under licence by GIAC in China.

CURRENT VERSIONS: **AMT-600 Guri:** Initial production version, as described.

Data below are provisional, and refer to prototype.

Advanced Trainer: Projected derivative with 134 kW (180 hp) Textron Lycoming engine, retractable landing gear and IFR avionics.

CUSTOMERS: Brazilian DAC (civil aeronautics department) signed order for 25 on 21 September 2004, to be distributed to several aero clubs. First (PR-LCB) delivered to Aero Club do Rio Grande do Sul on 11 November 2003; two to club at Amarais, Campinas, 1 December 2005. Hand-over of 13th and 14th production aircraft, to Pará Aero Club, took place on 27 October 2006.

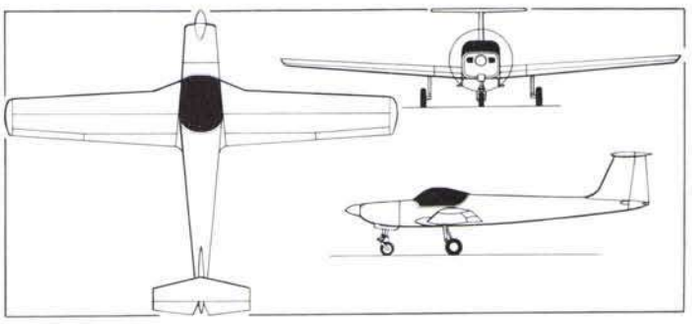
COSTS: BRL400,000 (2005).

DESIGN FEATURES: Generally as Ximango, but shortened wings (of same aerofoil section) and tricycle fixed landing gear. Wings can be removed for storage.

FLYING CONTROLS: Conventional and manual; ailerons and elevator operated by pushrods, rudder by cables; ground-adjustable trim tab on rudder and starboard aileron. Control surface maximum deflections: elevator +22/−25°, ailerons +27/−15°, rudder right, 28°, left 22°, flaps 15 and 30°.

STRUCTURE: Generally as for Ximango. Wing includes I-beam main spar, plus rear spar of Z shape to accommodate ailerons and flaps; two ribs in each panel, at centre-section break and tip, but three ribs per side at centre-section to strengthen walkways. Ailerons and flaps have leading- and trailing-edge spars, each with six glass fibre ribs stiffened with foam and aluminium skirt. Two fuselage bulkheads only: one horizontal, one vertical, for attachment of tail surfaces. Plywood for local strengthening in areas of equipment installations.

Aeromot AMT-600 Guri of Pará Aero Club *(ANAC)* 1040564



Aeromot AMT-600 Guri *(James Goulding)* 1042471

LANDING GEAR: Non-retractable tricycle type, with hydropneumatic trailing-link suspension on main units and rubber-in-compression suspension on nose leg. Oldi wheels and brakes. Mainwheel tyre size 6.00×6, nosewheel 5.00×5.

POWER PLANT: One 86.5 kW (116 hp) Textron Lycoming O-235-NBR (Aeromot-assembled O-235-NC2) flat-four, driving a two-blade Sensenich 72CK-0–50 aluminium propeller. Fuel contained in two wing tanks, combined capacity 90 litres (23.8 US gallons; 19.8 Imp gallons), of which 88 litres (23.2 US gallons; 19.3 Imp gallons) usable, with filler port in upper surface of each wing. Oil capacity 5.7 litres (1.5 US gallons; 1.25 Imp gallons).

ACCOMMODATION: Two persons, side by side, under single-piece, upward- and rearward-levered canopy. Dual controls standard. Boarding step on each side forward of wing on prototype will be relocated aft of wing on production aircraft.

AVIONICS: VFR avionics, including Garmin GPS 100; IFR avionics optional.

Instrumentation: ASI altimeter, VSI, turn/slip indicator, magnetic compass, tachometer, oil temperature gauge, oil pressure gauge, fuel pressure gauge, fuel quantity gauge and ammeter, all standard.

EQUIPMENT: Fire extinguisher standard.

DIMENSIONS, EXTERNAL:
Wing span ..... 10.50 m (34 ft 5½ in)
Wing aspect ratio 8.0
Aileron span ..... 2.00 m (6 ft 6¾ in)
Flap span ..... 2.50 m (8 ft 2½ in)
Length overall ..... 8.07 m (26 ft 5¾ in)
Height overall ..... 2.65 m (8 ft 8¼ in)
Tailplane span ..... 2.60 m (8 ft 6¼ in)
Wheel track ..... 2.99 m (9 ft 9¾ in)
Wheelbase ..... 1.75 m (5 ft 9 in)
Propeller diameter ..... 1.83 m (6 ft 0 in)
DIMENSIONS, INTERNAL:
Cabin max width ..... 0.86 m (2 ft 10 in)
AREAS:
Wings, gross ..... 13.79 m² (148.4 sq ft)
Ailerons (total) ..... 0.90 m² (9.69 sq ft)
Flaps (total) ..... 1.40 m² (15.07 sq ft)
Rudder ..... 0.63 m² (6.78 sq ft)
Tailplane ..... 1.41 m² (15.18 sq ft)
Elevator ..... 0.76 m² (8.18 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 675 kg (1,488 lb)
Max T-O weight ..... 900 kg (1,984 lb)
Max baggage weight ..... 10 kg (22 lb)
Max wing loading ..... 65.3 kg/m² (13.37 lb/sq ft)
Max power loading ..... 10.49 kg/kW (17.23 lb/hp)
PERFORMANCE:
Never-exceed speed (VNE) ..... 122 kt (226 km/h; 140 mph)
Cruising speed ..... 85 kt (157 km/h; 97 mph)
Stalling speed ..... 49 kt (90 km/h; 56 mph)
Max rate of climb at S/L ..... 216 m (709 ft)/min
Service ceiling ..... 5,300 m (17,380 ft)
T-O run ..... 130 m (427 ft)
Max range ..... 783 n miles (1,450 km; 901 miles)
Endurance ..... 6 h 0 min
g limits ..... +3.8/−1.52

AIRMAX

AIRMAX CONSTRUCOES AERONAUTICS LTDA

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Tel: (+55 21) 24 40 95 31
e-mail: falecom@airmax.com.br
Web: www.airmax.com.br
TECHNICAL DIRECTOR: Miguel Rosário

Designed by Sen Rosário, who has previously specialised in ultralight landplanes, the SeaMax amphibian is now being marketed in Europe by Pelicano of Portugal (www.pelicano.com.pt) and other dealers, including one in Norway.

AIRMAX M22 SEAMAX

TYPE: Two-seat amphibian kitbuilt.

PROGRAMME: Developed and flown in Brazil; prototype XM22 (PU-ASN) built 2002; European demonstrator registered (CS-UMZ) March 2004.

CUSTOMERS: Total 28 aircraft registered by mid-2006 to customers in Brazil, Portugal and Sweden.

DESIGN FEATURES: Single-step flying-boat hull with longitudinal strake inboard of chine, each side. Pusher propeller. High wing, braced by single, streamlined strut each side, with tapered outer panels. Stabilising float mounted on cantilever strut immediately inboard of wingtip. Cruciform empennage with sweptback fin. Tailplane fences, upper and lower, on early aircraft. Vortex generators fore and aft of mainwheel bays.

FLYING CONTROLS: Manual. Mass-balanced Frise ailerons and rudder; all-moving tailplane with two anti-balance tabs occupying full trailing-edge. Slotted flaps. Water rudder, stowed horizontally in base of rudder, rotates 90° when activated.

AirMax SeaMax two-seat amphibian *(Paul Jackson)* 1037943

STRUCTURE: Composites fuselage (glass fibre, carbon fibre/Kevlar) with aluminium and glass fibre wing (including Kevlar-reinforced fuel tanks) covered in polyester/Butyrate. Lighter, all-composites wing in process of design. Engine mounted on metal cabane with composites cowl.

LANDING GEAR: Tricycle type; retractable. Electromechanical actuation. Mainwheels 12×5.00-5, with hydraulic brakes. Stainless steel mainwheel legs, with oleo shock-absorbers, retract upwards and inwards. Freely-castoring nosewheel, size 11×3.50-4, with oleo shock-absorber, retracts forward.

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS flat-four driving a Warp Drive three-blade, ground-adjustable pitch, pusher propeller. Optional variable-pitch, reversible propeller. Optional 59.6 kW (79.9 hp) Rotax 912 UL. Fuel in two wing tanks and central collector tank, total capacity 96 litres (25.4 US gallons; 21.1 Imp gallons).

ACCOMMODATION: Two persons, side by side. Lead ballast required for single-pilot operation.
DIMENSIONS, EXTERNAL:
Wing span ..... 8.75 m (28 ft 8½ in)
Wing aspect ratio 6.3
Length overall ..... 5.68 m (18 ft 7½ in)
DIMENSIONS, INTERNAL:
Cabin max width ..... 1.19 m (3 ft 10¾ in)
AREAS:
Wings, gross ..... 12.24 m² (131.8 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 300 kg (661 lb)
Max T-O weight ..... 520 kg (1,146 lb)

PERFORMANCE:
Never-exceed speed (VNE) ..... 139 kt (257 km/h; 160 mph)
Max level speed ..... 113 kt (209 km/h; 130 mph)
Normal cruising speed ..... 104 kt (193 km/h; 120 mph)
Stalling speed, flaps down ..... 32 kt (58 km/h; 36 mph)
Max rate of climb at S/L ..... 305 m (1,000 ft)/min
T-O run: land ..... 85 m (280 ft)
water ..... 100 m (330 ft)
Landing run: land ..... 80 m (265 ft)
water ..... 100 m (330 ft)
Endurance ..... 5 h 15 min
g limits ..... +5/–3

EDRA AERONÁUTICA

EDRA AERONÁUTICA, PEÇAS E MANUTENÇAO LTDA

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Following cessation of manufacture by the Billie company in France, the Pétrel amphibian is being produced in Brazil for local and export markets. Marketing outside South America is undertaken by Amphibian Airplanes of Canada, which built the first North American SeaStar in 1998. Components are imported and augmented by North American standard items before sale as kits. Exports have been made as far afield as Australia, Portugal and Norway.

The Pétrel production line and design rights were sold in 2001 to Prolazer Ultraleves which, in a joint venture with EDRA, implemented a programme of aerodynamic, structural and powerplant improvements resulting in the Super Pétrel.

EDRA Aeronáutica, formed in 1986, is one of three components of the EDRA group, founded in 1974 as EDRA do Brasil and with interests in pilot training, aircraft maintenance, air taxi services and aircraft dealership (Schweizer helicopters, Pulsar and Comco Ikarus kits for Brazil). The group had 600 employees at the end of 2005, of whom 40 were employed by EDRA Aeronáutica.

EDRA AERONÁUTICA PÁTURI

English name: Masked Duck
Export marketing name: SeaStar
Canadian name: Sao Paolo Seabird

TYPE: Two-seat amphibian/kitbuilt.

PROGRAMME: Derived from Claude Tisserand's Hydroplum II, prototype of which first flew 1 November 1986; SMAN bought design rights in 1987; construction of Pétrel prototype began January 1989; first flight July 1989. Around 100 built in France; rights passed to Billie Aero Marine. Pétrel production transferred to Brazil by 1997, where renamed Páturi; manufacturing and design rights sold to Prolazer Ultraleves in 2001.

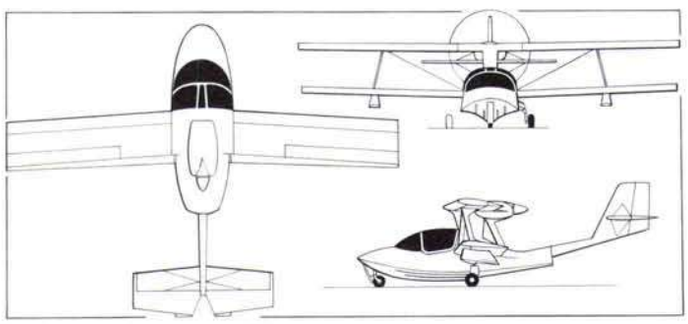
CURRENT VERSIONS: **Páturi:** Initial version, produced from 1997 onwards. *Data refer to this version unless otherwise stated.*

Super Pétrel: Introduced in 2002 as joint venture between EDRA Aeronáutica and Prolazer Ultraleves; redesigned version of Páturi, with lowered engine position, revised wheels and brakes and improved control surfaces.

SeaStar SP: North American version marketed by Amphibian Airplanes of Canada.

CUSTOMERS: Total of more than 190 produced by EDRA by late 2005; in addition, over 100 kits sold by December 2003. Customers in Europe, Africa, Canada, Australia, New Zealand, USA and Brazil.

EDRA Aeronautica Super Pétrel 1158438



Páturi amphibious two-seat lightplane *(James Goulding)* 0100404

COSTS: Super Pétrel kit USD26,980; SeaStar SP kit USD29,975, or flyaway USD58,000 (2006).

DESIGN FEATURES: Experimental category pusher-engined biplane; road-towable on custom-designed trailer with assembly/disassembly time of 30 minutes. Quoted kit build time 500 hours (fast-build kit).

Equal-span, constant-chord wings, upper unit mounted on cabane; V-type interplane struts, with diagonal strut brace to fuselage from upper plane. Single-step hull. Boom-mounted empennage, wire-braced. Floats at mid-span of lower plane. Shorter lower span with floats at tips.

Wing section NACA 2412; dihedral 2° 13' on upper wings, 3° 26' on lower; sweepback 4° upper, 2° lower.

FLYING CONTROLS: Conventional and manual. Ailerons on upper wing only. No flaps. Actuation by wires (rudder) and pushrods. Electric trim.

STRUCTURE: Moulded monocoque single-step hull of epoxy/carbon fibre foam with carbon fibre tailboom; wings have 2014-T6 aluminium alloy tubular main spar with PVC foam ribs and glass fibre/epoxy leading-edge and tips covered with fabric and braced by single diagonal strut and V interplane struts of 6061-T6 aluminium. Wings disassemble for ground transportation. Tail surfaces of glass fibre spars and PVC foam ribs, with fabric and glass fibre covering, stainless steel wire braced.

LANDING GEAR: Retractable tricycle type; based on Mooney design, with Johnson bar actuation; main units retract upwards into hull and undersurface of lower wing; nosewheel retracts upwards and forwards, tyre remaining partially exposed to serve as docking bumper when operating on water. Nosewheel maximum steering angle 80°. Hydraulic disc brakes on main units. No water rudders.

POWER PLANT: *Páturi:* One 73.5 kW (98.6 hp) Rotax 912 ULS four-stroke piston engine driving an Airplast 175 three-blade pusher propeller. Optional Airplast PV 50 in-flight adjustable pitch propeller with electric or manual control. Fuel capacity 100 litres (26.4 US gallons; 22.0 Imp gallons).

Super Pétrel: Choice of one 47.8 kW (64.1 hp) Rotax 582 or 73.5 kW (98.6 hp) Rotax 912 ULS driving Airplast 175 three-blade pusher propeller. Fuel capacity 90 litres (23.8 US gallons; 19.8 Imp gallons).

ACCOMMODATION: Two, side by side in open or enclosed cockpit, with windscreen or single-piece forward-hinged canopy. Dual controls.

EQUIPMENT: Optional BRS ballistic parachute. Bilge pump.

DIMENSIONS, EXTERNAL:
Wing span (both): Páturi ..... 8.25 m (27 ft 8 in)
Super Pétrel ..... 8.90 m (29 ft 2½ in)
Length overall: Páturi ..... 6.47 m (21 ft 2¾ in)
Super Pétrel ..... 5.97 m (19 ft 7 in)
Height overall: both ..... 2.26 m (7 ft 5 in)
Wheel track: Páturi ..... 1.78 m (5 ft 10 in)
Wheelbase: Páturi ..... 2.10 m (6 ft 10¾ in)
Propeller diameter: both ..... 1.65 m (5 ft 5 in)
DIMENSIONS, INTERNAL:
Cabin max width: both ..... 1.13 m (3 ft 8½ in)
AREAS:
Wings, gross: Páturi ..... 16.50 m² (177.6 sq ft)
Super Pétrel ..... 15.00 m² (161.46 sq ft)
WEIGHTS AND LOADINGS (Rotax 912 engine):
Weight empty: Páturi ..... 350 kg (772 lb)
Super Pétrel ..... 315 kg (694 lb)
Max T-O weight: Páturi ..... 650 kg (1,433 lb)
Super Pétrel, Rotax 912 ..... 545 kg (1,201 lb)
Max wing loading: Páturi ..... 39.4 kg/m² (8.07 lb/sq ft)
Super Pétrel ..... 36.33 kg/m² (7.44 lb/sq ft)
Max power loading: Páturi ..... 8.84 kg/kW (14.53 lb/hp)
Super Pétrel ..... 7.41 kg/kW (12.18 lb/hp)
PERFORMANCE (both with Rotax 912 ULS):
Never-exceed speed (VNE): both ..... 98 kt (180 km/h; 112 mph)
Max level speed: both ..... 92 kt (170 km/h; 106 mph)
Max cruising speed: Páturi ..... 86 kt (160 km/h; 99 mph)
Super Pétrel ..... 84 kt (155 km/h; 96 mph)
Manoeuvring speed: Páturi ..... 81 kt (150 km/h; 92 mph)
Stalling speed: Páturi ..... 35 kt (65 km/h; 41 mph)
Super Pétrel ..... 31 kt (56 km/h; 35 mph)

Max rate of climb at S/L: Páturi	152 m (500 ft)/min
Super Pétrel	305 m (1,000 ft)/min
Service ceiling: Páturi	3,660 m (12,000 ft)
Super Pétrel	3,048 m (10,000 ft)
T-O run: on land: Páturi	200 m (660 ft)
Super Pétrel	80 m (265 ft)
on water: Páturi	250 m (820 ft)
Super Pétrel	120 m (395 ft)
Landing run: on land: Páturi	250 m (820 ft)
Super Pétrel	120 m (395 ft)
on water: Páturi	150 m (495 ft)
Super Pétrel	100 m (330 ft)
Range with max fuel: Páturi	513 n miles (950 km; 590 miles)
Radius of action, auxiliary fuel	405 n miles (750 km; 466 miles)
Endurance: both	5 h 30 min
g limits: both	+4/−2

EMBRAER

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Created 19 August 1969, Embraer began operating on 2 January 1970. Its 250,000 m² (2,691,000 sq ft) factory at Faria Lima was officially joined on 15 January 2001 by the Eugênio de Mello plant, comprising 147,650 m² (1,589,300 sq ft) of covered space. Both facilities are near São José dos Campos. Fifth company plant, at Gavião Peixoto (300 km; 186 miles northwest of São Paulo) opened 11 June 2002; to expand over five years to 3,000,000 m² (32 million sq ft) and undertake final assembly of Legacy, Super Tucano, AMX-T and special missions versions of EMB-145.

Neiva (which see) became a subsidiary in March 1980. Embraer and subsidiaries have delivered nearly 5,500 aircraft.

Privatisation of Embraer was undertaken on 7 December 1994 with the auction of 55.4 per cent of voting stock. A consortium, led by Bozano Simonsen bank, acquired 45.44 per cent of auctioned stock, assumed a controlling interest in the company, and provided an extra USD36 million in capitalisation. A further 10 per cent of voting stock was offered to the public within 60 days, with Embraer employees and the Brazilian government retaining 10 and 18.4 per cent respectively. In October 1999 a consortium of French aerospace companies, comprising Aerospatiale Matra (now EADS France), Dassault, SNECMA and Thomson-CSF (now Thales), acquired 20 per cent of Embraer's voting shares. Embraer also embarked on a joint venture with Liebherr International of Germany to establish Embraer-Liebherr Equipamentos do Brasil SA (ELEB) to create additional opportunities for the company's landing gear and hydraulics components business. Embraer's controlling group — with 60 per cent of voting shares — comprises pension funds Previ and Sistel, plus investment house Companhia Bozano Simonsen.

Principal current own-design manufacturing programmes are ERJ-135/ERJ-140/ERJ-145 and ERJ-170/175/190/195 regional jet families, EMB-EMB-314 Super Tucano turboprop military trainer and Phenom 100 and Phenom 300 business jets. Subsidiary Neiva manufactures EMB-202 Ipanema agricultural aircraft and holds licences from New Piper in USA. Main production of International (with Italy) AMX attack fighter is complete, but Embraer holds outstanding contract for Venezuelan order.

In subcontract field, first deliveries made in 1994 of wingtips and vertical fin fairings for Boeing 777 under 1991 contract.

Embraer is a risk-sharing partner in the Sikorsky S-92 Helibus programme; under a June 1995 contract valued at US$170 million, it will supply 730 sets of S-92 fuel sponsons. In 1995 Embraer signed a co-operation agreement with PZL Warszawa-Okecie of Poland under which Embraer subsidiary Neiva SA would market PZL light aircraft in Brazil and PZL subsidiary Skypol would acquire Brasilias for its freight and charter services. This appears to have lapsed.

On 3 April 2002 Embraer, Dassault Aviation, SNECMA Moteurs and Thales Airborne Systems formed the Mirage 2000BR Consortium to develop a version of the Dassault Mirage 2000-5 Mk 2 as a contender for the Brazilian Air Force's F-X BR programme. If selected, FAB Mirage 2000BRs would be assembled at a new Embraer facility at Gavião Peixoto.

On 2 December 2002 Embraer signed an agreement with Harbin Aircraft Industry (Group) Co Ltd and Hafei Aviation Industry Co Ltd to form a new joint venture company, Harbin Embraer Aircraft Company Ltd, which will produce under licence the ERJ-135, ERJ-140 and ERJ-145, primarily for customers in the People's Republic of China. Launch customer China Southern Airlines ordered six ERJ-145s on 2 February 2004. A 24,000 m² (258,330 sq ft) facility has been established in Harbin, Heilongjiang Province, employing up to 220 staff. The first Harbin Embraer-built aircraft, an ERJ-145, was rolled out and made its first flight on 16 December 2003.

Embraer delivered 101 aircraft in 2003, comprising 14 ERJ-135s, 16 ERJ-140s, 57 ERJ-145s, 13 Legacys, and one EMB-145. Totals for 2004 were one ERJ-135, 87 ERJ-145s, 46 Embraer 170s, 13 Legacys and one EMB-145, or 148 in all. Totals for 2005 were two ERJ-135s, 46 ERJ-145s, 46 Embraer 170s, 14 Embraer 175s, 12 Embraer 190s, 20 Legacys and one EMB-145, or 141 in all. Total of 130 aircraft delivered in 2006, comprising 12 ERJ-145s, 36 Embraer 170s, 11 Embraer 175s, 41 Embraer 190s, three Embraer 195, 26 Legacy 600s, and one Legacy Shuttle. Planned target for 2007 is 165 to 170. Firm order backlog valued at USD14.8 billion at 31 December 2006 for airline, corporate, defence and government markets.

EMBRAER EMB-314 SUPER TUCANO

English name: Super Toucan
Brazilian Air Force designations: A-29A and AT-29B
TYPE: Basic turboprop trainer/attack lightplane.
PROGRAMME:

DEVELOPMENT MILESTONES

Development (as EMB-312H)	Jan 91
Announced	Jun 91
First flight	15 May 93
Certification	Aug 94
Selected by Brazilian Air Force	8 Aug 2001
Production started	Feb 2002
First delivery	18 Dec 2003

Design of original EMB-312 Tucano started January 1978. Ministry of Aeronautics contract received 6 December that year for two flying prototypes and two static/fatigue test airframes: first prototype (Brazilian Air Force serial number 1300) made first flight 16 August 1980, second (1301) on 10 December 1980; third to fly (PP-ZDK, on 16 August 1982) was to production standard. Total of 650 built by 1998; further details in 2000–01 and previous *Jane's* and in *Jane's Aircraft Upgrades*.

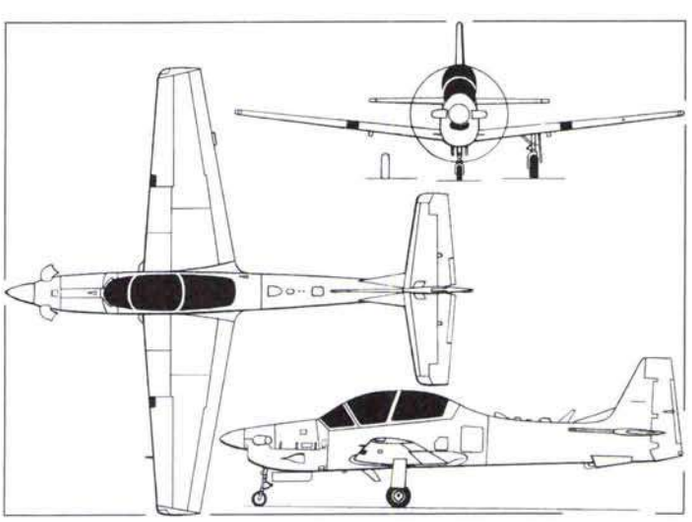
Development of EMB-314 began January 1991; announced (as EMB-312H) at Paris Air Show June 1991; Embraer development aircraft PT-ZTW (c/n 312161, previously used as prototype for TPE331-powered Tucano adopted by Royal Air Force) modified as Tucano H proof-of-concept (POC) prototype, making first flight in this form 9 September 1991. This aircraft toured US Air Force/Navy bases August and September 1992 as preliminary to Super Tucano entry in JPATS competition; Embraer teamed with Northrop May 1992 to bid Super Tucano for JPATS, but was unsuccessful. Provisional Brazilian type certification granted August 1994 after 500 hour, 396 sortie test and certification programme.

CURRENT VERSIONS: **EMB-314:** Two EMB-312H prototypes (PT[later PP]-ZTV, c/n 312454, first flight 15 May 1993, and PP-ZTF, c/n 312455, first flight 14 October 1993) tailored to US JPATS requirements as EMB-312HJ. Designation subsequently changed to EMB-314 to reflect extensive modifications to structure and systems.

ALX (EMB-314M): Brazilian Air Force (FAB) version, for border patrol missions under its SIVAM (*SIstema de Vigilancia da AMazonia*) programme. FAB finalised specification in early 1994; trials to validate projected flight characteristics, using POC aircraft and both Super Tucano prototypes, completed 1994. US$50 million development contract signed 18 August 1995 for two prototypes (one single-seat) to be modified from Super Tucano prototypes. The first flew in May 1996 and is being used for external stores compatibility and handling qualities testing; the second, which flew in early 1997, for testing the advanced weapons systems. Total 650 hours accumulated by early 2002, with up to 300 more required for completion.

FAB commitment to purchase 99 ALXs, of which 50 will be two-seat, **AT-29Bs** and 49 will be single-seat **A-29As**. Both versions operated by four squadrons: 2°/5° Grupo of Training Command at Natal AFB, 1°/3° Grupo at Boa Vista, 2°/3° Grupo at Porto Velho; and, from 12 May 2006, 3°/3° Grupo at Campo Grande; Prototype 5700 (the former EMB-314 PP-ZTV), designated **YA-29**, rolled out 28 May 1999; IOC originally intended in

Colombian Air Force Embraer Super Tucano delivered in December 2006
1040392



A-29B advanced trainer version of Embraer Super Tucano (*James Goulding*)
1158942

Brazilian Air Force Super Tucano (two-seat A-29B) in all-black colour scheme demonstrating in Singapore during 2006 ***(Paul Jackson)*** 1040372

May 2001 but FAB formal order only placed (76 firm, plus 23 options) on 8 August 2001; production started February 2002; deliveries began 18 December 2003; total of at least seven A-29As and 32 A-29Bs in service by late 2006. Elbit selected December 1996 to supply mission avionics, including ventral FLIR Systems AN-AAQ-22 turret, GPS/INS, radalt, Mode S transponder, DME, ILS, ADF, VOR, RWR, MAWS and chaff/flare dispenser. Export variants of both versions will be offered for border patrol/COIN missions and for basic/advanced pilot training. Can be flown as single-seat attack aircraft with fuel tank in rear cockpit.

CUSTOMERS: Following Brazil's commitment to 99 ALXs, Dominican Republic announced an order for 10 on 20 August 2001, but later abandoned procurement. Colombia finalized a contract for 25 Super Tucanos on 7 December 2005; delivery of first five was announced one year later, on 7 December 2006; to be followed by batches of 10 in 2007 and 2008. Unsuccessfully demonstrated to Singapore in 2006.

COSTS: Colombian programme cost of USD235 million includes simulator and some instructor training in Brazil.

DESIGN FEATURES: Meets requirements of FAR Pt 23 Appendix A, and MIL and CAA Section K specifications. Low-mounted wings, stepped cockpits in tandem, fully aerobatic. Small fillet forward of tailplane root each side.

EMB-314 differs from EMB-312 mainly in having more powerful engine, reprofiled wing and plugs of 0.37 m (1 ft 2½ in) forward and 1.00 m (3 ft 3¼ in) aft of cockpit to accommodate longer engine and retain CG and stability. Other changes include strengthened airframe for higher *g* loads and longer fatigue life, potentially 18,000 hours for typical training missions, or 12,000 hours in operational environments, depending on mission loads and utilisation; ventral strakes; five weapons hardpoints; NVG-compatible 'glass cockpit' with HOTAS controls. Able to cover whole primary and half of advanced pilot training syllabus, and fly precision weapons delivery and target towing missions.

Wing section NACA 63–415 at root; NACA 63A-212 at tip.

FLYING CONTROLS: Conventional and manual. Primary surfaces internally balanced; electrically actuated trim tab in, and small geared tab on, each Frise aileron; electromechanically actuated spring tab in rudder and port elevator. Electrically actuated single-slotted Fowler flaps on wing trailing-edges. Fixed incidence tailplane. Ventral airbrake.

STRUCTURE: Conventional all-metal construction from 2024 series aluminium alloys; continuous three-spar wing box forms integral fuel tankage. Steel flap tracks.

LANDING GEAR: Hydraulically retractable tricycle type, with single wheel and Piper oleo-pneumatic shock-absorber on each unit. Accumulator for emergency extension in the event of hydraulic system failure. Hydraulic steering for nose unit. Rearward-retracting steerable nose unit; main units retract inward into wings. Parker Hannifin 40–130 mainwheels, Oldi-DI-1.555-02-OL nosewheel. Tyre sizes 6.50–10 (8 ply) tubeless on mainwheels, 5.00–5 (6 ply) tubeless on nosewheel. Tyre pressures (±0.21 bar; 3 lb/ sq in in each case) are 5.17 bar (75 lb/sq in) on mainwheels, 4.48 bar (65 lb/sq in) on nosewheel. Parker Hannifin 30–95A hydraulic mainwheel brakes.

POWER PLANT: *ALX:* One 1,193 kW (1,600 shp) Pratt & Whitney Canada PT6A-68-3 turboprop, with FADEC, driving a Hartzell five-blade, constant-speed, fully feathering, reversible-pitch propeller.

EMB-314: One 969 kW (1,300 shp) PT6A-68A.

Single-lever combined control for engine throttling and propeller pitch adjustment. Two integral fuel tanks in each wing, total capacity 694 litres (183.3 US gallons; 152.7 Imp gallons). Fuel tanks lined with anti-detonation plastics foam. Optional self-sealing 303 litre (80.0 US gallon; 66.6 Imp gallon) tank in rear cockpit. Single-point pressure refuelling. Fuel system allows nominally for up to 30 seconds of inverted flight. Provision for three ferry fuel tanks (centreline and inboard wing pylons), each total capacity 330 litres (87.1 US gallons; 72.6 Imp gallons).

ACCOMMODATION: Two in tandem, on Martin-Baker Mk 10 LCX zero-zero ejection seats, in air conditioned and pressurised cockpit. One-piece fully transparent vacuum-formed canopy, opening sideways to starboard, with internal and external jettison provisions. Rear seat elevated 25 cm (9.9 in). Dual controls standard. Baggage compartment in rear fuselage, with access via door on port side.

SYSTEMS: Two-axis autopilot with embedded mission planning capability. Freon air cycle conditioning system, with engine-driven compressor. Single hydraulic system, consisting basically of (a) control unit, including reservoir with usable capacity of 1.9 litres (0.5 US gallon; 0.42 Imp gallon); (b) an engine-driven pump with nominal pressure of 131 bar (1,900 lb/sq in) and nominal flow rate of 4.6 litres (1.22 US gallons; 1.01 Imp gallons)/min at 3,800 rpm; (c) landing gear and gear door actuators; (d) filter; (e) shutoff valve; and (f) hydraulic fluid to MIL-H-5606. Under normal operation, hydraulic system actuates landing gear extension/retraction and control of gear doors. Landing gear extension can be performed under emergency operation; emergency retraction also possible during landing and T-O with engine running. Reservoir and system are suitable for aerobatics. No pneumatic system. 28 V DC electrical power provided by a 6 kW starter/generator, 26 Ah battery and, for 115 V and 26 V AC power at 400 Hz, a 250 VA inverter. Onboard oxygen generation system. Canopy and propeller de-icing. Integrated Data Acquisition Recorder (IDAR) includes VCR and FDR functions.

AVIONICS: *Comms:* Standard Rockwell Collins equipment. Integrated nav/com. Tactical VHF/UHF with datalink provisions; transponder.

Flight: Laser INS/dual GPS; twin VOR; ILS; DME; ADF; autopilot.

Instrumentation: Two 152 × 203 mm (6 × 8 in) CMFDs in each cockpit; HUD with up-front control panel in front cockpit. NVG Gen III compatible internal/external lighting. Optional HMD.

Mission: Provision for datalink; video camera and recorder. Embedded mission planning capability. Virtual radar/armament training systems. FLIR. Chaff/flare dispensers; MAWS and RWR.

EQUIPMENT: Landing light in each wing leading-edge; taxying lights on nosewheel unit. Optional Kevlar cockpit armour.

ARMAMENT: One 12.7 mm machine gun and 200 rounds mounted in each wing. Provision for a variety of ordnance including two Giat NC621 20 mm cannon pods, Mk 81/82 bombs, MAA-1 Piranha AAMs, BLG-252 cluster bombs, SBAT-70/19 or LAU-68A/G rocket pods or MLBs on underwing stations.

DIMENSIONS, EXTERNAL:

Wing span	11.14 m (36 ft 6½ in)
Wing chord: at root	2.30 m (7 ft 6½ in)
at tip	1.07 m (3 ft 6⅛ in)
Wing aspect ratio	6.4
Length overall	11.42 m (37 ft 5¾ in)
Fuselage: Length (excl rudder)	10.53 m (34 ft 6½ in)
Max depth	1.86 m (6 ft 1¼ in)
Height overall (static)	3.90 m (12 ft 9½ in)
Tailplane span	4.66 m (15 ft 3½ in)
Wheel track	3.76 m (12 ft 4 in)
Wheelbase	3.36 m (11 ft 0¼ in)
Propeller ground clearance (static)	0.345 m (1 ft 1½ in)
Baggage compartment door:	
Height	0.60 m (1 ft 11½ in)
Width	0.54 m (1 ft 9¼ in)
Height to sill	1.25 m (4 ft 1¼ in)

DIMENSIONS, INTERNAL:

Cockpits: Combined length	2.90 m (9 ft 6⅛ in)
Max height	1.55 m (5 ft 1 in)
Max width	0.85 m (2 ft 9½ in)
Baggage compartment volume	0.17 m³ (6.0 cu ft)

AREAS:

Wings, gross	19.40 m² (208.8 sq ft)
Ailerons (total)	1.97 m² (21.20 sq ft)
Trailing-edge flaps (total)	2.58 m² (27.77 sq ft)
Fin, incl dorsal fin	2.29 m² (24.65 sq ft)
Rudder, incl tab	1.38 m² (14.85 sq ft)
Tailplane, incl fillets	4.77 m² (51.34 sq ft)
Elevators, incl tab	2.00 m² (21.53 sq ft)

WEIGHTS AND LOADINGS (EMB-314, except where indicated):

Basic weight empty	2,420 kg (5,335 lb)
Max external load	1,500 kg (3,307 lb)
Max internal fuel load (usable)	538 kg (1,186 lb)
Max T-O weight: EMB-314, clean	3,190 kg (7,033 lb)
ALX	3,600 kg (7,936 lb)
Max ramp weight	3,210 kg (7,077 lb)
Max zero-fuel weight: EMB-314	2,670 kg (5,886 lb)
ALX	3,150 kg (6,945 lb)
Max wing loading	164.4 kg/m² (33.68 lb/sq ft)
Max power loading	3.29 kg/kW (5.41 lb/shp)

PERFORMANCE (EMB-314, at max clean T-O weight except where indicated):

Max level speed: EMB-314 at FL200	301 kt (557 km/h; 346 mph)
ALX with external stores	245 kt (454 km/h; 282 mph)
Max cruising speed at FL200	286 kt (530 km/h; 329 mph)
Econ cruising speed at FL200	228 kt (422 km/h; 262 mph)
Stalling speed, power off:	
flaps and landing gear up	85 kt (157 km/h; 98 mph) EAS
flaps and landing gear down	78 kt (145 km/h; 90 mph) EAS
Max rate of climb at S/L	895 m (2,925 ft)/min
Service ceiling	10,670 m (35,000 ft)
T-O run	350 m (1,150 ft)
T-O to 15 m (50 ft)	550 m (1,805 ft)
Landing from 15 m (50 ft)	860 m (2,820 ft)
Landing run	550 m (1,805 ft)
Range at FL300 with max fuel, 30 min reserves	847 n miles (1,568 km; 974 miles)
Ferry range at FL250 with underwing tanks and 30 min reserves	1,495 n miles (2,768 km; 1,720 miles)
Endurance on internal fuel at econ cruising speed at FL250, 30 min reserves	6 h 30 min
g limits: fully Aerobatic category at 2,770 kg (6,107 lb)	+7/–3.5
at 2,770 kg (6,107 lb) with external stores	+4/–2.2

EMBRAER ERJ-135

TYPE: Regional jet airliner.

PROGRAMME:

DEVELOPMENT MILESTONES

Programme launched	16 Sep 97
Rolled out	12 May 98
First flight	4 Jul 98
Certification	Jun 99
First delivery	23 Jul 99

Launched 16 September 1997; two pre-series ERJ-145s (001/PT-ZJA and 002/PT-ZJC) modified to create two prototype ERJ-135s; roll-out (PT-ZJA) 12 May 1998, followed by first flight 4 July 1998; public debut at Farnborough Air Show September 1998; second aircraft (PT-ZJC), flown 24 September 1998, for systems testing before conversion to production standard in March 1999. Brazilian Centro Técnico Aerospacial (CTA) certification achieved in June 1999; FAA certification (as EMB-135ER and LR) 15 July 1999. First delivery 23 July 1999 to Continental Express; other early aircraft to American Eagle. CTA and JAA approval granted 10 August 2003 for steep approach (5.5° glideslope) operations at London-City Airport.

CURRENT VERSIONS: **ERJ-135:** Regional airliner, *as described*. Available from the outset in 135ER and 135LR versions.

EMB-135BJ Legacy 600: Corporate version; *described separately*.

CUSTOMERS: Total of 108 firm commercial orders by 31 December 2006. See table. Additionally, one VIP-configured ERJ-135LR handed over to Greek Air Force on 7 January 2000 and two, also in VIP configuration, to the Belgian Air Force on 4 June and in August 2001, for operation by No. 21 Squadron at Melsbroek with two similarly configured ERJ-145s. Deliveries have been 16 in 1999, 45 in 2000, 27 in 2001, three in 2002, 14 in 2003, one in 2004, two in 2005, none in 2006.

Programme based on estimates of 500 sales.

COSTS: Development cost USD100 million, of which 40 per cent provided by risk-sharing partners. Unit cost USD11.8 million.

DESIGN FEATURES: Shares 96 per cent commonality with ERJ-145 including engines, wings, tail surfaces, flight deck and main systems; fuselage shortened by 3.53 m (11 ft 7 in) by removal of two frames (4.84 m; 15 ft 10½ in ahead of wing and 3.07 m; 10 ft 0¾ in at rear) and substitution of two shorter frames (2.85 m; 9 ft 4¾ in and 1.53 m; 5 ft 0¼ in, respectively).

FLYING CONTROLS: As for ERJ-145.

STRUCTURE: As for ERJ-145.

LANDING GEAR: As for ERJ-145.

POWER PLANT: Two 33.7 kN (7,580 lb st) Rolls-Royce AE 3007A3 or AE 3007A1/3 turbofans. Fuel as ERJ-145ER and ERJ-145LR, respectively.

ACCOMMODATION: Standard accommodation for 37 passengers in three-abreast configuration.

SYSTEMS: As for ERJ-145.

DIMENSIONS, EXTERNAL: As for ERJ-145 except:

Length: overall	26.33 m (86 ft 4½ in)
fuselage	24.39 m (80 ft 0¼ in)
Wheelbase	12.43 m (40 ft 9¼ in)

DIMENSIONS, INTERNAL:

Cabin (excl flight deck and baggage compartment, incl lavatory):

Length	12.95 m (42 ft 5¾ in)
Baggage compartment: Length	3.34 m (10 ft 11½ in)
Baggage volume:	
wardrobe and stowage compartment	1.0 m³ (35 cu ft)
overhead bins	1.4 m³ (49 cu ft)
underseat	1.7 m³ (60 cu ft)
Galley volume	0.99 m³ (35 cu ft)

Embraer ERJ-135 of American Airlines *(Paul Jackson)* 1040375

WEIGHTS AND LOADINGS:

Operating weight empty:	
ERJ-135ER	11,390 kg (25,111 lb)
ERJ-135LR	11,490 kg (25,331 lb)
Max baggage weight	1,000 kg (2,205 lb)
Max payload: ERJ-135ER	4,270 kg (9,414 lb)
ERJ-135LR	4,510 kg (9,943 lb)
Max fuel weight: ERJ-135ER	4,173 kg (9,200 lb)
ERJ-135LR	5,187 kg (11,435 lb)
Max T-O weight: ERJ-135ER	19,000 kg (41,888 lb)
ERJ-135LR	20,000 kg (44,092 lb)
Max landing weight:	
ERJ-135ER, ERJ-135LR	18,500 kg (40,785 lb)
Max ramp weight: ERJ-135ER	19,100 kg (42,108 lb)
ERJ-135LR	20,100 kg (44,313 lb)
Max zero-fuel weight: ERJ-135ER	15,600 kg (34,392 lb)
ERJ-135LR	16,000 kg (35,274 lb)
Max wing loading:	
ERJ-135ER	371.2 kg/m² (76.04 lb/sq ft)
ERJ-135LR	390.8 kg/m² (80.04 lb/sq ft)
Max power loading:	
ERJ-135ER	282 kg/kN (2.76 lb/lb st)
ERJ-135LR	297 kg/kN (2.91 lb/lb st)

PERFORMANCE:

Max cruising speed	M0.78 (450 kt; 833 km/h; 518 mph)
Time to FL350	20 min
Max certified altitude	11,275 m (37,000 ft)
T-O field length at S/L	1,700 m (5,577 ft)
Landing field length, S/L, at typical landing weight	1,360 m (4,460 ft)
Range with 37 passengers, 100 n mile (185 km; 115 mile) diversion, 45 min reserves	1,700 n miles (3,148 km; 1,956 miles)

EMBRAER EMB-135BJ LEGACY 600

TYPE: Business jet.

PROGRAMME:

DEVELOPMENT MILESTONES

Announced	23 Jul 00
First flight	31 Mar 01
Certification	10 Dec 01

Announced on eve of Farnborough International Air Show 23 July 2000; first flight of prototype (PP-XJO), converted from second ERJ-135 prototype (PT-ZJC), 31 March 2001; Brazilian CTA certification achieved 10 December 2001, followed by JAA certification on 9 July, FAA approval on 23 August 2002, and Russian Interstate Aviation Committee approval on 18 November 2003. Indonesian certification granted 19 June 2006. Early aircraft limited to MTOW of 22,200 kg (48,942 lb); increased by 300 kg (661 lb) from c/n 145625).

Improvements introduced in 2003 included removal of windscreen wipers, redesign of fairings and air inlets, polishing of wing leading-edges and surface smoothing, resulting in 50 n mile (93 km; 58 mile) increase in maximum range in Executive configuration.

Renamed Legacy 600 at the NBAA Convention at Orlando, Florida 9 November 2005.

CURRENT VERSIONS: Offered in **Corporate, Shuttle** and **Shuttle HC** variants.

CUSTOMERS: Total of 76 delivered by 18 July 2006 to customers in 18 countries. Launch customer Swift Aviation of Phoenix, Arizona, ordered 25, with 25 options in July 2000; other announced customers include an unnamed major energy company based in Houston, Texas, which ordered one in corporate shuttle configuration in April 2001; the Greek Air Force, which ordered one in Executive configuration for delivery in December 2001; Skeikh Fahad Al Athel of Saudi Arabia, who took delivery of one on 16 December 2002; the Indian Government, which ordered five in Executive configuration on 19 September 2003, four of which will replace HAL/Avro 748s with the Indian Air Force's Air HQ Communications Squadron at Palam, and one operated by the Border Security force; and fractional ownership operator flight options, which signed an MoU on 27 October 2003 for up to four in Executive configuration. Recent customers include ABJ of the Czech Republic (one), Fransabank SAL of the Lebanon (one), Celtel International of Kuwait (one), the Government of India (three), and PT Ekspres Transportasi Antarbenua of Indonesia (one). Total of 27, including one Shuttle, delivered during 2006.

COSTS: Shuttle USD18.6 million to USD19.35 million; Executive USD24.7 million (all 2007).

Description for ERJ-135 applies also to the Legacy 600, except the following.

Indian Air Force Embraer Legacy 600 1040378

DESIGN FEATURES: Compared with ERJ-135 Legacy Executive has belly and aft fuel tanks in extended underwing fairing, plus winglets.

STRUCTURE: Airframe manufactured as ERJ-135 and modified to Legacy configuration; Embraer performs interior completion, using components supplied by Nordam or Duncan Aviation.

POWER PLANT: Legacy Executive initially had two 37.1 kN (8,338 lb st) Rolls-Royce AE 3007A1P turbofans; from c/n 145625, two AE 3007A1Es, each 39.7 kN (8,917 lb st). Legacy Shuttle has two 33.7 kN (7,580 lb st) AE 3007 A1/3s. Legacy Executive initially 10,152 litres (2,682 US gallons; 2,233 Imp gallons). Increased from c/n 145625 to 10,266 litre (2,712 US gallons; 2,258 Imp gallons) in two wing- and two forward fuselage tanks, usable capacity 10,160 litres (2,684 US gallons; 2,235 Imp gallons). Legacy Shuttle has 6,397 litres (1,690 US gallons; 1,407 Imp gallons) of usable fuel.

ACCOMMODATION: Typical accommodation for 13 passengers in Legacy 600 Executive configuration. Legacy 600 Shuttle can accommodate 16 to 19 in two-abreast arrangement, or 30 to 37 in three-abreast configuration. Baggage compartment and lavatory at rear of cabin. Cabin equipment includes full-size galley for hot and cold meals, aft lavatory, wardrobe and storage cabinet, and entertainment system with DVD players, Satcom, HSD and Wi-Fi internet connectivity.

SYSTEMS: Hamilton Sundstrand T-62T-40C14 APU.

AVIONICS: Honeywell Primus 1000 as core system.

DIMENSIONS, INTERNAL (A: 600 Executive, B: 600 Shuttle):

Cabin volume: B ..... 40 m³ (1,413 cu ft)
Baggage compartment volume: A ..... 6.80 m³ (240 cu ft)
B ..... 9.20 m³ (325 cu ft)

WEIGHTS AND LOADINGS:

Basic operating weight: A ..... 13,600 kg (29,983 lb)
B ..... 11,500 kg (25,353 lb)
Max baggage weight: A ..... 454 kg (1,001 lb)
B ..... 1,000 kg (2,205 lb)
Max payload: A ..... 2,400 kg (5,291 lb)
B ..... 4,500 kg (9,921 lb)
Max fuel weight: A ..... 8,242 kg (1,817 lb)
B ..... 5,135 kg (11,321 lb)
Payload with max fuel: A ..... 728 kg (1,605 lb)
B ..... 3,465 kg (7,639 lb)
Max ramp weight: A ..... 22,570 kg (49,758 lb)
B ..... 20,100 kg (44,313 lb)
Max T-O weight: A ..... 22,500 kg (49,604 lb)
B ..... 20,000 kg (44,092 lb)
Max landing weight: A, B ..... 18,500 kg (40,785 lb)
Max zero-fuel weight: A, B ..... 16,000 kg (35,274 lb)
Max wing loading: A ..... 439.6 kg/m² (90.04 lb/sq ft)
B ..... 390.8 kg/m² (88.04 lb/sq ft)
Max power loading: A ..... 283.5 kg/kN (2.78 lb/lb st)
LR ..... 296.7 kg/kN (2.91 lb/lb st)

PERFORMANCE:

Cruising speed: A at FL390
A ..... M 0.80 (459 kt; 850 km/h; 528 mph)
B at FL370 ..... M 0.78 (447 kt; 828 km/h; 514 mph)
Max certified altitude: A, B ..... 12,500 m (41,000 ft)
T-O field length ..... 1,692 m (5,551 ft)
Landing field length: A, B ..... 817 m (2,681 ft)
Range with NBAA IFR reserves:
A with 8 pax ..... 3,250 n miles (6,019 km; 3,740 miles)
B with 16 pax ..... 1,840 n miles (3,408 km; 2,117 miles)

EMBRAER ERJ-140

TYPE: Regional jet airliner.

PROGRAMME:

DEVELOPMENT MILESTONES

Programme launched	20 Sep 99
First flight	27 Jun 00
Certification	Jun 01
First delivery	Jul 01

Launched 30 September 1999 at the European Regional Airline Association annual meeting in Paris; first flight of prototype, modified from prototype ERJ-135 c/n 801/PT-ZJA, 27 June 2000; public debut at Farnborough International Air Show July 2000; Brazilian CTA and FAA certification (for both ER and LR versions) achieved in June and 26 July 2001 respectively; first delivery (PP-XGF/N800AE) to American Eagle late July 2001.

CURRENT VERSIONS: **ERJ-140ER:** Standard version, *as described*. Engineering designation EMB-135KE.

ERJ-140LR: Long-range version. Engineering designation EMB-135KL.

CUSTOMERS: Launch customer American Eagle announced order for 66 on 27 September 2000, subsequently reduced to 59 through conversion of orders and options to ERJ-145s. Total of 74 firm orders, all of which had been delivered, by 31 December 2006. See table.

COSTS: USD15.2 million (1999).

Descriptions for the ERJ-135 and ERJ-145 apply also to the ERJ-140 except as follows:

DESIGN FEATURES: Shares 98 per cent commonality with ERJ-135/145, including engines, wings, tail surfaces, flight deck and main systems; ERJ-135 fuselage stretched by 2.30 m (7 ft 6½ in) by removal of two frames (2.85 m; 9 ft 4¼ in ahead of wing and 1.35 m; 4 ft 5 in at rear) and substitution of two longer frames (3.94 m; 12 ft 11 in and 2.56 m; 8 ft 4¾ in respectively).

POWER PLANT: Rolls-Royce AE 3007A1/3 turbofans, each rated at 33.7 kN (7,580 lb st); fuel as ERJ-145ER/MR and 145LR, respectively.

ACCOMMODATION: Standard accommodation for 44 passengers, three-abreast at seat pitch of 39 cm (31 in). Flight attendant seat on port side immediately aft of flight deck standard; attendant seat in centre of aisle at rear of cabin optional. Wardrobe/carry-on baggage cabinet and galley at front of cabin, lavatory at rear.

DIMENSIONS, EXTERNAL:

Length: overall ..... 28.47 m (93 ft 5 in)
fuselage ..... 26.52 m (87 ft 0 in)
Wheelbase ..... 13.51 m (44 ft 4 in)

DIMENSIONS, INTERNAL:

Baggage volume:
Wardrobe and stowage compartment ..... 0.93 m³ (32.84 cu ft)

WEIGHTS AND LOADINGS:

Basic operating weight: ER, LR ..... 11,800 kg (26,014 lb)
Baggage capacity ..... 1,200 kg (2,646 lb)
Max fuel weight: ER ..... 4,173 kg (9,200 lb)
LR ..... 5,187 kg (11,435 lb)
Max T-O weight: ER ..... 20,100 kg (44,312 lb)
LR ..... 21,100 kg (46,517 lb)
Max landing weight: ER, LR ..... 18,700 kg (41,226 lb)
Max ramp weight: ER ..... 20,200 kg (44,533 lb)
LR ..... 21,200 kg (46,738 lb)
Max zero-fuel weight: ER, LR ..... 17,100 kg (37,699 lb)
Max wing loading: ER ..... 392.7 kg/m² (80.44 lb/sq ft)
LR ..... 412.3 kg/m² (84.44 lb/sq ft)
Max power loading: ER ..... 298 kg/kN (2.92 lb/lb st)
LR ..... 313 kg/kN (3.07 lb/lb st)

PERFORMANCE:

Max cruising speed: ER, LR ..... Mach 0.78 (450 kt; 833 km/h; 518 mph)
T-O field length: ER ..... 1,720 m (5,643 ft)
LR ..... 1,320 m (4,331 ft)
Time to climb to 10,670 m (35,000 ft): ER, LR ..... 16 min
Service ceiling: ER, LR ..... 11,278 m (37,000 ft)
Range with 44 passengers at long-range cruising speed 100 n mile (185 km; 115 mile) alternate and 45 min reserves:
ER ..... 1,230 n miles (2,278 km; 1,415 miles)
LR ..... 1,630 n miles (3,018 km; 1,875 miles)

EMBRAER ERJ-145

Brazilian Air Force designations: R-99A, R-99B and P-99

TYPE: Regional jet airliner.

PROGRAMME:

DEVELOPMENT MILESTONES

Announced	12 June 89
First prototype material cut	2Q 93
First flight	11 Aug 95
Officially rolled out	18 Aug 95
Certification	10 Dec 96
First delivery	19 Dec 96

Development plans revealed 12 June 1989, aimed at first flight late 1991 and first deliveries mid-1993; programme delayed by company cutbacks, complete redesign of wing and other changes, as described in 2000–01 and earlier *Jane's*.

First metal cut for prototype, and tooling fabrication, in second quarter 1993; assembly of prototype (PT-ZJA) began October 1994; fuselage sections mated January 1995; first flight 11 August 1995 ahead of formal roll-out and 'official' first flight a week later; first of three pre-series aircraft (PT-ZJB) first flown 17 November 1995; second ('ZJC) flew on 14 February and third ('ZJD) 2 April 1996; FAA and Brazilian CTA certification (to FAR/JAR 25, FAR Pt 36, ICAO Annex 16 and FAR Pt 121) achieved 10 December 1996. Single prototype and three pre-series aircraft undertook a 1,600 hour, 13 month development flight testing and certification programme. Deliveries began on 19 December 1996 with two aircraft (N15925 and N15926) to US launch customer Continental Express. Designation changed from EMB-145 to ERJ-145 in October 1997 to reflect 'Regional Jet' terminology, although former is retained for corporate and military variants. Certified by the aviation authorities of 27 countries by September 1998.

In addition to its suitability for executive transport and corporate shuttle roles, Embraer foresees military potential for the ERJ-145 as a tanker aircraft for small combat units, and as an AEW, elint, comint, sigint or battlefield surveillance platform. See Current Versions.

Two static test airframes: first (802) completed trials on 30 August 1996; second (803) began 10 year programme in December 1996.

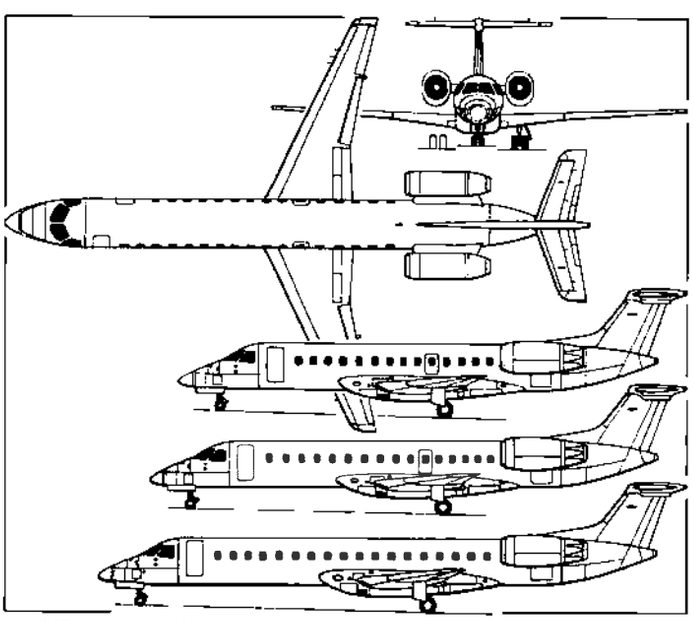
ERJ series achieved 10 million flight hours in November 2006.

CURRENT VERSIONS: **ERJ-145:** Initial version. Certified (by FAA) 10 December 1996 at 19,200 kg (42,328 lb) MTOW.

ERJ-145ER: (Extended Range) FAA co-certification 10 December 1996 at 20,600 kg (45,415 lb) MTOW.

ERJ-145MR: Certified by FAA 7 May 1998 at 22,000 kg (48,501 lb) MTOW. Two only, subsequently converted to ERJ-145LR standard. See ERJ-145MP, below.

ERJ-145LR: (Long Range) FAA co-certification 7 May 1998 for full passenger payload range of 1,640 n miles (3,037 km; 1,887 miles); increases in fuel capacity and all operating weights; 22,000 kg (48,501 lb) MTOW; and uprated AE 3007A1 turbofans providing 15 per



ERJ-145 rear-engined twin-turbofan regional airliner with additional side views of ERJ-135 (top) and ERJ-140 (centre) *(James Goulding)* 1158943

Embraer ERJ-145 of China's Sichuan Airlines 1040385

cent more thermodynamic power, but flat rated to 33.1 kN (7,430 lb st), for improved climb and hot weather cruise performance.

ERJ-145MP: Combines ERJ-145LR's fuselage, zero-fuel weight and maximum landing weight with ERJ-145ER's landing gear, fuel tanks and range. Maximum take off weight 20,990 kg (46,275 lb). Available from 1999 as replacement for ERJ-145MR.

ERJ-145XR: (Extra Long Range) Announced at Farnborough International Air Show 25 July 2000 with launch order for 75, plus 100 options, from Continental Express subsequently increased to 104, plus 100 options. Features strengthened fuselage, wings and horizontal stabiliser, winglets, uprated AE 3007A1E turbofans providing lower specific fuel consumption, improved hot-and-high operation and higher single-engine ceiling; and auxiliary fuel tank in wing/fuselage fairing. Prototype (PT-ZJB, modified from first pre-series ERJ-145) first flown 29 June 2001; first production aircraft (c/n 590) flew early April 2002; two aircraft took part in a 400 hour test programme. Brazilian CTA granted 3 September 2002, followed by FAA approval 22 October 2002, and first deliveries to Continental Express/ExpressJet, which was scheduled to receive 18 ERJ-145XRs by the end of 2002.

ERJ-145EP: FAA certification 14 October 2003. MTOW 20,990 kg (46,275 lb); max ramp weight 21,090 kg (46,495 lb); MLW 18,700 kg (41,226 lb); MZFW 17,100 kg (37,699 lb); fuel as ER/MR versions.

ERJ-135: Short-fuselage, 37-seat version; *described separately*.

ERJ-140: Mid-size, 44-seat version; *described separately*.

EMB-145AEW&C: Formerly EMB-145SA; Brazilian Air Force designation **R-99A**. Airborne early warning and remote sensing version of ERJ-145LR developed for Brazilian government's *SIstema de Vigilancia de AMazonia* (SIVAM) programme for which Raytheon is prime contractor; initial requirement for five; contract signature March 1997. Selected on 15 December 1998 by Greek Air Force for its four-aircraft AEW requirement, with delivery from 2002; contract, signed 1 July 1999, valued at USD500 million. Announced late 1996 and features a strengthened fuselage, ventral strakes, more powerful APU, increased fuel capacity (three extra tanks at extreme rear of cabin, plus jettison capability), extending endurance to more than 8 hours; enhanced electrical system, five seats for relief crew and four (with provision for additional two) operators' consoles, including tactical co-ordinator. Flight crew of two.

Mission systems comprise civil version of Ericsson PS-890 Erieye side-looking airborne radar with antenna housed in long overfuselage fairing, optimised for lower-speed targets typically encountered in border incursions; five Erieye systems purchased at cost of USD145 million in 1997 for installation in EMB-145SAs, with first system delivery scheduled for 1999. Onboard command and control system, and BAE Systems North America Comms-Non Comms system. Radar is pulse Doppler type, operating in E/F-band, offering coverage from very low level up to about 25,000 m (82,000 ft) and at ranges exceeding 162 n miles (300 km; 186 miles). Datalink; GPS; secure communications. Second airframe (PP-XSA/6702) was first to fly, on 22 May 1999, ahead of formal roll-out on 28 May. Following systems integration by Raytheon in USA, first two R-99As and one R-99B handed over to 2°/6° Grupo at Anapolis on 24 July 2002; third and fourth R-99As followed in December 2002 and last on 12 December 2003.

Greek selection of Erieye-equipped EMB-145 announced 1 July 1999; four aircraft ordered, of which first handed over on 16 October 2003 to begin equipment outfitting.

Mexican government order for one EMB-145AEW&C announced 1 March 2001; equipment includes comint system installed by Raytheon.

EMB-145RS: Brazilian Air Force designation **R-99B**. Remote sensing version, of which three ordered for FAB's SIVAM programme for delivery commencing first quarter 2001. Similar to AEW variant, and with ventral strakes, but different mission systems for primary roles in natural resources exploitation, environmental and river pollution control, economic activities, ground occupation monitoring and illegal activities surveillance. Main sensor is version of Canadian MacDonald Dettwiler IRIS (Integrated Radar Imaging System) synthetic aperture radar, installed in underfuselage bulge with auxiliary antennas beneath wingroots, operating in D-band interferometric mode and capable of generating 3-D imagery. Other main sensors include Star Safire FLIR mounted behind nosewheel bay, Daedalus ultraviolet/visible/infra-red linescanner and BAE Systems North America Comms-Non Comms system. Roll-out (PP-XRT/6751) November 1999, with first delivery to 2°/6° Grupo at Anapolis AFB on 24 July 2002; all received by late 2003.

EMB-145AGS: Airborne ground sensor version, under study during 2000; equipped with a mission package comprising Airborne Platform Subsystem (APS), Airborne Mission Equipment Subsystem (AMES) and Ground Exploitation Station Subsystem (GESS) including HF, UHF, VHF, ELINT and IMINT equipment, providing a self-deployable and cost-effective surface reconnaissance system.

EMB-145 airframe selected as aerial platform for Lockheed Martin's and Harris Corporation's bid for US Army Aerial Common Sensor (ACS) requirement, designed to replace Guardrail Common Sensor and Airborne Reconnaissance Low intelligence, surveillance and reconnaissance systems.

EMB-145MP and EMB-145MP/ASW: Brazilian Air Force designation **P-99**. Maritime patrol and anti-submarine warfare versions, under development by 2000; equipped with surveillance radar with multiple target track-while-scan mode, autodetection, FLIR interface, digital map, incorporated tactical aids, SAR/ISAR mode allowing real-time imaging, adaptive processing for different sea states, and simultaneous side and range views; high-altitude and resolution FLIR; ESM suite; COMINT/ELINT; MAD; IFF/SSR and acoustics.

Mexican government order for two EMB-145MPs announced 1 March 2001. Equipment includes SeaVue radar and AN/APX-114 IFF interrogator to be installed by Raytheon at Greenville. FAA Type Certificate granted 3 July 2003; AE3007A, A1/1, A1/2, A1 or A1P engines; MTOW 20,990 kg (46,275 lb); max ramp weight 21,090 kg (46,495 lb); MLW 19,300 kg (42,549 lb); MZFW 17,900 kg (39,462 lb).

CUSTOMERS: Total of 914 firm orders and 133 options for ERJ-135, ERJ-140 and ERJ-145 commercial variants by 31 December 2006, of which 861 then delivered. See table. Four hundredth ERJ series delivery was an ERJ-145 (HB-JAL) to Crossair on 22 March 2001; 500th was an ERJ-145 (N2933K) delivered to Chautauqua Airlines of Indiana on 21 September 2001; 600th to Swiss (as HB-JAY) on 28 May 2002, and 700th to Alitalia Express (as I-EXML) on 9 May 2003, 800th (ERJ-145) to Chautauqua Airlines on 13 May 2004, and 900th (ERJ-135) to Luxair on 28 February 2005.

EMBRAER ERJ-135/140/145 ORDERS AND DELIVERIES
(at 31 December 2006)

Customer	Variant	Ordered	Del'd	Backlog
Aerolitoral	145	5	5	
Air Caraibes	145	2	2	
Alitalia Express	145	14	14	
American Eagle	135	40	40	
	140	59	59	
	145	118	118	
Axon Airlines	145	3	3	
bmi (British	135	3	3	
Midland)	145	9	9	
British Regional	145	23	23	
Brymon Airways	145	7	7	
China Southern Jiangsu	145	6	6	
China Eastern	145	5	5	
China Eastern Wuham	145	5	2	3
Cirrus Airlines	145	1	1	
City Airlines AB Sweden	135	2	2	
ERA Spain	145	2	2	
ExpressJet	135	30	30	
	145	245	245	
Flandre Air	135	3	3	
	145	5	5	
GECAS (PB Air Thailand)	145	2	2	
HNA Group China	145	50	0	50
Jet Magic	135	1	1	
KLM Exel	145	2	2	
LOT Polish	145	14	14	
Luxair	135	2	2	
	145	9	9	
Mesa	145	36	36	
Pan Européenne	135	1	1	
Portugalia	145	8	8	
Proteus	135	3	3	
	145	8	8	
Regional Airlines				
(France)	135	3	3	
	145	15	15	
Republic Airways				
Management)	135	15	15	
	140	15	15	
	145	60	60	
Rheintalflug	145	3	3	
Rio-Sul	145	16	16	
Satena	145	3	3	
Sichuan Airlines	145	5	5	
Skyways AB	145	4	4	
South African				
Airlink	135	5	5	
Swiss	145	25	25	
Trans States				
Airlines	145	22	22	
Totals	**914**	**861**	**53**	
of which	135	914	861	53
	140	74	74	
	145	732	679	53

Notes: Total excludes military versions, EMB-135/145s in corporate service and Legacys.

COSTS: Estimated development costs USD300 million.

Following description applies to ERJ-145ER except where indicated.

DESIGN FEATURES: Stretched EMB-120 Brasilia fuselage (with tailcone adapted for rear-mounted engine installation), allied to new-design wing with Embraer supercritical section; CBA-123 nose and cabin; T tailplane.

Wing sweepback 22° 43' 48" at quarter-chord.

FLYING CONTROLS: Conventional and assisted. Ailerons and two-section rudder hydraulically actuated, with artificial feel; mechanically actuated elevator with automatic and spring tab. Four-segment in-flight and ground spoilers; two pairs of electrically actuated double-slotted flaps. Control surface movements: ailerons +25/−15°, elevators +27/−14°, rudder ±15° (first segment) ±11° 15' (second segment), flaps +7° 30'/−45° (inboard) +9° 10'/−45° (outboard), spoilers +52° (inboard) +30° (outboard).

STRUCTURE: Fuselage as for Brasilia; two-spar wing with integral fuel tanks, plus auxiliary third spar supporting landing gear; T tail unit with aluminium main boxes; wing and tailplane leading-edges aluminium, fin leading-edge composites sandwich. Gamesa (Spain) builds wings, wing/body fairings, main landing gear doors and engine nacelles; rear fuselage section 1, including engine pylons and passenger/service/baggage doors, plus centre-fuselage section 1, including doors, by Sonaca (Belgium); fin, tailplane and elevators by ENAER (Chile); engine nacelles and thrust reversers by Hurel Hispano UK; nose radome by Norton; passenger cabin and baggage compartment interiors by C & D Interiors (USA). Structure designed for an economical service life of 60,000 flights.

LANDING GEAR: Twin-wheel main legs retract inward into wing/fuselage fairings; twin-wheel nose unit retracts forward. EDE/Liebherr landing gear system, with EDE responsible for whole system and Liebherr for development and production of nose unit. Goodrich wheels and carbon brakes. Tyre sizes 30×9.5–14 (16 ply) tubeless (main), 19.5×6.75–8 (8 ply) tubeless (nose); tyre pressure 8.60 to 9.00 bar (125 to 130 lb/sq in). Minimum ground turning radius at nosewheel 12.51 m (41 ft 0 in). Minimum turning circle 29.22 m (95 ft 10½ in).

Portuguese national colours on Embraer ERJ-145 of PGA 1040386

POWER PLANT: Two turbofans pylon-mounted on rear cone of ERJ-145ER, 145MR and 145LR have 33.7 kN (7,580 lb st), Rolls-Royce AE 3007A, 3007A1/1 or 3007A1/2 as standard; 37.1 kN (8,338 lb st) AE 3007A1P optional, all with FADEC. ERJ-145XR has two 39.6 kN (8,895 lb st) AE 3007A1Es. Clamshell-type thrust reversers optional.

Parker Hannifin fuel system. Fuel capacity of ER and MR 5,201 litres (1,374 US gallons; 1,144 Imp gallons) in two wing tanks; usable fuel 5,091 litres (1,345 US gallons; 1,120 Imp gallons). ERJ-145LR capacity increased to 6,439 litres (1,701 US gallons; 1,418 Imp gallons; 6,352 litres (1,678 US gallons; 1,397 Imp gallons) usable. ERJ-145XR fuel comprises two wing tanks, each of 3,199 litres (845 US gallons; 704 Imp gallons), plus 1,037 litre (274 US gallon; 228 Imp gallon) ventral tank, for total of 7,435 litres (1,964 US gallons; 1,635 Imp gallons), of which 7,382 litres 1,950 US gallons; 1,624 Imp gallons) usable.

ACCOMMODATION: Two pilots, flight observer and cabin attendant. Standard accommodation for 50 passengers, three-abreast at seat pitch of 79 cm (31 in). Carry-on baggage wardrobe, galley and cabin attendant's seat at front of cabin; lavatory and main baggage compartment at rear of cabin. Cabinet plus overhead bins carry-on baggage capacity 358 kg (789 lb); underseat capacity 450 kg (992 lb); main baggage compartment capacity 1,200 kg (2,646 lb). Additional baggage cabinet or galley capacity can be provided by removing one or two single forward passenger seats. Outward-opening plug-type door, incorporating airstair, at front on port side, identical to that of EMB-120; upward-sliding baggage door at rear on port side; sideways-opening service door at front on starboard side; inward-opening emergency exit above wing on each side. Entire accommodation, including baggage compartments, pressurised and air conditioned.

SYSTEMS: Liebherr Aerospace pressurisation system (maximum differential 0.54 bar; 7.8 lb/sq in) maintains 2,440 m (8,000 ft) cabin altitude to 11,275 m (37,000 ft). Hamilton Sundstrand air conditioning and bleed air systems (wing and tailplane leading-edges and engine intakes anti-iced by engine bleed air); electric anti-icing system for windscreen and static and pitot tubes and sensors. Lucas electrical power generation system. Hamilton Sundstrand T-62T-40C11 or C14 APU. Honeywell air turbine starter. Parker Hannifin flight control and steering systems. Hydro-Aire brake-by-wire control system. EROS oxygen system.

AVIONICS: Honeywell Primus 1000 as core system.

Comms: Dual Primus II radios and radio management units.

Radar: Primus 1000 colour weather radar.

Flight: Dual digital air data computers, dual AHRS, TCAS and GPWS standard. FMS/GPS optional. Flight Dynamics HUD selected April 1998 for certification in 2000, providing Cat. III landing capability.

Instrumentation: EFIS panel comprising five 280 × 180 mm (11 × 7 in) displays, two PFDs, two MFDs and IECAS.

DIMENSIONS, EXTERNAL:

Wing span: ERJ-145ER/LR	20.04 m (65 ft 9 in)
ERJ-145XR over winglets	21.01 m (68 ft 11 in)
Wing chord: at root	4.09 m (13 ft 5 in)
at tip	1.04 m (3 ft 5 in)
Wing aspect ratio	7.9
Length overall	29.87 m (98 ft 0 in)
Fuselage: Length	27.93 m (91 ft 7½ in)
Max diameter	2.28 m (7 ft 5¾ in)
Height overall	6.76 m (22 ft 2 in)
Tailplane span	7.55 m (24 ft 9 in)
Wheel track (c/l of shock-struts)	4.10 m (13 ft 5½ in)
Wheelbase	14.45 m (47 ft 5 in)
Passenger door (fwd, port): Height	1.70 m (5 ft 7 in)
Width	0.71 m (2 ft 4 in)
Height to sill (max)	1.63 m (5 ft 4 in)
Baggage door (rear, port): Height	1.12 m (3 ft 8 in)
Width	1.00 m (3 ft 3¼ in)
Height to sill (max)	1.76 m (5 ft 9¼ in)
Service door (rear, stbd): Height	1.42 m (4 ft 8 in)
Width	0.62 m (2 ft 0½ in)
Height to sill	1.60 m (5 ft 3 in)
Emergency exits (overwing, each):	
Height	0.92 m (3 ft 0¼ in)
Width	0.51 m (1 ft 8 in)

DIMENSIONS, INTERNAL:

Cabin (excl flight deck and baggage compartment, incl lavatory):	
Length	16.49 m (54 ft 1¼ in)
Max width	2.10 m (6 ft 10¾ in)
Max height	1.83 m (6 ft 0 in)
Max aisle width	0.52 m (1 ft 8½ in)
Floor area	25.7 m² (277 sq ft)
Volume	53.0 m³ (1,872 cu ft)
Baggage compartment: Length	3.26 m (10 ft 8¼ in)
Baggage volume:	
wardrobe and stowage compartment	1.4 m³ (49 cu ft)
overhead bins	1.9 m³ (67 cu ft)
underseat	2.3 m³ (80 cu ft)
baggage compartment	9.2 m³ (325 cu ft)

AREAS:

Wings, gross	51.18 m² (550.9 sq ft)
Ailerons (total)	1.70 m² (18.30 sq ft)
Trailing-edge flaps (total)	8.36 m² (89.99 sq ft)
Spoilers (total)	2.32 m² (24.97 sq ft)
Fin	5.07 m² (54.57 sq ft)
Rudder	2.13 m² (22.93 sq ft)
Tailplane	11.20 m² (120.55 sq ft)
Elevators (total, incl tabs)	3.34 m² (35.95 sq ft)

WEIGHTS AND LOADINGS:

Operating weight empty:	
ERJ-145ER	11,940 kg (26,323 lb)
ERJ-145LR	12,100 kg (26,676 lb)
ERJ-145XR	12,580 kg (27,734 lb)
Max baggage weight	1,200 kg (2,646 lb)
Max payload: ERJ-145ER	5,160 kg (11,376 lb)
ERJ-145LR	5,800 kg (12,787 lb)
ERJ-145XR	5,920 kg (13,051 lb)
Max fuel: ERJ-145ER	4,173 kg (9,200 lb)
ERJ-145LR	5,187 kg (11,435 lb)
ERJ-145XR	6,032 kg (13,298 lb)
Max T-O weight: ERJ-145ER	20,600 kg (45,415 lb)
ERJ-145LR	22,000 kg (48,500 lb)
ERJ-145XR	24,100 kg (53,131 lb)
Max ramp weight: ERJ-145ER	20,700 kg (45,635 lb)
ERJ-145LR	22,100 kg (48,721 lb)
ERJ-145XR	24,200 kg (53,351 lb)
Max landing weight: ERJ-145ER	18,700 kg (41,226 lb)
ERJ-145LR	19,300 kg (42,549 lb)
ERJ-145XR	20,000 kg (44,092 lb)
Max zero-fuel weight:	
ERJ-145ER	17,100 kg (37,698 lb)
ERJ-145LR	17,900 kg (39,463 lb)
ERJ-145XR	18,500 kg (40,785 lb)
Max wing loading:	
ERJ-145ER	402.5 kg/m² (82.44 lb/sq ft)
ERJ-145LR	429.8 kg/m² (88.04 lb/sq ft)
ERJ-145XR	470.9 kg/m² (96.44 lb/sq ft)
Max power loading:	
ERJ-145ER, ERJ-145XR	305 kg/kN (3.00 lb/lb st)
ERJ-145LR	326 kg/kN (3.20 lb/lb st)

PERFORMANCE:

High cruising speed: ERJ-145ER, ERJ-145LR	M0.78 (450 kt; 833 km/h; 518 mph)
ERJ-145XR	M0.80
Time to climb to FL350	20 min
Max certified altitude: all	11,275 m (37,000 ft)
Service ceiling, OEI: ERJ-145ER/LR	6,100 m (20,000 ft)
FAR T-O field length at S/L:	
ERJ-145ER/LR	1,970 m (6,465 ft)
ERJ-145XR	2,089 m (6,855 ft)
FAR landing field length, S/L, at typical landing weight:	
ERJ-145ER/LR	1,390 m (4,560 ft)
ERJ-145XR	1,430 m (4,692 ft)
Range, 50 passengers, 100 n mile (185 km; 115 mile) diversion, 45 min reserves:	
ERJ-145LR	1,620 n miles (3,000 km; 1,864 miles)
ERJ-145XR	2,000 n miles (3,704 km; 2,301 miles)

EMBRAER 170 and 190

TYPE: Regional jet airliner.

PROGRAMME:

DEVELOPMENT MILESTONES

Announced	Feb 99
Selected by Crossair and Regional Airlines	14 Jun 99
First prototype material cut	14 Jul 00
Rolled out	29 Oct 01
First flight	19 Feb 02
Certification	13 Nov 03
First delivery	8 Mar 04

Announced (officially 'pre-launch') in February 1999; designations then ERJ-170 and ERJ-190; engine selection May 1999; first orders announced 14 June 1999; risk-sharing partners (see 'Structure', below) revealed at European Regional Airline Association annual meeting in Paris, 30 September 1999. Joint definition phase leading to ERJ-170 design

Embraer 175 operated in Canada 1040458

Ecuadorean-registered Embraer 190 1040455

Flybe was first Embraer 195 recipient 1040459

freeze, completed in April 2000; first metal cut for first of six pre-series ERJ-170s 14 July 2000; ERJ-170 (c/n 0001/PP-XJE) first rolled out 29 October 2001, first flight 19 February 2002; followed by c/n 0002/PP-XJC (to be HB-JCA) in Crossair (to become Swiss) colours on 9 April 2002, by which time the first aircraft had completed 40 hours of test flying; c/n 0003/PP-XJB (first equipped with full Honeywell Primus Epic avionics suite) on 25 May 2002; c/n 0004/PP-XJF on 19 June 2002; c/n 0005/PP-XJA on 14 July 2002; and c/n 0006/PP-XJS on 28 December 2002. Announced at roll-out that ERJ prefix was discontinued and that ERJ-190–200 to be known as Embraer 195; intermediate Embraer 175 simultaneously revealed.

Public debut (PP-XJE) at Regional Airline Association convention at Nashville, Tennessee 12 to 15 May 2002, followed by European debut (PP-XJA) at Farnborough International Air Show 22 July 2002, followed by European demonstration tour comprising 18 flights totalling more than 100 hours.

Six flying pre-series aircraft and one production aircraft conducted 3,000 hour flight test programme, culminating in provisional type certification by CTA on 13 November 2003, and by FAA on 8 December 2003, followed by full certification by CTA (19 February 2004), FAA (20 February 2004) and JAA in first quarter 2004 following completion of flight control system certification documentation. Transport Canada certification granted 19 July 2005. First deliveries, to LOT Polish and Alitalia, on 8 and 10 March 2004 respectively. Further two static test airframes (801 and 802) conducted and static fatigue test programme with aim of completing 5,000 simulated flights to clear aircraft for 2,500 actual flight hours by time of certification, and eventual demonstration of 80,000 cycle economic service life. Initial production of four per month in 2003, rising to six per month in 2004 and maximum capacity of 10 per month. 100th E-series, an Embraer 175, delivered to Air Canada 21 October 2005, followed by 200th delivery, an Embraer 190 for Copa Airlines, on 4 December 2006.

CURRENT VERSIONS: **Embraer 170:** Baseline version with 70 to 80 seats; available in Standard and Long-Range versions both FAA-certified (-100 and -100LR) 20 February 2004. Derivatives of LR, with no weight changes are -100SU with 76 seats and -100SE with 70 seats; certified by FAA 14 May and 17 September 2004.

Embraer 175: Longer version with 1.77 m (5 ft 9¾ in) fuselage stretch by means of two plugs to accommodate 76 to 80 passengers; offered in Standard and Long-Range versions, designations ERJ-170-200 and -200LR, while -200SU is -200LR version with seating reduced to 76. First flight (c/n 0014-PP-XJD) 14 June 2003, followed by second aircraft on 7 August 2003. Brazilian certification achieved 23 December 2004; Transport Canada certification granted 19 July 2005 followed by US FAA approval for all three versions 31 August 2006.

Embraer 190: Further stretch by 6.34 m (20 ft 9½ in) to accommodate up to 114 passengers; wing span increased by 2.72 m (8 ft 11 in); GE CF34-8E-10E engines; strengthened landing gear; available in Standard, Long-Range and Increased Gross Weight (IGW) versions as 190-100, 100LR and -100IGW versions. Launch customer jetBlue ordered 100, plus 100 options, on 10 June 2003. Prototype rolled out 9 February 2004; first flight 12 March 2004. Brazilian certification granted to all -100 versions 30 August 2005 followed by US FAA approval 2 September 2005 and Transport Canada certification on 6 December 2005.

Embraer 195: Otherwise ERJ-190–200. Further stretch of Embraer 190–100 by 2.41 m (7 ft 11 in) to accommodate up to 118 passengers; available in Standard, Long-Range and IGW versions; first metal cut 23 August 2002; first flight 7 December 2004; Brazilian certification achieved 30 June 2006 following 475 hour flight test programme involving two aircraft. EASA approval granted 17 July 2006; first delivery, to Flybe, on 1 September 2006.

Lineage 1000: Variant of Embraer 190 Long Range. Announced at European Business Aviation Convention & Exhibition at Geneva 3 May 2006. Features include five-zone cabin designed by Priestman Goode accommodating up to 19 passengers with Internet and Wi-Fi access, up to three lavatories and stand-up shower. Cost USD40.95 million (2006). Completions will be undertaken by DeCrane Aircraft Holdings. Cabin volume 115.7 m³ (4,085 cu ft); baggage volume 17.4 m³ (615 cu ft); take-off field length 2,103 m (6,900 ft); range with eight passengers, IFR reserves 4,200 n miles (7,778 km; 4,833 miles). Service entry mid 2008. Two scheduled for delivery in 2008 and up to four in 2009.

CUSTOMERS: Total of 619 orders and 568 options by 30 September 2006, of which 209 then delivered. See table. Launch customers Crossair and Regional Airlines of France announced at Paris Air Show 14 June 1999; Crossair (now Swiss) ordered 30 Embraer 170s and 30 Embraer 195s, with options on a further 100 Embraer 170/195s, for intended delivery (Embraer 170) from December 2002, but subsequently reduced on 25 March 2003 to 15 of each model, with first delivery (Embraer 170) in August 2004 (but see table, below), followed by first Embraer 195 in 2006. North American launch customer US Airways initially ordered 85 Embraer 170s, plus 50 options, on 12 May 2003, for delivery commencing 2004.

EMBRAER 170/190 ORDERS AND DELIVERIES
(at 31 December 2006)

Customer	Variant	Ordered	Del'd	Backlog
AeroRepublic Columbia	190	5	1	4
Air Canada	175	15	15	
	190	45	18	27
Air Caraibes (Guadeloupe)	175	1	1	
	190	1	-	1
Alitalia	170	6	6	
Cirrus	170	2	2	
Copa (Panama)	190	15	6	9
EgyptAir	170	6	-	6
Finnair	170	10	10	
	190	10	1	9
Flybe	195	14	2	12
GECAS	170	9	8	1
	175	5	5	
	190	15	-	15
	195	8	1	7
HNA Group China	190	50	-	50
JetBlue	190	101	23	78
LOT Polish	170	6	6	
	175	4	4	
Northwest	175	36	-	36
Paramount India	170	2	2	
Regional Airlines (France)	190	6	1	5
Republic Airlines	170	48	48	
	175	30	-	30
Royal Jordanian	195	4	-	4
Satena (Colombia)	170	2	2	
Saudi Arabian Airlines	170	15	14	1
Sirte Oil Libya	170	1	-	1
South African Airlink	170	2	-	2
Swiss	170	15	-	15
	190	15	-	15
TAME (Ecuador)	170	2	2	
	190	1	1	
US Airways	170	28	28	
	190	57	2	55
Virgon Blue Pty (Australia)	170	3	-	3
	190	11	-	11
Undisclosed	175	8	-	8
	195	5	-	5
Total		**619**	**209**	**410**

In October 2003 Swiss requested postponement of its firm orders for Embraer 170s and 190s.

COSTS: Embraer 170 USD24.8 million; Embraer 190, USD29.6 million (both 2003). US Airways order for 85 Embraer 170s valued at USD2.1 billion; jetBlue order for 100 Embraer 190s valued at USD3 billion (both 2003). Development USD850 million for whole family (2001).

DESIGN FEATURES: Design goals include low weight, simplicity of operation, common crew type rating, high reliability, ease and economy of maintenance and ability to operate from same airports as ERJ-135/145. Low-wing airliner of conventional appearance, with podded engine below each wing and (on Embraer 170) winglets; airframe designed for an economic life of 60,000 to 80,000 cycles.

FLYING CONTROLS: Fly-by-wire. Ailerons, rudder and all-moving tailplane. Double-slotted flaps, four-section leading-edge slats and five-section spoilers on each wing, of which three outboard panels are multifunctional and inboard pair operate as ground spoilers. Movable horizontal stabiliser for pitch trim. Control surface movements:

170 and 175: Ailerons +25°/–15°, elevator +24° 40'/–14° 40', tailplane +13°/–2°; rudder ±30° 40', ground spoilers 60°, outboard spoilers 40°. Flaps deployable in six stages, max deflections 34° 30' main section and 13° 50' aft section, inboard; and 34° 10' main and 15° 20' aft, outboard flap. Slat angles 20° No. 1 and 25° Nos. 2, 3 and 4.

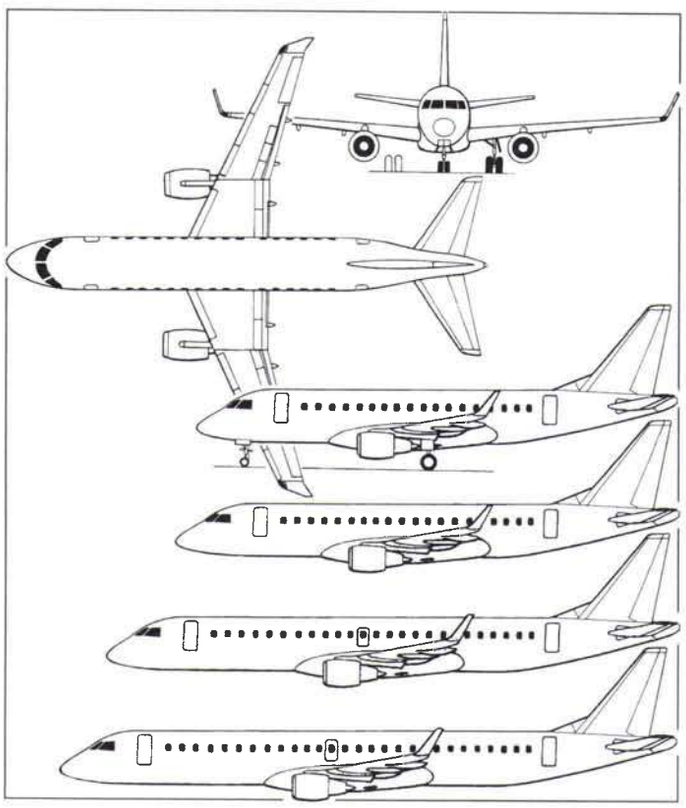
190 and 195: Ailerons +25°/–15°, elevator +25°/–18°, tailplane +11°/–4°, rudder ±31°/–30' and spoilers as 170/175. Flaps in six stages: 37° 5' and 22° (main and aft), outboard 36° 30' (both). Slats as 170/175.

Ventral airbrake optional to meet steep glideslope requirements for airports such as London City and Lugano.

STRUCTURE: Embraer is responsible for, forward fuselage, centre fuselage II, fuselage plugs, wing-to-fuselage fairing and final assembly; risk-sharing partners are C & D Interiors (cabin interior); Gamesa (rear fuselage and horizontal and vertical tail surfaces); General Electric (power plant and nacelles); Hamilton Sundstrand (tailcone, APU and air management and electrical systems); Honeywell (avionics); Kawasaki (wing stub, fixed leading- and trailing-edge assemblies, flaps, spoilers, control surfaces and engine pylons); Latécoère (centre fuselage I and III); Liebherr (landing gear); Parker Hannifin (hydraulic, flight control and fuel systems); and Sonaca (wing slats).

Embraer 170 regional jet of Hong Kong Express 1040454

Manufactured image of Embraer Lineage 1000 1040456



Embraer 170 regional jet, with additional side views of Embraer 175, Embraer 190 and Embraer 195 (bottom) *(James Goulding)* 1158973

LANDING GEAR: Twin wheels on each unit. Mainwheels size H38×13.0-18 (18 ply) on Embraer 170/175 and H41×16.0-20 (22 ply) on Embraer 190/195; nosewheels 24×7.7 (12 ply) and 24×7.7 (16 ply), respectively. Aircraft Braking Systems Corporation carbon brakes.

POWER PLANT: Embraer 170/175 series has two 63.2 kN (14,200 lb st) General Electric CF34-8E5 or -8E5A1 turbofans; 190/195 series has two 88.9 kN (20,000 lb st) CF34-10E (optionally -10E6, -10E6A1, -10E5 or -10E5A1) turbofans; both engines have FADEC.

Fuel capacity: *170 and 175:* 11,709 litres (3,093 US gallons; 2,576 Imp gallons), of which 11,596 litres (3,063 US gallons; 2,551 Imp gallons) usable, total in two wing tanks. Oil capacity 10 litres (2.6 US gallons; 2.2 Imp gallons) per engine.

190 and 195: 16,266 litres (4,297 US gallons; 3,578 Imp gallons), of which 16,153 litres (4,267 US gallons; 3,553 Imp gallons) usable, total in two wing tanks. Oil capacity 21 litres (5.5 US gallons; 4.6 Imp gallons) per engine.

ACCOMMODATION: *Embraer 170:* Single Class: 70 at 81 cm (32 in) seat pitch or 78 at 79 cm (31 in) seat pitch; Mixed Class: Eight at 96 cm (38 in) seat pitch and 64 at 79 cm (31 in) seat pitch; Dual Class: six at 91 cm (36 in) seat pitch, three abreast (2+1) and 64 at 79 cm (31 in) seat pitch; High Density 80 at 79 cm (31 in) seat pitch. Doors main (fwd, port), secondary (rear, port), service (two, fwd and aft, Starboard), all functioning as Type I emergency exits; flight deck emergency window exits each side.

Embraer 175: Single Class: 78 at 81 cm (32 in) seat pitch or 86 at 79 cm (31 in) seat pitch; Mixed Class: Eight at 96 cm (38 in) seat pitch and 72 at cm (31 in) seat pitch; Dual Class: six at 91 cm (36 in) seat pitch, three abreast (2+1) and 72 at 79 cm (31 in) seat pitch; High Density 88 at 79 cm (31 in) seat pitch. Doors as Embraer 170.

Embraer 190: Single Class: 98 at 81 cm (32 in) seat pitch or 106 at 79 cm (31 in) seat pitch; Mixed Class: 12 at 91 cm (36 in) seat pitch and 88 at 79 cm (31 in) seat pitch; Dual Class: eight at 96 cm (38 in) seat pitch, three abreast (2+1) and 86 at 79 cm (31 in) seat pitch; High Density 114 at 79 cm (31 in) seat pitch. Doors as Embraer 170, plus Type III emergency exit, centre, each side.

Embraer 195: Single Class: 108 at 81 cm (32 in) seat pitch or 118 at 79 cm (31 in) seat pitch; Mixed Class: 12 at 91 cm (36 in) seat pitch and 100 at 79 cm (31 in) seat pitch; Dual Class: eight at 96 cm (38 in) seat pitch, three abreast (2+1) and 98 at 79 cm (31 in) seat pitch; High Density 122 at 79 cm (31 in) seat pitch. Doors as Embraer 190.

All configurations have forward and aft lavatories; forward and aft galleys; forward and aft flight attendant seats; and forward wardrobes on port side aft of door.

SYSTEMS: Hamilton Sundstrand APS 2300 APU.

AVIONICS: Honeywell Primus Epic five-tube EFIS. Thales Avionics integrated electronic standby instrument (IESI) system standard.

DIMENSIONS, EXTERNAL (all versions, except where stated):

Wing span over winglets:

170, 175 ..... 26.00 m (85 ft 3½ in)
190, 195 ..... 28.72 m (94 ft 2¾ in)

Wing mean aerodynamic chord: 170, 175 ..... 3.195 m (10 ft 5¾ in)
190, 195 ..... 3.68 m (12 ft 1 in)
Length overall: 170 ..... 29.90 m (98 ft 1¼ in)
175 ..... 31.68 m (103 ft 11¼ in)
190 ..... 36.24 m (118 ft 10¾ in)
195 ..... 38.65 m (126 ft 9½ in)
Height overall: 170 ..... 9.85 m (32 ft 4 in)
175 ..... 9.73 m (31 ft 11 in)
190 ..... 10.28 m (33 ft 8¾ in)
195 ..... 10.52 m (34 ft 6 in)
Fuselage height: all ..... 3.35 m (11 ft 0 in)
Fuselage width: all ..... 3.01 m (9 ft 10½ in)
Tailplane span: all ..... 10.00 m (32 ft 9¾ in)
Doors: Main: Height ..... 1.82 m (5 ft 11¾ in)
Width ..... 0.75 m (2 ft 5½ in)
Secondary: Height ..... 1.80 m (5 ft 10¾ in)
Width ..... 0.635 m (2 ft 1 in)
Service, fwd: Height ..... 1.37 m (4 ft 6 in)
Width ..... 0.61 m (2 ft 0 in)
Service, aft: Height ..... 1.38 m (4 ft 6¼ in)
Width ..... 0.63 m (2 ft 0¾ in)
Flight deck emergency exits (two):
Height ..... 0.51 m (1 ft 8 in)
Width ..... 0.485 m (1 ft 7 in)
Type III emergency (two: 190, 195 only)
Height ..... 1.03 m (3 ft 4½ in)
Width ..... 0.53 m (1 ft 8¾ in)

DIMENSIONS, INTERNAL:
Cabin (excl flight deck):
Length: 170 ..... 19.43 m (63 ft 9 in)
175 ..... 21.20 m (69 ft 6¾ in)
190 ..... 25.76 m (84 ft 6 in)
195 ..... 28.17 m (92 ft 5 in)
Max width: all ..... 2.74 m (8 ft 11¾ in)
Max height: all ..... 2.00 m (6 ft 6¾ in)
Aisle width: all ..... 0.50 m (1 ft 7¾ in)
Baggage hold volume:
forward: 170 ..... 8.7 m^3 (306 cu ft)
175 ..... 10.1 m^3 (355 cu ft)
190 ..... 12.5 m^3 (442 cu ft)
195 ..... 13.8 m^3 (488 cu ft)
aft: 170 ..... 5.8 m^3 (204 cu ft)
175 ..... 7.2 m^3 (254 cu ft)
190 ..... 10.1 m^3 (358 cu ft)
195 ..... 12.7 m^3 (448 cu ft)

AREAS:
Wings, gross: 170, 175 ..... 72.72 m^2 (782.8 sq ft)
190, 195 ..... 92.53 m^2 (996.0 sq ft)

WEIGHTS AND LOADINGS:
Basic operating weight:
170 ..... 21,140 kg (46,606 lb)
175 ..... 21,810 kg (48,083 lb)
190 Standard, Long-Range ..... 28,080 kg (61,906 lb)
190 IGW ..... 28,180 kg (62,126 lb)
195 Standard, Long-Range ..... 28,970 kg (63,868 lb)
195 IGW ..... 29,070 kg (64,088 lb)
Max baggage weight: 170: forward ..... 1,370 kg (3,020 lb)
rear ..... 1,030 kg (2,271 lb)
190: forward ..... 1,850 kg (4,078 lb)
rear ..... 1,650 kg (3,638 lb)
Max payload: 170 ..... 9,000 kg (19,842 lb)
175 ..... 9,890 kg (21,804 lb)
190 ..... 13,530 kg (29,829 lb)
195 ..... 12,720 kg (28,043 lb)
Max fuel: 170, 175 ..... 9,335 kg (20,580 lb)
190, 195 ..... 12,872 kg (28,378 lb)
Max T-O weight:
170 Standard ..... 35,990 kg (79,344 lb)
170 Long-Range ..... 37,200 kg (82,012 lb)
175 Standard ..... 37,500 kg (82,673 lb)
175 Long-Range ..... 38,790 kg (85,517 lb)
190 Standard ..... 47,790 kg (105,359 lb)
190 Long-Range ..... 50,300 kg (110,892 lb)
190 IGW ..... 51,800 kg (114,199 lb)
195 Standard ..... 48,790 kg (107,563 lb)
195 Long-Range ..... 50,790 kg (111,973 lb)
195 IGW ..... 52,290 kg (115,280 lb)
Max zero-fuel weight:
170 all ..... 30,140 kg (66,447 lb)
175 all ..... 31,700 kg (69,886 lb)
190 Standard, Long-Range ..... 40,800 kg (89,948 lb)
190 IGW ..... 40,900 kg (90,169 lb)
195 Standard, Long-Range ..... 42,500 kg (93,696 lb)
195 IGW ..... 42,600 kg (93,917 lb)
Max landing weight:
170, all ..... 32,800 kg (72,311 lb)
175, all ..... 34,000 kg (74,957 lb)
190 Standard, Long-Range ..... 43,000 kg (94,799 lb)
190 IGW ..... 44,000 kg (97,003 lb)
195 Standard, Long-Range ..... 45,000 kg (99,208 lb)
195 IGW ..... 45,800 kg (100,972 lb)
Max wing loading:
170 Standard ..... 494.9 kg/m^2 (101.37 lb/sq ft)
170 Long-Range ..... 511.6 kg/m^2 (104.77 lb/sq ft)
175 Standard ..... 515.7 kg/m^2 (105.62 lb/sq ft)
175 Long-Range ..... 533.4 kg/m^2 (109.25 lb/sq ft)
190 Standard ..... 516.5 kg/m^2 (105.78 lb/sq ft)
190 Long-Range ..... 543.6 kg/m^2 (111.34 lb/sq ft)
190 IGW ..... 559.8 kg/m^2 (114.66 lb/sq ft)
195 Standard ..... 527.3 kg/m^2 (108.00 lb/sq ft)
195 Long-Range ..... 548.9 kg/m^2 (112.42 lb/sq ft)
195 IGW ..... 565.1 kg/m^2 (115.74 lb/sq ft)
Max power loading:
170 Standard ..... 285 kg/kN (2.79 lb/lb st)
170 Long-Range ..... 294 kg/kN (2.89 lb/lb st)
175 Standard ..... 297 kg/kN (2.91 lb/lb st)
175 Long-Range ..... 307 kg/kN (3.01 lb/lb st)
190 Standard ..... 268 kg/kN (2.63 lb/lb st)
190 Long-Range ..... 282 kg/kN (2.77 lb/lb st)
190 IGW ..... 291 kg/kN (2.85 lb/lb st)
195 Standard ..... 274 kg/kN (2.69 lb/lb st)
195 Long-Range ..... 285 kg/kN (2.80 lb/lb st)
195 IGW ..... 294 kg/kN (2.88 lb/lb st)

PERFORMANCE:
Max operating speed: all M0.82
Time to FL350:
170 ..... 17 min
175 ..... 19 min
190 ..... 15 min
195 ..... 18 min
Max certified altitude (all): ..... 12,495 m (41,000 ft)
Max runway height: 170, 175 ..... 2,440 m (8,000 ft)
190, 195 ..... 3,050 m (10,000 ft)
T-O field length:
170 Long-Range ..... 1,590 m (5,220 ft)
175 Long-Range ..... 1,734 m (5,690 ft)
190 Long-Range ..... 2,107 m (6,915 ft)
195 Long-Range ..... 2,251 m (7,385 ft)
Landing field length:
170 Long-Range ..... 1,273 m (4,180 ft)
175 Long-Range ..... 1,309 m (4,295 ft)
190 Long-Range ..... 1,392 m (4,570 ft)
195 Long-Range ..... 1,435 m (4,710 ft)
Range with max passengers at long-range cruising speed:
170 Long-Range ..... 2,000 n miles (3,704 km; 2,301 miles)
175 Long-Range ..... 1,900 n miles (3,518 km; 2,186 miles)
190 IGW ..... 2,300 n miles (4,259 km; 2,646 miles)
195 IGW ..... 2,100 n miles (3,889 km; 2,416 miles)

EMBRAER PHENOM 100

TYPE: Light business jet.

PROGRAMME: Announced, then as Very Light Jet (VLJ), 3 May 2005; BMW Group DesignworksUSA announced as interior designer 6 October 2005; named Phenom 100 and cabin mockup unveiled at the NBAA Convention in Orlando, Florida, 9 November 2005; wind tunnel testing completed by July 2006; first PW615F engine run 29 June 2006; engine first flown on Pratt & Whitney Canada test bed aircraft 16 October 2006; first flight expected in mid-2007; engine certification anticipated fourth quarter 2007; service entry scheduled for mid-2008.

CUSTOMERS: More than 235 firm orders held by 5 September 2006. Announced customers include ABC Taxi Aereo (one), Avantair (20), Eagle Creek Aviation Service (12 plus five options), Gold Aviation Services of Fort Lauderdale, Florida (five, plus 10 options for either Phenom 100s or 300s), JetBrief of Geneva (50, plus 50 options), Magnum Jet of Houston, Texas (50, plus 50 options for either Phenom 100s or 300s)), United Aviation (one), and Wondair of Valencia, Spain (24, plus 12 options for either Phenom 100s or 300s).

COSTS: USD2.85 million (2006).

DESIGN FEATURES: Low wing with modest sweepback; T tail; twin, podded, rear-mounted turbofans.

STRUCTURE: Generally of aluminium alloy. Named suppliers include Eaton Corporation (hydraulic power generation package, flap system, landing gear hydraulic components and cockpit controls for throttle, landing gear and flaps) and Pratt & Whitney Canada (engines). Airframe engineered for 35,000 cycles.

LANDING GEAR: Nosewheel type; retractable. Brake-by-wire system with anti-skid.

POWER PLANT: Two Pratt & Whitney Canada PW617T turbofans, with FADEC, each rated at 7.18 kN (1,615 lb st).

ACCOMMODATION: Choice of interior layouts for up to six passengers in 'Oval Light' cabin, designed by BMW Group DesignworksUSA. Typical layouts include six forward-facing seats, or four seats in club arrangement with forward wardrobe or refreshment centre and lavatory at rear. Door on port side, forward of wing. Four cabin windows per side. Cabin is pressurised and air-conditioned.

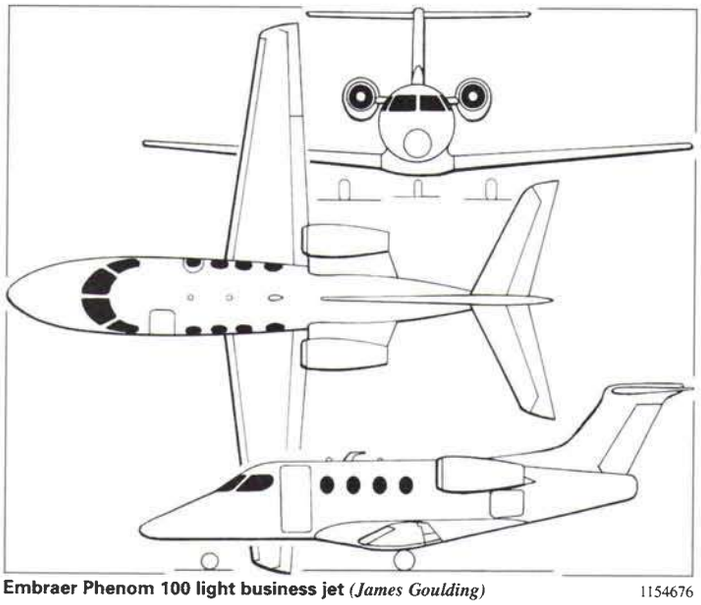
AVIONICS: 'Prodigy' flight deck with three landscape format flat panel screens, two for PFD and one for MFD functions.

DIMENSIONS, EXTERNAL:
Wing span ..... 12.29 m (40 ft 4 in)
Length overall ..... 12.80 m (42 ft 0 in)
Height overall ..... 4.37 m (14 ft 4 in)
Tailplane span ..... 5.38 m (17 ft 8 in)

DIMENSIONS, INTERNAL:
Cabin: Max width ..... 1.55 m (5 ft 1 in)
Max height ..... 1.50 m (4 ft 11 in)
Baggage compartment volume (total) ..... 1.6 m^3 (55 cu ft)

PERFORMANCE (estimated):
Max operating Mach No 0.70
High cruising speed ..... 380 kt (704 km/h; 437 mph)
Max operating altitude ..... 12,495 m (41,000 ft)
T-O field length ..... 1,037 m (3,400 ft)

Manufactured image of Embraer Phenom 100 1040460



Embraer Phenom 100 light business jet *(James Goulding)* 1154676

Range with four passengers:
with VFR reserves ..... 1,320 n miles (2,444 km; 1,519 miles)
with NBAA IFR reserves, 100 n mile (185 km; 115 mile alternate) ..... 1,160 n miles (2,148 km; 1,334 miles)

EMBRAER PHENOM 300

TYPE: Business jet.

PROGRAMME: Announced, then as Light Jet (LJ), 3 May 2005; BMW Group DesignworksUSA announced as interior designer 6 October 2005; named Phenom 300 and cabin mockup unveiled at the NBAA Convention in Orlando, Florida, 9 November 2005; service entry scheduled for mid-2009.

CUSTOMERS: Announced customers include Eagle Creek Aviation Services, which ordered four with five options (last named for either Phenom 100s or Phenom 300s) on 18 October 2006, and United Aviation, which ordered one in July 2006.

COSTS: USD6.65 million (2005).

DESIGN FEATURES: Low, sweptback wing with winglets; T tail; twin, podded, rear-mounted turbofans.

STRUCTURE: Generally of aluminium alloy.

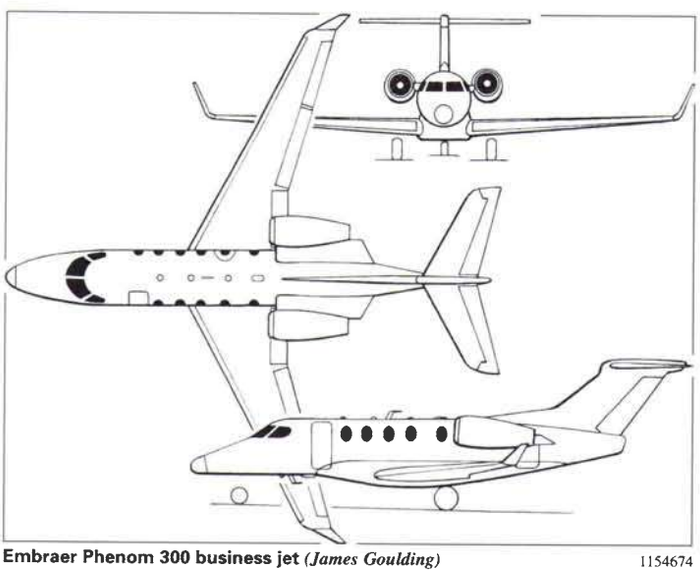
LANDING GEAR: Nosewheel type; retractable.

POWER PLANT: Two Pratt & Whitney Canada PW535E turbofans, with FADEC, each rated at 14.23 kN (3,200 lb st).

ACCOMMODATION: Choice of interior layouts for up to nine passengers in 'Oval Light' cabin, designed by BMW Group DesignworksUSA. Typical layouts include four seats in club arrangement with single rear-facing seat forward and two forward-facing seats aft, plus lavatory at rear; or four seats in club arrangement with two forward-facing seats and lavatory at rear. Cabin is pressurised and air-conditioned.

AVIONICS: 'Prodigy' flight deck with three landscape format flat panel screens, two for PFD and one for MFD functions.

Artist's impression of Embraer Phenom 300 1040457



Embraer Phenom 300 business jet *(James Goulding)* 1154674

DIMENSIONS, INTERNAL:
Cabin: Max width ..... 1.55 m (5 ft 1 in)
Max height ..... 41.50 m (4 ft 11 in)
Baggage compartment volume (total): ..... 2.2 m³ (76 cu ft)

PERFORMANCE (estimated):
Max operating Mach No 0.78
High cruising speed ..... 450 kt (833 km/h; 518 mph)
Max operating altitude ..... 13,715 m (45,000 ft)
T-O field length ..... 1,128 m (3,700 ft)
Range with six passengers, NBAA IFR reserves, 100 n mile (185 km; 115 mile alternate) ..... 1,800 n miles (3,333 km; 2,071 miles)

EVIATION JETS DO BRASIL

EVIATION JETS DO BRASIL INDUSTRIA AERONAUTICA LTDA

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Formed in November 2004 as Eviation Jets do Brasil Engenharia de Aeronaves Ltda. In mid-2005, the company changed its name to Eviation Jets do Brasil Indústria Aeronáutica Ltda to reflect aircraft manufacturing intentions.

Work began in January 2005 to re-engineer Visionaire VA-10 Vantage as Eviation EV-20 Vantage for Eviation Jets at Ames, Iowa, US, involving considerable changes to wing, engine position, fuselage structure and empennage. New configuration frozen mid-2005; currently in detail design phase. EV-20 prototype had been due to fly in mid-2006; certification due late 2007 after 1,200 hours by prototype, plus static test and fatigue airframes. Production aircraft will be built in Brazil in location yet to be defined; marketing by Eviation Jets at Ames.

HELIBRAS

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COMMERCIAL AND CUSTOMER SUPPORT DIRECTOR: Luiz Eduardo Mauad
MARKETING MANAGER: Julien Négrel

Formed 1978; owned jointly by Grupo Bueninvest (30 per cent), MGI Participações (25 per cent) and Eurocopter France (45 per cent). First assembly hall inaugurated 28 March 1980; facility occupies 12,000 m² (129,200 sq ft); new facilities, totalling 3,800 m² (40,900 sq ft) opened at São Paulo in second quarter of 1998 for maintenance, spares, training, sales and marketing. Total of 250 personnel employed in 2005.

Assembly, marketing and overhaul, under Eurocopter licence, of single- and twin-engined Ecureuil/Fennec helicopters and twin-engined Dauphin/Panther; markets in Brazil and overhauls civil Eurocopter AS 350/355 Esquilo (Fennec), EC 130, EC 135, AS 332 Super Puma; Eurocopter/Kawasaki BK 117C-1 (EC 145); and Eurocopter EC 120.

Total of 500 helicopters, 70 per cent of which are Esquilos, sold by 2006, representing 52 per cent of the turbine-powered helicopter fleet in Brazil); sold to more than 90 customers, including 240 to Brazilian police forces, Army, Navy and Air Force; nearly 10 per cent of overall total exported to Argentina, Bolivia, Chile, Paraguay and Venezuela. Supply of new EC 120B Colibri to local owners began in 1999.

IPE

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Formerly a producer of sailplanes, founded by Sen Boscardin (Senior), IPE manufactured the KW-1/KW-2/IPE 05 Quero-Quero (156 built, beginning in 1972) and IPE 02 Nhapecan (80). It also designed the IPE 03 motor glider and IPE 04, a variant of the Mudry CAP 10. The IPE 06 Curucaca tandem-seat lightplane has been re-engineered in composites, while on the drawing board is an agricultural sprayer designated IPE 010.

IPE 06A

TYPE: Two-seat lightplane.

PROGRAMME: IPE 06 Curucaca tandem-seat lightplane first flew in January 1990, built of steel tube with fabric covering, with side-V and half-axle landing gear and powered by a modified 52.2 kW (70 hp) Volkswagen engine. Production totalled 15.

In May 2003, the significantly re-engineered IPE 06A was flown (PP-ZFD), fitted with a more powerful engine and with its airframe translated into composites, resting on spring cantilever main gear. Three production aircraft were under construction in 2004, one assigned to demonstration in North America.

COSTS: USD120,000 (2004).

DESIGN FEATURES: High-mounted, constant-chord wings braced by V struts and intermediate struts; sweptback fin with constant-chord tailplane at base.

FLYING CONTROLS: Conventional and manual. Flaps.

STRUCTURE: Fuselage of 4130 steel with composites skin; composites wing structure with glass fibre skin.

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted spring cantilever mainwheel legs; steerable tailwheel. Speed fairings on mainwheels. Optional floats.

POWER PLANT: One piston engine; 85.8 kW (115 hp) Textron Lycoming O-235C or 134 kW (180 hp) unspecified motor, according to version. Usable fuel capacity 120 litres (31.7 US gallons; 26.4 Imp gallons).

ACCOMMODATION: Two persons in tandem with longitudinal displacement.

DIMENSIONS, EXTERNAL:

Wing span	10.00 m (32 ft 9¾ in)
Wing chord, constant	1.40 m (4 ft 7 in)
Wing aspect ratio	7.1
Length overall	6.50 m (21 ft 4 in)

AREAS:

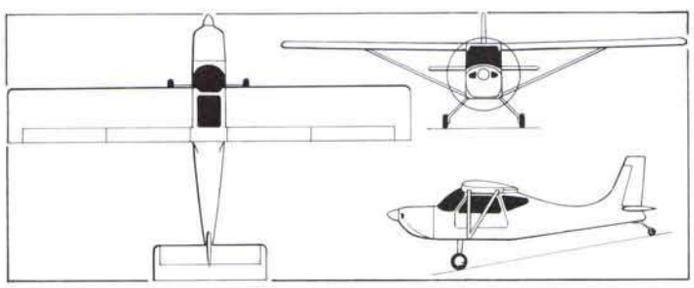
Wings, gross	14.00 m² (150.7 sq ft)

WEIGHTS AND LOADINGS (134 kW; 180 hp engine):

Weight empty	580 kg (1,279 lb)
Max T-O weight	950 kg (2,094 lb)
Max wing loading	67.9 kg/m² (13.90 lb/sq ft)
Max power loading	7.08 kg/kW (11.63 lb/hp)

PERFORMANCE:

Max level speed	119 kt (220 km/h; 137 mph)
Normal cruising speed	97 kt (180 km/h; 112 mph)
Stalling speed	32 kt (58 km/h; 36 mph)
Max rate of climb at S/L	442 m (1,450 ft)/min
Service ceiling	1,830 m (6,000 ft)
Landing run	50 m (165 ft)
Range	288 n miles (535 km; 332 miles)



IPE 06A tandem-seat lightplane *(James Goulding)* 1154284

IPE 010

TYPE: Agricultural sprayer.

PROGRAMME: Under development by 2004.

DESIGN FEATURES: Conventional crop sprayer configuration with low, constant-chord wing braced by V struts; high cockpit behind hopper, sealed against chemical ingress. Sweptback fin and low-mounted tailplane. STOL performance.

FLYING CONTROLS: Conventional and manual. Flaps.

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted, spring cantilever mainwheel legs.

POWER PLANT: One 224 kW (300 hp) Textron Lycoming flat-six driving a three-blade propeller. Usable fuel capacity 200 litres (52.8 US gallons; 44.0 Imp gallons).

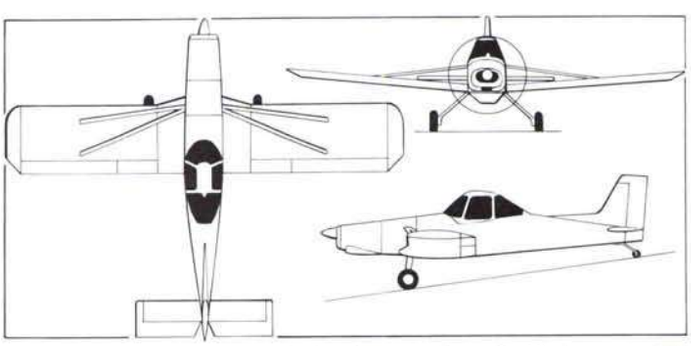
ACCOMMODATION: Pilot only. High mounted cockpit in line with wing trailing-edge and with all-round transparencies.

EQUIPMENT: Chemical hopper, capacity 1,000 litres (264 US gallons; 220 Imp gallons).

DIMENSIONS, EXTERNAL:

Wing span	10.00 m (32 ft 9¾ in)
Wing chord, constant	1.60 m (5 ft 3 in)
Wing aspect ratio	6.3
Length overall	7.65 m (25 ft 1¼ in)
Tailplane span	3.40 m (11 ft 1¾ in)

Artist's impression of IPE 010 agricultural sprayer 1151716



IPE 010 project for a Brazilian agricultural sprayer *(James Goulding)* 1154285

Prototype of IPE 06A 1047829

For details of the latest updates to ***Jane's All the World's Aircraft*** online and to discover the additional information available exclusively to online subscribers please visit
jawa.janes.com

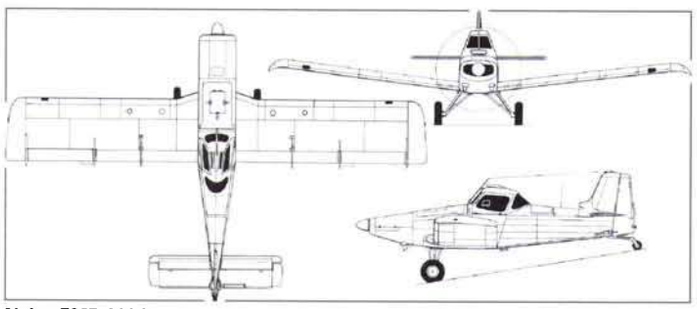
Wheel track ..... 2.65 m (8 ft 8¼ in)
AREAS:
Wings, gross ..... 16.00 m² (172.2 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 800 kg (1,764 lb)
Max T-O weight ..... 2,000 kg (4,409 lb)
Max wing loading ..... 125.0 kg/m² (25.60 lb/sq ft)
Max power loading ..... 8.94 kg/kW (14.70 lb/hp)
PERFORMANCE:
Cruising speed at 70% power: at S/L ..... 108 kt (200 km/h; 124 mph)
at FL65 ..... 135 kt (250 km/h; 155 mph)
Stalling speed: flaps up ..... 49 kt (90 km/h; 56 mph)
flaps down ..... 38 kt (70 km/h; 44 mph)
T-O run ..... 271 m (890 ft)
Landing run ..... 259 m (850 ft)
Range ..... 356 n miles (660 km; 410 miles)

NEIVA

INDÚSTRIA AERONÁUTICA NEIVA SA (SUBSIDIARY OF EMBRAER)

Caixa Postal 1011, Avenida Alcides Cagliari 2281, 18606-900 Botucatu-SP
Tel: (+55 14) 38 11 20 46
Fax: (+55 14) 38 11 19 36
e-mail: neiva@laser.com.br
PRESIDENT AND DIRECTOR: Mauricio Novis Botelho
MANAGING DIRECTOR: Paolo Urbanavicius
SALES MANAGERS:
Luiz Fabiano
Zaccarelli Cunha

Formed 12 October 1954 by José Carlos de Barros Neiva; produced Paulistinha, Regente, Universal and related lightplanes of own design. Became wholly owned Embraer subsidiary 11 March 1980; factory area 35,700 m² (384,275 sq ft), workforce 1,324 in October 2004. Previously played major role in Embraer general aviation programmes, including complete production of EMB-711ST Corisco Turbo, EMB-710 Carioca, EMB-720D Minuano (of which some 300 delivered), EMB-721 Sertanejo and EMB-810D Seneca IV (licence-built Piper models); also responsible since 1980 for total production of EMB-202 and now discontinued EMB-201A agricultural sprayers, and for components manufacture for ERJ-145 and Embraer 170/190 programmes. Low-volume production of EMB-120 Brasilia was transferred from Embraer in 2001. Total of more than 3,800 aircraft built by 2005, including over 1,000 Ipanemas.



Neiva EMB-202 Ipanema (one Textron Lycoming IO-540) *(Dennis Punnett)*
0507120

NEIVA EMB-202 IPANEMA

TYPE: Agricultural sprayer.
PROGRAMME: Embraer design; first flight (EMB-200 Ipanema prototype PP-ZIP) 31 July 1970; certified 14 December 1971; see 1977–78 and earlier editions for EMB-200/200A (49/24 built), EMB-201 (200 built) and EMB-201R (three built); and 1992–93 edition for EMB-201A (402 built). Manufacture transferred to Neiva in March 1980; many detail improvements (listed in 1991–92 and earlier *Jane's*) introduced late 1988. Available from 2002 onwards as airframe only, giving option of customer engine installation.
On 10 October 2002, Embraer revealed the prototype (PP-XHQ) of an ethanol-fuelled (Lycoming) Ipanema.
CURRENT VERSIONS: **EMB-202 Ipanema:** Current version from 1992; generally similar to EMB-201A except for larger hopper and choice of Lycoming or Continental engine. First delivery 2 October 1992.
Experimental ethanol-fuelled ('AvAlc') version announced 10 October 2002 as joint development project between Neiva and CTA, with technical support from Textron Lycoming and Hartzell, aimed at reducing emissions and extending engine maintenance cycle; Brazilian CTA certification achieved 19 October 2004.
Prototype was conversion of standard EMB-202 PT-ULA which flew on trials as PP-XHO before reverting to original markings.
CUSTOMERS: Delivery of 900th Ipanema (including 678 of earlier versions) took place on 4 December 2003; 1,000th (PT-UTF) delivered 15 March 2005 was also the first ethanol-fuelled Ipanema for a customer. Sales totalled 29 in 2002, 56 in 2003, and 83 in 2004; total of 63 orders for alcohol fuel conversion held by October 2004. Total 1,008 completed by August 2005; none further by December 2005, although aircraft up to 1,062 reserved.
COSTS: USD245,000; alcohol fuel retrofit USD25,000 (both 2005).
DESIGN FEATURES: Designed to Brazilian Ministry of Agriculture specifications. Typical agricultural aircraft features, including hopper ahead of pilot and high cockpit for good view over nose; low-mounted unbraced wings, with cambered leading-edges (detachable) and tips; rectangular-section fuselage; slightly sweptback vertical tail.
Wing section NACA 23015 (modified); incidence 3°; dihedral 7° from roots.
FLYING CONTROLS: Conventional and manual. Frise ailerons; trim tab in starboard elevator, ground-adjustable tab on rudder. Slotted flaps on wing trailing-edges.
STRUCTURE: All-metal safe-life fuselage frame of welded 4130 steel tube, with removable skin panels of 2024 aluminium alloy and glass fibre and specially treated against chemical corrosion. All-metal wings (single-spar) and tail surfaces (two-spar).
LANDING GEAR: Non-retractable mainwheels and tailwheel, with rubber shock-absorbers in main units. Tailwheel has tapered spring shock-absorber. Mainwheels and tyres size 8.50–10. Tailwheel diameter 250 mm (10 in). Tyre pressures: main, 2.07 to 2.41 bar (30 to 35 lb/sq in); tailwheel, 3.79 bar (55 lb/sq in). Hydraulic disc brakes on mainwheels.
POWER PLANT: One 224 kW (300 hp) Textron Lycoming IO-540-K1J5D flat-six engine, driving a Hartzell three-blade constant-speed metal propeller. Integral fuel tanks in each wing leading-edge, with total capacity of 292 litres (77.1 US gallons; 64.2 Imp gallons), of which 264 litres (69.75 US gallons; 58.1 Imp gallons) are usable. Refuelling point on top of each tank. Oil capacity 12 litres (3.2 US gallons; 2.6 Imp gallons).
ACCOMMODATION: Single horizontally/vertically adjustable seat in fully enclosed cabin with bottom-hinged, dual-lock, jettisonable window/door on each side and two overhead windows. Air conditioning and inertia reel shoulder harness standard.
SYSTEMS: 28 V DC electrical system supplied by 24 Ah batteries and a Bosch KI 28 V 70 A alternator. Power receptacle for external battery (AN-2552-3A type) on port side of forward fuselage.
AVIONICS: *Comms:* Optional portable VHF transceiver.
Flight: Optional portable Garmin GPS.
EQUIPMENT: Hopper for agricultural chemicals, capacity 950 litres (251 US gallons; 209 Imp gallons) liquid or 750 kg (1,653 lb) dry. Dusting system below centre of fuselage. Spraybooms or Micronair atomisers aft of or above wing trailing-edges respectively. Options include ram air pressure generator for use with liquid spray system; improved lightweight spraybooms; smaller/lighter Micronair AU5000 rotary atomisers; Swathmaster spreader.
DIMENSIONS, EXTERNAL:
Wing span ..... 11.69 m (38 ft 4¼ in)
Wing chord, constant ..... 1.71 m (5 ft 7½ in)
Wing aspect ratio 6.9
Length overall (tail up) ..... 7.43 m (24 ft 4½ in)
Height overall (tail down) ..... 2.20 m (7 ft 2½ in)
Fuselage: Max width ..... 0.93 m (3 ft 0½ in)
Tailplane span ..... 3.66 m (12 ft 0 in)
Wheel track ..... 2.20 m (7 ft 2½ in)
Wheelbase ..... 5.20 m (17 ft 7¼ in)
Propeller diameter ..... 2.13 m (7 ft 0 in)

Neiva EMB-202 Ipanema crop srpayer
1151692

DIMENSIONS, INTERNAL:
Cockpit: Length 1.20 m (3 ft 11¼ in)
Max width 0.85 m (2 ft 9½ in)
Max height 1.34 m (4 ft 4¾ in)
AREAS:
Wings, gross 19.94 m² (214.6 sq ft)
Ailerons (total) 1.60 m² (17.22 sq ft)
Trailing-edge flaps (total) 2.30 m² (24.76 sq ft)
Fin 0.58 m² (6.24 sq ft)
Rudder 0.63 m² (6.78 sq ft)
Tailplane 3.17 m² (34.12 sq ft)
Elevators (total, incl tab) 1.50 m² (16.15 sq ft)
WEIGHTS AND LOADINGS (N: Normal, R: Restricted category):
Weight empty: N, R 1,020 kg (2,249 lb)
Max payload: N, R 750 kg (1,653 lb)
Max T-O and landing weight: N 1,550 kg (3,417 lb)
R 1,800 kg (3,968 lb)
Max wing loading: N 77.7 kg/m² (15.92 lb/sq ft)
R 90.3 kg/m² (18.49 lb/sq ft)
Max power loading: N 6.92 kg/kW (11.39 lb/hp)
R 8.03 kg/kW (13.23 lb/hp)
PERFORMANCE (clean):
Never-exceed speed (VNE):
N 147 kt (272 km/h; 169 mph)
Max level speed at S/L:
N 124 kt (230 km/h; 143 mph)
R 121 kt (225 km/h; 140 mph)
Max cruising speed at 75% power at FL60:
N 115 kt (213 km/h; 132 mph)
R 111 kt (206 km/h; 128 mph)
Stalling speed, power off (N):
flaps up 56 kt (103 km/h; 64 mph)
8° flap 54 kt (100 km/h; 62 mph)
30° flap 50 kt (92 km/h; 57 mph)
Stalling speed, power off (R):
flaps up 60 kt (110 km/h; 68 mph)
8° flap 58 kt (107 km/h; 66 mph)
30° flap 53 kt (99 km/h; 61 mph)
Max rate of climb at S/L, 8° flap:
N 283 m (930 ft)/min
R 201 m (660 ft)/min
Service ceiling, 8° flap: R 3,470 m (11,380 ft)
T-O run at S/L, asphalt runway:
N 200 m (655 ft)
R 354 m (1,160 ft)
T-O to 15 m (50 ft), conditions as above:
N 332 m (1,090 ft)
R 564 m (1,850 ft)
Landing from 15 m (50 ft) at S/L, 30° flap, asphalt runway: N 412 m (1,355 ft)
R 476 m (1,565 ft)
Landing run, conditions as above: N 153 m (505 ft)
R 170 m (560 ft)
Range at FL60, no reserves:
N 506 n miles (938 km; 583 miles)
R 474 n miles (878 km; 545 miles)

Bulgaria

DAR

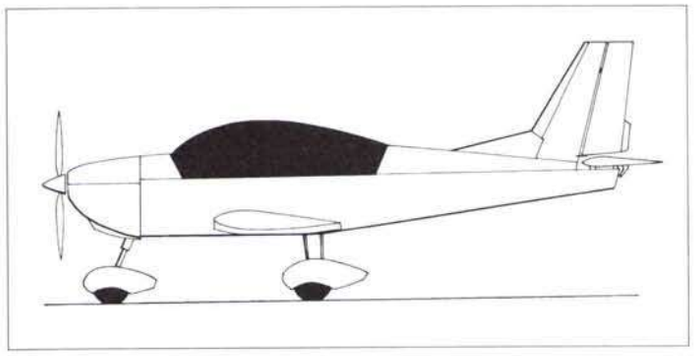
DAR SAMOLETI OOD (DAR AIRCRAFT LTD)

Mladost 103-A-49, Sofia 1797
Tel: (+359) 888 22 64 45
Fax: (+359) 28 70 38 93
e-mail: dar-info@dir.bg
Web: dar.dir.bg
MANAGER AND CO-OWNER: Tony Ilief
CHIEF DESIGNER AND CO-OWNER: Vesselin Valkanov

DAR's product line was expanded with the Impuls in 2003, although the company decided in 2005 to terminate the project because of unspecified "difficulties". Also in 2005, DAR announced it was working on designs called Courier, Speedster and Single, one of which is a low-wing, tricycle lightplane.

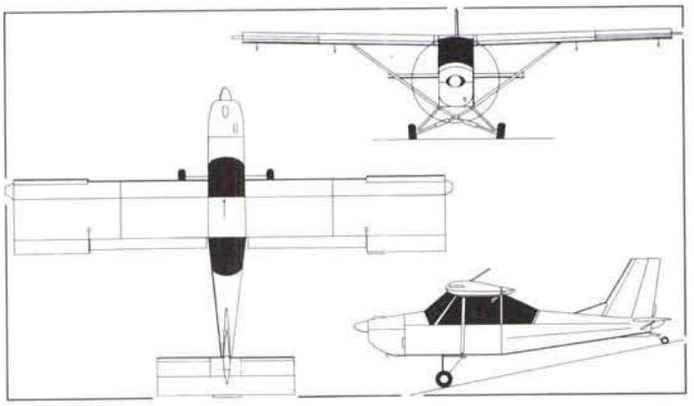
Production plants are at Gurmazovo Road, Sofia, and Iskar Industrial zone.

Company name revives initials of former Darjavna Aeroplanna Rabotilnitza (State Aircraft Factory), which produced trainers and a prototype light attack aircraft in late 1930s/early 1940s.



Unnamed aircraft under development by DAR 1151696

Prototype DAR-21 Vector with original landing gear 1151705



DAR-21 Vector tandem-seat ultralight *(Paul Jackson)* 0552994

DAR-21 VECTOR

TYPE: Tandem-seat ultralight.

PROGRAMME: Designed by Vesselin Valkanov. Prototype (LZ-DAP) first flew 20 May 2000, initially powered by a 39.0 kW (52.3 hp) Hirth 2704. Second aircraft, shown at Blois, France, September 2004, has spring cantilever main landing gear. Agricultural version marketed only in Bulgaria. A nosewheel variant and a DAR-21 Biplane were under development in 2005.

CURRENT VERSIONS: **DAR-21**: Prototype only.

DAR-21S: Production version. Spring cantilever main landing gear permitting carriage of ventral tank for agricultural spraying; larger fin fillet; increased wing span; downturned wingtips; and revised cabin glazing. Displayed at Blois, France, September 2004, prior to first flight.

DAR-21 Tropic: Employs 1050 and 3105 aluminium alloys with improved corrosion resistance. Wing span 8.00 m (26 ft 3 in); wing area 10.40 m² (111.9 sq ft); length 5.75 m (18 ft 10½ in); cockpit width 0.63 m (2 ft 0¾ in); AZUSA brakes and 5.00-5 tyres; 47.8 kW (64.1 hp) Rotax 582 two-stroke; max level speed 76 kt (140 km/h; 87 mph).

COSTS: USD50,000 (agricultural version, 2002).

DESIGN FEATURES: Conventional high-wing monoplane of angular appearance; constant-chord wing and tailplane, both strut-braced; sweptback fin; good all-round view from cockpit. Horizontal wingtip vanes and leading-edge slots outboard.

FLYING CONTROLS: Conventional and manual. Flaps (0, 15 and 30°). Trim tabs on starboard aileron and rudder; flight-adjustable (electric) tab on single-piece elevator. Aileron and rudder actuation by cables; elevator by pushrods. No aerodynamic balances.

STRUCTURE: Generally of 2024 and 6061 aluminium alloy sheet, with 4130 steel for welded elements and 4340 steel for milled and turned parts in landing gear. Composites engine cowling. Single-spar wing.

LANDING GEAR: Tailwheel type; fixed. Prototype fitted with two faired-in side Vs hinged to lower longerons, plus half-axles, each with bungee cord shock-absorber, attached to compression frame. Spring cantilever main legs and wheel fairings on later aircraft. Mainwheel size 6.00 standard; 8.00 optional. Steerable tailwheel. Matco wheels and Grove hydraulic brakes.

POWER PLANT: One piston engine driving a Powerfin F three-blade, composites propeller. Options include 59.7 kW (80 hp) Jabiru 2200; 59.6 kW (79.9 hp) Rotax 912 UL; 59.7 kW (80 hp) Quality Drive 1400; and 68.6 kW (92 hp) Simonini Victor 2. Provision for tank in each wing and fuselage, each 30 litres (7.9 US gallons; 6.6 Imp gallons); normal fuel 60 litres (15.8 US gallons; 13.2 Imp gallons). Standard fit is fuselage tank only.

ACCOMMODATION: Two pilots in tandem in enclosed, extensively glazed cockpit, with single door, starboard, to seats and baggage area to rear. Solo flight from front seat only.

EQUIPMENT: Optional Spray Miser spraying bars mounted at mainwheel leg roots.

DIMENSIONS, EXTERNAL:
Wing span ..... 9.42 m (30 ft 10¾ in)
Length overall ..... 6.35 m (20 ft 10 in)
Height overall ..... 1.80 m (5 ft 10¾ in)
DIMENSIONS, INTERNAL:
Cockpit max width ..... 0.68 m (2 ft 2¾ in)
AREAS:
Wings, gross ..... 12.43 m² (133.8 sq ft)
WEIGHTS AND LOADINGS (Rotax 912 engine):
Weight empty ..... 245 kg (540 lb)
Max T-O weight: option 1 ..... 450 kg (992 lb)
option 2 ..... 495 kg (1,091 lb)
PERFORMANCE (Rotax 912 engine):
Max level speed ..... 100 kt (185 km/h; 115 mph)
Cruising speed ..... 86 kt (160 km/h; 99 mph)
Stalling speed, flaps down ..... 32 kt (58 km/h; 36 mph)
Max rate of climb at S/L ..... 390 m (1,280 ft)/min
g limits ..... +4/−2

DAR-23 Aktsent prototype 1121683

DAR-23 AKTSENT

English name: Accent

TYPE: Side-by-side ultralight.

PROGRAMME: Prototype (LZ-DAS) flying by 2002; joined by second aircraft (LZ-DAF) early 2003. No known production, but promotion continuing in 2005.

COSTS: Available on application.

DESIGN FEATURES: Cabin pod underslung from boom carrying uncowled engine, wings and empennage. Wings braced to cabin; cabin braced to boom ahead of windscreen.

FLYING CONTROLS: Conventional and manual. Plain flaps. Flight adjustable elevator tab. No aerodynamic balances. Ailerons, elevator and flaps actuated by pushrods; rudder by cables.

STRUCTURE: Metal boom and composites cabin. Metal wings fabric-covered.

LANDING GEAR: Tricycle type; fixed. Tubular steel legs. Mainwheels Azusa 6.00. Cable mainwheel brakes.

POWER PLANT: One 34.0 kW (45.6 hp) Rotax 503 UL two-stroke driving a Powerfin two blade, composites propeller via 2.58:1 reduction gear. Fuel capacity 30 litres (7.9 US gallons; 6.6 Imp gallons).

ACCOMMODATION: Optional cover for cockpit.

DIMENSIONS, EXTERNAL:
Wing span ..... 8.00 m (26 ft 3 in)
Length overall ..... 5.00 m (16 ft 4¾ in)
Height at wing ..... 1.80 m (5 ft 10¾ in)
DIMENSIONS, INTERNAL:
Cockpit max width ..... 0.90 m (2 ft 11½ in)
AREAS:
Wings, gross ..... 10.40 m² (111.9 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 180 kg (397 lb)
Max T-O weight ..... 380 kg (837 lb)
PERFORMANCE:
Max level speed ..... 67 kt (125 km/h; 78 mph)
Max cruising speed ..... 51 kt (95 km/h; 59 mph)
Stalling speed, flaps down ..... 27 kt (50 km/h; 32 mph)
Endurance ..... 3 h
g limits ..... +4/−2

Canada

21ST CENTURY

21ST CENTURY AIRSHIPS INC

PO Box 177, Main Station, Newmarket, Ontario L3Y 4X1
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e-mail: info@21stcenturyairships.com
Web: www.21stcenturyairships.com
CHAIRMAN AND CEO: Hokan Colting

Formed 1988 as a privately owned R&D company aimed at improving airship technology, and has developed a new type of airship which is spherical and finless. Current airships have an internal cabin for crew and passenger(s); a hybrid Diesel-electric propulsion system with a low noise profile; amphibious ability to land on and take off from water; internal illumination for spectacular visuals during night flights; and a basic design suitable for a variety of tasks.

Eight airship prototypes have been built and flown in 11 different configurations, as listed in the accompanying table. They include the SPAS-62.5 which, on 12 June 2003, crewed by Hokan Colting and Tim Buss, set an absolute altitude record of 6,234 m (20,453 ft) in a flight from Drumheller, Alberta, to Gull Lake, Saskatchewan. Since 2004, the basic design has been

SPAS-62.5, one-time holder of absolute world record for altitude 1111647

SPAS-70-B internal cabin, looking rearwards from flight deck 0593265

Model	Reg'n	Seats	Engines (hp)	Diam (ft)	Vol (cu ft)	MTOW (lb)	Remarks
SPAS-1	C-FJHH	1	2 × 24	35	23,000	1,280	First manned spherical prototype; first flight 8 June 1991
SPAS-2	C-FMKK	1	4 × 2.5	33	18,700	1,166	First flight 15 March 1992; later re-engined as SPAS-3
SPAS-3	C-FMKK	1	2 × 5 + 1 × 24	33	18,700	1,166	SPAS-2 with new engine and control configuration; world altitude records in Classes BA-2 to BA-10 on 8 November 1992
SPAS-13	C-FRLM	2	2 × 50	43	41,500	2,400	Semi-rigid with internal frame for structure and engine support; internal flight deck. First flight 10 June 1994
SPAS-13-B	C-FRLM	2	2 × 50	43	41,500	2,400	Re-engineered without internal frame but with internal flight deck
SPAS-70	C-FYOK	2	4 × 100	56	91,000	5,300	Four piston engines; first flight 5 September 1996
SPAS-70-B	C-FYOK	2	2 × 90	56	91,000	5,300	Re-engined with two turbo-diesel engines driving 13 ft diameter propeller; stub wings redesigned. First flight 5 August 1997
SPAS-R1	C-GJKI	4	2 × 90	60	112,000	5,830	First flight 30 June 2002
SPAS-62.5	C-FZRY	2	2 × 80	62.5	126,700	7,480	Absolute world altitude record for airships, 12 June 2003. As of September 2004 (latest information received), was being converted to a hybrid-electric propulsion system with propellers driven by turbo-diesel diesel-generators
SPAS-70-1A	N8041X	2	2 × 80 + 1 × 60	62.5	126,700	7,480	Built for TSI as SA-60. First flight 24 June 2004 with temporary propulsion system. Converted to hybrid-electric propulsion system in September 2004
SPAS-396	C-FAUP	1	2 × 5	30	13,860	825	Used solely for testing a new buoyancy control system for long-duration flights

SPAS-70-B during test flights in 2002 0593258

Hybrid electric propulsion control panel of the SPAS-70-B 0593267

refined for: (1) a high-altitude platform for telecommunications (cellular phones, microwave and broadband) and national security applications; (2) sightseeing flights; (3) aerial advertising; and (4) heavy lifting.

In 2003, manufacturing and sales rights to certain types of 21st Century spherical airship designs were sold to Techsphere Systems International of Atlanta, Georgia, USA (TSI, which see), for whom a SPAS-70-1A was built as a prototype under the new name AeroSphere SA-60.

AIRSTART

AIRSTART CORPORATION

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*e-mail:*griffin@airstart.com
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POSTAL ADDRESS: 11760 109th Street, Edmonton, Alberta T5G 2T8
CEO: Ron Wunder
VICE-PRESIDENT, SALES AND MARKETING: William (Bill) Crampton

Following refinancing, the former Canada Air RV company was reorganised. Manufacturing is now undertaken by AC Millennium Corporation, and Sales and Marketing by AirStart Corporation. Research and development is undertaken by ARV Development Corporation. The Griffin is at present available only in North America; research and development continues under the aegis of ARV Development Corporation; no recent information received.

AIRSTART GRIFFIN

TYPE: Side-by-side kitbuilt.
PROGRAMME: Design work started January 1989; construction of first prototype Griffin I began September 1989; first flight 1993. Construction of Mark II began 1995 with first flight that year; Mark III first flown 1997 followed by Mark IV first flight October 1998. First kit delivered 4 January 1996.
CURRENT VERSIONS: **Griffin III:** Lower-powered version; no longer available.

Airstart Griffin IV 1042704

Griffin IV: Baseline version, *as described*.
CUSTOMERS: Total of 72 ordered and nine flying by end 2004 including four in Canada and two in USA (latest information received).
COSTS: Kit CAD28,900 excluding engine, propeller and instruments (2005). Estimated design/programme cost USD3.5 million to date.
DESIGN FEATURES: High-wing monoplane. Good all-round visibility, including roof windows, enhanced by instrument panel positioned low in cockpit and convex side windows. Quoted build time 800 hours.
FLYING CONTROLS: Manual. Full-span continuously positionable flaperons deflect to 20° and also reflex slightly for cruise drag reduction. Electrically operated full-span trim on port elevator.
STRUCTURE: All-aluminium semi-monocoque fuselage and wings; elevator and rudder are fabric-covered. Single-strut laminar flow high-aspect ratio wing; thickness/chord ratio 19 per cent. Wing dihedral 1° 30'. Low-mounted tailplane.
LANDING GEAR: Choice of fixed tricycle or tailwheel layout. Fuselage-mounted spring aluminium cantilever mainwheel legs. Tricycle version has oleo-pneumatic nosewheel suspension. Tailwheel version has steerable Matco 11 cm (4½ in) tailwheel. Matco disc brakes. Mainwheels and nosewheel Matco 6.00–6, all tyres pressurised to 2.9 bar (42 lb/sq in).
POWER PLANT: *Griffin IV:* One 119 kW (160 hp) Textron Lycoming O-320 flat-four engine, driving a two-blade fixed-pitch wooden propeller in demonstrator; engines in range 74.6 to 119 kW (100 to 160 hp) can be fitted including 59.6 kW (79.9 hp) Rotax 912 and 74.6 kW (100 hp) Teledyne Continental O-200A.
Griffin III: 74.6 kW (100 hp) CAM 100 piston engine.
Fuel capacity 136 litres (35.9 US gallons; 29.9 Imp gallons) in two wing tanks. Oil capacity 8 litres (2.1 US gallons; 1.8 Imp gallons).
ACCOMMODATION: Pilot and passenger in side-by-side seating with dual controls. Upward-opening door on each side of fuselage. Baggage stowage behind seats.
DIMENSIONS, EXTERNAL:

Wing span	10.82 m (35 ft 6 in)
Wing chord: at root	1.23 m (4 ft 0½ in)
at tip	0.74 m (2 ft 5 in)
Wing aspect ratio	11.0
Length overall	6.25 m (20 ft 6 in)
Fuselage max width	1.09 m (3 ft 7 in)
Height overall: tricycle	2.44 m (8 ft 0 in)
Tailplane span	2.54 m (8 ft 4 in)
Wheel track	2.44 m (8 ft 0 in)
Wheelbase: tricycle	2.44 m (8 ft 0 in)
Propeller diameter	1.83 m (6 ft 0 in)
Propeller ground clearance: tricycle	0.26 m (10¼ in)
Passenger doors (each): Height	0.76 m (2 ft 6 in)
Width	0.76 m (2 ft 6 in)

DIMENSIONS, INTERNAL:
- Cabin: Length ..... 1.07 m (3 ft 6 in)
- Max width ..... 1.09 m (3 ft 7 in)
- Max height ..... 1.07 m (3 ft 6 in)
- Floor area ..... 1.28 m² (13.8 sq ft)

Baggage hold volume ..... 0.51 m³ (18.0 cu ft)

AREAS:
- Wings, gross ..... 10.68 m² (115.0 sq ft)
- Rudder ..... 0.55 m² (5.90 sq ft)
- Tailplane ..... 1.89 m² (20.34 sq ft)
- Elevator ..... 1.01 m² (10.87 sq ft)

WEIGHTS AND LOADINGS (with 119 kW; 160 hp engine):
- Weight empty ..... 490 kg (1,080 lb)
- Baggage capacity ..... 91 kg (200 lb)
- Max T-O and landing weight:
  - Griffin IV ..... 785 kg (1,731 lb)
- Max zero-fuel weight ..... 682 kg (1,503 lb)
- Max wing loading ..... 73.7 kg/m² (15.09 lb/sq ft)
- Max power loading ..... 6.60 kg/kW (10.84 lb/hp)

PERFORMANCE (with 119 kW; 160 hp engine):
- Never-exceed speed (VNE):
  - Griffin IV ..... 144 kt (266 km/h; 165 mph)
- Max operating speed (VMO):
  - Griffin IV ..... 141 kt (261 km/h; 162 mph)
- Max cruising speed at 75% power:
  - Griffin IV ..... 130 kt (241 km/h; 150 mph)
- Econ cruising speed ..... 114 kt (211 km/h; 131 mph)
- Stalling speed ..... 40 kt (73 km/h; 45 mph)
- Max rate of climb at S/L ..... 396 m (1,300 ft)/min
- Service ceiling ..... 5,485 m (18,000 ft)
- T-O run ..... 107 m (350 ft)
- Landing run ..... 183 m (600 ft)
- Range with max fuel ..... 565 n miles (1,046 km; 650 miles)

BELL

BELL HELICOPTER TEXTRON CANADA (DIVISION OF TEXTRON CANADA LTD)

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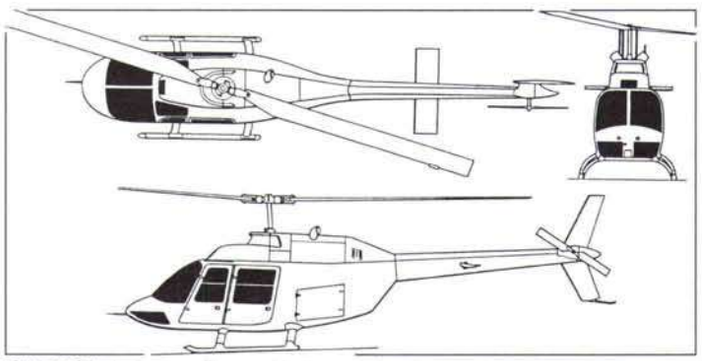
Memorandum of Understanding to start helicopter industry in Canada signed 7 October 1983; 38,900 m² (418,725 sq ft) factory opened late 1985 and employs 1,700 people; US civil production of 206B JetRanger transferred to Canada in 1986, 206L LongRanger by early 1987; then 212 in 1988 and 412 in 1989. The 230 was introduced and certified in Canada in 1992, but has been replaced by the 430. Newest products are the 407 and 427. About half of each helicopter made in Canada (dynamic systems supplied by Bell Fort Worth). Total of 233 commercial helicopters delivered in 1997, followed by 197 in 1998, 146 in 1999, 145 in 2000, 122 in 2001 92 in 2002, 97 in 2003, and 109 in 2004. Deliveries in 2005 were 105 commercial and 18 military, not including 19 Bell Boeing V-22 Ospreys.



Bell 206B-3 JetRanger five-seat helicopter *(Paul Jackson)* 0507574

BELL 206B-3 JETRANGER III

US Army designation: TH-67 Creek

TYPE: Light utility helicopter.

PROGRAMME: Model 206 first flew (N73999) 8 December 1962 and unsuccessfully offered to US Army as four-seat OH-4 with Allison 250-C10 turboshaft and 1,134 kg (2,500 lb) MTOW; certified by FAA on 28 April 1964, but only five YOH-4As built. Redesigned as five-seat Model 206A Jet Ranger, with 236 kW (317 hp) Allison 250-C18 engine and 3,000 lb MTOW; first flown (N8560F) 10 January 1966; certified 20 October 1966. Model 206A-1, with longer main blades and re-shaped rear windows, certified 6 May 1969 and built as OH-58A/B Kiowa (of which several civilianised under former designation) and TH-57A Sea Ranger.

Model 206B Jet Ranger II certified 19 August 1971, with 236 kW (317 hp) Allison 250-C20 engine and 3,200 lb MTOW (some 206As retrofitted); Model 206B-1 certified 10 November 1971 but produced only for Australia; Model 206B-2 introduced 1976 and 206B-3 in mid-1977, latter with Allison (later Rolls Royce) 250-C20J power plant which originally certified for Bell 206L; also built for US Navy as TH-57B/C. Production transferred from Fort Worth, Texas, to Mirabel, Canada, in 1986, beginning with c/n 3959. Increase of 68 kg (150 lb) in payload announced in January 2004.

CURRENT VERSIONS: **206B-3 JetRanger III**: Current civil production version.

Following description refers to JetRanger III.

TH-67 Creek (Bell designation TH-206): Selected March 1993 as US Army NTH (New Training Helicopter) choice to replace UH-1 at pilot training school, Fort Rucker, Alabama (223 Aviation Regiment at Cairns AAF and 212 Aviation Regiment at Lowe AHP). Instructor and pupil in front seats; plans abandoned for second pupil to be seated at the rear, observing flight instruments by closed-circuit TV screen mounted on back of right-hand front seat. Powered by Rolls-Royce (formerly Allison) 250-C20JN engine. First batch included nine cockpit procedures trainers outfitted by Frasca International; three configurations: VFR, IFR, and VFR with IFR provision.

TH 67 features also include dual controls, crashworthy seats, five-point seat restraints, heavy-duty battery, particle separator, bleed air heater, heavy-duty skid shoes and enlarged instrument panel. IFR version additionally possesses force trim system, auxiliary electrical system and is FAA certified for dual pilot operation. Also supplied to Taiwan Army, based at Gwe-Ren.

CUSTOMERS: TH-206 (TH-67 Creek) declared winner of US Army NTH competition March 1993; initial 102 ordered in IFR configuration; second batch of 35 VFR helicopters ordered February 1994; deliveries began 15 October 1993 with N67001 and N67014 (all TH-67s have civilian registrations); 45 aircraft (and six procedures trainers) delivered in time for first training course to open 5 May 1994; initial orders 137 TH-67s and nine cockpit procedures trainers; all delivered by late 1995. Additional orders placed on behalf of Taiwanese Army, which received 30 TH-67s in 1997-99. Deliveries in 1999 included six to the Bulgarian Air Force. Further 50 ordered for US Army for delivery between September 2001 and November 2003. Recent customers include Fort Worth Police Air Support Division of Texas, which took delivery of one at Heli-Expo 2004 in Las Vegas in March 2004, replacing an earlier JetRanger.

Production of Model 206 (not including four-blade Model 406s) up to January 2006 has comprised five YOH-4As, 713 Model 206As, 2,202 Model 206A-1/OH-58s, 74 Canadian CH-136/OH-58As, 56 Australian CA-32/OH-58As, 40 TH-57As, 50 OH-58Bs, 217 TH-67As, 1,177 Model 206Bs, 321 Model 206B-2s and some 2,384 Model 206B-3s, while further 911 Jet Rangers built by Agusta in Italy. Total 8,150. Bell Canada delivered 28 206Bs in 1999; 14 in both 2000 and 2001; 20 in 2002 (including 10 TH-67s), 30 in 2003 (including 20 TH-67s), eight in 2004 (including one TH-67) and 16 (10 civil, six military) in 2005.

Bell 206B-3 JetRanger III *(Paul Jackson)* 1151691

COSTS: US Army initial NTH contract USD84.9 million. Average direct operating cost USD221.47 per hour (2004).

DESIGN FEATURES: Typical light utility helicopter with skid landing gear, high-mounted tailboom and horizontal stabiliser. Two-blade teetering main rotor with preconed and underslung bearings; blades retained by grip, pitch change bearing and torsion-tension strap assembly; two-blade tail rotor driven via 2.3:1 reduction gearbox; main rotor rpm 374 to 394.

FLYING CONTROLS: Hydraulic fully powered cyclic and collective controls and foot-powered tail rotor control; tailplane with highly cambered inverted aerofoil section and stall strip produces appropriate nose-up and nose-down attitude during climb and descent; optional autostabiliser, autopilot and IFR systems.

STRUCTURE: Conventional light alloy structure with two floor beams and bonded honeycomb sandwich floor; transmission mounted on two beams and deck joined to floor by three fuselage frames; main rotor blades have extruded aluminium D-section leading-edge with honeycomb core behind, covered by bonded skin; tail rotor blades have bonded skin without honeycomb core.

LANDING GEAR: Aluminium alloy tubular skids bolted to extruded cross-tubes. Tubular steel skid on ventral fin to protect tail rotor in tail-down landing. Ground handing wheels optional. Special high skid gear (0.25 m; 10 in greater ground clearance) available for use in areas with high brush. Pontoons or lightweight pop-out floats, available as optional kits.

POWER PLANT: One Rolls-Royce 250-C20J turboshaft, rated at 313 kW (420 shp) for T-O; 276 kW (370 shp) max continuous. Optionally, one Rolls-Royce 250-C20R/4 rated at 336 kW (450 shp) for T-O. Transmission rating 236 kW (317 shp) for T-O; 201 kW (270 shp) continuous. Rupture-resistant fuel tank below and behind rear passenger seat, usable capacity 344 litres (91.0 US gallons; 75.75 Imp gallons). Refuelling point on starboard side of fuselage, aft of cabin. Oil capacity 5.68 litres (1.5 US gallons; 1.25 Imp gallons).

ACCOMMODATION: Two seats side by side in front and rear bench comprising three equal-width seats. Corporate interior optional. Dual controls optional. Two forward-hinged doors on each side, made of formed aluminium alloy with transparent panels (bulged on rear pair). Baggage compartment aft of rear seats, capacity 113 kg (250 lb), with external door on port side.

SYSTEMS: Hydraulic system, pressure 41.5 bar (600 lb/sq in), for cyclic, collective and directional controls. Maximum flow rate 7.57 litres (2.0 US gallons; 1.65 Imp gallons)/min. Open reservoir. Electrical supply from 150 A starter/generator. One 28 V 17 Ah Ni/Cd battery; auxiliary 13 Ah battery optional. Optional ECS.

AVIONICS: *Comms:* Optional Bendix/King VHF communications, transponder, intercom and speaker system.

Flight: VOR, ADF, DME and R/Nav optional.

EQUIPMENT: Standard equipment includes cabin fire extinguisher, first aid kit, door locks, night lighting, and dynamic flapping restraints. Optional items include clock, engine hour meter, turn and slip indicator, custom seating, soundproofing, internal stretcher kit, rescue hoist, cabin heater, snow baffle, camera access door, high-intensity night lights, SX-16C NightSun searchlight, engine fire detection system, wire-strike protection kit and external cargo hook of 680 kg (1,500 lb) capacity.

DIMENSIONS, EXTERNAL:

Main rotor diameter	10.16 m (33 ft 4 in)
Main rotor blade chord	0.33 m (1 ft 1 in)
Tail rotor diameter	1.65 m (5 ft 5 in)
Tail rotor blade chord	0.12 m (4¾ in)
Distance between rotor centres	5.96 m (19 ft 6½ in)
Length: overall, rotors turning	11.96 m (39 ft 2¾ in)
fuselage, incl tailskid	9.89 m (32 ft 5¼ in)
Height: over tailfin	2.54 m (8 ft 4 in)
to top of rotor head:	
standard skids	2.89 m (9 ft 6 in)
high skids	3.17 m (10 ft 4¾ in)
emergency floats	3.20 m (10 ft 6 in)
Stabiliser: span	1.97 m (6 ft 5¾ in)
chord	0.46 m (1 ft 6 in)
Width over landing gear:	
standard skids	1.92 m (6 ft 3½ in)
high skids	2.07 m (6 ft 9½ in)
emergency floats	2.68 m (8 ft 9½ in)
Fuselage ground clearance:	
standard skids	0.30 m (1 ft 0 in)
high skids	0.58 m (1 ft 10¾ in)
emergency floats	0.64 m (2 ft 1¼ in)
Forward cabin doors (each): Height	1.02 m (3 ft 4 in)
Width	0.61 m (2 ft 0 in)
Rear cabin doors (each): Height	1.02 m (3 ft 4 in)
Width	0.91 m (3 ft 0 in)

DIMENSIONS, INTERNAL:

Cabin: Length of seating area	2.13 m (7 ft 0 in)
Max width	1.27 m (4 ft 2 in)
Max height	1.28 m (4 ft 3 in)
Volume	1.1 m^3 (40 cu ft)
Baggage compartment:	
Max width	1.10 m (3 ft 7¼ in)
Max height	0.55 m (1 ft 9½ in)
Max length	0.94 m (3 ft 1¼ in)
Volume	approx 0.45 m^3 (16 cu ft)

AREAS:

Main rotor blades (each)	1.68 m^2 (18.05 sq ft)
Tail rotor blades (each)	0.11 m^2 (1.18 sq ft)
Main rotor disc	81.07 m^2 (872.7 sq ft)
Tail rotor disc	2.14 m^2 (23.05 sq ft)
Stabiliser	0.90 m^2 (9.65 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: standard civil	777 kg (1,713 lb)
TH-67: VFR	852 kg (1,879 lb)
IFR	911 kg (2,009 lb)
Operating weight, TH-67: VFR	1,369 kg (3,019 lb)
IFR	1,428 kg (3,149 lb)
Max payload: internal	676 kg (1,490 lb)
external	680 kg (1,500 lb)
Max T-O weight: internal load, standard	1,451 kg (3,200 lb)
internal load optional and external load	1,519 kg (3,350 lb)
Max disc loading:	
internal load	17.9 kg/m^2 (3.67 lb/sq ft)
external load	18.7 kg/m^2 (3.84 lb/sq ft)
Transmission loading at max T-O weight and power:	
internal load	6.15 kg/kW (10.09 lb/shp)
external load	6.43 kg/kW (10.57 lb/shp)

PERFORMANCE (at internal load max T-O weight, ISA):

Never-exceed speed (VNE) at S/L	122 kt (225 km/h; 140 mph)
Max and econ cruising speed at S/L	115 kt (214 km/h; 133 mph)
Max rate of climb at S/L	411 m (1,350 ft)/min
Vertical rate of climb at S/L	91 m (300 ft)/min
Service ceiling	4,115 m (13,500 ft)
Hovering ceiling: IGE	4,025 m (13,200 ft)
OGE	1,615 m (5,300 ft)
Range with max fuel, no reserves:	
at S/L	374 n miles (692 km; 430 miles)
at FL50	395 n miles (732 km; 455 miles)
Range, max fuel, long-range cruising speed	374 n miles (692 km; 430 miles)
Endurance	4 h 30 min

OPERATIONAL NOISE LEVELS (FAR Pt 36):

T-O	88.7 EPNdB
Flyover	85.4 EPNdB
Approach	90.6 EPNdB

BELL 206L-4 LONGRANGER IV

TYPE: Light utility helicopter.

PROGRAMME: Stretched JetRanger. LongRanger announced 25 September 1973; first flight (N206L) 11 September 1974; initial versions were 206L (certified 22 September 1975, 1,814 kg; 4,000 lb MTOW) and 206L-1 LongRanger II (certified 17 May 1978, 1,837 kg; 4,050 lb (internal) MTOW); plus limited production of 206L-2 (derated 186 kW; 250 shp engine). Model 206L-3 LongRanger III certified 10 December 1981 with -C30P engine derated to 324 kW (435 shp) and 1,882 kg (4,150 lb) MTOW. Production having transferred to Canada in January 1987.

CURRENT VERSIONS: **LongRanger IV:** Announced March 1992 as new current standard model; transmission uprated to absorb 365 kW (490 shp) instead of 324 kW (435 shp) from same engine; gross weight raised from 1,882 kg (4,150 lb) to 2,018 kg (4,450 lb); certified 2 October 1992 and delivered from December that year.

TwinRanger: Twin-engined version; model **206LT;**13 built on LongRanger IV line between 1993 and 1997. No longer available.

Gemini ST: Twin-engined rebuild of LongRanger III/IV developed by Tridair and Soloy in USA; see *Jane's Aircraft Upgrades*.

CUSTOMERS: Production up to early 2006 totalled 153 Model 206Ls, 637 Model 206L-1s, 17 Model 206L-2s, 612 Model 206L-3s (final 398 at Mirabel) and 321 Model 206L-4s (and LTs) or 1,740 in all. Total of 12 delivered in 1999, 27 in 2000, 10 in 2001, 12 in 2002, six in 2003, 18 in 2004 and 22 in 2005. Recent customers include Rotorcraft Leasing LLC of Louisiana, which ordered six in February 2005 for delivery in the third and fourth quarters of 2005.

COSTS: Average direct operating cost USD280.47 per hour (2004).

DESIGN FEATURES: As JetRanger, but cabin length increased to make room for club seating and extra window; Bell Noda-Matic transmission to reduce vibration; vertical stabilisers added to horizontal tail surfaces. Improvements introduced on LongRanger II include new freewheel unit, modified shafting and increased-thrust tail rotor; main rotor rpm 394; rotor brake optional.

FLYING CONTROLS: As JetRanger, but with endplate fins on tailplane; single-pilot IFR with Rockwell Collins AP-107H autopilot; optional SFENA autopilot with stabilisation and holds for heading, height and approach.

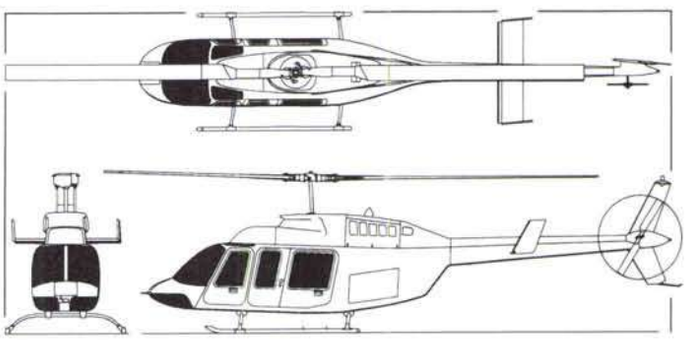
STRUCTURE: As JetRanger.

LANDING GEAR: As JetRanger.

POWER PLANT: One 541 kW (726 shp) Rolls-Royce 250-C30P turboshaft (maximum continuous rating 470 kW; 630 shp). Transmission rated at 365 kW (490 shp) for take-off, with a continuous rating of 276 kW (370 shp); 340 kW (456 shp) transmission optional. Rupture-resistant fuel system, comprising three interconnected cells, total usable capacity 419 litres (111 US gallons; 92.0 Imp gallons).

ACCOMMODATION: Redesigned rear cabin, more spacious than JetRanger. With a crew of two, standard cabin layout accommodates five passengers in two canted rearward-facing seats

Bell 206L LongRanger *(Paul Jackson)* 1151690



Bell 206L-4 LongRanger IV general purpose light helicopter *(Paul Jackson)* 1151699

and three forward-facing seats. Optional DeLuxe and Custom DeLuxe interiors with fabric, fabric/vinyl, all vinyl or fabric/leather seats. Port forward passenger seat has folding back to allow loading of a 2.44 × 0.91 × 0.30 m (8 × 3 × 1 ft) container, making possible carriage of such items as survey equipment, skis and other long components. Double doors on port side of cabin provide opening 1.55 m (5 ft 1 in) wide, for straight-in loading of stretcher patients or utility cargo; in ambulance or rescue role two stretcher patients and two ambulatory patients/attendants can be carried. Dual controls optional.

SYSTEMS: Hydraulic system: 28 V DC electrical power from 180 A starter/generator and 17 Ah battery. Engine bleed air ECS optional.

AVIONICS: *Comms:* Bendix/King suite includes dual nav/com and transponder.

Flight: ADF, DME and marker beacon receiver. Honeywell R/Nav, radio altimeter and encoding altimeter optional.

EQUIPMENT: Optional kits include emergency flotation gear, 907 kg (2,000 lb) cargo hook, rescue hoist, NightSun searchlight (requires high skid gear).

DIMENSIONS, EXTERNAL:

Main rotor diameter	11.28 m (37 ft 0 in)
Main rotor blade chord	0.33 m (1 ft 1 in)
Tail rotor diameter	1.65 m (5 ft 5 in)
Tail rotor blade chord	0.135 m (5¼ in)
Length: overall, rotors turning	12.92 m (42 ft 4¾ in)
fuselage, incl tailskid	10.55 m (34 ft 7¼ in)
Height: over tailfin	3.05 m (10 ft 0 in)
to top of rotor head	3.14 m (10 ft 3¾ in)
Fuselage: Max width	1.32 m (4 ft 4 in)
Stabiliser span	1.98 m (6 ft 6 in)
Width over skids, under load	2.34 m (7 ft 8 in)
Forward cabin doors (each): Height	1.04 m (3 ft 5 in)
Max width	0.61 m (2 ft 0 in)
Centre cabin door (port): Height	1.04 m (3 ft 5 in)
Width	0.64 m (2 ft 1¼ in)
Rear cabin doors (each): Height	1.04 m (3 ft 5 in)
Width	0.91 m (3 ft 0 in)
Baggage door: Height	0.55 m (1 ft 9½ in)
Width	0.94 m (3 ft 1¼ in)

DIMENSIONS, INTERNAL:

Cabin: Length	2.74 m (9 ft 0 in)
Max width and height	as JetRanger
Volume	2.4 m³ (83 cu ft)
Cabin cargo volume (all passenger seats removed)	2.83 m³ (100 cu ft)
Baggage compartment volume	0.45 m³ (16.0 cu ft)

AREAS:

Main rotor disc	99.89 m² (1,075.2 sq ft)
Tail rotor disc	2.13 m² (22.97 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, standard	1,056 kg (2,327 lb)
useful load, standard	963 kg (2,123 lb)
Max external load	907 kg (2,000 lb)
Max T-O weight: normal	2,018 kg (4,450 lb)
external load	2,064 kg (4,550 lb)
Max disc loading: normal	20.7 kg/m² (4.23 lb/sq ft)
external load	19.3 kg/m² (3.95 lb/sq ft)
Transmission loading at max T-O weight and power:	
internal load	5.52 kg/kW (9.08 lb/shp)
external load	5.65 kg/kW (9.29 lb/shp)

PERFORMANCE (at max normal T-O weight, ISA):

Never-exceed speed (VNE):	
at S/L	130 kt (241 km/h; 150 mph)
at FL50	133 kt (246 km/h; 153 mph)
Max cruising speed: at S/L	110 kt (204 km/h; 127 mph)
at FL50	111 kt (206 km/h; 128 mph)
Max rate of climb at S/L	408 m (1,340 ft)/min
Service ceiling at max cruise power	3,050 m (10,000 ft)
Hovering ceiling: IGE	3,050 m (10,000 ft)
OGE	1,980 m (6,500 ft)
Range with max fuel, no reserves:	
at S/L	324 n miles (600 km; 372 miles)
at FL50	357 n miles (661 km; 411 miles)
Endurance	3 h 42 min

OPERATIONAL NOISE LEVELS (FAR Pt 36):

T-O	88.4 EPNdB
Flyover	85.2 EPNdB
Approach	90.7 EPNdB

BELL 407

TYPE: Light utility helicopter.

PROGRAMME: Design definition launched in 1993 as Bell Light Helicopter to supplement, and eventually replace, JetRanger and LongRanger; concept demonstrator Model 407 (N407LR) first flown 21 April 1994 (standard Bell 206L-3 modified with tailboom and dynamic system of military OH-58D, plus sidewall fairings to simulate broader fuselage); programme first revealed at Heli-Expo '95, Las Vegas, January 1995. Two prototype/preproduction 407s (C-GFOS and C-FORS) first flown on 29 June and 13 July 1995, respectively; first production airframe (C-FWQY/N407BT) flown 10 November 1995. Transport Canada certification 9 February 1996, with FAA certification same day, as extension of Bell 206 certificate; first customer delivery at Heli-Expo '96, Dallas, in February. MoU of June 1996 provided for licensed assembly and marketing by Dirgantara (formerly IPTN) of Indonesia.

Law Enforcement Demonstrator being promoted from 2002 features bubble windows, NightSun searchlights and FLIR, equipped by Edwards and Associates of Bristol, Tennessee.

Improvements under consideration in late 2003 included night vision goggles (NVG) qualification, and extended maintenance intervals aimed at reducing operating costs.

CURRENT VERSIONS: **Bell 407:** *As described.*

Bell ARH: *Described separately.*

CUSTOMERS: Launch customers Petroleum Helicopters, Niagara Helicopters and Greenland Air. The 500th production Bell 407 was delivered in October 2001 to Pabst Air, Germany; 700th exported to Guatemala in October 2006. Fleet time in October 2004 totalled more than 1,170,000 hours, with two high-time airframes exceeding 10,000 hours each.

Law enforcement operators include Tampa Police Department, Florida; Palm Beach County Sheriff's Office; and the State Police Departments of Connecticut, Delaware (four, of which last delivered in early 2004), Louisiana, New York and Virginia. Recent customers include Air Methods Corporation of Englewood, Colorado, which took delivery of two in June 2003, bringing its fleet total to 20; Anne Arundel County Police Department (one); The Flitner Ranch of Wyoming (one); L E Jones Production Company of Duncan, Oklahoma (one); Life Flight Eagle of Kansas City, Missouri (two); Med-Trans Corporation of Bismarck, North Dakota (five, supplementing existing fleet of 14 Bell 407s and two JetRangers); Petroleum Helicopters Inc (six ordered in February 2005 for delivery in first quarter, bringing total fleet of 407s to 45); Rotorcraft Leasing, LLC (two, delivered by April 2004); and Las Vegas Helicopters (one). Selected by US Drug Enforcement Agency for its light utility helicopter requirement. Total of 62 delivered in 1999, 62 in 2000, 47 in 2001, 33 in 2002, 46 in 2003, 40 in 2004, and 41 in 2005.

COSTS: USD1.37 million (1999) flyaway. Average direct operating cost USD365.03 per hour (2004). Development cost estimated as USD50 million, of which USD9 million provided by Canadian government.

DESIGN FEATURES: As for JetRanger and LongRanger. Based on Bell 206L-4 LongRanger fuselage with cabin widened by 17.8 cm (7 in); 35 per cent larger cabin window area; Litton LCD active matrix cockpit displays; all-composites four-blade main rotor based on that of OH-58D, with soft-mounted pylon isolation system; single Rolls-Royce 250-C47 turboshaft; enlarged vertical stabilisers. 'Ring-fin' shrouded rotor tested in 1995 as possible future option. Rotor speed 413 rpm.

STRUCTURE: Generally as for LongRanger, but with carbon fibre tailboom and flush-fitting cabin door windows and skylights.

LANDING GEAR: LongRanger unit modified to match new rotor's ground-resonance characteristics, and with rear cross-tube pivoted in centre between outboard damping pads. High skids, low skid fairings and pop-out floats, optional.

POWER PLANT: One Rolls-Royce 250-C47B turboshaft rated at 606 kW (813 shp) for T-O, 523 kW (701 shp) maximum continuous; transmission rating 503 kW (674 shp) for T-O, 470 kW (630 shp) continuous operation. Single-channel FADEC standard. Standard usable fuel capacity 484 litres (128 US gallons; 106.6 Imp gallons); optional auxiliary fuel tank in aft baggage compartment, usable capacity 72 litres (19 US gallons; 15.8 Imp gallons); oil capacity 5.7 litres (1.5 US gallons; 1.25 Imp gallons). 'Quiet Cruise' system, in development in early 1997, reduces flyover noise level by using FADEC to reduce rotor rpm to 90 to 93 per cent in the cruise, with accompanying reduction in VNE to 110 kt (204 km/h; 126 mph).

ACCOMMODATION: With a crew of two, standard cabin layout accommodates five passengers in two rearward-facing seats with centre armrest/console, and three forward-facing seats, all fabric-covered. Optional utility cabin has vinyl-covered seats; corporate interior features two extra-wide forward-facing seats in the outboard positions, an occasional-use seat in the centre and additional soundproofing. Supplementary type certificate awarded in November 2006 for Aeronautical Accessories Hi-Visibility doors with increased transparency area.

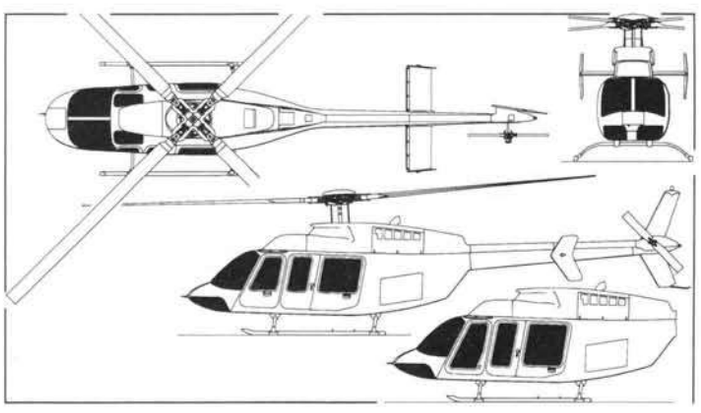
SYSTEMS: Electrical system, includes 28 V 17 Ah Ni/Cd battery and 180 A starter generator

AVIONICS: Bendix/King suite options to customer's choice include KX 155 and KX 165 nav/com, KY 196A VHF, KT 70 and KY 76A transponder, KR 87 ADF, KLN 89B GPS, KCS 55A compass system and ELT.

DIMENSIONS, EXTERNAL:

Main rotor diameter	10.67 m (35 ft 0 in)
Main rotor blade chord	0.27 m (10¾ in)
Tail rotor diameter	1.65 m (5 ft 5 in)
Tail rotor blade chord	0.16 m (6½ in)
Length: overall, rotors turning	12.74 m (41 ft 9½ in)
rotor in X configuration	11.16 m (36 ft 7¼ in)[1]
fuselage	10.58 m (34 ft 8½ in)
Stabiliser span over endplate fins	2.22 m (7 ft 3½ in)

Bell 407 light utility helicopter *(Peter J Cooper/Falcon Aviation)* 1040561



Bell 407 seven-seat light helicopter, with scrap view of Hi-Visibility door version *(Paul Jackson)* 1158941

Aeronautical Accessories Hi-Visibility doors, incorporating larger transparencies, fitted to Bell 407 1040565

Bell 407 of Titan Airways, based at Stansted, UK *(Paul Jackson)* 1043850

Height: over tailfin	3.10 m (10 ft 2 in)
overall: low skids	3.11 m (10 ft 2½ in)
high skids	3.32 m (10 ft 10¾ in)
Ground clearance:	3.10 m (10 ft 2 in)
low skids	0.41 m (1 ft 4 in)
high skids	0.62 m (2 ft 0½ in)
Width: over skids	2.29 m (7 ft 6 in)
rotor in X configuration	7.65 m (25 ft 1¼ in)
Rear cabin door:	
Width: port	1.55 m (5 ft 1 in)
starboard	0.91 m (3 ft 0 in)
Height to sill (standard skids)	0.51 m (1 ft 8 in)

[1] *Blades at 45° to fuselage centreline*

DIMENSIONS, INTERNAL:

Cabin: Max width	1.37 m (4 ft 6 in)
Max height	1.00 m (3 ft 3¼ in)
Baggage compartment volume	0.45 m³ (16.0 cu ft)

AREAS:

Main rotor disc	89.38 m² (962.1 sq ft)
Tail rotor disc	2.08 m² (22.34 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, equipped	1,209 kg (2,665 lb)
Max payload	1,173 kg (2,585 lb)
Max baggage	113 kg (250 lb)
Max hook capacity	1,200 kg (2,646 lb)
Max T-O weight: internal load:	
standard	2,268 kg (5,000 lb)
optional	2,381 kg (5,250 lb)
external load	2,721 kg (6,000 lb)
Max disc loading	27.9 kg/m² (5.72 lb/sq ft)
Max disc loading: internal load:	
standard	25.4 kg/m² (5.20 lb/sq ft)
optional	26.6 kg/m² (5.46 lb/sq ft)
external load	30.4 kg/m² (6.24 lb/sq ft)
Transmission loading at max T-O weight and power:	
internal load: standard	4.52 kg/kW (7.42 lb/shp)
optional	4.74 kg/kW (7.79 lb/shp)
external load	5.42 kg/kW (8.90 lb/shp)

PERFORMANCE (at standard internal load MTOW, ISA):

Never-exceed speed (VNE)	140 kt (259 km/h; 161 mph)
Max cruising speed:	
at S/L	133 kt (246 km/h; 153 mph)
at FL 40	135 kt (250 km/h; 155 mph)
Long-range cruising speed:	
at S/L	121 kt (224 km/h; 139 mph)
at FL 40	120 kt (222 km/h; 138 mph)
Max certified T-O height	5,180 m (17,000 ft)
Max certified altitude	6,100 m (20,000 ft)
Hovering ceiling: IGE	3,720 m (12,200 ft)
OGE	3,185 m (10,450 ft)
Max range	330 n miles (611 km; 379 miles)
Endurance	3 h 42 min

BELL 412

Canadian Forces designation: CH-146 Griffon
UK armed forces designations: Griffin HT. Mk 1 and HAR. Mk 2

TYPE: Multirole medium helicopter.

PROGRAMME: Original 412 announced 8 September 1978; FAR Pt 29 VFR approval received 9 January 1981, (as extension of original Bell 212 certificate of 30 October 1970); IFR 13 February 1981; 213 built in USA; production (SP version) transferred to Canada February 1989; first delivery (civil) 18 January 1981. Production licences obtained by Dirgantara of Indonesia and Agusta of Italy, but Indonesian aircraft not certifiable in US.

Increase in payload of 91 kg (200 lb) in development in late 2003, through use of composites in engine access doors, chemical milling of landing gear skids and removal of mountings and avionics boxes for redundant equipment.

CURRENT VERSIONS: **412SP:** Special Performance version with increased maximum T-O weight, new seating options and 55 per cent greater standard fuel capacity. No change to Type Certificate; marketing designation only. Superseded by 412HP early 1991.

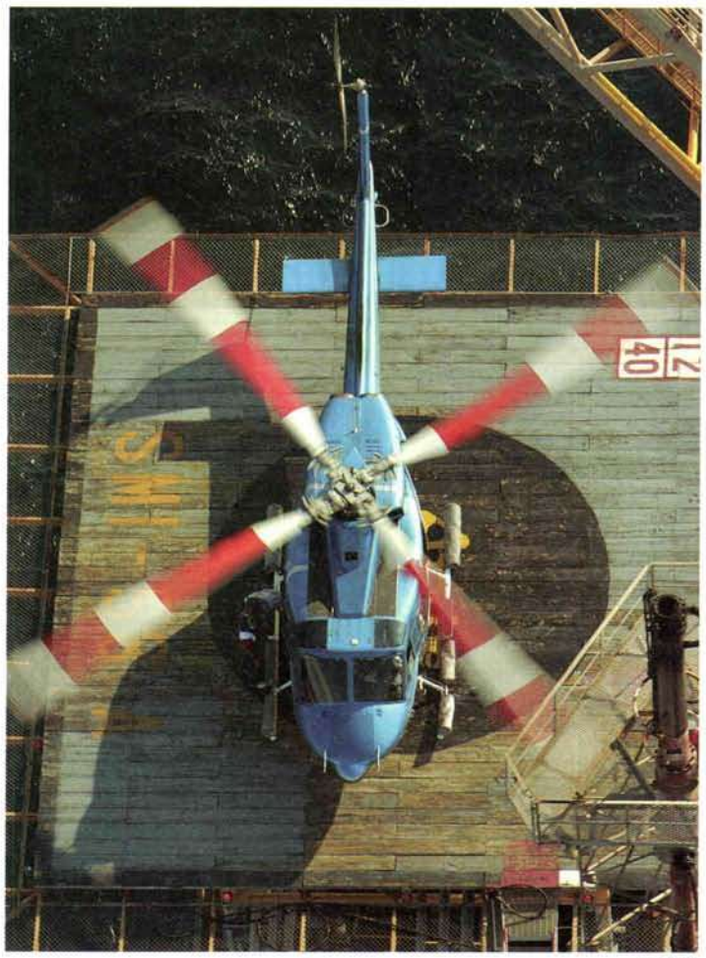
412HP: Improved transmission giving better OGE hover; first delivery February 1991. No change to Type Certificate; marketing designation only.

412EP: (Enhanced Performance) PT6T-3D engine, dual digital automatic flight control system (DDAFCS), three-axis in basic aircraft but customer option for four-axis and EFIS. FAA certification 23 June 1994. Also customer option for SAR fit. Now only current version.

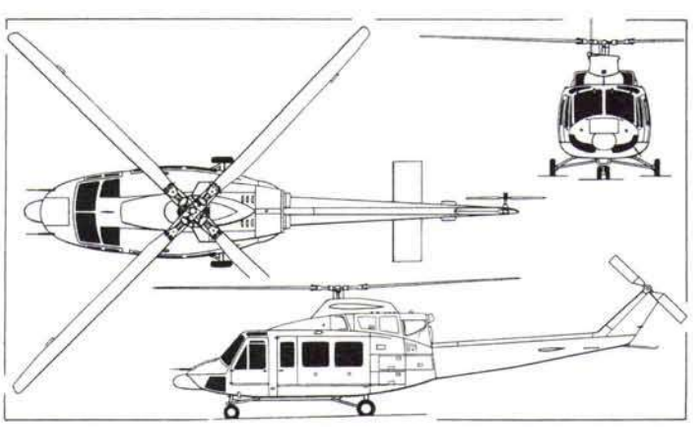
Detailed description applies to Bell 412EP.

Military 412: Announced by Bell June 1986; fitted with Lucas Aerospace chin turret and Honeywell Head Tracker helmet sight similar to that in AH-1S; turret carries 875 rounds, weighs 188 kg (414 lb) and can be removed in under 30 minutes; firing arcs ±110° in azimuth, +15° and −45° in elevation; other armament includes twin dual FN Herstal 7.62 mm gun pods, single FN Herstal 0.50 in pod, pods of seven or nineteen 2.75 in rockets, M240E1 pintle-mounted door guns, FN Herstal four-round 70 mm rocket launcher and a 0.50 in gun or two Giat M621 20 mm cannon pods.

412CF (CH-146) Griffon: Canadian Forces C$700 million contract for 100 CH-146s (modified Bell 412EP) placed in 1992. Duties include armed support, troop/cargo transport,



Bell 412 resupplying an offshore oil rig 1151688



Bell 412EP (P&WC PT6T turboshaft) *(Dennis Punnett)* 1151700

medevac, ASW, SAR and patrol; first flight (146000) 30 April 1994; deliveries began 14 October 1994; completed early 1998. Generally as commercial Bell 412EP except for avionics and mission equipment; FAA certification 2 March 1995; Canadian certification eight days later. Empty weight 3,402 kg (7,500 lb); maximum weight as civil version.

412EP Sentinel: First of two modified in 1998 by Heli-Dyne Systems with quick-change ASV and ASW mission packages; intended for Ecuadorean Navy, but order cancelled and aircraft became demonstrator. ASV equipment comprises Honeywell RDR-1500B chin radar, Hughes Starburst searchlight, radar warning receiver, Wescam sensor turret and possibly Penguin Mk 2 Mod 7 ASMs; ASW fit is L3 Ocean Systems AN/AQS-18A dipping sonar and Raytheon Mk 46 torpedo.

412SA: First three of 16 ordered by Royal Saudi Air Force built in 2001 for manufacturer's trials. Equipment standard not disclosed, but sufficiently different from 412EP to warrant separate c/n sequence beginning 33501. Production continued in 2002, although only eight confirmed built by late 2003. Further aircraft produced by AgustaWestland in 2003.

412 Plus: Projected improved version under study in 1999 with MTOW increased to 5,647 kg (12,450 lb), uprated PT6C engines, new dynamic components and Rogerson-Kratos avionics. Development terminated in early 2001.

NBell-412: Indonesia's Dirgantara obtained a licence to produce up to 100 Model 412SPs. Production ended by 1997 after approximately 36 aircraft.

CUSTOMERS: Some 713 Bell 412s of all versions built in North America by early 2006, comprising 115 Model 412s, 114 412SPs, 81 412HPs, 295 412EPs, 100 CH-146s and eight 412SAs. 26 delivered in 1999 and 24 in 2000; 22 in 2001 (including five to El Salvador), 25 in 2002 (including five to Saudi Arabia), 29 in 2003 (including nine assembled by AgustaWestland to Saudi Arabia); 31 in 2004, including examples for Mexico and Pakistan; and 29 (including 12 military) in 2005.

Military deliveries include Venezuelan Air Force (two), Botswana Defence Force (three), Public Security Flying Wing of Bahrain Defence Force (two), Sri Lankan armed forces (four), Nigerian Police Air Wing (two), Mexican government (two VIP transports), South Korean Coast Guard (one), Honduras (10), Royal Norwegian Air Force (19, of which 18 assembled by Helikopter Service, Stavanger, to replace UH-1Bs of 339 Squadron at Bardufoss and 720 Squadron at Rygge). Three 412EPs delivered to Slovenian Territorial Forces in 1995, for border patrol and rescue duties; four ordered by Philippine Air Force late in 1996, comprising two for VVIP transport and two SAR.

First of nine 412EPs entered service in April 1997 as HT. Mk 1s with civilian-operated Defence Helicopter Flying School at RAF Shawbury, UK, within which they constitute No. 60 (Reserve) Squadron, RAF; two more ordered in May 2002, together with four HAR. Mk 2s, latter replacing Wessex SAR helicopters of No. 84 Squadron at Akrotiri, Cyprus, from April 2003. Four in SAR/utility fit delivered to Venezuelan Navy, 1999.

Recent customers include the National Defence Secretariat of Mexico, which took delivery of four in mid-2002; Venezuelan Navy, which ordered four in SAR configuration in early 2002; Khalifa Airways of Algeria, which took delivery of one 412EP in June 2002; Aeroservicios Especialijados SA of Mexico, which ordered 10 412EPs; New York City Police Aviation Department, which took delivery of one 412EP in September 2003; the Government of Pakistan, which has ordered 26 412EPs, of which nine were delivered in June 2004, with final delivery scheduled for May 2005; and the National Police Agency of Japan, which ordered two 412EPs for delivery in early 2005.

COSTS: Bell 412EP, VFR-equipped USD4.895 million (1999); Bell 412EP, IFR-equipped USD5.12 million (1999). Average direct operating cost USD750.34 per hour (2004).

DESIGN FEATURES: Four-blade main rotor with blades retained within central metal star fitting by single elastomeric bearings; shorter rotor mast than 212; blades can be folded; rotor brake standard; two-blade tail rotor; main rotor rpm 314.

FLYING CONTROLS: Fully powered hydraulic controls; gyroscopic stabiliser bar above main rotor; automatic tailplane incidence control.

STRUCTURE: Generally of conventional light metal. Main rotor blade spar unidirectional glass fibre with 45° wound torque casing of glass fibre cloth; Nomex rear section core with trailing-edge of unidirectional glass fibre; leading-edge protected by titanium abrasion strip and replaceable stainless steel cap at tip; lightning protection mesh embedded; provision for electric de-icing heater elements; main rotor hub of steel and light alloy; all-metal tail rotor.

LANDING GEAR: High skid, emergency pop-out float or non-retractable tricycle gear optional. Spats optional for last-named.

POWER PLANT: Pratt & Whitney Canada PT6T-3D Turbo Twin-Pac, rated at 1,342 kW (1,800 shp) for T-O and 1,193 kW (1,600 shp) maximum continuous. OEI ratings 850 kW (1,140 shp) for 2½ minutes, or 723 kW (970 shp) for 30 minutes. Transmission rating 1,022 kW (1,370 shp) for T-O, 828 kW (1,110 shp) maximum continuous; OEI rating 850 kW (1,140 shp). Optional 30 kW (40 shp) for accessory drives from main gearbox.

Seven interconnected rupture-resistant fuel cells, with automatic shutoff valves (breakaway fittings), have a combined usable capacity of 1,249 litres (330 US gallons; 275 Imp gallons). Two 76 or 310.5 litre (20.0 or 82.0 US gallon; 16.7 or 68.3 Imp gallon) auxiliary fuel tanks, in any combination, can increase maximum total capacity to 1,870 litres (494 US gallons; 411.6 Imp gallons). Single-point refuelling on starboard side of cabin.

ACCOMMODATION: Pilot and up to 14 passengers: one in front port seat and 13 in cabin. Dual controls optional. Accommodation heated and ventilated.

SYSTEMS: Dual hydraulic systems, pressure 69 bar (1,000 lb/ sq in) each. 28 V DC electrical system supplied by two completely independent 450 VA inverters. 40 Ah Ni/Cd battery.

AVIONICS: *Comms:* Optional IFR avionics include dual Bendix/King Gold Crown III.

Radar: Weather radar optional.

Flight: Dual KNR 660A VOR/LOC/RMI receivers, KDF 800 ADF, KMD 700A DME, KXP 750A transponder and KGM 690 marker beacon/glideslope receiver. Optional Honeywell AFCS.

EQUIPMENT: Optional equipment includes cargo sling and rescue hoist.

DIMENSIONS, EXTERNAL:

Main rotor diameter	14.02 m (46 ft 0 in)
Main rotor blade chord: at root	0.40 m (1 ft 4 in)
at tip	0.22 m (8½ in)
Tail rotor diameter	2.62 m (8 ft 7 in)
Tail rotor blade chord	0.29 m (11½ in)
Length: overall, rotors turning	17.12 m (56 ft 2 in)
fuselage, excl rotors	12.70 m (41 ft 8 in)
Height: to top of rotor head	3.48 m (11 ft 5 in)
overall, tail rotor turning	4.57 m (15 ft 0 in)
Stabiliser: span	2.87 m (9 ft 5 in)
chord	0.79 m (2 ft 7 in)
Width over skids	2.84 m (9 ft 4 in)
Rear sliding doors (each): Height	1.24 m (4 ft 1 in)
Width	1.88 m (6 ft 2 in)
Height to sill	0.76 m (2 ft 6 in)
Baggage compartment door: Height	0.53 m (1 ft 9 in)
Width	1.71 m (2 ft 4 in)
Emergency exits (centre cabin windows, each):	
Height	0.76 m (2 ft 6 in)
Width	0.97 m (3 ft 2 in)

DIMENSIONS, INTERNAL:

Baggage compartment volume	0.79 m^3 (28.0 cu ft)

AREAS:

Main rotor disc	154.40 m^2 (1,661.9 sq ft)
Tail rotor disc	5.38 m^2 (57.86 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, standard equipped: VFR	3,113 kg (6,863 lb)
IFR	3,160 kg (6,966 lb)
Max external hook load	2,041 kg (4,500 lb)
Useful load: VFR	2,285 kg (5,037 lb)
IFR	2,238 kg (4,934 lb)
Max T-O and landing weight, internal or external load	5,397 kg (11,900 lb)
Max disc loading	35.0 kg/m^2 (7.16 lb/sq ft)
Transmission loading at max T-O weight and power	5.29 kg/kW (8.69 lb/shp)

PERFORMANCE:

Never-exceed speed (VNE)	140 kt (259 km/h; 161 mph)
Max cruising speed: at S/L	122 kt (226 km/h; 140 mph)
at FL50	124 kt (230 km/h; 143 mph)
Long-range cruising speed at FL50	130 kt (241 km/h; 150 mph)
Service ceiling, OEI: continuous power	1,646 m (5,400 ft)
30 min power rating	2,316 m (7,600 ft)
Hovering ceiling: IGE	3,110 m (10,200 ft)
OGE	1,585 m (5,200 ft)
Range at FL50, long-range cruising speed, standard fuel, no reserves	402 n miles (744 km; 462 miles)
Endurance	3 h 42 min

OPERATIONAL NOISE LEVELS (FAR Pt 36) (412 EP):

T-O	92.8 EPNdB
Flyover	93.4 EPNdB
Approach	95.6 EPNdB

BELL 417

TYPE: Light utility helicopter.

PROGRAMME: Previously unannounced mockup unveiled at Heli-Expo, Dallas, Texas, 26 February 2006. First flight then planned for April 2006, but delayed, although engine running began 8 May; and maiden sortie (N417TX) eventually achieved on 1 June 2006 (but not announced until 17 July); programme cancelled 1 March 2007.

CUSTOMERS: Total of 46 sales announced during February 2006 debut.

DESIGN FEATURES: Development of Bell 407 with 723 kW (970 shp) Honeywell HTS900 turboshaft providing more power, more payload and improved hot and high performance. Basic fit includes cabin with club seating for five; improved 'bubble cockpit' providing greater headroom (accommodation for 95 percentile male wearing helmet with NVG equipment stowed); integrated Chelton EFIS; dual VHF-com, GPS/WAAS, AD/AHRS, transponder, and ICS audio panel; new FADEC equipped with dual electronic control units (ECU) offering dual channel reliability.

Mockup of Bell 417 unveiled on 26 February 2006 1158282

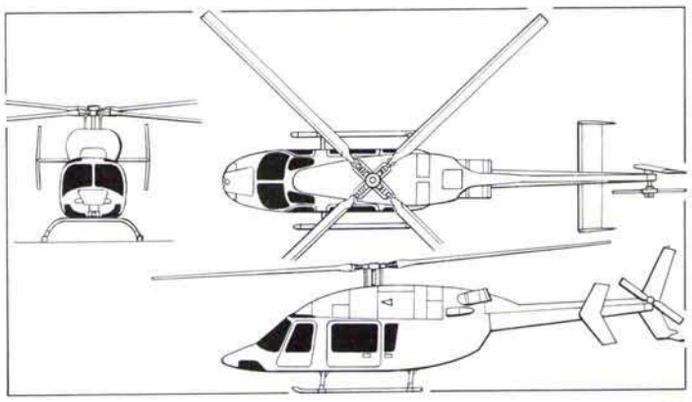
Maiden flight of Bell 417 1159102

BELL 427

TYPE: Light utility helicopter.

PROGRAMME: Launched as New Light Twin (NLT) in February 1996 on signature of collaborative agreement with Samsung Aerospace Industries of South Korea. Prototype assembly began early 1997; first flight (C-GBLL) 11 December 1997; second prototype (C-FCSS) completed February 1998; two prototypes undertook flight test programme, gaining Transport Canada certification on 19 November 1999; FAA VFR certification achieved 24 January 2000. First production aircraft (C-GDEJ) flown June 1998; compared with prototypes, production 427 has longer exhausts and revised upper surface contours.

CURRENT VERSIONS: **Bell 427/VFR:** *As described.*



Bell 427 light utility helicopter *(James Goulding)* 0552086

427i: Single-pilot IFR version. Announced at Heli-Expo 2004 in Las Vegas in March 2004; on 19 June 2004 Bell signed agreements with Korea Aerospace Industries Ltd and Mitsui Bussan Aerospace Ltd for joint development, with KAI responsible for the design and manufacture of the fuselage, cabin wiring and fuel system. FAA certification scheduled for fourth quarter 2006, with first customer deliveries then expected in late 2007. Compared to the 427VFR, in addition to IFR capability, the 427i has a 0.355 m (1 ft 2 in) fuselage stretch; uprated 820 kW (1,100 shp) transmission; dual hydraulic systems; Garmin GNS 430 GPS/com/nav; 'third generation' glass cockpit with Rogerson-Kratos large format MFDs; three-axis autopilot (four-axis optional) coupled to the nav system and incorporating a stability augmentation system; and Bell-developed aircraft data interface unit (ADIU) with automatic engine monitoring, logging and tracking, power assurance hover performance and weight and balance capability. Provisional data include: useful load 1,225 kg (2,700 lb); maximum take-off weight external load 3,175 kg (7,000 lb); maximum cruising speed 142 kt (263 km/h; 163 mph); and maximum range 365 nm (676 km; 420 miles). Total of 47 orders held by July 2004, including 15 for launch customer Air Methods Corporation for delivery at the rate of three per year from late 2007. Development halted in favour of Bell 429, described below.

SB427: South Korean version; planned licence production by KAI abandoned in 2003 after only two demonstrators produced.

Super Kiowa: Proposed armed scout offered by Bell.

CUSTOMERS: Orders for 22 placed during the mockup's first public display at Farnborough Air Show 1996; 85 on order by May 2000 from 50 customers, including five sold by Samsung to CitiAir in South Korea. Deliveries began 2000, but only 50 produced up to early 2006. Total of five delivered during 2000, 15 in 2001, five in 2002, seven in 2003, nine in 2004 and five in 2005. MoU signed in 1999 with Elbit Systems Inc for joint pre-design phase of military light helicopter using Bell 427 as baseline platform.

COSTS: 427i USD3.7 million (2004). Direct operating cost (427VFR) USD514.40 per hour (2004).

DESIGN FEATURES: Similar in appearance to Bell 407, with cabin stretch of 33 cm (13 in), but is all-new design, incorporating twin-engine safety margins. Flight dynamics based on four-blade rotor system of Bell OH-58D Kiowa (see US section), allied to tail rotor of Bell 407; folding main blades. Main rotor rpm 395; tail rotor rpm 2,375. Purpose-designed 'flat pack' main transmission, with direct input from both engines, has only four gear meshes to simplify design and operation. Transmission attached to airframe by four liquid-inertia vibration eliminators. First Bell helicopter designed entirely with use of computer (Dassault CATIA programme).

FLYING CONTROLS: Sextant AFDS 95–1 AFCS, with two- to four-axis autopilot computer, flight director computer and associated equipment, to be certified by 2000.

STRUCTURE: Generally as for Bell 206, but extensive use of carbon/epoxy composites reduces airframe parts count by some 33 per cent. Cabin floor and roof are flat panels for ease of manufacture; minimal use of curved panels elsewhere. Composites main and tail rotors; main blades have nickel-plated stainless steel leading-edges. Soft-in-plane hub of main rotor employs a composites flexbeam yoke and elastomeric joints, eliminating lubrication and maintenance requirements. Brake and main rotor blade folding optional. Composites cabins and rolled aluminium tailbooms built by Samsung; assembly in Canada, except for sales to Korea and China; Hexcel honeycomb as stiffener.

Bell 427 light utility helicopter *(Paul Jackson)* 1151689

LANDING GEAR: Twin skids with dynamically tuned cross tubes to reduce ground resonance. Low skids standard; optional high skids and emergency floats.

POWER PLANT: Two Pratt & Whitney Canada PW207D turboshafts with FADEC, each rated at 529 kW (710 shp) for T-O (5 minutes) or 466 kW (625 shp) maximum continuous; OEI ratings 611 kW (820 shp) for 30 seconds, 582 kW (780 shp) for 2 minutes, 559 kW (750 shp) for 30 minutes or 529 kW (710 shp) maximum continuous. Twin-engine transmission rating, T-O and maximum continuous, 597 kW (800 shp). OEI transmission rating, 485 kW (650 shp) for 30 seconds; 451 kW (605 shp) for 2 minutes; 343 kW (460 shp) maximum continuous.

Fuel contained in three crash-resistant tanks; two forward, one aft, total usable capacity 770 litres (203.5 US gallons; 169 Imp gallons). One forward fuel tank can be removed in EMS configurations to provide additional stretcher space in cabin or to permit stretcher to extend into port side of cockpit. Oil capacity (total, both engines) 10.2 litres (2.69 US gallons; 2.24 Imp gallons).

ACCOMMODATION: Standard accommodation is for two crew in cockpit, on 20 *g* energy-attenuating seats, and six passengers in cabin on two rows of three seats in club configuration (all-forward-facing seats optional); all seats equipped with inertia-reel shoulder harnesses. Alternative configurations include corporate club-four seating with refreshment/entertainment console between each pair of seats, club-five with console between rearmost seats, or club-six, without consoles. Optional EMS interiors provide for carriage of one or two stretchers with up to two medical attendants, affording either full patient or head-only in-flight access, with single- or two-person crew. In cargo configuration, with all passenger seats removed, an optional removable flat cargo floor can be installed, equipped with integral tie-downs. Two forward-hinged doors each side; cabin doors, both sides, are forward-hinged, but port unit can be replaced by optional rearward-sliding door for cargo handling. External door on starboard side to rear baggage hold.

SYSTEMS: Hydraulic system, operating pressure 86 bar (1,250 lb/sq in), provides boost power for main and tail rotor controls; 28 V DC electrical power from 17 Ah Ni/Cd battery and two engine-mounted 17 Ah starter/generators; 28 Ah battery and 200 A starter/generator optional. Air conditioning optional.

AVIONICS: Rogerson-Kratos NeoAV two-screen LCD integrated instrument display system (IIDS) for monitoring engine instruments, fuel quantity, hydraulic and electrical systems and weight and balance functions. Rogerson Kratos NeoAV EFIS optional, featuring GPS interface, area navigation map, non-precision approach capability and weather radar display. Bendix/King nav/com avionics suite to customer's choice.

EQUIPMENT: Optional kits include engine air particle separator, cargo hook, cargo floor, sliding cabin door, external rescue hoist, NightSun searchlight, EMS installation and wire strike protection system.

DIMENSIONS, EXTERNAL:

Main rotor diameter	11.28 m (37 ft 0 in)
Main rotor blade chord	0.34 m (1 ft 1¼ in)
Tail rotor diameter	1.73 m (5 ft 8 in)
Tail rotor blade chord	0.18 m (7¼ in)
Length: overall, rotors turning	12.99 m (42 ft 7¼ in)
overall, rotor in X configuration	11.55 m (37 ft 10¾ in)[1]
fuselage, incl tailskid	10.97 m (36 ft 0 in)
low skids	3.23 m (10 ft 7¼ in)
high skids	3.49 m (11 ft 5½ in)
Height over tailfin	3.49 m (11 ft 5¼ in)
Ground clearance: low skids	0.41 m (1 ft 4¼ in)
high skids	0.67 m (2 ft 2½ in)
Width: overall, rotor in X configuration	8.24 m (27 ft 0½ in)[1]
over skids	2.29 m (7 ft 6 in)
over tailfins	2.89 m (9 ft 5¾ in)
Cabin door: Height	1.07 m (3 ft 6 in)
Width	1.24 m (4 ft 0¾ in)

[1] *Blades at 45° to fuselage centreline*

DIMENSIONS, INTERNAL:

Cabin: Max height	1.30 m (4 ft 3 in)
Baggage hold volume	0.76 m³ (27.0 cu ft)

AREAS:

Main rotor disc	99.89 m² (1,075.2 sq ft)
Tail rotor disc	2.34 m² (25.2 sq ft)

WEIGHTS AND LOADINGS (provisional):

Weight empty, standard	1,758 kg (3,875 lb)
Max payload	1,213 kg (2,675 lb)
Max baggage weight	113 kg (250 lb)
Max T-O weight: internal load:	2,880 kg (6,350 lb)
optional and external load	2,971 kg (6,550 lb)
Cargo hook capacity	1,361 kg (3,000 lb)
Max cargo floor loading	366.2 kg/m² (75 lb/sq ft)
Max disc loading	29.74 kg/m² (6.09 lb/sq ft)
Transmission loading at max T-O weight and power:	
internal load	4.56 kg/kW (7.50 lb/shp)
external load	4.98 kg/kW (8.19 lb/shp)

PERFORMANCE (at standard internal load MTOW, ISA):

Never-exceed speed (VNE)	140 kt (259 km/h; 161 mph)
Max cruising speed at S/L	138 kt (256 km/h; 159 mph)
Long-range cruising speed at S/L	134 kt (248 km/h; 154 mph)
Service ceiling:	
max continuous power	3,050 m (10,000 ft)
OEI (30 min)	2,438 m (8,000 ft)
Hovering ceiling: IGE	2,743 m (9,000 ft)
OGE	1,829 m (6,000 ft)
Range with max fuel, long-range cruising speed, no reserves	390 n miles (722 km; 449 miles)
Endurance	4 h 0 min

BELL 429 GLOBALRANGER

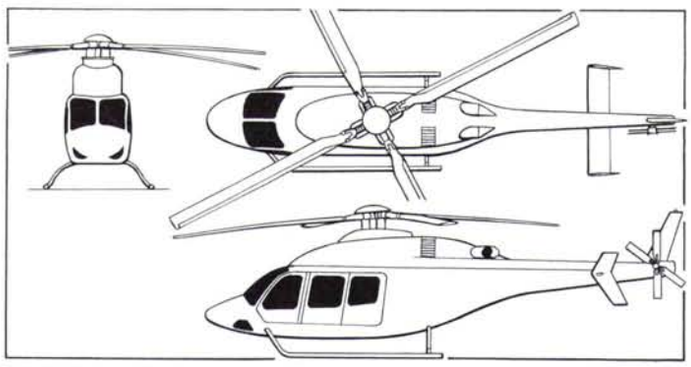
TYPE: Light utility helicopter.

PROGRAMME: Announced at Heli-Expo 2005 in Anaheim, 6 February 2005, when mockups of corporate and EMS versions unveiled; replaces proposed Bell 427i; systems and components being tested on Bell 427s during late 2005; main rotor blades thus test-flown in February 2006; first flight was scheduled for third quarter 2006 but prototype only registered (C-GBLL) on 23 January 2007; seven aircraft will participate in flight test and certification programme, leading to Transport Canada and FAA certification.

CUSTOMERS: Total of 90 orders held at time of launch, of which about 80 were converted from orders for the Bell 427i; 136 orders held by November 2005 including several in EMS configuration; 213 by July 2006.

Mockup of Bell 429 *(Paul Jackson)* 1040579

Prototype Bell 429 taking shape in late 2006 1154668



Bell 429 light utility helicopter *(James Goulding)* 1151426

COSTS: USD3.95 million; estimated direct operating cost USD480 per hour (both 2005).

DESIGN FEATURES: Design includes advanced technology elements of Bell's modular affordable product line (MAPL) studies. Features include advanced main rotor blade design with inverse taper ratio, more twist at root and swept tip shape; damage tolerant composites tailboom; two-piece composites driveshaft; and four-blade tail rotor.

STRUCTURE: Risk-sharing partner Korean Aerospace Industries manufactures cabin structure.

LANDING GEAR: High or low skid landing gear standard; retractable, wheeled landing gear optional.

POWER PLANT: Two Pratt & Whitney Canada PW207D turboshafts, each rated at 544 kW (730 shp). Fuel in underfloor tanks, maximum capacity 803 litres (212 US gallons; 177 Imp gallons).

ACCOMMODATION: Standard seating for pilot and up to seven passengers. Cockpit lighting is compatible with night vision goggles. Cabin has 7 per cent more volume than that of Bell 427 and features flat floor, tracked seating, sliding door on each side to facilitate side-loading of medical patients, and optional clamshell doors at rear. EMS interior features articulated patient loading system for wheeled and secondary patient litters; seats for three medical attendants; medical panel; medical storage cabinet; liquid oxygen storage system; pressurised gaseous oxygen system; high intensity lighting; intravenous solutions warmer and flip-down hooks for IV bags; soft goods storage, non-skid sealed medical floor; and medical equipment mounting bars and securing systems.

SYSTEMS: Dual hydraulic system, operating pressure 86 bar (1,250 lb/sq in). Avionics package includes health and usage management system with laptop access. Fully coupled three-axis autopilot standard.

AVIONICS: Single-pilot IFR cockpit features two 203 × 152 mm (8 × 6 in) Rogerson Kratos LCD colour displays, with third optional, twin Garmin GNS 430 GPS and Bendix/King radios.

DIMENSIONS, EXTERNAL:

Length overall	12.22 m (40 ft 1¼ in)
Tailplane span	3.02 m (9 ft 10¾ in)
Skid track	2.44 m (8 ft 0 in)

DIMENSIONS, INTERNAL:
Cabin volume ..... 5.7 m³ (200 cu ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 1,950 kg (4,300 lb)
Max T-O weight ..... 3,175 kg (7,000 lb)
Cargo hook capacity ..... 1,361 kg (3,000 lb)
PERFORMANCE (estimated):
Never-exceed speed (VNE) ..... 150 kt (278 km/h; 172 mph)
Max cruising speed ..... 142 kt (263 km/h; 163 mph)
Econ cruising speed ..... 138 kt (256 km/h; 159 mph)
Hovering ceiling: IGE ..... 3,660 m (12,000 ft)
OGE ..... 2,835 m (9,300 ft)
Range ..... 350 n miles (648 km; 402 miles)
Endurance ..... 3 h 48 min

BELL 430

TYPE: Light utility helicopter.

PROGRAMME: Preliminary design 1991; four-blade rotor, higher-powered and stretched variant of Bell 230; programme launched February 1992; two prototypes, modified from Bell 230 airframes; first prototype (C-GBLL; wheel-equipped) flown 25 October 1994; second prototype (C-GEXP; skid-equipped, with complete avionics suite) flown 19 December 1994; first flight of production 430 (C-GRND) in 1995; deliveries began 25 June 1996 after Canadian type approval on 23 February. MoU of June 1996 with Dirgantara (formerly IPTN) for licensed assembly and marketing in Indonesia. Under an agreement signed in September 2003, Hafei Aviation Industry Company Ltd of China will become sole supplier of Bell 430 airframes to the manufacturer.

Second production aircraft, N4300 circumnavigated the world in a record time of 17 days 6 hours 14 minutes, landing back at Fairoaks, UK, on 3 September 1996.

In July 2004 c/n 49037/N430CH, operated by Chevron Texaco, became the high-time Bell 430 airframe, having logged more than 7,000 flying hours since entering service in Gulf of Mexico offshore operations in July 1998.

CUSTOMERS: Total 116 helicopters registered by late 2005. First delivery 25 June 1996, when sixth production aircraft (N6282X) handed over to IPTN (now Dirgantara) of Indonesia in eight-seat executive configuration. Thirteen delivered in 1996; followed by eight, 15 and 18 in 1997–99, 11 in 2000, 14 in 2001, seven in 2002, eight in 2003, four in 2004 and 10 in 2005. Recent customers include Life flight Network of Portland, Oregon, which took delivery of one in August 2003, the University of Tennessee's Medical Center, which took delivery of two in 2003, replacing Bell 412s in its Lifestar EMS operation, and the US Department of Homeland Security, Customs and Border Protection, which has selected the Bell 430 for its twin-turbine medium utility helicopter requirement. Total of more than 100 built by late 2004.

COSTS: Programme USD18 million, 35 per cent financed by Canadian Defence Industry Productivity Program (DIPP) and repayable as royalty on each sale. Direct operating cost USD522.49 per hour (2004).

DESIGN FEATURES: Optimised for high cruising speed with (retractable) wheel landing gear, although traditional skids optional; inclined towards executive transport market. Bell 230 fuselage lengthened by 0.46 m (1 ft 6 in) plug; Bell 680 all-composites four-blade bearingless, hingeless main rotor; approximately 10 per cent power increase over Bell 230; uprated transmission; and optional EFIS. Short-span sponson each side of fuselage houses mainwheel units and fuel tanks, and serves as work platform.

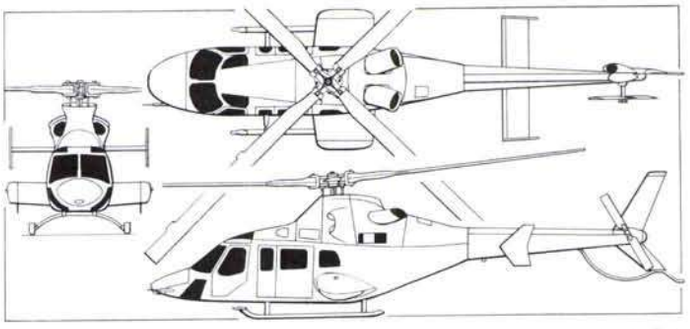
FLYING CONTROLS: Fully powered hydraulic, with elastomeric pitch change and flapping bearings; fixed tailplane with leading-edge slats and endplate fins; strakes under sponsons; single-pilot IFR system without auto-stabilisation.

STRUCTURE: Semi-monocoque fuselage of light alloy, with limited use of light alloy honeycomb panels. Fail-safe structure in critical areas. One-piece nosecone tilts forward and down for access to avionics and equipment bay. Short span cantilever sponson set low on each side of fuselage, serving as main landing gear housings, fuel tanks and work platforms. Section NACA 0035. Dihedral 3° 12'. Incidence 5°. Sweepback at quarter-chord 3° 30'.

Fixed vertical fin in sweptback upper and lower sections. Tailplane, with slotted leading-edge and endplate fins, mounted midway along rear fuselage. Small skid below ventral fin for protection in tail-down landing. Four-blade main rotor with stainless steel spars and leading-edges, Nomex honeycomb trailing-edge with glass fibre skin, and glass fibre safety straps; tail rotor blades stainless steel. Rotors shaft-driven through gearbox with two spiral bevel reductions and one planetary reduction. Main blade and hub life, 10,000 hours.

LANDING GEAR: Tubular skid type on Utility version. Executive version has hydraulically retractable tricycle gear, single mainwheels retracting forward into sponsons; forward-retracting nosewheel fully castoring and self-centring; hydraulic disc brakes on main units. Mainwheel tyre size 18×5.5, nosewheel 5.00–5. Emergency floats optional.

POWER PLANT: Two Rolls-Royce 250-C40B turboshafts, each rated at 603 kW (808 shp) for T-O and 518 kW (695 shp) maximum continuous. OEI ratings 701 kW (940 shp) for 30 seconds, 656 kW (880 shp) for 2 minutes, 623 kW (835 shp) for 30 minutes and 602 kW (808 shp) continuous. Chandler Evans FADEC. Transmission rating 779 kW (1,045 shp) for 5 minutes for T-O, 737 kW (989 shp) maximum continuous. Power train TBO, 5,000 hours. Usable fuel capacity 935 litres (247 US gallons; 206 Imp gallons) in skid version, 710 litres (187.5 US gallons; 156 Imp gallons) in wheeled version; provision in both versions for 182 litre (48 US gallon; 40 Imp gallon) auxiliary tank. Fuel system is rupture resistant, with self-sealing breakaway fittings.



Skid version of Bell 430 nine-seat helicopter (two Rolls-Royce 250 turboshafts) *(James Goulding)* 1151695

ACCOMMODATION: Standard layout has forward-facing seats for nine persons (two-two-two-three) including pilot. Options include 10-seat layout (two-two-three-three); eight-seat corporate (rear six in club layout), six-seat corporate (rear four in club layout with console between each pair); and five- and four-seat corporate with one or two refreshment cabinets; seat pitches vary between 86 cm (34 in) and 91 cm (36 in). Pilots on crashworthy (energy attenuating) seats, which are optional for passengers. Customised emergency medical service (EMS) versions also available, configured for pilot-only operation plus one or two pivotable stretchers and four or three medical attendants/sitting casualties respectively. Two forward-opening doors each side; EMS version has optional stretcher door between forward and rear doors on port side. Entire interior ram air ventilated and soundproofed. Dual controls optional.

SYSTEMS: Dual hydraulic systems (dual for main rotor collective and cyclic, single for tail rotor). Dual 28 V DC electrical systems, powered by two 30 V 200 A engine-mounted starter/generators (derated to 180 A) and a 24 V 28 Ah Ni/Cd battery.

AVIONICS: *Comms:* Bendix/King Gold Crown III.

Flight: Honeywell KFC 500 AFCS. GPS optional.

Instrumentation: Rogerson-Kratos LCD integrated instrument display system (IIDS) comprising two active matrix LCDs displaying engine and system parameters; optional Rogerson-Kratos EFIS.

EQUIPMENT: Standard equipment includes rotor and cargo tiedowns, ground handling wheels for skid version, retractable 450 W search/landing light. Options include dual controls, auxiliary fuel tankage, force/feel trim system, more comprehensive nav/com avionics, 272 kg (600 lb) capacity rescue hoist, 1,587 kg (3,500 lb) capacity cargo hook, emergency flotation gear, heated windscreen, particle separator and snow baffles.

DIMENSIONS, EXTERNAL:
Main rotor diameter ..... 12.80 m (42 ft 0 in)
Main rotor blade chord ..... 0.36 m (1 ft 2¼ in)
Tail rotor diameter ..... 2.10 m (6 ft 10½ in)
Tail rotor blade chord ..... 0.25 m (10 in)
Length: fuselage (incl tailskid) ..... 13.44 m (44 ft 1¼ in)
overall, rotors turning ..... 15.30 m (50 ft 2½ in)
rotor in X configuration ..... 9.40 m (30 ft 10 in)
Max width: rotors turning ..... 15.30 m (50 ft 2½ in)
rotor in X configuration ..... 13.595 m (44 ft 7¼ in)
Fuselage max width over sponsons ..... 3.45 m (11 ft 4 in)
Height to top of rotor head:
standard skids ..... 4.03 m (13 ft 2½ in)
high skids ..... 4.33 m (14 ft 2½ in)
wheels ..... 3.72 m (12 ft 2½ in)
Stabiliser span ..... 3.45 m (11 ft 4 in)
Skid track ..... 2.54 m (8 ft 4 in)
Wheel track ..... 2.78 m (9 ft 1½ in)
Wheelbase ..... 4.17 m (13 ft 8¼ in)
Passenger doors: forward:
Height ..... 1.34 m (4 ft 4¾ in)
Width ..... 0.88 m (2 ft 10¾ in)

Bell 430 light utility helicopter *(Paul Jackson)* 1151687

aft:
Height ..... 1.22 m (4 ft 0 in)
Width ..... 0.91 m (3 ft 0 in)
Baggage door: Height ..... 0.60 m (1 ft 11½ in)
Width ..... 0.85 m (2 ft 9½ in)
DIMENSIONS, INTERNAL:
Cabin: Length, excl cockpit ..... 2.46 m (8 ft 1 in)
Max width ..... 1.37 m (4 ft 6 in)
Max height ..... 1.30 m (4 ft 3 in)
Volume ..... 4.5 m^3 (158 cu ft)
Baggage compartment volume ..... 1.05 m^3 (37.2 cu ft)
AREAS:
Main rotor disc ..... 128.71 m^2 (1,385.4 sq ft)
Tail rotor disc ..... 3.45 m^2 (37.12 sq ft)
WEIGHTS AND LOADINGS (A: wheeled version; B: skid version):
Weight empty: A ..... 2,433 kg (5,364 lb)
B ..... 2,418 kg (5,331 lb)
Useful load: A ..... 1,785 kg (3,936 lb)
B ..... 1,800 kg (3,969 lb)
Max external load: A, B ..... 1,270 kg (2,800 lb)
Max T-O weight, all conditions ..... 4,218 kg (9,300 lb)
Max disc loading ..... 32.8 kg/m^2 (6.71 lb/sq ft)
Transmission loading at max T-O weight and power ..... 5.42 kg/kW (8.90 lb/shp)
PERFORMANCE:
Never-exceed speed (VNE):
A, B ..... 150 kt (277 km/h; 172 mph)
Max level speed: A ..... 143 kt (265 km/h; 165 mph)
B ..... 139 kt (257 km/h; 160 mph)
Long-range cruising speed:
A ..... 135 kt (250 km/h; 155 mph)
B ..... 131 kt (243 km/h; 151 mph)
Service ceiling: A, B ..... 4,932 m (16,180 ft)
Hovering ceiling, IGE: A, B ..... 3,170 m (10,400 ft)
OGE: A, B ..... 1,890 m (6,200 ft)
Max range, standard fuel, no reserves:
A ..... 275 n miles (509 km; 316 miles)
B ..... 353 n miles (653 km; 406 miles)
Max endurance: A ..... 2 h 48 min
B ..... 3 h 48 min
OPERATIONAL NOISE LEVELS (FAR Pt 36, Stage 2):
T-O ..... 92.4 EPNdB
Sideline ..... 91.6 EPNdB
Approach ..... 93.8 EPNdB

BELL MODULAR AFFORDABLE PRODUCT LINE

TYPE: New-concept rotorcraft.

PROGRAMME: At the NBAA Convention in Orlando, Florida, in October 2003, Bell announced brief details of Modular Affordable Product Line (MAPL) programme that is expected to result in three all-new helicopters sharing common cockpits, avionics and tailbooms, mated to fuselage of common configuration but varying in size. Initial certification target is for the end of the decade, with first MAPL model available in 2008, and all three variants achieving service entry by 2012. Further data released in February 2004 mentioned the five-seat, single-engined **Bell 351**, eight-seat, single-engine **Bell 381**, and eight-seat **Bell 382** twin, all with four-blade rotors and 'fantail' anti-torque rotor. Design targets include 20 per cent improvements in speed and useful load, 20 per cent reduction in operating costs, and 10dB reduction in noise over existing helicopters in the same class, with 99 per cent despatch reliability. Price range expected to be between USD500,000 and USD1 million (2005).

MAPL 'TailFan' demonstrator, Bell 407 (N41835) modified with a 1.02 m (3 ft 4 in) diameter fan and duct replacing the standard tail rotor, made its first flight at Bell's XworX research center in Arlington, Texas, on 15 July 2004. It will be used for evaluation of the performance and acoustics of various duct configurations in hover and forward flight. During altitude flight testing at Bell's facility in Leadville, Colorado, which was completed in October 2004, the MAPL demonstrator achieved hover out of ground effect (HOGE) at more than 3,566 m (11,700 ft), flight at more than 3,962 m (13,000 ft), and sideways flight up to 45 kt (83 km/h; 52 mph).

Some MAPL technology was introduced on the Bell 429 GlobalRanger, announced at the HAI Convention in Anaheim, California on 6 February 2005.

Artist's impression of Bell MAPL 0580704

Bell TailFan demonstrator 0583649

BLUE YONDER

BLUE YONDER AVIATION

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PRESIDENT: Wayne Winters

Blue Yonder designed the E-Z Flyer in 1991; built under licence by Merlin in USA until bankruptcy of December 1995; production tooling transferred to Canada and manufacture of it (and Merlin GT) resumed; Aerocomp is US agent, although Blue Yonder responsible for global sales. The company has added the E-Z KingCobra and Harvard to its product line. Manufacturing is undertaken at Indus Winter Airport.

BLUE YONDER E-Z FLYER

TYPE: Tandem-seat kitbuilt.

PROGRAMME: First kitbuilt E-Zs delivered by Merlin mid-1995. Programme transferred in 1998 to Blue Yonder, which has also produced a twin-engined prototype, designated E-Z Flyer Twin.

CURRENT VERSIONS: **E-Z Flyer:** Basic version; *as described.*

E-Z Flyer Twin: As E-Z Flyer, but with two Rotax engines in range 37.0 to 73.5 kW (49.6 to 98.6 hp). Wing span 10.82 m (35 ft 6 in); maximum T-O weight 635 kg (1,400 lb). First flown 1999; prototype (C-ITEZ) only to date with second aircraft under construction late 2004.

CUSTOMERS: Total 52 kits sold by late 2005.

COSTS: E-Z Flyer USD17,090 including Rotax 503 engine; E-Z Flyer Twin USD31,950 including Rotax 503 engines (2006).

DESIGN FEATURES: Open tube fuselage married to high-mounted Aerocomp Merlin GT wing and tail sections. Quoted build time 300 hours for E-Z Flyer and 450 hours for E-Z Flyer Twin.

FLYING CONTROLS: Manual. Non-drooping Junkers-type ailerons.

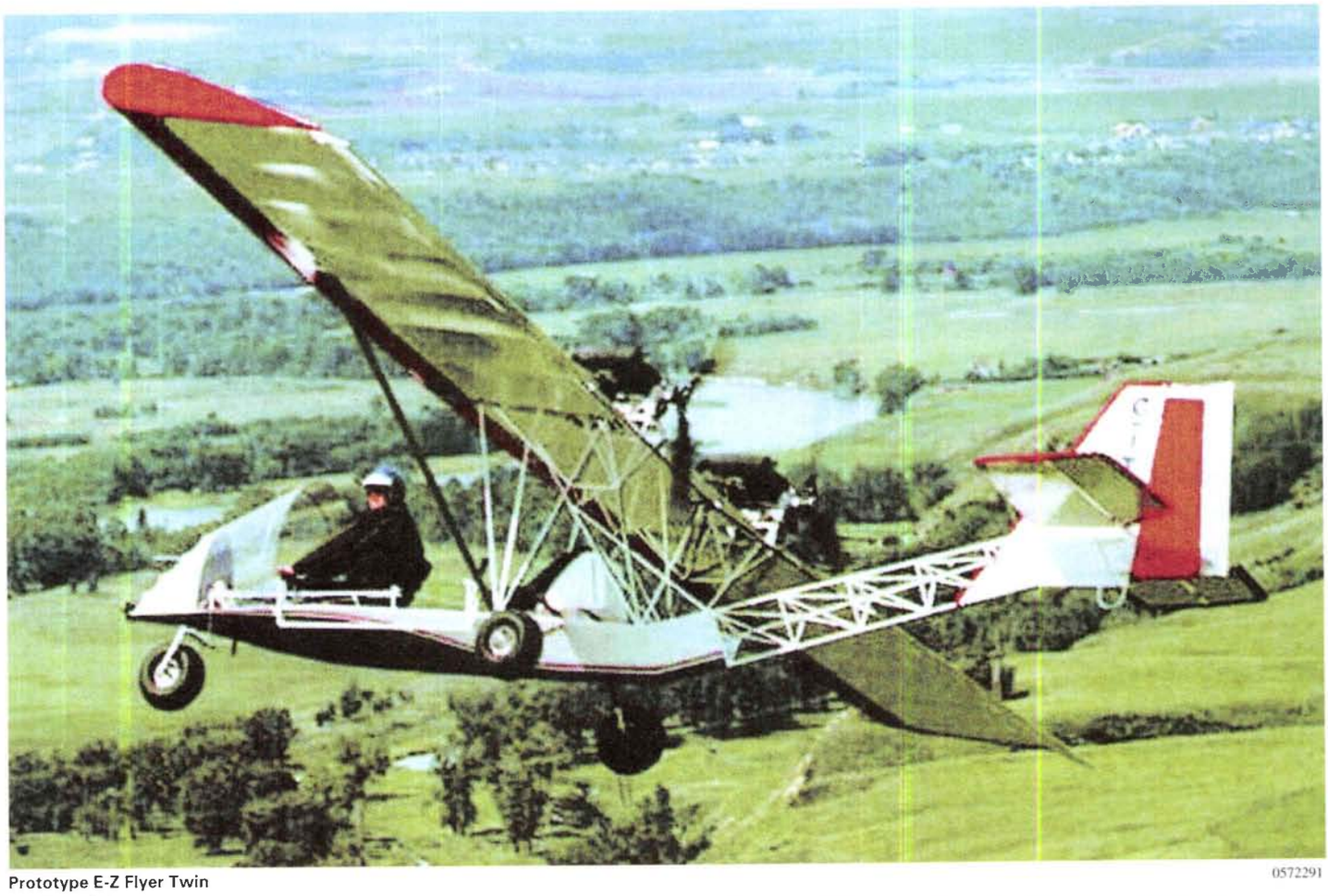
Blue Yonder E-Z Flyer two-seat kitbuilt 0507562

STRUCTURE: Fuselage is welded 4130 chromoly. Wings are aluminium D-cell construction with aluminium and Styrofoam constructed ribs; Stits Poly-Fiber covering.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted cantilever mainwheel legs. Hegar rims with brakes; solid spring steel legs; 18 in tundra tyres on mainwheels.

POWER PLANT: One 37.0 kW (49.6 hp) Rotax 503 or 47.8 kW (64.1 hp) Rotax 582 engine, driving a two- or three-blade pusher propeller. Fuel capacity 34 litres (9.0 US gallons; 7.5 Imp gallons), optionally expandable to 83 litres (22.0 US gallons; 18.3 Imp gallons) in E-Z Flyer and 125 litres (33.0 US gallons; 27.5 Imp gallons) in E-Z Flyer Twin.

DIMENSIONS, EXTERNAL (A: E-Z Flyer, B: E-Z Flyer Twin):
Wing span: A ..... 9.45 m (31 ft 0 in)
B ..... 10.82 m (35 ft 6 in)
Length overall: A ..... 6.40 m (21 ft 0 in)
B ..... 7.01 m (23 ft 0 in)
Height overall: A ..... 1.83 m (6 ft 0 in)



Prototype E-Z Flyer Twin

0572291

AREAS:
Wings, gross, incl extended tips: A ..... 16.35 m² (176.0 sq ft)
B ..... 21.83 m² (235.0 sq ft)
WEIGHTS AND LOADINGS:
Weight empty: A ..... 225 kg (495 lb)
B ..... 358 kg (789 lb)
Max T-O weight: A ..... 607 kg (1,340 lb)
B ..... 657 kg (1,450 lb)
PERFORMANCE:
Max level speed: both ..... 87 kt (161 km/h; 100 mph)
Max cruising speed: both ..... 56 kt (105 km/h; 65 mph)
Stalling speed: A ..... 35 kt (65 km/h; 40 mph)
B ..... 33 kt (62 km/h; 38 mph)
Max rate of climb at S/L: A ..... 137 m (450 ft)/min
T-O run: A ..... 31 m (100 ft)
B ..... 15 m (50 ft)
T-O to 15 m (50 ft): A ..... 99 m (325 ft)
Landing from 15 m (50 ft): A ..... 61 m (200 ft)
Landing run: A, B ..... 53 m (175 ft)
Range: A ..... 330 n miles (611 km; 379 miles)
B ..... 350 n miles (648 km; 402 miles)

BLUE YONDER E-Z KINGCOBRA

TYPE: Single-seat ultralight kitbuilt.

PROGRAMME: Designed by Blue Yonder for Dr Jack Barlass; prototype (C-IFWW) first flown late 1998. Aircraft and design rights later purchased from Barlass estate.

CURRENT VERSIONS: **King Cobra:** *As described.*

Harvard: Adaptation resembling North American AT-6 Texan/Harvard.

CUSTOMERS: Two (one of each version) flying by end 2004.

COSTS: Kingcobra kit USD21,625 including Rotax 582 engine; firewall back USD13,855; Harvard: kit USD22,275 including Rotax 582 engine; firewall back USD14,270 (2006).

DESIGN FEATURES: Low-wing monoplane; uses (shortened) wing from Merlin and E-Z Flyer allied to new tail unit. Options include electric starter. Quoted build time 400 hours.

FLYING CONTROLS: Manual. Junkers-type ailerons.

STRUCTURE: Fabric covered 4130 chromoly welded steel tube fuselage and fabric-covered aluminium D cell cantilever wings.

LANDING GEAR: Tailwheel type. Hegar 46 cm (18 in) wheels and tundra tyres standard. Hydraulic brakes.

POWER PLANT: One 47.8 kW (64.1 hp) Rotax 582 UL driving two-blade, wooden propeller; design will accept engines up to 73.5 kW (98.6 hp). Fuel capacity 91 litres (24.0 US gallons; 20.0 Imp gallons).

DIMENSIONS, EXTERNAL:
Wing span ..... 8.23 m (27 ft 0 in)
Length overall ..... 6.40 m (21 ft 0 in)
Height overall ..... 1.83 m (6 ft 0 in)
AREAS:
Wings, gross ..... 14.68 m² (158.0 sq ft)

Blue Yonder E-Z KingCobra

0572304

Blue Yonder Harvard

0572303

WEIGHTS AND LOADINGS:
Weight empty ..... 246 kg (543 lb)
Max T-O weight ..... 544 kg (1,200 lb)
PERFORMANCE:
Never-exceed speed (VNE) ..... 104 kt (193 km/h; 120 mph)
Normal cruising speed ..... 78 kt (145 km/h; 90 mph)
Stalling speed ..... 27 kt (49 km/h; 30 mph)
Max rate of climb ..... 305 m (1,000 ft)/min
Service ceiling ..... 4,265 m (14,000 ft)
T-O run ..... 46 m (150 ft)
Landing run ..... 69 m (225 ft)
Range ..... 540 n miles (1,000 km; 621 miles)

BOMBARDIER

BOMBARDIER AEROSPACE

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DESIGN DIVISIONS:

Bombardier Aerospace Montreal: formerly Canadair; follows Bombardier entry

Bombardier Aerospace Toronto: formerly de Havilland; follows Bombardier Aerospace Montreal entry

Bombardier Aerospace Learjet: see under US under Learjet

Bombardier Aerospace Belfast: formerly Shorts

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PRESIDENT, AMPHIBIOUS AIRCRAFT: Michael Bourgeois
PRESIDENT, NEW COMMERCIAL AIRCRAFT PROGRAMMES: Gary R Scott

Bombardier Inc, a diversified Canadian corporation with 79,000 employees, formed Bombardier Aerospace in 1986, subsequently combining design and manufacturing activities of Canadair (1986), de Havilland (1992), Learjet (1990) and Shorts (1989). Sales, marketing and support are conducted by the Amphibious Aircraft, Regional Aircraft and Business Aircraft units.

Bombardier Aerospace also designs and manufactures components for Airbus and Boeing.

Bombardier Aerospace's revenue for the year ended 31 January 2005 totalled CAD15.8 billion. Employment stood at 27,100 worldwide in late 2005.

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VICE-PRESEIDENT, OPERATIONS, MIRABEL PLANT: Alain Dugas

Acquired by Bombardier Inc 23 December, 1986, Bombardier Aerospace Montreal (formerly Canadair) has manufactured more than 4,500 aircraft since 1944. Mirabel plant, adjacent to Montréal International Airport, until recently comprised 27,870 m^2 (300,000 sq ft) of floor space for manufacture and assembly of the Challenger and Regional Jet. However, 27,870 m^2 (300,000 sq ft) final assembly building for CRJ700 and CRJ900 formally opened on 22 October 2001, having begun operations in previous August. An 18,580 m^2 (200,000 sq ft) interior outfitting, flight testing, inspection and delivery centre is also part of the Mirabel facility. Parts, components and spare parts for various aircraft, including Challenger, Regional Jet series, Global Express and Bombardier 415, are manufactured at St Laurent plant, 214,350 m^2 (2,307,275 sq ft) in Québec. Structural components for other aircraft builders, such as Boeing and Aerospatiale Matra, are also manufactured in this plant.

The Challenger series and Global Express series are completed at the 38,590 m^2 (415,400 sq ft) Bombardier Completion Center, Montréal, beside the Bombardier Aerospace headquarters at Dorval. Total workforce in the Montréal area is more than 15,000.

BOMBARDIER CRJ200 AND CHALLENGER 800/850

Engineering designation: CL-600-2B19

TYPE: Regional jet airliner.

PROGRAMME: Design studies began in third quarter of 1987; basic configuration frozen June 1988; formal programme go-ahead given 31 March 1989; extended-range CRJ100ER announced September 1990. Three development aircraft built (c/n 7001–7003), plus static test airframe (c/n 7991) and forward fuselage test article (7992); first flight of 7001 (C-FCRJ) 10 May 1991; 7002 (C-FNRJ) first flew 2 August 1991 and 7003 on 17 November 1991; all three in 1,400-hour flight test programme in Wichita, USA. CF34-3A1 engine obtained its US type certificate 24 July 1991. Transport Canada type approval (CRJ100 and CRJ100ER) 31 July 1992. Japanese Civil Aviation Bureau certification 23 May 2000.

First delivery aircraft (c/n 7004) flew 4 July 1992, and to Lufthansa CityLine of Germany (as D-ARJA) 29 October 1992; European JAA and US FAA certification 14 and 21 January 1993 respectively; long-range CRJ100LR certified 29 April 1994; CRJ200 with CF34-3B1 engines announced in 1995. Replaced CRJ100 after 226 of the latter had been delivered. Total fleet time at August 2004 (not including corporate aircraft) was 8,808,762 flight hours and 7,634,924 cycles, with 99.6 per cent despatch reliability rate. 200th aircraft delivered (to Lufthansa) 24 October 1997; 300th to Atlantic Coast Airlines in April 1999. 400th to Delta Connection/SkyWest in July 2000. 500th to Atlantic Coast Airliners 26 April 2001, and 600th to Atlantic Southeast Airlines 29 January 2002, and 700th to Air Nostrum 30 October 2002, and 1,000th aircraft in CRJ series, a CRJ 700, to Conair on 9 December 2003. Production of CRJ200 running at 9.5 per month in 2000, rising to 12.5 per month by late 2001, and 14.5 per month by 2003, with annual targets of 165 in 2003 and 174 in 2004. Delivery of four CRJ200s in 2006 exhausted orders for 1,021 of short-fuselage CRJs.

CURRENT VERSIONS: **CRJ100:** Original standard aircraft. Engineering designation CL-600-2B19.

CRJ100ER: Replaced by CRJ200ER.

CRJ100LR: Announced March 1994; launch customer, Lauda Air of Austria; replaced by CRJ200LR.

CRJ200: Standard aircraft; designed to carry 50 passengers over 985 n mile (1,824 km; 1,133 mile) range; CF34-3B1 engines with 2.8 per cent lower specific fuel consumption than CF34-3A1 of CRJ100, increasing initial cruise altitude by 213 m (700 ft), cruising speed by 2.5 kt (4.5 km/h; 3 mph), and range typically by 1.5 per cent; Class C baggage compartment as standard. First delivery, to Tyrolean Airways as OE-LCF, 15 January 1996. Further improvements in development for introduction on CRJ200 variants during early 1996 included 3 kt (5.5 km/h; 3.5 mph) reduction in V_2 speed to provide 91 m (300 ft) reduction in T-O run at maximum T-O weight; 1 kt (1.8 km/h; 1.2 mph) reduction in V_{REF} to provide 15 m (50 ft) reduction in landing run at typical landing weights; new 8° flap setting to improve second-segment climb performance; and GPS integrated with an upgraded FMS.

CRJ200ER: Extended-range capability with optional increase in maximum T-O weight to 23,133 kg (51,000 lb) and optional additional fuel capacity, for range of 1,645 n miles (3,046 km; 1,893 miles).

CRJ200LR: Longer-range version of CRJ200ER (more than 2,005 n miles; 3,713 km; 2,307 miles); maximum T-O weight increased by 907 kg (2,000 lb) to 24,040 kg (53,000 lb).

CRJ200B, CRJ200B ER and CRJ200B LR: As above, but with optional hot-and-high CF34-3B1 engines providing normal T-O thrust up to ISA+7.8°C (ISA+6.1°C for standard engines), and APR thrust up to ISA+15°C (ISA+6.1°C for standard engines).

CRJ440: Engineering designation CL-600–2B19. Version seating 44 passengers in standard configuration. Launch customer Northwest Airlines has ordered 75.

CRJ700: *Described separately.*

Corporate Jetliner: Company shuttle version with more spacious cabin accommodation for 18 to 30 passengers. One delivered June 1993 to Xerox Corporation. Five ordered by the People's Republic of China in January 1997; operated on behalf of PRC government by China United Airlines' crews; contract value C$116 million, including outfitting, pilot and maintenance staff training and spares. Supplanted from September 2002 by corporate version of Challenger 800 (see below).

Challenger 800: Corporate version developed in consultation with launch customer TAG Aeronautics Ltd to meet requirement for non-stop flights, London to Jeddah or equivalent, with three crew and five passengers; or between Middle East city pairs with 15 passengers. First flown 26 May 1995 and formally announced at Paris Air Show in the following month; initially designated **Canadair Special Edition;** first delivery (N877SE) to TAG during Dubai International Aerospace Show in November 1995; second TAG aircraft delivered November 1997. Accommodation for up to 19 passengers in customised cabin; additional 1,814 kg (4,000 lb) of fuel carried in two auxiliary tanks behind main cabin, extending range to more than 3,000 n miles (5,556 km; 3,452 miles); maximum T-O weight 24,040 kg (53,000 lb); first aircraft powered by standard CF34-3A1 turbofans, but subsequent examples are equipped with CF34-3B1s increasing range to 3,120 n miles (5,778 km; 3,590 miles); Rockwell Collins Pro Line 4 avionics as on RJ, but with third FMS, third VHF, dual Collins HF and Selcal. Manufactured to special order only. Recent customers include Poly Technologies Inc, which ordered two on 16 August 2001 for operation by China Ocean Aviation Group, with deliveries scheduled for 2002. Renamed Challenger 800 on eve of NBAA Convention at Orlando, Florida, 8 September 2002. Replaced by Challenger 850.

BOMBARDIER AEROSPACE DELIVERIES

FY (ending 31 January)	Regional	Business	Amphibian	Total
1999–2000	104	183	5	292
2000–01	157	203	10	370
2001–02	206	162	2	370
2002–03	220	77	1	298
2003–04	232	89	3	324
2004-05	200	128	1	329
2005-06	149	186	2	337

One of several elaborately decorated Bombardier CRJ200s serving China Yunnan Airlines 1040562

Challenger 850: Corporate transport based on CRJ200LR: announced 17 May 2005 at EBACE, Geneva, Switzerland. First delivery (C-GSUW, c/n 8047) to Suncor Energy of Alberta 27 March 2006, ex Bombardier. Other conversions by Lufthansa Technik. Range 1,537 n miles (2,846 km; 1,768 miles) with maximum 50 passengers; or 1,920 n miles (3,555 km; 2,209 miles) with split cabin seating eight executives (forward) and 36 staff (rear). Cost USD29 million.

CUSTOMERS: See table. Total 44 deliveries in Bombardier's 2005-06 fiscal year, including eight Challenger 850 corporate shuttles. By 31 October 2006, had received orders for 226 CRJ100s, 709 CRJ200s and 86 CRJ440s, all of which delivered, including four CRJ200s in 2006.

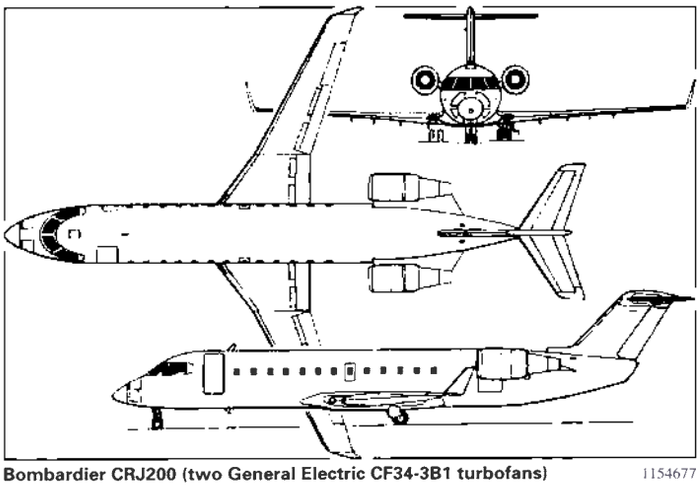
BOMBARDIER CRJ ORDERS AND DELIVERY
(at 31 October 2006)

Customer	Variant	Ordered	Delivered	Backlog
Adria Airways	200	5	5	
Air Canada	100	24	24	
	200	17	17	
	705	15	15	
Air Dolomiti	200	5	5	
Air Littoral	100	19	19	
Air Nostrum	200	35	35	
	900	16	6	10
Air One	900	6	5	1
Air Wisconsin	200	64	64	
American Eagle	701	25	25	
Arik Air	900	2	2	-
Atlantic Southeast (ASA)	200	45	45	
	701	12	12	
Atlas Jet	900	3	3	-
[1]Austrian arrows	200	13	13	
Brit Air	100	20	20	
	701	12	12	
British European	200	4	4	
China Eastern Yunnan	200	6	6	
Cimber Air	200	2	2	
COMAIR	100	110	110	
	701	20	20	
DAC Air	200	2	2	
Delta Connection	200	94	94	
	701	30	30	
GECAS	200	5	5	
	701	17	17	
GoJet	701	4	4	
Horizon Air	701	20	20	
[2]Independence Air	200	87	87	
Japan Air Lines (J-AIR)	200	9	9	
Kendell/Ansett	200	12	12	
Lauda Air	100	8	8	
Lufthansa CityLine	100	35	35	
	200	10	10	
	701	20	20	
	900	12	12	
Lufthansa/Eurowings	200	12	12	
Macedonian	900	1	1	-
Maersk Air	200	11	11	
	701	5	5	
Malev	200	4	4	
Mesa Air	200	32	32	
	701	20	18	2
	900	40	38	2
Midway	200	24	24	
My Way	900	19	-	19
Northwest Airlines	200	56	56	
	440	86	86	
	900	36	-	36
Saeaga Airlines	200	1	1	
Shandong Airlines	200	5	5	
	701	2	2	
Shanghai Airlines	200	3	3	
SkyWest	100	10	10	
	200	100	100	
	701	57	57	
	900	17	7	10
South African Express	200	6	6	
Southern Winds	200	2	2	
Styrian Spirit	200	1	1	
	701	1	1	
The Fair Inc	200	2	2	
undisclosed	900	1	1	
US Airways	200	35	35	
	701	8	8	
Challenger 800	SE	33	33	
Totals		**1,475**	**1,395**	**80**

[1] Formerly Tyrolean
[2] Formerly Atlantic Coast Airlines
[3] Comprising 26 Series 200 and seven Series 700, of which, all delivered

COSTS: Programme development costs CAD275 million. Atlantic Coast Airlines order for 10 CRJ200ERs valued at USD200 million (September 1998). Order for two Special Editions valued at USD54.2 million (August 2001).

DESIGN FEATURES: Evolved from Challenger (which see), designed expressly for regional airline operating environment. Advanced transonic wing design, with winglets for high-speed operations; fuel-efficient GE turbofans; options include higher design weights, additional fuel capacity, more comprehensive avionics, and maximum certified altitude raised to 12,500 m (41,000 ft).



Bombardier CRJ200 (two General Electric CF34-3B1 turbofans) 1154677

Wings, designed with computational fluid dynamics (CFD), have 13.2 per cent (root) and 10 per cent (tip) thickness/chord ratios, 2° 20' dihedral, 3° 25' root incidence and 24° 45' quarter-chord sweepback.

FLYING CONTROLS: Conventional and power-assisted. Primary controls with cables and push/pull rods for multiple redundancy; hydraulically actuated ailerons, elevators and rudder with at least two hydraulic power control unit actuators per surface (three on rudder and elevator); ailerons and elevators fitted with flutter dampers (dual on elevators); rudder with dual-channel control yaw damping; artificial feel and electric trim for roll and yaw; electronically controlled, variable incidence T tailplane for pitch trim and electronically controlled artificial pitch feel. Double-slotted electromechanical flaps with electronically controlled Datron electric motors; BAE fly-by-wire spoiler and spoileron system, four spoilers each side, with inner two functioning as ground spoilers, outer two comprising one flight spoiler and one spoileron, both also providing lift dumping on touchdown. Avionics suite includes engine indication and crew alerting system (EICAS).

STRUCTURE: Semi-monocoque fuselage is damage tolerant FAR/JAR 25 certified airframe with chemically milled skins; flat pressure bulkheads forward of flight deck and aft of baggage compartment; extensive use of advanced composites in secondary structures (passenger compartment floor, wing/fuselage fairings, nacelle doors, wing access door covers, winglets, tailcone, avionics access doors and landing gear doors); comprehensive anti-corrosion treatment and drainage. Wing is one-piece unit mounted to underside of fuselage; two-spar box joined by ribs, covered top and bottom with integrally stiffened skin panels (three upper and three lower each side) for smooth flow; machined or built-up spars and shearweb-type ribs. Short Brothers (UK) manufactures fuselage central section, fore and aft fuselage plugs, wing flaps, ailerons, spoilerons and inboard spoilers.

LANDING GEAR: Hydraulically retractable tricycle type, manufactured by Dowty. Inward-retracting main units each have 15 in Aircraft Braking System (ABS) wheels with H29×9.0-15 (16 ply) Goodyear tubeless tyres, pressure 11.17 bar (162 lb/sq in) unladen. Nose unit has 18×4.4 (12 ply) tyres (deflector type) and Dowty Canada steer-by-wire steering; unladen tyre pressure 8.62 bar (125 lb/sq in). Aircraft Braking System steel multidisc brakes and fully modulated Hydro Aire Mk III anti-skid system. Minimum taxiway width for 180° turn (with 3.35 m; 11 ft 0 in safety margin) is 22.86 m (75 ft 0 in).

POWER PLANT: Two General Electric CF34-3B1 turbofans, each rated at 41.0 kN (9,220 lb st) with APR and 38.8 kN (8,729 lb st) without. Nacelles produced by Short Brothers. Pneumatically actuated thrust reversers. Fuel in two integral wing tanks, combined capacity 5,300 litres (1,400 US gallons; 1,166 Imp gallons); increasable to 8,080 litres (2,135 US gallons; 1,778 Imp gallons) with optional centre-wing tank. Pressure refuelling point in starboard leading-edge wingroot; transfer rate 474 litres (125 US gallons; 104 Imp gallons)/min at 3 45 bar (50 lb/sq in); two gravity points on starboard wing (one for centre tank) and one on port wing.

ACCOMMODATION: Two-pilot flight deck; one or two cabin attendants. Main cabin seats up to 50 passengers in standard configuration, four-abreast at 79 cm (31 in) pitch, with centre aisle; maximum capacity 52 seats. Various configurations, from 15 to 50 seats, available for corporate version. Downward-opening front passenger door with integral airstairs on port side; plug-type forward emergency exit/service door opposite on starboard side (inoperative on Challenger 800). Inward-opening baggage door on port side at rear. Overwing Type III emergency exit each side (port side door inoperative on Challenger 800). Entire accommodation pressurised, including rear baggage compartment.

SYSTEMS: Cabin pressurisation and air conditioning system (maximum differential 0.57 bar; 8.3 lb/sq in). Primary flight control systems powered by hydraulic servo-actuators with distinct, alternate paths cable and pushrod systems. Electric trim and dual yaw dampers. Three fully independent 207 bar (3,000 lb/sq in) hydraulic systems. Three-phase 115 V AC electrical primary power at 400 Hz supplied by two 30 kVA engine-driven generators; alternative power provided by APU and air-driven generator. Conversion to 28 V DC by five transformer-rectifier units. Main (Ni/Cd) battery 17 Ah, APU battery 43 Ah. Honeywell GTCP 36–150 (RJ) APU and two-pack air conditioning system in rear of fuselage. Wing leading-edges and engine intake cowls anti-iced by engine bleed air. Electric anti-icing of windscreen and cockpit side windows, pitot heads, air data vanes, static sources and sensors. Ice detection system standard

AVIONICS: *Comms:* Dual VHF nav/com radios. Options include HF radio, single Selcal and 8.33 kHz VHF.

Radar: Rockwell Collins digital weather radar system; split-scan weather radar and radar with turbulence mode optional.

Flight: Dual flight management systems optional. GPWS, windshear detection system and TCAS. EGPWS optional in place of GPWS. L3 flight data recorder and CNE. Dual FMS 4200 and dual IRS in Corporate Jetliner and Challenger 800.

Instrumentation: Rockwell Collins Pro Line 4 integrated all-digital suite, including dual primary flight displays, dual multifunction displays, dual EICAS, dual AFCS, dual AHRS, dual air data system and Cat II capability with Cat. IIIa optional using head-up guidance system. Dual inertial reference system optional in lieu of AHRS. Flight Dynamics Inc HGS 2100 HUD approved by Transport Canada November 1995, permitting Cat. IIIa operation.

DIMENSIONS, EXTERNAL: (As for Challenger 604 except):

Wing span over winglets	21.21 m (69 ft 7 in)
Wing chord: at fuselage c/l	5.13 m (16 ft 10 in)
at tip	1.27 m (4 ft 2 in)
Wing aspect ratio (excl winglets)	8.9

Length: overall ..... 26.77 m (87 ft 10 in)
fuselage ..... 24.38 m (80 ft 0 in)
Height overall ..... 6.22 m (20 ft 5 in)
Fuselage max diameter ..... 2.69 m (8 ft 10 in)
Wheel track ..... 3.17 m (10 ft 5 in)
Wheelbase ..... 11.41 m (37 ft 5 in)
Passenger/crew door (fwd, port):
Height ..... 1.78 m (5 ft 10 in)
Width ..... 0.91 m (3 ft 0 in)
Service door (stbd, fwd): Height ..... 1.22 m (4 ft 0 in)
Width ..... 0.61 m (2 ft 0 in)
Height to sill (crew/service) ..... 1.63 m (5 ft 4 in)
Baggage door (port, rear): Height ..... 1.09 m (3 ft 7 in)
Width ..... 0.84 m (2 ft 9 in)
Height to sill ..... 1.63 m (5 ft 4 in)
Emergency exit (overwing, stbd):
Height ..... 0.96 m (3 ft 2 in)
Width ..... 0.51 m (1 ft 8 in)

DIMENSIONS, INTERNAL (As for Challenger 604 except):
Cabin (incl baggage compartment, excl flight deck):
Length ..... 14.76 m (48 ft 5 in)
Max height ..... 1.85 m (6 ft 1 in)
Width: at centreline: except 800 ..... 2.57 m (8 ft 5 in)
800 ..... 2.49 m (8 ft 2 in)
at floor level ..... 2.18 m (7 ft 2 in)
Floor area: except 800 ..... 32.1 m^2 (346 sq ft)
800 ..... **30.3 m^2 (326 sq ft)**
Volume: except 800 ..... **57.1 m^3 (2,015 cu ft)**
800 ..... **53.8 m^3 (1,900 cu ft)**
Stowage volume:
main (rear) baggage compartment ..... 9.0 m^3 (318 cu ft)
wardrobes/bins/underseat (total) ..... 4.7 m^3 (165 cu ft)

AREAS:
Wings: gross (excl winglets) ..... **54.54 m^2 (587.1 sq ft)**
net ..... **48.35 m^2 (520.4 sq ft)**
Ailerons (total) ..... **1.93 m^2 (20.8 sq ft)**
Trailing-edge flaps (total) ..... 10.60 m^2 (114.1 sq ft)
Spoilers (total) ..... 2.26 m^2 (24.3 sq ft)
Winglets (total) ..... 1.38 m^2 (14.9 sq ft)
Fin ..... 9.18 m^2 (98.8 sq ft)
Rudder ..... 2.03 m^2 (21.9 sq ft)
Tailplane ..... 9.44 m^2 (101.6 sq ft)
Elevators (total) ..... 2.84 m^2 (30.52 sq ft)

WEIGHTS AND LOADINGS:
Manufacturer's weight empty:
200 ..... 13,236 kg (29,180 lb)
200ER, 200LR ..... 13,243 kg (29,195 lb)
800 Corporate ..... 11,703 kg (25,800 lb)
Operating weight empty: 200 ..... 13,730 kg (30,270 lb)
200ER, 200LR ..... 13,835 kg (30,500 lb)
800 Corporate ..... 14,424 kg (31,800 lb)
800 ..... 15,377 kg (33,900 lb)
Max payload (structural): 200 ..... 5,411 kg (11,930 lb)
200ER, 200LR ..... 6,124 kg (13,500 lb)
800 Corporate ..... 5,533 kg (12,200 lb)
800 ..... 2,540 kg (5,600 lb)
Max fuel: 200 ..... 4,254 kg (9,380 lb)
200ER, 200LR, 800 Corporate ..... 6,489 kg (14,305 lb)
800 ..... 8,303 kg (18,305 lb)
Payload with max fuel: 200 ..... 3,651 kg (8,050 lb)
200ER ..... 2,923 kg (6,445 lb)
200LR ..... 3,831 kg (8,445 lb)
800 Corporate ..... 2,333 kg (5,145 lb)
800 ..... 474 kg (1,045 lb)
Fuel with max payload: 800 ..... 6,237 kg (13,750 lb)
Max T-O weight: 200 ..... 21,523 kg (47,450 lb)
200ER, 800 Corporate ..... 23,133 kg (51,000 lb)
200LR, 800 Corporate (optional), 800 ..... 24,040 kg (53,000 lb)
Max ramp weight: 200 ..... 21,636 kg (47,700 lb)
200ER ..... 23,246 kg (51,250 lb)
200LR, 800 ..... 24,154 kg (53,250 lb)
Max zero-fuel weight: 800 ..... 17,917 kg (39,500 lb)
200 ..... 19,141 kg (42,200 lb)
200ER, 200LR, 800 Corporate ..... 19,958 kg (44,000 lb)
Max landing weight: 200 ..... 20,275 kg (44,700 lb)
200ER, 200LR, 800 Corporate, 800 ..... 21,319 kg (47,000 lb)
Max wing loading: 200 ..... 394.6 kg/m^2 (80.82 lb/sq ft)
200ER ..... 424.1 kg/m^2 (86.87 lb/sq ft)
200LR, 800 Corporate (optional), 800 ..... 440.8 kg/m^2 (90.27 lb/sq ft)
Max power loading (APR rating):
200 ..... 263 kg/kN (2.57 lb/lb st)
200ER, 800 Corporate ..... 282 kg/kN (2.77 lb/lb st)
200LR, 800 Corporate (optional), 800 ..... 293 kg/kN (2.87 lb/lb st)

PERFORMANCE:
Max operating speed:
above FL314 ..... M0.85
below FL254 ..... 335 kt (621 km/h; 386 mph)
High-speed cruising speed: CRJ200 at FL370 ..... M0.81 or 464 kt (859 km/h; 534 mph)
800 Corporate, 800 ..... M0.80 or 459 kt (850 km/h; 528 mph)
Normal cruising speed: CRJ200 at FL370 ..... M0.74 or 424 kt (785 km/h; 488 mph)
800 Corporate, 800 ..... M0.77 or 442 kt (819 km/h; 509 mph)
Long-range cruising speed: 800 Corporate, 800 ..... M0.74 or 424 kt (785 km/h; 488 mph)
Approach speed, 45° flap, AUW of 19,504 kg (43,000 lb) ..... 135 kt (250 km/h; 155 mph)
Max rate of climb at FL15, 250 kt CAS/M0.74 climb schedule: 200 ..... 1,128 m (3,700 ft)/min
200LR ..... 1,036 m (3,400 ft)/min
800 ..... 1,034 m (3,395 ft/min)
Max certified altitude ..... 12,500 m (41,000 ft)
FAR T-O field length at S/L, ISA:
200 ..... 1,527 m (5,010 ft)
200ER ..... 1,768 m (5,800 ft)
200LR ..... 1,917 m (6,290 ft)
800 Corporate ..... 1,765 m (5,790 ft)
800 ..... 1,918 m (6,295 ft)
FAR landing field length at S/L, ISA, at max landing weight: 200 ..... 1,423 m (4,670 ft)
200ER, 200LR ..... 1,478 m (4,850 ft)
800 Corporate, SE ..... 887 m (2,910 ft)
Range with max payload at long-range cruising speed, FAR Pt 121 reserves:
200 ..... 965 n miles (1,787 km; 1,110 miles)
200ER ..... 1,645 n miles (3,046 km; 1,893 miles)
200LR ..... 2,005 n miles (3,713 km; 2,307 miles)
Corporate (30 seats), NBAA IFR reserves ..... 2,017 n miles (3,735 km; 2,321 miles)
800 with 3,674 kg (8,100 lb) payload ..... 1,541 n miles (2,853 km; 1,773 miles)
Range with max fuel:
800 Corporate ..... 2,250 n miles (4,167 km; 2,589 miles)
800 ..... 3,120 n miles (5,778 km; 3,590 miles)

OPERATIONAL NOISE LEVELS (CRJ200, FAR Pt 36):
CRJ200: T-O ..... 77.6 EPNdB
Approach ..... 92.1 EPNdB
Sideline ..... 82.4 EPNdB
800 Corporate, 800: T-O ..... 78.7 EPNdB
Approach ..... 92.1 EPNdB
Sideline ..... 82.2 EPNdB

BOMBARDIER CRJ700 and CHALLENGER 870

Engineering designation: CL-600-2C10

TYPE: Regional jet airliner.

PROGRAMME: Design and market evaluation began in 1995 in consultation with 15-member advisory panel of airline operators; stretched derivative of Regional Jet; originally designated CRJ-X. GE CF34-8C1 engines selected February 1995; low-speed wind tunnel testing began early 1995 at Institute of Aeronautical Research, Ottawa; high-speed wind tunnel testing began November 1995 at Rockwell facilities in California. More than 650 hours of wind tunnel testing completed by September 1996. Bombardier Board gave approval for launch on 21 January 1997, at which time orders included four from launch customer Brit Air of France. Aerodynamic configuration frozen 14 March 1997; design frozen 17 July 1998. New version of CF34 engine first ground run in February 1998, followed by flight tests on GE-owned Boeing 747 testbed in first quarter of 1999 and certification in November 1999. First flight (C-FRJX c/n 10001) 27 May 1999; official roll-out 28 May 1999; public debut (c/n 10004) at Farnborough International Air Show 23 July 2000; Transport Canada certification achieved 22 December 2000; first delivery, to Brit Air of France, in February 2001, followed by deliveries to Horizon Air and Lufthansa CityLine in May.

Four flying aircraft and two static test airframes participated in the certification programme; one static test airframe was used for Complete Aircraft Static Test (CAST), while the other underwent Durability and Damage Tolerance Test (DDTT), and was subjected to the equivalent of 160,000 flight cycles. Test programme was conducted at the Bombardier Flight Test Centre at Wichita, Kansas, totalling 1,600 flight hours on four aircraft: C-FRJX (handling and performance evaluation), 10002/C-FJFC (systems), 10003/C-FBKA (avionics) and 10004/C-FCRJ, the first to be fully furnished (function and reliability testing), which initially flew on 16 December 1999. In December 2002 Bombardier signed a tentative agreement with China Aviation Corporation I (AVIC I) that could lead to final assembly of the CRJ700 and CRJ900 by Shanghai Aviation Industrial Corporation.

Total fleet time, including CRJ900s, at March 2005 stood at 893,760 hours and 697,473 cycles, with a 99.2 per cent despatch reliability rate.

CURRENT VERSIONS: **CRJ700 Srs 701:** Formerly CRJ700 68-seat version in standard and extended range (ER) weight options. *As described.*

CRJ700 Srs 705: Formerly CRJ701. 70-seat version in standard, extended range (ER) and long range (LR) weight options. *Described separately.*

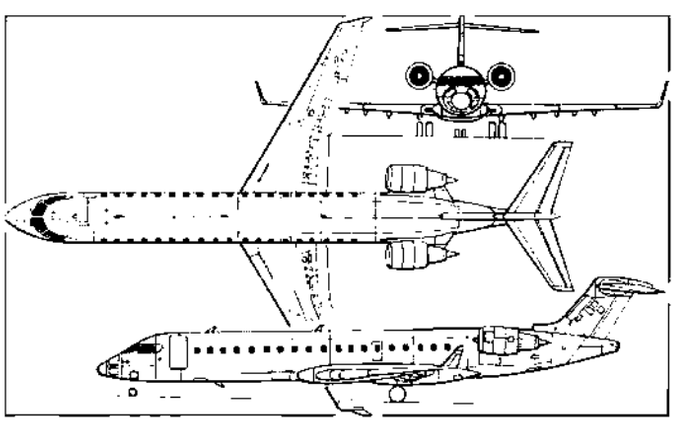
Challenger 870: Corporate shuttle version of CRJ700 Srs 701. Three delivered in 2004-05 and three in 2005-06.

CRJ900: Further stretch, *described separately.*

CUSTOMERS: Refer to table in CRJ200 entry. By 31 October 2006 had gained 268 (251 CRJ701 and 15 CRJ705) orders, of which 266 (251 CRJ701 and 15 CRJ705) had then been delivered. Deliveries of CRJ700 and 900 variants in Bombardier's 2005-06 fiscal year totalled 77, including three Challenger 870 corporate shuttles. At 31 October 2006, only two aircraft remained to be delivered from 253 CRJ700s (excluding Srs 705).

COSTS: Development cost CAD645 million, of which CAD440 million provided by Bombardier and balance by risk-sharing partners. Unit cost USD26.8 million (1998). Break-even point is at 200th of 400 aircraft production run.

DESIGN FEATURES: Commonality (including crew training and type rating) with CRJ100/200; direct operating cost per seat-mile to be 20 per cent lower than that of CRJ100/200 and lowest of any airliner in its class. Fuselage stretched 4.72 m (15 ft 6 in) by plugs fore and aft of centre-section to seat 70 passengers; rear pressure bulkhead moved aft by 1.29 m (4 ft 3 in); cabin 6.02 m (19 ft 9 in) longer; APU moved to tailcone; cabin floor lowered by 2.5 cm (1 in) and ceiling raised by 1.3 cm (½ in) to provide 1.89 m (6 ft 2¼ in) headroom;



Bombardier CRJ700 series regional jet airliner *(James Goulding)* 1158940

Bombardier CRJ700 70-seat regional airliner 1040566

cabin windows raised 11.5 cm (4½ in); new underfloor baggage compartment, volume 3.09 m³ (109 cu ft) to facilitate ramp check-in; wing span increased by 1.83 m (6 ft 0 in) by wingroot plug; wing leading-edge extended and equipped with high-lift devices; larger horizontal tail surfaces; new pitch control system; main landing gear lengthened; new wheels, tyres, brakes; air conditioning and anti-icing systems upgraded; new engines; new underfloor baggage compartment on forward port side; overhead stowage bins redesigned.

Incorporation of CRJ900's strengthened wing and avionics software upgrades under consideration in mid-2001 to increase commonality between CRJ700 and CRJ900, affording a 200 n mile (370 km; 230 mile) increase in range for CRJ700.

FLYING CONTROLS: Sextant and Menasco primary and secondary flight control system; flying controls are actuated via a dual network of cables, pulleys and pushrods which operate hydraulic power drive units; secondary controls are fly-by-wire.

STRUCTURE: Programme participants include Bombardier Canadair operations (wing, cockpit, rudder and doors, electrical system, primary flight controls, plus final assembly and interior completion), C & D Interiors (cabin interior), Gamesa (vertical and horizontal stabilisers), General Electric (power plant), GKN Westland (tailcone and doors), Hella Aerospace GmbH (lighting system), Honeywell (APU), Intertechnique (fuel system), Liebherr Aerospace Toulouse (air management system), Menasco Aerospace (landing gear), Mitsubishi Heavy Industries (aft fuselage), Parker Abex (hydraulic system), Rockwell Collins (avionics), Sextant Avionique (flight control system), Shorts (nacelles and thrust reversers) and Hamilton Sundstrand (flaps, leading-edge slats and electrical system).

LANDING GEAR: Hydraulically retractable tricycle type by Menasco with twin wheels on each unit. Mainwheel tyre size H36×12.0–18, pressure 10.55 bar (153 lb/sq in); nosewheel tyre size H20.5×6.75–10, pressure 9.24 bar (134 lb/sq in).

POWER PLANT: Two General Electric CF34-8C1 turbofans with dual-channel FADEC. Engine rating 56.4 kN (12,670 lb st), or 61.3 kN (13,790 lb st) with automatic power reserve, flat rated to ISA + 15°C. Intertechnique fuel management system with Ratier-Figeac controls. Fuel capacity 10,989 litres (2,903 US gallons; 2,417 Imp gallons).

ACCOMMODATION: Two-pilot flight deck. Main cabin seats 70 passengers, four-abreast at 79 cm (31 in) pitch. Baggage compartment and lavatory at rear of cabin; underfloor baggage compartment; various combinations of galleys, wardrobes and lavatory at front of cabin according to seating capacity. Passenger door, forward emergency exit/service door, overwing emergency exits and baggage door as for Regional Jet.

SYSTEMS: Hamilton Sundstrand electrical generation system comprising two 40 kVA integrated drive generators; tailcone-mounted Honeywell APU approved for operation up to 12,500 m (41,000 ft); Liebherr air management system; Intertechnique fuel system; Walter Kidde fire detection system; Goodrich potable water system; Hella lighting system; Parker/Abex Hydraulics hydraulic systems, and Teleflex anti-icing system.

AVIONICS: *Radar:* Rockwell Collins digital weather radar.

Flight: Rockwell Collins AHRS and TCAS.

Instrumentation: Rockwell Collins Pro Line 4 EFIS with six 127 × 178 mm (5 × 7 in) CRT displays, including dual PFD, dual MFD and dual EICAS; Flight Dynamics HGS 2000 head-up guidance system. Autopilot, FMS and centralised avionics maintenance functions are provided by integrated avionics processing system (IAPS). Windshear detection and recovery system standard. Equipped for Cat. II landings.

Following data are provisional.

DIMENSIONS, EXTERNAL:

Wing span	23.24 m (76 ft 3 in)
Wing aspect ratio	7.4
Length overall	32.51 m (106 ft 8 in)
Max diameter of fuselage	2.69 m (8 ft 10 in)
Height overall	7.57 m (24 ft 10 in)
Tailplane span	8.53 m (28 ft 0 in)
Wheelbase	13.67 m (44 ft 10 in)
Turning circle	22.86 m (75 ft 0 in)
Passenger door (port, fwd):	
Height	1.78 m (5 ft 10 in)
Width	0.91 m (3 ft 0 in)
Height to sill	1.73 m (5 ft 8 in)
Baggage door (port, aft): Height	0.84 m (2 ft 9 in)
Width	1.09 m (3 ft 7 in)
Height to sill	2.31 m (7 ft 7 in)
Baggage door (port, fwd): Height	0.51 m (1 ft 8 in)
Width	1.07 m (3 ft 6 in)
Height to sill	1.28 m (4 ft 2½ in)
Service door (starboard, fwd): Height	1.22 m (4 ft 0 in)
Width	0.61 m (2 ft 0 in)
Height to sill	1.73 m (5 ft 8 in)

DIMENSIONS, INTERNAL:

Cabin (excl flight deck):	
Length	18.03 m (59 ft 2 in)
Max width: at centreline	2.57 m (8 ft 5 in)
at floor level	2.13 m (7 ft 0 in)
Max height	1.89 m (6 ft 2¼ in)
Floor area, excl cockpit	38.46 m² (414 sq ft)
Volume	75.95 m³ (2,682 cu ft)
Baggage volume (total)	23.3 m³ (824 cu ft)

AREAS:

Wings, net	68.63 m² (738.7 sq ft)
Horizontal tail surfaces (total)	20.74 m² (223.3 sq ft)
Vertical tail surfaces (total)	13.36 m² (143.8 sq ft)

WEIGHTS AND LOADINGS:

Operating weight empty	19,731 kg (43,500 lb)
Max payload	8,528 kg (18,800 lb)
Payload with max fuel: standard	4,364 kg (9,620 lb)
ER	5,384 kg (11,870 lb)
Max fuel weight	8,822 kg (19,450 lb)
Max T-O weight: standard	32,999 kg (72,750 lb)
ER	34,019 kg (75,000 lb)
Max ramp weight: standard	33,112 kg (73,000 lb)
ER	34,132 kg (75,250 lb)
Max landing weight	30,390 kg (67,000 lb)
Max zero-fuel weight	28,259 kg (62,300 lb)
Max wing loading: standard	480.8 kg/m² (98.48 lb/sq ft)
ER	495.7 kg/m² (101.53 lb/sq ft)
Max power loading: standard	293 kg/kN (2.87 lb/lb st)
ER	302 kg/kN (2.96 lb/lb st)

PERFORMANCE:

Cruising Mach No.:	
high speed	0.825 (470 kt; 870 km/h; 541 mph)
normal	0.78 (444 kt; 822 km/h; 511 mph)
Max certified altitude	12,500 m (41,000 ft)
T-O field length at S/L, ISA:	
standard	1,564 m (5,130 ft)
ER	1,676 m (5,500 ft)
Landing field length at S/L, ISA, at max landing weight:	
standard and ER	1,551 m (5,090 ft)
Range, 70 passengers, at M0.77, IFR reserves:	
standard	1,649 n miles (3,053 km; 1,897 miles)
ER	1,946 n miles (3,604 km; 2,239 miles)

OPERATIONAL NOISE LEVELS (FAR Pt 36):

T-O at max T-O weight	82.7 EPNdB
Approach at max landing weight	92.6 EPNdB
Sideline	89.4 EPNdB

BOMBARDIER CRJ700 SERIES 705

TYPE: Regional jet airliner.

PROGRAMME: Launch customer, Air Canada Jazz, placed order on 27 September 2004. Canadian type certificate issued 3 May 2005. First aircraft C-GJAZ (c/n 15036 - 36th CRJ900 fuselage) delivered to Air Canada Jazz, 27 May 2005, followed by service entry on 1 June 2005 on Calgary, Alberta, to Houston, Texas, route.

CUSTOMERS: See table under CRJ200 entry. By late 2005, all 15 ordered (all for Air Canada) had been delivered.

DESIGN FEATURES: Essentially is CRJ900 certified for reduced number of 75 passengers.

POWER PLANT: Two General Electric CF34-8C5 turbofans, each rated at 58.4 kN (13,123 lb st), or 64.5 kN (14,510 lb st) with automatic power reserve. CF-34-8C5A1 engines optional.

ACCOMMODATION: Main cabin seats 75 passengers, four abreast, with central aisle. Jazz seating for 10 executive class passengers at 94 cm (37 in) pitch and 65 economy at 87 cm (34 in).

Data generally as for CRJ900; specific data follow:

WEIGHTS AND LOADINGS:

Basic operating weight: all	21,432 kg (47,250 lb)
Max fuel weight	8,822 kg (19,450 lb)
Max T-O weight: 705	36,514 kg (80,500 lb)
705 ER	37,421 kg (82,500 lb)
705 LR	38,328 kg (84,500 lb)
Max landing weight: 705, 705 ER	33,339 kg (73,500 lb)
705 LR	34,019 kg (75,000 lb)
Max ramp weight: 705	36,628 kg (80,750 lb)
705 ER	37,535 kg (82,750 lb)
705 LR	38,555 kg (85,000 lb)
Max zero-fuel weight: 705, 705 ER	31,751 kg (70,000 lb)
705 LR	32,023 kg (70,600 lb)
Max wing loading: 705	517.2 kg/m² (105.92 lb/sq ft)
705 ER	530.0 kg/m² (108.55 lb/sq ft)
705 LR	542.8 kg/m² (111.18 lb/sq ft)
Max power loading: 705	313 kg/kN (3.07 lb/lb st)
705 ER	320 kg/kN (3.14 lb/lb st)
705 LR	328 kg/kN (3.22 lb/lb st)

PERFORMANCE:

T-O field length at S/L, ISA, max T-O weight:	
705	1,779 m (5,835 ft)
705 ER	1,860 m (6,105 ft)
705 LR	1,944 m (6,380 ft)
Landing field length at S/L, max landing weight:	
705, 705 ER	1,596 m (5,235 ft)
705 LR	1,623 m (5,325 ft)

Bombardier CRJ700 Series 705 75-seat twin-jet 1040533

Max range with 75 passengers at long range cruising speed:
705 ..... 1,939 n miles (3,591 km; 2,231 miles)
705 ER, 705 LR ..... 2,037 n miles (3,772 km; 2,344 miles)
OPERATIONAL NOISE LEVELS, 705 LR:
T-O ..... 83.9 EPNdB
Approach ..... 92.4 EPNdB
Sideline ..... 89.1 EPNdB

BOMBARDIER CRJ900

Engineering designation: CL-600-2D24

TYPE: Regional jet airliner.

PROGRAMME: Announced October 1999; stretched derivative of CRJ700; wind tunnel testing began November 1999; partner/supplier selection finalised second quarter 2000; interior mockup completed March 2000; formal launch at Farnborough International Air Show 24 July 2000; prototype, modified from CRJ700 prototype C-FRJX, with fuselage plugs but retaining CRJ700 wings, landing gear and engines, first flown 21 February 2001; public debut at Paris Air Show 14 June 2001; first production aircraft, c/n 15001/C-GRNH, first flown 20 October 2001; Transport Canada certification achieved 9 September 2002, followed by FAA approval 25 October 2002 and JAA certification 23 December 2002; first customer delivery (c/n 15002) to Mesa Air on 3 February 2003, followed by service entry on 26 April.

In December 2002 Bombardier signed a tentative agreement with China Aviation Industry Corporation I (AVIC I) that could lead to final assembly of the CRJ700 and CRJ900 by Shanghai Aviation Industries Group.

CURRENT VERSIONS: **900:** Standard version.

900ER: Extended-range version.

900ER European: As 900ER but with maximum T-O weight limited to 36,995 kg (81,560 lb) to minimise weight-related charges when operating in European airspace.

900LR: Long-range version.

900LR European: As 900LR but with maximum T-O weight limited to 37,995 kg (83,764 lb).

Challenger 890: Corporate shuttle version of CRJ900.

900X: Proposed in 2006 as 2.95 m (9 ft 8 in) stretch, increasing passenger capacity to between 89 and 100. Launch conditional on orders, although MyAir contract for 19 CRJ900s includes option to convert 15 to 900X; Atlasjet showing interest. Deliveries 24 to 36 months after go-ahead.

CUSTOMERS: Total 153 ordered and 75 delivered by 31 October 2006. Estimated market for 800 aircraft in CRJ900 class over 20-year period.

COSTS: Development cost CAD200 million; unit cost CAD30 million (2002).

DESIGN FEATURES: Compared to CRJ700, has fuselage stretched — by means of 2.29 m (7 ft 6 in) plug forward of centre-section and 1.57 m (5 ft 2 in) plug aft of centre-section — to accommodate 86 to 90 passengers in four-abreast configuration with fore and aft lavatories; 5 to 10 per cent higher thrust engines; strengthened main landing gear with upgraded wheels and brakes; strengthened wing; two additional overwing emergency exits; increased volume in forward underfloor baggage hold, and an additional underfloor baggage door and aft service door on starboard side. Common crew qualification with CRJ200/700 series.

STRUCTURE: Programme partners as for CRJ700. Final assembly and completion by Bombardier at new CRJ700/900 facility at Montréal-Mirabel Airport.

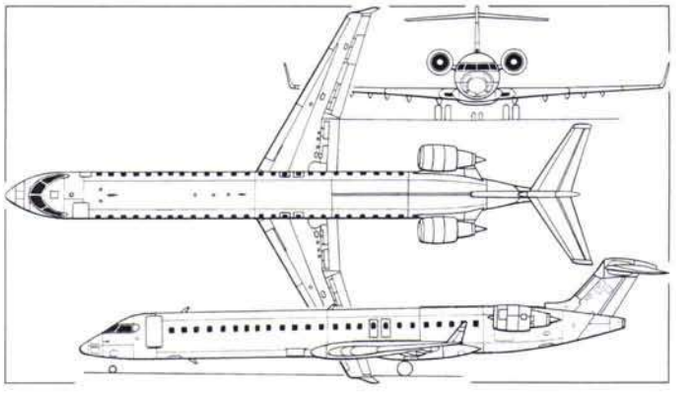
LANDING GEAR: As for CRJ700.

POWER PLANT: Two General Electric CF34-8C5 turbofans. Engine rating 58.4 kN (13,123 lb st) or 63.4 kN (14,255 lb st) with automatic power reserve, flat rated to ISA + 15°C. Fuel capacity 10,989 litres (2,903 US gallons; 2,417 Imp gallons).

ACCOMMODATION: Standard dual-class accommodation for 86 passengers in four-abreast configuration at 79 cm (31 in) seat pitch with fore and aft lavatories and forward galley; alternative configurations include high density with accommodation for 90 passengers at 79 cm (31 in) seat pitch, dual-class with 15 business class seats three-abreast at 86 cm (34 in) seat pitch in forward section and 60 economy class four-abreast at 79 cm (31 in) seat pitch at rear, and dual class with 55 business class seats in four-abreast configuration at 84 cm (33 in) seat pitch in forward section and 24 economy class at 79 cm (31 in) seat pitch at rear. Standard additional floor beam facilitates offset seat rail for three-abreast seating throughout cabin.

SYSTEMS: Honeywell RE220 APU.

AVIONICS: As for CRJ700.



Bombardier CRJ900 *(James Goulding)* 1158939

DIMENSIONS, EXTERNAL (As for CRJ700 Srs 701 except):
Wing span ..... 24.84 m (81 ft 6 in)
Wing aspect ratio 9.0
Length overall ..... 36.37 m (119 ft 4 in)
Height overall ..... 7.49 m (24 ft 7 in)
Wheelbase ..... 14.73 m (48 ft 4 in)
Aft service door (stbd):
Height ..... 1.22 m (4 ft 0 in)
Width ..... 0.61 m (2 ft 0 in)
Height to sill ..... 2.39 m (7 ft 10 in)
Emergency exits (four, overwing):
Height ..... 0.91 m (3 ft 0 in)
Width ..... 0.51 m (1 ft 8 in)
DIMENSIONS, INTERNAL:
Cabin (excl flight deck):
Length ..... 21.92 m (71 ft 11 in)
Floor area, excl cockpit ..... 46.73 m² (503 sq ft)
Baggage volume: checked ..... 16.81 m³ (593.5 cu ft)
total ..... 25.57 m³ (903 cu ft)
AREAS:
Wings, gross ..... 68.63 m² (738.7 sq ft)
WEIGHTS AND LOADINGS:
Operating weight empty ..... 21,432 kg (47,250 lb)
Max payload ..... 10,319 kg (22,750 lb)
Payload with max fuel: 900 ..... 6,178 kg (13,620 lb)
900ER ..... 6,972 kg (15,370 lb)
Max fuel weight ..... 8,822 kg (19,450 lb)
Max T-O weight: 900 ..... 36,514 kg (80,500 lb)
900ER ..... 37,421 kg (82,500 lb)
900ER European ..... 36,995 kg (81,560 lb)
900LR ..... 38,328 kg (84,500 lb)
900LR European ..... 39,808 kg (87,763 lb)
Max ramp weight: 900 ..... 36,627 kg (80,750 lb)
900ER ..... 37,535 kg (82,750 lb)
900LR ..... 38,442 kg (84,750 lb)
Max landing weight ..... 33,339 kg (73,500 lb)
Max zero-fuel weight ..... 31,751 kg (70,000 lb)
Max wing loading: 900 ..... 532.1 kg/m² (108.98 lb/sq ft)
900ER ..... 545.3 kg/m² (111.68 lb/sq ft)
900ER European ..... 539.1 kg/m² (110.41 lb/sq ft)
900LR ..... 558.5 kg/m² (114.39 lb/sq ft)
900LR European ..... 580.1 kg/m² (118.81 lb/sq ft)

Lufthansa CityLine Bombardier CRJ900 1040539

Max power loading: 900 ..... 313 kg/kN (3.07 lb/lb st)
900ER ..... 320 kg/kN (3.14 lb/lb st)
900ER European ..... 317 kg/kN (3.11 lb/lb st)
900LR ..... 328 kg/kN (3.22 lb/lb st)
900LR European ..... 325 kg/kN (3.19 lb/lb st)

PERFORMANCE:

Cruising Mach No:
high speed ..... 0.83 (476 kt; 882 km/h; 548 mph)
for max range ..... 0.80 (458 kt; 848 km/h; 527 mph)
Max certified altitude: 900, 900ER ..... 12,500 m (41,000 ft)
Service ceiling, OEI: 900 ..... 4,968 m (16,300 ft)
900ER ..... 4,755 m (15,600 ft)
FAR T-O field length:
900 ..... 1,779 m (5,835 ft)
900ER ..... 1,861 m (6,105 ft)
900LR ..... 1,945 m (6,380 ft)
FAR landing field length at S/L, ISA, at max landing weight:
900, 900ER ..... 1,596 m (5,235 ft)
900LR ..... 1,623 m (5,325 ft)
Range, 86 passengers, at M0.77:
900 ..... 1,596 n miles (2,955 km; 1,836 miles)
900ER ..... 1,840 n miles (3,407 km; 2,117 miles)
900LR ..... 1,976 n miles (3,659 km; 2,273 miles)

OPERATIONAL NOISE LEVELS (FAR Pt 36):

T-O ..... 84.2 EPNdB
Approach ..... 93.2 EPNdB
Sideline ..... 89.6 EPNdB

Bombardier Challenger 300 cabin interior 1040578

BOMBARDIER BD-100 CHALLENGER 300

Engineering designation: BD-100-1A10

TYPE: Business jet.

PROGRAMME: Design study, then known as 'Bombardier Model 70', revealed at the Paris Air Show in June 1997; formally announced at NBAA Convention at Las Vegas 18 October 1998; launched at Paris Air Show 13 June 1999; initially named Continental; first metal cut 21 October 1999 following completion of joint definition phase; HTF7000 (formerly AS907) engine first flown 29 January 2000, engine certification achieved 25 June 2002; wing/fuselage mating of first aircraft achieved 19 November 2000; first flight (c/n 20001/C-GJCJ) from the Bombardier Flight Test Center at Wichita's Mid-Continent Airport 14 August 2001, followed by second aircraft (c/n 20002/C-GJCF) on 9 October. These and three further aircraft (c/n 20003/C-GIPX, dedicated to avionics test and flown 6 December 2001; c/n 20004/C-GJCV for systems testing and the first to be fully outfitted with standard interior, flew 5 April 2002; and c/n 20005/C-GIPZ, for function and reliability testing (including cabin systems), originally due to fly in May 2002 but delayed until 8 March 2003; participated in the flight test and certification programme culminating in Transport Canada 525 approval, FAA FAR Pt 25 and JAA JAR 25 certification, with RVSM approval, FAR Pt 36 Stage 3 noise compliance, Transport Canada certification achieved 31 May 2003, followed by FAA approval on 4 June 2003 and JAA certification on 31 July 2003, first delivery (N505FX c/n 20006) to Bombardier Business Jet Solutions (Flexjet) 23 December 2003; first revenue flight 8 January 2004. First corporate operator delivery (c/n 20010/N41DP) 15 April 2004, to Dean Phillips Inc.

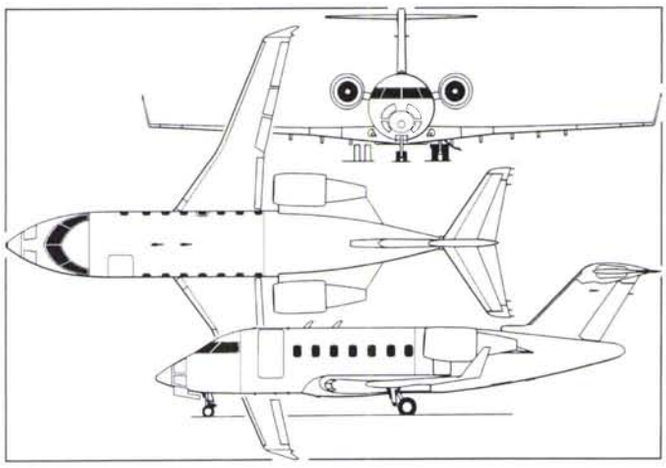
Public debut at NBAA Convention, New Orleans, 11 December 2001 (formal presentation 12 December). European debut (C-GJCV) at EBACE 2003 at Geneva 5 May 2003. Re-named Challenger 300 on 8 September 2002, immediately prior to NBAA Convention at Orlando, Florida.

CUSTOMERS: Two orders signed at time of launch, by customers in Germany and United Arab Emirates; total of 125 firm orders received by 5 May 2003, including 25 for Bombardier's Flexjet fractional ownership programme, 15 for European customers and five for its Middle East and Arab nations distributor TAG Aeronautics. Total of 28 delivered in 2004, 50 in 2005 and 54 in 2006. Bombardier anticipates gaining 30 per cent of estimated 1,200-aircraft market in this class by 2012, with fractional ownership operations especially targeted.

COSTS: Development cost CAD500 million (1998); break-even estimated at 300th aircraft. Unit cost USD19.21 million typically equipped (2006). Direct operating cost estimated at USD1,969 per hour (2006).

DESIGN FEATURES: Design goals included coast-to-coast range across USA with eight passengers in cabin with stand-up headroom and take-off field length less than 1,525 m (5,000 ft). General configuration is as shown in the accompanying illustrations; supercritical wing with winglets, sweepback 27° at quarter-chord.

FLYING CONTROLS: Conventional. Ailerons manually actuated via cables, pulleys and pushrods, each with a geared tab and fixed tab, plus trim tab on port aileron only; maximum aileron deflections ±18°. Horn balanced elevators, maximum deflections +24/–18°, and single rudder panel, maximum deflection ±30°, hydraulically actuated by cables and pulleys with manual reversion, each with dual PCUs; variable incidence tailplane for pitch trim, maximum travel +2/–12°. Hydraulically actuated Fowler flaps, maximum deflection 30°; each wing has two segment multifunction spoiler outboard, maximum deflection 45°, and two-segment ground spoiler/lift dumper inboard, maximum deflection 60°; yaw damper standard.



Bombardier Challenger 300 *(Paul Jackson)* 1158936

Bombardier Challenger 300 *(Paul Jackson)* 1153779

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jawa.janes.com

STRUCTURE: Primarily light alloy, with composites for some non-structural fairings; fuselage of semi-monocoque construction with frames and stringers; two-spar wing; three-spar fin. Programme suppliers include: AIDC Taiwan (rear fuselage and tail unit); Canadair (cockpit, forward fuselage and primary flight controls); Fischer Austria (cabin interior) ECE (electrical system and cockpit lighting); Fischer Austria (wing-to-fuselage fairings); GKN Westland (engine nacelles); Goodrich (wheels and brakes); Hawker de Havilland Australia (tailcone and APU installation kit); Hella (lighting); Honeywell (power plant and APU); Hurel-Dubois (thrust reversers); Intertechnique (fuel system); Liebherr Aerospace-Toulouse (environmental control and anti-icing systems); Liebherr Aerospace Lindenberg (flap control system); Messier-Dowty (landing gear); Mitsubishi Heavy Industries (wing); Moog (secondary flight controls); NLX (flight training device and level C/D flight simulator); Parker Aerospace (hydraulic system); PPG Industries (cockpit windscreens and cabin windows); Rockwell Collins (avionics); Scott Aviation (oxygen system); Shorts (centre fuselage), and Walter Kidde (fire detection and suppression system). Final assembly with interior completion is at Bombardier's facility in Dorval Quebec.

LANDING GEAR: Hydraulically retractable tricycle type by Messier-Dowty, with two wheels on each unit; trailing-link-type main units retract inwards, nosewheel forwards. Steerable nosewheel, maximum deflection ±65°. Mainwheel tyre size 26.5×8.0-18, nosewheel tyre size 18×5.5-10. Goodrich carbon composites multiple disc brakes. Turning radius 17.68 m (58 ft 0 in).

POWER PLANT: Two Honeywell HTF7000 (formerly AS907) turbofans with FADEC, each with thermodynamic rating of 35.81 kN (8,050 lb st), flat-rated to 30.4 kN (6,826 lb st) with APR at ISA+15°C. All fuel contained in two integral wing tanks, combined capacity 7,934 litres (2,096 US gallons; 1,745 Imp gallons). Oil capacity both engines, 10.40 litres (2.75 US gallons; 2.29 Imp gallons). Gravity fuelling point in top of each wing, near leading-edge, plus single-point pressure refuelling/defuelling port in starboard wingroot near leading-edge. Target-type reversers standard.

ACCOMMODATION: Two crew flight deck; cabin, with flat floor, accommodates eight passengers in standard 'double club' arrangement on tracking, swivelling and reclining 16 *g* seats with retractable headrests, cabin management controls, cupholders and shoulder harnesses; three-seat 16 *g* take-off and landing-certified divan with extending backrest optional as interchange for two club seats. Standard cabin equipment includes fold-out work tables; one 110 V electrical outlet per club seat group; hot drinks dispensers; DVD/CD player, integrated i-pod with hi-fi trim panel speakers and two 508 mm (20 in) flat screen monitors; Airshow 400 system; ICG Iridium in-flight telephone with two handsets and switchable locations; extended-life LED lighting; forward galley with microwave oven; forward passenger wardrobe and crew coat closet; aft lavatory and vanity unit with hot and cold water and removable waste tank, and flight-accessible baggage compartment. Free-fall opening/power-assisted-closure, semi-plug-type airstair cabin door, on port side immediately aft of flight deck, also serves as Type I emergency exit; single plug-type overwing Type III emergency exit on starboard side, between rearmost pair of club seats. External baggage door aft of port wing trailing-edge. Cabin and baggage compartment pressurised, air-conditioned and heated.

SYSTEMS: Two independent phosphate-ester hydraulic systems with one engine-driven pump and one DC motor pump per system, pressure 207 bar (3,000 lb/sq in), plus one auxiliary system powered by an accumulator. Pressurisation system, differential 0.60 bar (8.78 lb/sq in), with auxiliary system providing pressurisation up to 10,670 m (35,000 ft). 28 V DC electrical system comprises three 400 Ah DC brushless generators (one each on the engines and one on the APU) and two 24 V 44 Ah Ni/Cd batteries which provide power for APU starting, in-flight emergency power and ground power. APU generator can carry load of a failed engine generator, and one battery can supply power for APU starting. Oxygen system, capacity to suit customer requirements, with demand-type masks for crew and drop-down masks for passengers.

Engine bleed air automatically controlled anti-icing for wing leading-edges and nacelle lips; electrically anti-iced windscreen; heated angle-of-attack vanes and pitot probes. Honeywell tailcone-mounted RE220 APU, with FADEC, will be certified for operation up to 11,280 m (37,000 ft) and in-flight starting to 9,150 m (30,000 ft).

AVIONICS: Rockwell Collins Pro Line 21 as core system.

Comms: Dual VHF com with 8.33 kHz frequency spacing capability; dual integrated radio control and display units; dual transponders, and ELT with NAV all standard. Dual HF com, and VHF/satcom datalink capability with Selcal optional.

Radar: Dual-scan digital weather radar with optional turbulence detection.

Flight: Standard equipment includes dual ILS/VOR/markers, AHRS and air data computers; single ADF, DME, FMS/CDU, GPS sensor, EGPWS, TCAS II, EICAS, radio altimeter, CVR and flight deck aural warning system. Second ADF, three-dimensional flight plan maps, FDR and lightning sensor optional.

Instrumentation: EFIS with four 305 × 254 mm (12 × 10 in) colour LCDs providing PFD and MFD functions for pilot and co-pilot.

DIMENSIONS, EXTERNAL:

Wing span over winglets	19.46 m (63 ft 10 in)
Length overall	20.92 m (68 ft 7½ in)
Height overall	6.20 m (20 ft 4 in)
Fuselage max diameter	2.34 m (7 ft 8 in)
Tailplane span	7.23 m (23 ft 8½ in)
Wheel track	3.20 m (10 ft 6 in)
Wheelbase	8.46 m (27 ft 9 in)
Passenger door: Height	1.89 m (6 ft 2½ in)
Width	0.76 m (2 ft 6 in)
Baggage door: Height	0.76 m (2 ft 6 in)
Width	0.61 m (2 ft 0 in)
Height to sill	1.63 m (5 ft 4 in)
Emergency exit: Height	0.91 m (3 ft 0 in)
Width	0.51 m (1 ft 8 in)

DIMENSIONS, INTERNAL:

Cabin (excl cockpit):	
Length	8.72 m (28 ft 7¼ in)
Width: at centreline	2.19 m (7 ft 2¼ in)
at floor	1.55 m (5 ft 1 in)
Max height	1.85 m (6 ft 1 in)
Floor area	13.5 m^2 (146 sq ft)
Volume	24.35 m^3 (860 cu ft)
Baggage compartment volume	2.99 m^3 (105.50 cu ft)

AREAS:

Wings, net	48.49 m^2 (522.0 sq ft)
Ailerons, total	0.93 m^2 (10.00 sq ft)
Trailing-edge flaps, total	7.56 m^2 (81.40 sq ft)
Spoilers, total	3.55 m^2 (38.26 sq ft)
Rudder, incl tabs	1.89 m^2 (20.40 sq ft)
Tailplane	11.39 m^2 (122.55 sq ft)
Elevators	4.22 m^2 (45.40 sq ft)

WEIGHTS AND LOADINGS:

Operating weight empty	10,659 kg (23,500 lb)
Payload: max	1,588 kg (3,500 lb)
with max fuel	612 kg (1,350 lb)
Fuel weight:max	6,418 kg (14,150 lb)
with max payload	5,443 kg (12,000 lb)
Max T-O weight	17,622 kg (38,850 lb)
Max ramp weight	17,690 kg (39,000 lb)
Max landing weight	15,308 kg (33,750 lb)
Max zero-fuel weight	12,247 kg (27,000 lb)
Max wing loading	363.4 kg/m^2 (74.43 lb/sq ft)
Max power loading	290 kg/kN (2.85 lb/lb st)

PERFORMANCE:

Max level speed	476 kt (882 km/h; 548 mph)
Max operating speed:	
S/L to FL80	300 kt (556 km/h; 345 mph)
FL80 to 8,984 m (29,475 ft)	320 kt (593 km/h;368 mph)
Above 8,984 m (29,475 ft)	M0.83
High cruising speed	M0.82 or 470 kt (870 km/h; 541 mph)
Normal cruising speed	M0.80 or 459 kt (850 km/h; 528 mph)
Max rate of climb at S/L	1,097 m (3,600 ft)/min
Rate of climb at S/L, OEI	205 m (673 ft)/min
Initial cruising altitude	12,500 m (41,000 ft)
Max certified altitude	13,715 m (45,000 ft)
T-O balanced field length	1,466 m (4,810 ft)
Landing run at max landing weight	792 m (2,600 ft)
Range with eight passengers, NBAA IFR reserves	3,100 n miles (5,741 km; 3,567 miles)

BOMBARDIER CL-600 CHALLENGER

Canadian Forces designations: CC-144, CC-144B and CE-144A
Engineering designation: CL-600-2B16

TYPE: Business jet.

PROGRAMME:

DEVELOPMENT MILESTONES

Challenger 600	
First flight	8 Nov 78
Certification	10 Aug 80
First flight, production	21 Sep 79
First delivery	30 Dec 80
Subsequent versions	
Challenger 601	
First flight	10 Apr 82
First flight, production	17 Sep 82
Certification	25 Feb 83
First delivery	6 May 83
Challenger 604	
First flight	18 Sep 94
Certification	20 Sep 95

First flight of prototype (C-GCGR-X) 8 November 1978; first flight production Challenger 600 with AlliedSignal ALF 502L-2 turbofans 21 September 1979; first customer delivery 30 December 1980; first flight Challenger 601 with GE CF34s 10 April 1982; first 601-1A delivered 6 May 1983; first 601-3A 6 May 1987 and first 601-3A/ER 19 May 1989; first 601-3R 14 July 1993; first 604 25 January 1996. Challenger certified for operation in 40 countries by 1998. By 28 February 2003 the Challenger fleet had flown 2.36 million hours, with a despatch reliability in excess of 99.7 per cent. 500th Challenger rolled out 'green' 25 May 2000 and handed over (as N816CC) 1 September 2000; 600th for customer delivery (c/n 5557) delivered for completion 6 February 2003 and (as C-GAWH) formally handed over to Clearwater Fine Foods of Nova Scotia at NBAA Convention, Orlando, Florida, on 8 October 2003.

CURRENT VERSIONS: **Challenger 600:** Total 84 (excluding one prototype) built (76 since retrofitted with winglets); 12 delivered to Canadian Department of National Defence as CC-144 (three) and CE-144A (three), plus three for coastal patrol, two for general transport and one test aircraft. Production completed with final delivery on 22 June 1983.

Challenger 601-1A: First production version to have CF34 engines; first flight 17 September 1982. Deliveries (66, including four CC-144Bs) between 6 May 1983 and 29 May 1987.

Challenger 601-3A: Version with 'glass' cockpit and CF34-3A engines; first flight 28 September 1986; Canadian and US certification 21 and 30 April 1987; also certified for Cat. II and in 22 other countries; improvements include CF34-3A engines flat rated to 21°C, and fully integrated digital flight guidance and flight management systems. Total of 134 delivered between 6 May 1987 and 29 October 1993.

Challenger 601-3R: Extended-range option available on new 601-3As since 1989 (c/n 5135 and onwards) and as retrofit to 601-1As and 601-3As; range increased to 3,585 n miles (6,639 km; 4,125 miles) with NBAA IFR reserves; first flight 8 November 1988; Canadian certification 16 March 1989; tail fairing replaced with conformal tailcone fuel tank which extends fuselage length by 46 cm (1 ft 6 in) and adds 118 kg (260 lb) to operating weight empty; maximum ramp weight increased by 680 kg (1,500 lb). Optional gross weight increase of 227 kg (500 lb). Total of 92 modification kits supplied between March 1989 and October 1993. Challenger 601-3ER, incorporating extended-range modifications, CF34-3A1 engines and 20,457 kg (45,100 lb) max T-O weight, was standard production version from 14 July 1993 (first delivery); last of 59 new-build aircraft delivered by early 1996.

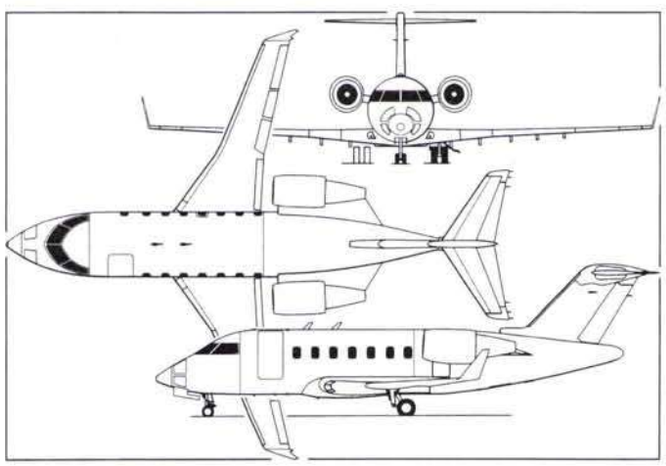
Challenger 604: Prototype (C-FTBZ) modified on the production line from a Challenger 601-3R; engineering designation CL-600-2B16; first flight (with CF34-3A engines) 18 September 1994; first flight with definitive CF34-3B engines 17 March 1995. Exploits systems developed in Regional Jet programme. Rockwell Collins Pro Line 4 EFIS; extra 1,242 litres (328 US gallons; 273 Imp gallons) of fuel in aft equipment bay, forward fuselage tank and tail tank. Automatic aft-CG control to reduce trim drag for longer range. New landing gear, carbon brakes and anti-skid system; strengthened tail unit; new wing-to-fuselage and underbelly fairings. Transport Canada certification achieved 20 September 1995.

From June 2001, Challenger 604s have been delivered with upgraded PrecisionPlus Collins Pro Line 4 avionics, intended to reduce pilot workload and make the aircraft more compatible with future air traffic environments. Standard PrecisionPlus features include

First flight of Bombardier Challenger 605 on 22 January 2006 1154398

Bombardier Challenger 605 prototype landing after its maiden flight 1154397

Bombardier Challenger 604 business jet *(Paul Jackson)* 1153780



Bombardier Challenger 605 *(Paul Jackson)* 1158937

automatic look-up and display of take-off, approach, landing and missed-approach speeds, eliminating the need to refer to manual charts; automatic look-up and display of thrust setting (N_1) for take-off, climb, cruise and go-around; blending of actual observed wind and entered wind to improve the prediction of flight time and fuel requirements; position reporting in non-radar environments such as the North Atlantic; improved polar navigation, enabling the crew to navigate and steer the aircraft at latitudes over 89°; full-time DME reporting on the pilot's MFD; EICAS improvements including the addition of metric fuel indication capability, logic enhancements and FMS performance enhancements; and full integration with the Flight Dynamics HUD and Safe Flight AutoPower autothrottle system. Optional features include flight plan map feature providing an intuitive, three-dimensional graphic representation of the programmed flight plan and predicted flight path for the pilot's and co-pilot's MFDs; long-range cruise feature allowing pilots to select a cruise speed computed by the FMS for either maximum range or maximum speed; search pattern feature offering automatic generation of waypoints; and expanded FDR to meet FAA FAR Pt 135.152 requirements. The PrecisionPlus avionics upgrade is also available for retrofit to earlier Challenger 604s.

Max-Viz EVS-1000 enhanced vision system received FAA certification on 13 March 2003 for installation on Challengers.

Detailed description applies to Challenger 604.

Challenger 605: Announced at the NBAA Convention in Orlando, 8 November 2005, when a full-size cabin mockup was displayed. Features include conical (replacing wedge-shape) rear fuselage; 91 kg (200 lb) reduction in basic operating weight compared with the Challenger 604 despite standard inclusion of 10 items previously optional; Collins Pro Line 21 avionics with four vertical format 305 × 254 mm (12 × 10 in) LCD screens, increasing display area by over 55% compared to Challenger 604's six smaller CRT screens; Collins integrated flight information system (IFIS) with electronic chart capability 'paperless' operation and a class 3 EFB; Thales solid-state integrated standby instrument system; restyled cabin interior providing more headroom and volume; enlarged and relocated cabin windows which increase natural lighting; LED cabin lighting; new galley design with increased storage capacity; on-demand audio/video and optional; high-speed Internet connectivity. Performance and weights generally as for Challenger 604, except operating weight empty of 12,240 kg (26,985 lb) and slight range increase to 4,045 n miles (7,491 km; 4,654 miles). First flight C-FGYM (c/n 5701) 22 January 2006, followed by Transport Canada certification on 5 October 2006, Federal Aviation Administration certification on 20 October 2006, and European Aviation Safety Agency certification on 24 October 2006. The Challenger 605 was scheduled for first deliveries in third quarter of 2007.

Special Missions: One Challenger 604 delivered in late 2000 to (South) Korean National Maritime Police with unspecified sensor and communications suite. First of three maritime surveillance 604s entered service with Royal Danish Air Force in late 2002 although first flight with full modifications (ventral radome and retractable EO sensor installed by Field Aviation) not achieved until 28 February 2003.

CUSTOMERS: See under individual headings in Current Versions. Total more than 680 Challengers of all versions delivered (including to completion centres) by January 2006, including 340 Challenger 604s. Annual deliveries have included 33 in 1997, 36 in 1998, 40 in 1999, 38 in 2000, 41 in 2001, 31 in 2002, 24 in 2003, 29 in 2004, 36 in 2005 and 23 in the first nine months of 2006.

COSTS: Unit cost (605), USD26.714 million, typically equipped (2006).

DESIGN FEATURES: Advanced wing section; quarter-chord sweep 25°; thickness/chord ratio 14 per cent at root, 12 per cent at leading-edge sweep break and 10 per cent at tip; dihedral 2° 33'; incidence at root 3° 30'; fuselage circular cross-section, pressurised.

FLYING CONTROLS: Conventional, fully powered hydraulic controls; electrically actuated variable incidence tailplane; two-segment spoilers (outboard airbrake panels, inboard lift dumpers); two-segment double-slotted flaps.

STRUCTURE: Two-spar wing torsion box; chemically milled fuselage skin panels with riveted frames and stringers form damage-tolerant structure; multispar fin and tailplane.

LANDING GEAR: Hydraulically retractable tricycle type, with twin wheels and Dowty oleo-pneumatic shock-absorber on each unit. Mainwheels retract inward into wing centre-section, nose unit forward. Nose unit steerable and self-centring. Mainwheels have H27×8.5-14 (16 ply) tubeless tyres, pressure 12.07 bar (175 lb/sq in); nosewheels have Goodrich 18×4.4 (12 ply) tubeless (deflector-type) tyres, pressure 10.00 bar (145 lb/sq in). ABS (Aircraft Braking Systems) hydraulically operated multiple-disc carbon brakes with fully modulated anti-skid system. Minimum ground turning radius 12.19 m (40 ft 0 in).

POWER PLANT: Two General Electric CF34-3B1 turbofans, each rated at 41.0 kN (9,220 lb st) with automatic power reserve, or 38.8 kN (8,729 lb st) without APR, pylon-mounted on rear fuselage and fitted with cascade-type fan-air thrust reversers. Nacelles and thrust reversers by Shorts. Integral fuel tank in centre-section, capacity 2,839 litres (750 US gallons; 624 Imp gallons), one in each wing (each 2,725 litres; 720 US gallons; 600 Imp gallons) and auxiliary tanks (combined capacity 1,181 litres; 312 US gallons; 260 Imp gallons) beneath cabin floor. Saddle tanks, total capacity 999 litres (264 US gallons; 220 Imp gallons); tank in tailcone, capacity 745 litres (197 US gallons; 164 Imp gallons). Total fuel capacity 11,214 litres (2,963 US gallons; 2,468 Imp gallons). Pressure and gravity fuelling and defuelling. Oil capacity 13.6 litres (3.6 US gallons; 3.0 Imp gallons).

ACCOMMODATION: Two-pilot flight deck with dual controls. Blind-flying instrumentation standard. Cabin interiors to customer's specifications; maximum of 19 passenger seats and three crew approved. Typical installations include lavatory, buffet, bar and wardrobe. Medevac version can carry up to seven stretcher patients, infant incubator, full complement of medical staff and comprehensive intensive care equipment. Baggage compartment, with own loading door, accessible in flight. Downward-opening, power-assisted door on port side, forward of wing. Overwing emergency exit on starboard side. Entire accommodation heated, pressurised and air conditioned. Optional extended cabin interior increases cabin length by 0.51 m (1 ft 8 in) and provides two additional cabin windows by removing rear

closet and moving the lavatory and baggage compartment bulkheads, with corresponding 0.20 m^3 (7 cu ft) reductions in baggage capacity. Ultra Electronics active noise vibration control (ANVC) system optional.

SYSTEMS: Honeywell pressurisation and air conditioning systems, maximum pressure differential 0.63 bar (9.1 lb/sq in). Three independent hydraulic systems, each of 207 bar (3,000 lb/sq in). No. 1 system powers flight controls (via servo-actuators positioned by cables and pushrods); No. 2 system for flight controls and brakes; No. 3 system for flight controls, landing gear extension/retraction, brakes and nosewheel steering. Nos. 1 and 2 systems each powered by an engine-driven pump, supplemented by an AC electric pump; No. 3 system by two AC pumps. Two 30 kVA engine-driven generators supply primary 115/200 V three-phase AC electric power at 400 Hz. Four transformer-rectifiers to convert AC power to 28 V DC; one primary 24 V 17 Ah Ni/Cd battery and one auxiliary 24 V 43 Ah battery. Alternative primary power provided by APU and/or an air-driven generator, latter deployed automatically in flight if engine-driven generators and APU are inoperative. Stall warning system, with stick shakers and stick pusher. Honeywell GTCP 35-150 (CL) gas-turbine APU for engine start, ground air conditioning and other services. Electric anti-icing of windscreen, flight deck side windows and pitot heads; Hamilton Sundstrand bleed air anti-icing of wing leading-edges, engine intake cowls and guide vanes. Gaseous oxygen system, pressure 127.5 bar (1,850 lb/sq in). Continuous-element fire detectors in each engine nacelle, APU and main landing gear bays; two-shot extinguishing system for engines, single-shot system for APU.

AVIONICS: Rockwell Collins Pro Line 21.

Comms: Dual VHF; dual ATC transponders; dual HF; cockpit voice recorder.

Radar: Rockwell Collins TWR-850 colour digital weather radar with turbulence detection.

Flight: Dual VHF nav with provision for third; dual DME; dual ADF; dual Honeywell laseref V laser inertial reference systems (LIRS) with full provision for third; dual flight management system with provision for third; digital automatic flight control system, with dual-channel autopilot and flight director; Mach trim and auto trim; dual digital air data system. Space provisions for flight data recorder, ELT, dual GPS, EGPWS, AFIS, TCAS II and Safe Flight Instrument Corporation AutoPower enhanced autothrottle system.

Instrumentation: Rockwell Collins digital avionics include Pro Line 21 four-display EFIS with 305 × 254 mm (12 × 10 in) LCD displays which include two-tube EICAS display (MFD); standby instruments (artificial horizon, airspeed indicator, compass and altimeter). Systems certified for Cat. II operations.

EQUIPMENT (Medevac version): Includes cardiopulmonary resuscitation unit; physio control lifepack comprising heart defibrillator, ECG and cardioscope; ophthalmoscope; respirators and resuscitators; infant monitor; X-ray viewer; cardiostimulator; foetal heart monitor; and anti-shock suit.

DIMENSIONS, EXTERNAL:

Wing span over winglets	19.61 m (64 ft 4 in)
Wing chord: at root	3.99 m (13 ft 1 in)
at tip	1.27 m (4 ft 2 in)
Wing aspect ratio (excl winglets)	8.0
Length overall	20.85 m (68 ft 5 in)
Fuselage: Length	18.77 m (61 ft 7 in)
Max diameter	2.69 m (8 ft 10 in)
Height overall	6.30 m (20 ft 8 in)
Tailplane span	6.20 m (20 ft 4 in)
Wheel track (c/l of shock-struts)	3.18 m (10 ft 5 in)
Wheelbase	7.99 m (26 ft 2½ in)
Passenger door (port, fwd): Height	1.78 m (5 ft 10 in)
Width	0.94 m (3 ft 1 in)
Height to sill	1.63 m (5 ft 4 in)
Baggage door (port, rear): Height	0.84 m (2 ft 9 in)
Width	0.71 m (2 ft 4 in)
Height to sill	1.73 m (5 ft 8 in)
Overwing emergency exit (stbd):	
Height	0.91 m (3 ft 0 in)
Width	0.51 m (1 ft 8 in)

DIMENSIONS, INTERNAL:

Cabin: Length, incl galley, lavatory and baggage area, excl flight deck	8.66 m (28 ft 5 in)
Max width	2.49 m (8 ft 2 in)
Width at floor level	2.18 m (7 ft 2 in)
Max height	1.85 m (6 ft 1 in)
Floor area	18.8 m^2 (202 sq ft)
Volume	32.6 m^3 (1,150 cu ft)

AREAS:

Wings, gross (excl winglets)	48.31 m^2 (520.0 sq ft)
Ailerons (total)	1.39 m^2 (15.0 sq ft)
Trailing-edge flaps (total)	7.80 m^2 (84.0 sq ft)
Fin	9.18 m^2 (98.8 sq ft)
Rudder	2.03 m^2 (21.9 sq ft)
Tailplane	6.45 m^2 (69.4 sq ft)
Elevators (total)	2.15 m^2 (23.1 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	11,759 kg (25,923 lb)
Operating weight empty	12,240 kg (26,985 lb)
Max fuel weight	9,072 kg (20,000 lb)
Max payload	2,275 kg (5,015 lb)
Payload with max fuel	596 kg (1,315 lb)
Fuel with max payload	7,394 kg (16,300 lb)
Max T-O weight	21,863 kg (48,200 lb)
Max ramp weight	21,908 kg (48,300 lb)
Max landing weight	17,236 kg (38,000 lb)
Max zero-fuel weight	14,515 kg (32,000 lb)
Max wing loading	452.6 kg/m^2 (92.69 lb/sq ft)
Max power loading	267 kg/kN (2.61 lb/lb st)

PERFORMANCE (at standard max T-O weight, except where indicated):

Cruising speed: max	M0.82 (470 kt; 870 km/h; 541 mph)
normal cruising speed	M0.80 (459 kt; 851 km/h; 529 mph)
long-range cruising speed	M0.74 (425 kt; 787 km/h; 489 mph)
Time to initial cruising altitude	22 min
Initial cruising altitude	11,460 m (37,600 ft)
Max certified altitude	12,500 m (41,000 ft)
Service ceiling, OEI: at mid-cruise weight 17,373 kg (38,300 lb)	6,920 m (22,700 ft)
at max T-O weight	5,170 m (16,960 ft)
Balanced T-O field length (ISA at S/L)	1,780 m (5,840 ft)
Landing distance at S/L at max landing weight	846 m (2,777 ft)
Range with max fuel and five passengers, NBAA IFR reserves:	
long-range cruising speed	4,027 n miles (7,458 km; 4,634 miles)
normal cruising speed	3,714 n miles (6,878 km; 4,274 miles)
Design *g* limit	+2.5

OPERATIONAL NOISE LEVELS:

T-O	81.2 EPNdB
Sideline	86.2 EPNdB
Approach	90.3 EPNdB

BOMBARDIER BD-700 GLOBAL EXPRESS

Engineering designation: BD-700-1A10

TYPE: Long-range business jet.

PROGRAMME:

DEVELOPMENT MILESTONES

Announced	28 Oct 91
Rolled out	26 Aug 96
First flight	13 Oct 96
Public debut	Nov 96
Certification	31 Jul 98
First delivery	8 Jul 99

Announced 28 October 1991 at NBAA Convention; full-scale cabin mockup exhibited at NBAA Convention September 1992; conceptual design started early 1993. Programme launched 20 December 1993; high-speed configuration frozen June 1994; low-speed configuration established August 1994.

Ground test programme using static test airframe c/n 0001 began August 1996; prototype C-FBGX (engineering designation BD-700-1A10) rolled out 26 August 1996; first flight 13 October 1996; public debut at NBAA Convention at Orlando, Florida, November 1996; prototype and three other aircraft undertook 2,000-hour, 18-month flight test programme based at Bombardier's flight test centre in Wichita, Kansas; second aircraft, (C-FHGX), which is used for systems evaluation and testing, flew 3 February 1997, third (C-FJGX), which is used for avionics and autopilot testing, 22 April 1997; fourth (C-FKGX), first flown 8 September 1997 and the first to be fully outfitted, was used for function and reliability testing.

Transport Canada certification 31 July 1998; FAA certification 13 November 1998; JAA certification 7 May 1999; German LBA certification 26 May 1999; first customer delivery of completed aircraft 8 July 1999 to AirFlite Inc of Long Beach, California, which operates the aircraft on behalf of Toyota Motor Sales USA; 50th 'green' airframe delivered to Montréal completion centre 7 June 2000. Transport Canada and JAA RVSM approval granted 16 January 2001, followed by FAA RVSM approval on 29 January. Thales Avionics head-up flight display system (HFDS) achieved Transport Canada certification on 14 September 2001 and FAA approval on 4 October 2001. Following exploratory discussions with potential suppliers, in-house development of Bombardier Enhanced Vision System (BEVS) began in 2002 and received Transport Canada certification 11 August 2005, followed by FAA approval on 26 August and EASA approval on 16 September 2005. At 28 February 2003 total fleet time stood at 73,000 flying hours with a despatch rate of 99.25 per cent. 100th aircraft (c/n 9100/N1SA) delivered 18 December 2002 to Stanford Financial Group of Houston, Texas.

CURRENT VERSIONS: **Global Express:** *As described.*

Global Express XRS: Improved version, announced at NBAA Convention in Orlando, Florida, 6 October 2003. Prototype C-FCOI (c/n 9159) first flew 16 January 2005. Design goals include increased range at high speed, improved take-off performance and new fast-refuelling technology. Additional forward fuselage tank in wing/fuselage fairing adds 674 kg (1,486 lb) of usable fuel; zero-flap take-off capability enhances hot-and-high performance with increased fuel load; software upgrades to the fuel computer, coupled with structural changes, reduce refuelling time by 15 minutes. Bombardier enhanced vision system (BEVS) is standard. Increased pressure differential maintains a 1,372 m (4,500 ft) cabin environment at FL450, and 1,737 m (5,700 ft) environment at FL510; upgraded humidification system optional. Cabin features two additional windows (forward starboard, opposite door; and rear port; adjacent to flaps), providing 40 per cent more natural light in forward vestibule area; redesigned floor plan with full galley on port side; 12-hour non-stop-flight-approved crew area with overhead storage on starboard side; 0-42 m^3 (15 cu ft) of additional aft storage volume; increased overhead stowage in crew area; and standard forward and aft vacuum lavatories; integrated cabin system diagnostic tool to manage environmental system including temperature, lighting, water and waste systems; Goodrich-Hella-designed LED mood lighting; and Rockwell Collins Airshow 21 integrated cabin electronics including DVD/CD/MP3 players, optional satellite TV and standard digital airborne wireless local area network (LAN) with cabin telephone system and multichannel satcoms with Inmarsat Aero H+, Swift64 and Iridium communication services interfaces.

First two customer aircraft delivered from completion centre on 25 November 2005 and 6 December 2005 respectively, last named entering service on 10 December 2005 with OJSC AK Transneft oil company. Unit cost USD45.5 million, typically equipped (2003).

Sentinel R. Mk 1: Ground surveillance version for UK; prime contractor Raytheon Systems of USA.

Sentinel AGS: Airborne ground surveillance. The Global Express has been chosen as the airborne platform for the Raytheon-led Co-operative Transatlantic AGS Solution (CTAS) bid for the NATO Alliance Ground Surveillance (AGS) system, for which a development contract was expected to be awarded in December 2004. If selected, the AGS-modified Global Express would have reduced service ceiling and range compared with the business jet, estimated at 13,715 m (45,000 ft) and 5,000 n miles (9,260 km; 5,754 miles), respectively.

CUSTOMERS: 150th aircraft entered service on 26 August 2005. Recent customers include Qatar Airways which ordered two, with two options, on 8 December 2003, for delivery in mid- and late 2004. Estimated market for 500 to 800 long-range business jets over 15 years; Bombardier anticipates capturing 50 per cent of the market, breaking even at approximately 100; target production rate 34 per year; total of 35 delivered in 2000, 21 in 2001, 16 in 2002, 17 in 2003, 20 in 2004, 13 in 2005 and 17 in the first nine months of 2006.

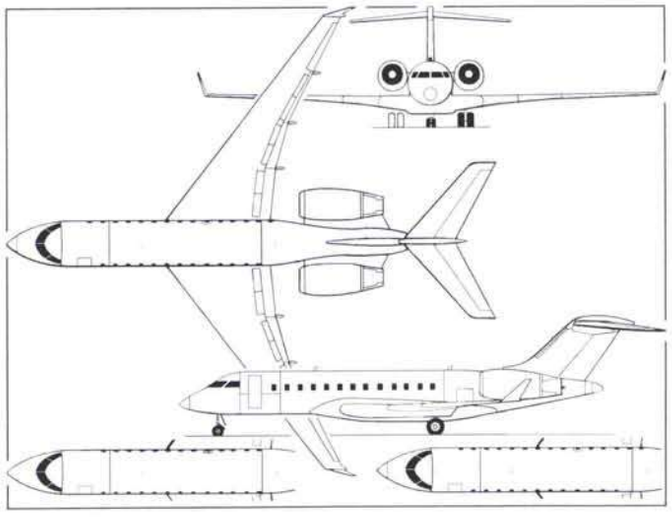
COSTS: Development costs CAD800 million; half carried by Bombardier, balance by risk-sharing partners. Unit cost USD45.5 million (XRS, 2005).

DESIGN FEATURES: Design goal was longest possible range at highest speed from short runway with 99.5 per cent despatch reliability; wide-body fuselage, combining Challenger cabin cross-section with cabin length of Regional Jet; all-new, 'third-generation supercritical' wings with leading-edge slats and winglets.

Wing sweep 35° at quarter-chord, thickness/chord ratio 11 per cent, dihedral 2° 30', root incidence 2° 30'. Wing, high-lift devices and wing/fuselage interface and area-ruled rear fuselage/engine pylon junction contours developed with extensive use of computational fluid dynamics (CFD). Rear-mounted engines. Sweptback T tail with 38° sweep and 5° anhedral on tailplane, 45° sweep on fin.

Bombardier Global Express *(Paul Jackson)* 1153781

Impression of Global Express AGS, offered to NATO 0548618



Bombardier BD-700 Global Express with maximum option of 15 standard cabin windows, plus scrap views of (left) standard cabin glazing and (right) Global Express XRS *(Paul Jackson)* 1158938

FLYING CONTROLS: Conventional and mechanical. Fully powered primary flying controls with variable artificial feel and emergency back-up via ram air turbine following triple hydraulic failure; dual sidestick controllers; duplicated cable runs with automatic disconnect in the event of control surface jamming; dual power control units on ailerons (maximum deflections +26.5/−23°) and elevators (maximum deflections +24/−19°), triple units on rudder (maximum deflection 37° left/right). Eight-section (total) leading-edge slats (maximum deflection 20°) and six-section (total) single-slotted Fowler flaps (maximum deflection 30°) are signalled by dual electronic control units and operated by dual-motor power units connected by rigid driveshafts to ball-screw actuators. Electrically signalled, hydraulically actuated multifunction spoilers (four per side, outboard, operating differentially to assist ailerons and improve roll response, and symmetrically for speed brake or lift dump functions) and ground spoilers (two per side, inboard), maximum deflection +40°. Horizontal stabiliser incidence adjustable for pitch trim (+13/−2°) via dual-channel electrically driven screw actuator; roll trim accomplished by electric trim actuator located at aileron feel simulator unit; yaw trim accomplished by electric trim actuator at summing unit in fin. Dual yaw damper stability augmentation system and stick shaker/pusher stall protection system standard.

STRUCTURE: Semi-monocoque fuselage with chemically milled C-188 A1 aluminium alloy skin riveted over alloy frames and stringers to form damage-tolerant structure; main two-spar torsion box wing structure mostly of alloy construction, with machined alloy spars and ribs and polyurethane-coated machined alloy skin panels; two-spar winglets of mixed alloy/composites construction; multispar fin is alloy; ailerons, flaps, spoilers, rudder, two-spar tailplane, elevators, wing/fuselage fairings, flap track fairings, main landing gear bay, upper and lower engine nacelle doors and cabin floor panels are of composites construction.

Bombardier's Canadair division is design authority and manufactures nose section; de Havilland manufactures rear fuselage, engine pylons and vertical stabiliser and is responsible for final assembly at Downsview; Mitsubishi supplies wings and centre fuselage; Short Brothers designed and manufactures forward fuselage, engine nacelles, horizontal stabiliser and other composites components; Bombardier is responsible for interior completions at its Montréal facility. Other participants in the programme are Honeywell Aerospace (APU), Ametek Aerospace (data acquisition unit, engine vibration monitoring system, fuel flow transmitters and engine thermocouples), Rolls-Royce Deutschland (power plant), Hella (lighting systems), Honeywell (avionics), Liebherr-Aerospace Toulouse (air management system), Lucas Aerospace (electrical systems), Messier-Dowty International (landing gear), Parker Bertea Aerospace (flight controls and fuel and hydraulic systems), Raytheon E-Systems (pitch feel systems), Thales Avionics (flight control system) and Hamilton Sundstrand (slat/flap actuation system and ram air turbine).

LANDING GEAR: Hydraulically retractable tricycle type with Messier-Dowty oleo-pneumatic shock-absorber and twin wheels on each unit; main units retract inward into wing, nosewheel forwards. Goodyear tyres, mainwheels tyre size H38×12.0-19 (20 ply) tubeless, maximum pressure 11.45 bar (166 lb/sq in); nosewheel tyres 21×7.25-10 (12 ply) tubeless (deflector-type), maximum pressure 9.93 bar (144 lb/sq in). Carbon brakes with dual Goodrich/HydroAire hydraulic digital brake-by-wire/modulated anti-skid system providing pilot-selectable, three-level autobrake capability. Steerable nosewheel, maximum steering angle ±75°; minimum ground turning radius 20.73 m (68 ft 0 in).

POWER PLANT: Two rear-mounted 65.6 kN (14,750 lb st) Rolls-Royce Deutschland BR710A2-20 turbofans, flat rated to ISA + 20°C, with FADEC. International Nacelle Systems (Shorts/Hurel-Dubois joint venture) hydraulically actuated two-petal target-type thrust reversers.

Fuel contained in two integral wing tanks, each of 8,415 litres (2,223 US gallons; 1,851 Imp gallons) capacity, centre-section tank, capacity 6,227 litres (1,645 US gallons; 1,370 Imp gallons), and auxiliary tank in aft fuselage, capacity 1,276 litres (337 US gallons; 281 Imp gallons), giving total standard capacity of 24,333 litres (6,428 US gallons; 5,353 Imp gallons). On aircraft incorporating Service Bulletin 700-28-40, capacities are: wing tanks (each) 8,437 litres (2,229 US gallons; 1,856 Imp gallons); centre-section tank 7,113 litres (1,879 US gallons; 1,565 Imp gallons), and auxiliary tank 1,276 litres (337 US gallons; 281 Imp gallons) for a total of 25,265 litres (6,674 US gallons; 5,557 Imp gallons). Fuel from centre-section and auxiliary tanks is transferred to wing tanks from where two AC main pumps and DC back-up pump feed to engines; automatic fuel management system balances quantities in port and starboard wing tanks. Gravity and pressure refuelling; single-point pressure fuelling/defuelling coupling in starboard wing/fuselage fairing. Oil capacity 20 litres (5.3 US gallons; 4.4 Imp gallons) with oil replenishment tank, capacity 5.7 litres (1.5 US gallons; 1.2 Imp gallons) permitting remote oil servicing from the cockpit.

ACCOMMODATION: Crew of three or four (including cabin attendant) and eight to 19 passengers depending on interior fit. Customised cabin interior according to customer requirements. Typical arrangement comprises three-compartment cabin with lavatory at rear, crew area, galley, small lavatory and wardrobe forward, and standard 'office in the sky', stateroom and conference area. Flight-accessible baggage compartment at rear of cabin with external plug-type door forward of port engine intake. Accommodation is heated, air conditioned and pressurised; predicted cabin noise level 52 dB. Thirteen windows on port side of cabin; standard 13 to starboard, with option of up to two extra windows, one forward, one rear (for totals of 13, 14 or 15), each 40 cm (1 ft 3¾ in) high × 27.4 cm (10¾ in) wide; one window over wing on starboard side doubles as plug-type emergency exit. Electrically operated airstair door at front of cabin on port side.

SYSTEMS: Integrated air management system by Liebherr-Aerospace Toulouse provides engine bleed, wing anti-ice, air conditioning, cabin pressurisation and avionics ventilation. Digitally controlled dual cooling pack system with ozone converters and bleed air filters provides cabin air circulation at standard rate 1.81 m³ (64 cu ft)/min/person, maximum rate 2.29 m³ (81 cu ft)/min/person with crew-selectable 100 per cent fresh air or recirculation and three air sources for cabin pressure control; maximum pressure differential 0.66 bar (9.64 lb/sq in) maintains a 1,525 m (5,000 ft) cabin altitude to 12,500 m (41,000 ft) and a 2,200 m (7,220 ft) cabin altitude to maximum operating altitude of 15,545 m (51,000 ft). Engine bleed air anti-icing for wing leading-edge fixed surfaces and slats; tail surfaces unprotected; bleed management system automatically switches between low-and high-pressure compressor air to improve engine efficiency. Oxygen system comprises four 1,417 litre (50 cu ft) oxygen cylinders pressurised to 127.6 bar (1,850 lb/sq in) for passenger and crew use.

Lucas/Leach electrical power generation and distribution system comprises two 40 kVA variable frequency generators on each engine, supplying primary 115/200 V three-phase AC electrical power at 324 to 596 Hz; alternative AC power provided by 45 kVA APU-mounted generator and emergency power by 9 kVA air-driven generator, the latter automatically deployed in the event of power loss; electrical management system automatically performs priority-based load-shedding and reconfiguration in event of failure. Four 150 A TRUs convert AC to 28 V DC; emergency DC provided by 25 Ah and 42 Ah low-maintenance Ni/Cd batteries. Provision for external AC and DC power connection. Triple logic-controlled AC power centre performs primary AC power distribution and high-power secondary distribution via solid-state switches and 'smart' -contactors; low-power AC distributed through thermal circuit breakers in the cockpit. Triple logic-controlled DC power centre provides non-interruptible primary DC power distribution, emergency bus supplies and normal DC supplies to four secondary power distribution assemblies (SPDAs) throughout the aircraft to provide remote logic-controlled power to all DC loads. Two CDUs in the cockpit allow for remote sensing/setting and resetting of circuit breakers.

Tailcone-mounted Honeywell RE220(GX) APU provides electrical power (45 kVA ground; 40 kVA flight), as well as bleed air and main engine starting; APU is certified for operation up to 13,715 m (45,000 ft), in-flight starting up to 11,280 m (37,000 ft) and engine starting up to 9,145 m (30,000 ft).

Triple-redundant hydraulic systems at pressure of 207 bar (3,000 lb/sq in), with bootstrap reservoirs.

Walter Kidde Aerospace integrated aircraft fire detection and extinguishing system provides continuous fire detection monitoring in engine nacelles, APU compartment, main landing gear bays and cabin; dual extinguishers provide two-shot fire suppression in main engine and APU bays. Aircraft serviceability monitored by CAIMS (central aircraft information and maintenance system) with facilities including in-flight display.

AVIONICS: Honeywell Primus 2000XP as core system.

Comms: Dual VHF (third optional); dual Rockwell Collins HF; dual transponders; dual radio management systems; Coltech five-channel Selcal; Honeywell digital FDR and CVR; ELT; satcom optional, with antenna mounted in fin cap; Teledyne Magnastar Office in the Sky datalink optional.

Radar: Colour weather radar with dual controllers.

Flight: Dual flight management systems (third optional) with dual Cat. II autopilots and triple digital air data computers providing fail-safe AFCS; triple laser gyro inertial reference systems; GPS with option for second sensor; ADF; VOR/ILS; DME; TCAS II; Honeywell EGPWS with terrain database integrated into Primus 2000XP system for EFIS display.

Instrumentation: Dual EFIS comprising six 203 × 178 mm (8 × 7 in) CRT multifunction displays, for PFD and EICAS functions; dual Rockwell Collins digital radio altimeter; combined standby airspeed/altimeter, standby artificial horizon and stowable standby heading indicator. Thales HFDS with Cat. II landing capability and lightning sensor system optional. Bombardier Enhanced Vision System (BEVS) standard from first quarter 2005.

Data below apply to Global Express and Global Express XRS, except where noted.

DIMENSIONS, EXTERNAL:

Wing span over winglets	28.65 m (94 ft 0 in)
Wing chord: at root	6.43 m (21 ft 1 in)
at tip	1.24 m (4 ft 1 in)
Wing aspect ratio	8.6
Length: overall	30.30 m (99 ft 5 in)
fuselage	26.31 m (86 ft 4 in)
Diameter of fuselage, constant portion	2.69 m (8 ft 10 in)
Height overall	7.57 m (24 ft 10 in)
Tailplane span	9.68 m (31 ft 9 in)
Wheel track (c/l of shock-absorbers)	4.06 m (13 ft 4 in)
Wheelbase	12.78 m (41 ft 11 in)
Passenger door: Height	1.83 m (6 ft 0 in)
Width:	0.91 m (3 ft 0 in)
Baggage door: Height	0.84 m (2 ft 9 in)
Width	1.09 m (3 ft 7 in)
Emergency exit: Height	0.99 m (3 ft 3 in)
Width	0.51 m (1 ft 8 in)

DIMENSIONS, INTERNAL:

Flight deck volume	3.99 m^3 (141.0 cu ft)
Cabin (excl flight deck): Length	14.73 m (48 ft 4 in)
Width at floor	2.11 m (6 ft 11 in)
Max width	2.49 m (8 ft 2 in)
Max height	1.90 m (6 ft 3 in)
Floor area	31.1 m^2 (335 sq ft)
Volume, incl baggage compartment	60.6 m^3 (2,140 cu ft)

AREAS:

Wings, basic	94.95 m^2 (1,022.0 sq ft)
Horizontal tail surfaces (total)	22.76 m^2 (245.0 sq ft)
Vertical tail surfaces (total)	17.28 m^2 (186.0 sq ft)

WEIGHTS AND LOADINGS (A: Global Express; B: Global Express XRS):

Operating weight empty: A	22,816 kg (50,300 lb)
B	23,360 kg (51,500 lb)
Max payload: A	2,585 kg (5,700 lb)
Payload with max fuel: A	725 kg (1,600 lb)
B	805 kg (1,775 lb)
Fuel with max payload	17,804 kg (39,250 lb)
Max fuel weight: A	19,663 kg (43,350 lb)
B	20,400 kg (44,975 lb)
Max ramp weight: A standard	43,205 kg (95,250 lb)
A optional	43,658 kg (96,250 lb)
B	44,565 kg (98,250 lb)
Max T-O weight: A standard	43,091 kg (95,000 lb)
A optional	43,545 kg (96,000 lb)
B	44,452 kg (98,000 lb)
Max landing weight: A, B	35,652 kg (78,600 lb)
Max zero-fuel weight: A, B	25,401 kg (56,000 lb)
Max wing loading:	
A standard	453.8 kg/m^2 (92.95 lb/sq ft)
A optional	458.6 kg/m^2 (93.93 lb/sq ft)
B	468.2 kg/m^2 (95.89 lb/sq ft)
Max power loading:	
A standard	328 kg/kN (3.22 lb/lb st)
A optional	332 kg/kN (3.25 lb/lb st)
B	339 kg/kN (3.32 lb/lb st)

PERFORMANCE:

Max level speed (VMO):	
S/L to FL80	300 kt (555 km/h; 345 mph) CAS
FL80 to FL309	340 kt (629 km/h; 391 mph) CAS
above FL309	M0.89
High cruising speed: A, B	M0.89 (515 kt; 954 km/h; 593 mph)
Normal cruising speed: A, B	M0.85 (488 kt; 904 km/h; 562 mph)
Long-range cruising speed at FL450: A	M0.80 (459 kt; 850 km/h; 528 mph)
Initial cruising altitude: A	13,105 m (43,000 ft)
Time to climb to initial cruising altitude:	
A, B	30 min
Max certified altitude: A, B	15,545 m (51,000 ft)
T-O balanced field length: A	1,774 m (5,820 ft)
B	1,887 m (6,190 ft)
Landing distance, A, B	814 m (2,670 ft)
Runway LCN	55
Range with max fuel and eight passengers, NBAA IFR reserves:	
at M0.85: A	6,010 n miles (11,130 km; 6,916 miles)
B	6,150 n miles (11,390 km; 7,077 miles)
at M0.87: A	5,276 n miles (9,771 km; 6,071 miles)
B	5,450 n miles (10,093 km; 6,272 miles)
Range with max payload:	
A at M0.85	5,187 n miles (9,606 km; 5,969 miles)
A at M0.87	4,596 n miles (8,511 km; 5,289 miles)
Design *g* limit: A, B	+2.5

OPERATIONAL NOISE LEVELS (all):

T-O	82.4 EPNdB
Approach	89.8 EPNdB
Sideline	88.6 EPNdB

BOMBARDIER GLOBAL 5000

Engineering designation: BD-700-1A11

TYPE: Long-range business jet.

PROGRAMME:

DEVELOPMENT MILESTONES

Design began	99
Announced	25 Oct 01
Marketing began	5 Feb 02
First order (Sino Private Aviation)	28 Feb 02
First flight	7 March 03
Certification	12 Mar 04
First delivery	18 Apr 05

Market and design studies began 1999; announced 25 October 2001; formal launch 5 February 2002; first flight (c/n 9127/C-GERS) 7 March 2003; public debut at Paris Air Show in June 2003; second test aircraft (c/n 9130/C-GLRM) first flew 8 January 2004. Certification by Transport Canada, achieved 12 March 2004 following two aircraft flight test programme; deliveries of 'green' aircraft to completion centres scheduled to begin in second quarter 2004; EASA certification achieved 15 July 2004, followed by JAA Letter of Recommendation on 26 August and FAA certification 20 September 2004; service entry (C-GERS, as demonstrator) fourth quarter 2004; customer service entry 18 April 2005.

On 11 October 2004, second prototype Global Express 5000, carrying three crew and a representative payload equivalent to eight passengers, set a National Aeronautic Association-sanctioned speed record, flying 4,597 n miles (8,514 km; 5,290 miles) from Dublin to Las Vegas to attend the NBAA Convention in 9 hours 55 minutes.

CUSTOMERS: Launch customer TAG Aeronautics ordered five on 5 November 2001; letters of intent for 15 aircraft at time of launch (these delivery positions all assigned by late 2004, 15th being 173rd of Global Express family). Sino Private Aviation of Hong Kong ordered one aircraft during Asian Aerospace 2002 in Singapore on 28 February 2002, and the US Federal Aviation Administration ordered one on 19 October 2004 for delivery by 30 September 2005 after outfitting as an airborne research and development laboratory by Midcoast Aviation of St Louis, prior to service at the FAA William J Hughes Technical Center in Atlantic City, New Jersey. First delivery of completed aircraft 18 April 2005 to a customer in the Middle East; total of 17 delivered in 2005, and 11 in the first nine months of 2006. Potential market for 750 aircraft in class by 2010.

COSTS: USD33 million 'green' (2002).

DESIGN FEATURES: Based on Global Express, with 1.83 m (6 ft 0 in) reduction in fuselage length, and 1,200 n mile (2,222 km; 1,381 mile) reduction in maximum range. Up to 19 passengers.

ACCOMMODATION: Standard interior, developed by Bombardier and C&D Aerospace, features a three-zone cabin with club and conference seating; forward and aft vacuum lavatories; integrated cabin system diagnostic tool to manage environmental system including temperature, lighting, water and waste systems; Goodrich-Hella-designed LED mood lighting; and Rockwell Collins Airshow 21 integrated cabin electronics including DVD/CD/MP3 players, optional satellite TV and standard digital airborne wireless Local Area Network with cabin telephone system and multichannel satcoms with Inmarsat Aero H+, Swift64 and Iridium communication services interfaces.

AVIONICS: Thales Enhanced Flight Vision System (EFVS) granted provisional certification by Transport Canada by June 2005.

Data generally as for Global Express, except the following.

DIMENSIONS, EXTERNAL:

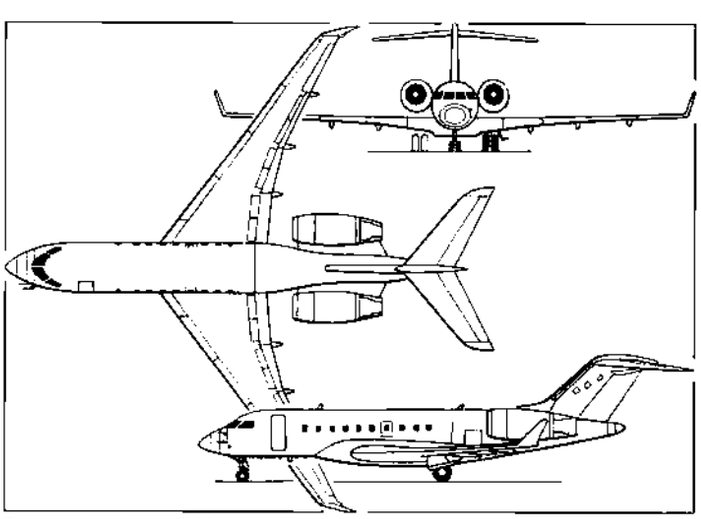
Length overall	29.49 m (96 ft 9 in)

DIMENSIONS, INTERNAL:

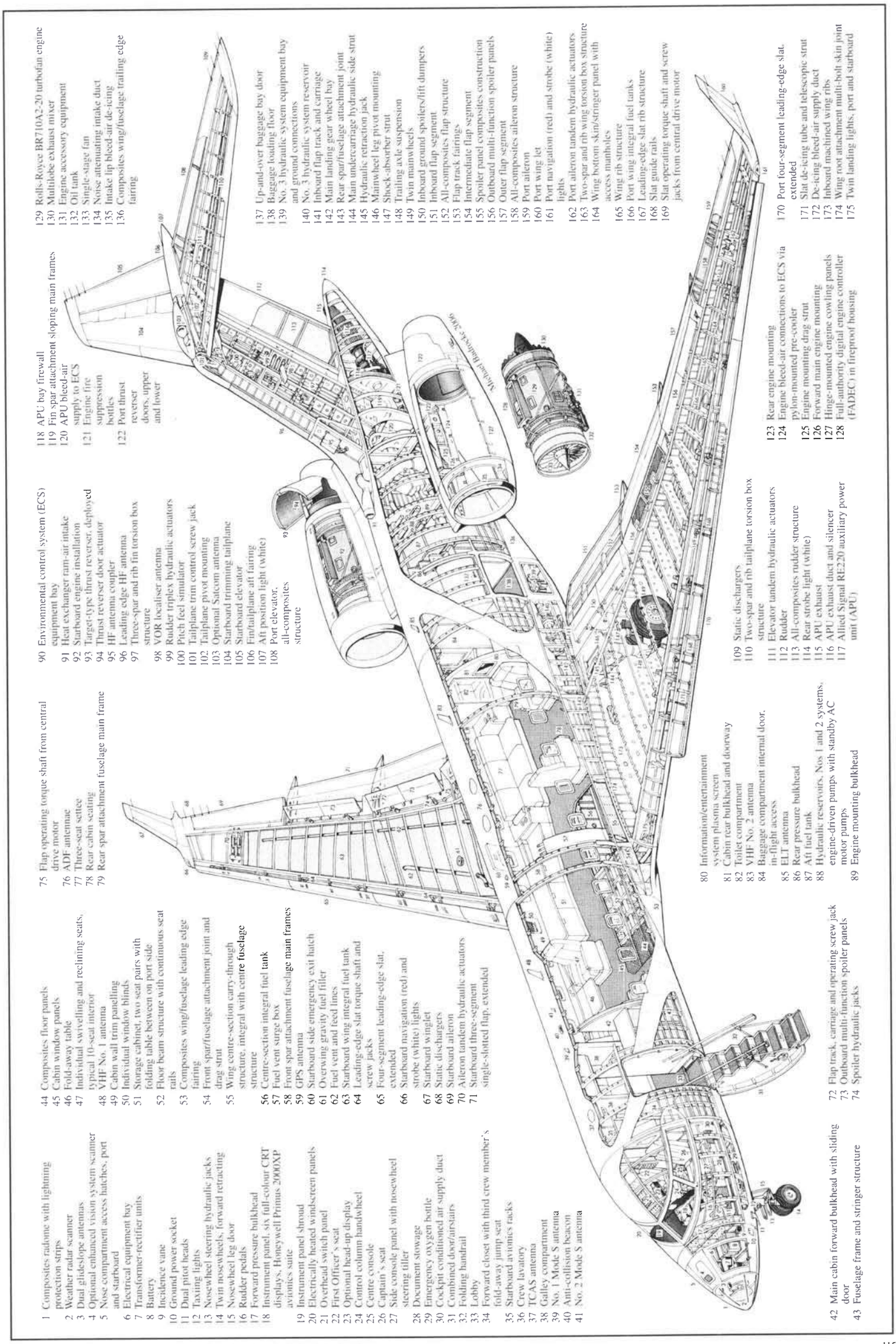
Cabin (excl flight deck):	
Length	12.95 m (42 ft 6 in)
Volume	53.29 m^3 (1,882 cu ft)

WEIGHTS AND LOADINGS:

Basic operating weight	23,056 kg (50,830 lb)
Payload: max	2,345 kg (5,170 lb)
with max fuel	508 kg (1,120 lb)
Max fuel weight	16,329 kg (36,000 lb)
Fuel with max payload	16,112 kg (35,520 lb)
Max T-O weight: normal	39,780 kg (87,700 lb)
option 1	40,234 kg (88,700 lb)
option 2	40,687 kg (89,700 lb)
Max ramp weight	39,893 kg (87,950 lb)
Max landing weight	35,652 kg (78,600 lb)
Max zero-fuel weight	25,401 kg (56,000 lb)
Max wing loading: normal	419.0 kg/m^2 (85.81 lb/sq ft)
option 1	423.7 kg/m^2 (86.79 lb/sq ft)
option 2	428.5 kg/m^2 (87.77 lb/sq ft)
Max power loading: normal	303 kg/kN (2.97 lb/lb st)
option 1	307 kg/kN (3.01 lb/lb st)
option 2	310 kg/kN (3.04 lb/lb st)



Bombardier Global 5000 general arrangement (*James Goulding*) 1154679



Bombardier Global 5000, cutaway drawing key *(Michael Badrocke)*

1151682

Bombardier Global 5000 delivered to US Federal Aviation Administration 1153803

PERFORMANCE:

Cruising speed: max	M0.89 (510 kt; 945 km/h; 587 mph)
normal	M0.85 (488 kt; 904 km/h; 562 mph)
Initial cruising altitude	13,105 m (43,000 ft)
Time to climb to initial cruising altitude	23 min
Max certified altitude	15,545 m (51,000 ft)
T-O balanced field length	1,525 m (5,000 ft)
Landing run	814 m (2,670 ft)
Range, NBAA IFR reserves, three crew, eight passengers:	
at M0.85	4,800 n miles (8,889 km; 5,523 miles)
at M0.88	3,700 n miles (6,852 km; 4,257 miles)

OPERATIONAL NOISE LEVELS:

T-O	79.9 EPNdB
Approach	89.7 EPNdB
Sideline	89.1 EPNdB

BOMBARDIER CSERIES

TYPE: Twin-jet airliner.

PROGRAMME: Bombardier launched new regional jet programme at Farnborough International air show on 8 September 1998 with unveiling of 90 to 110-seat BRJ-X, but this was abandoned in September 2000. Larger CSeries, formerly known as New Commercial Aircraft Program (NCAP), announced at Farnborough on 19 July 2004 with service entry expected in 2010.

However, on 31 January 2006, after investing USD100 million, Bombardier announced that market conditions were then inappropriate for launching the CSeries. Development work was suspended and 300 employees transferred to other activities, but 50 personnel and USD20 million were assigned to a year of further work on the CSeries business plan with emphasis on attracting partners from China, India, Russia and other areas of fast-growing aerospace markets.

Low rate development continued during 2006, with substitution of C130 variant for C135 and shallower winglets, effectively increasing wing span.

CURRENT VERSIONS: **CSeries 110-STD:** Baseline version.

CSeries 110-ER: Long-range version; strengthened fuselage.

CSeries 130-STD: Stretched version; fuselage plugs fore and aft of wing; strengthened structure.

CSeries 130-ER: Long-range version.

CUSTOMERS: Market for aircraft in CSeries class estimated at 5,800, valued at USD250 billion, between 2004 and 2024.

DESIGN FEATURES: Swept low wing, with winglets common to all versions; sweptback tail surfaces; wing-mounted, podded engines. Design goals include operational flexibility on short- and long-haul routes; total life-cycle cost improvement over existing airliners; 15 per cent improvement in direct operating costs, compared with contemporary in-service designs and 20 per cent improvement over out-of-service designs; 99 per cent despatch reliability, and high passenger appeal through comfort, cabin spaciousness and in flight entertainment systems.

FLYING CONTROLS: Fly-by-wire, with sidestick controllers and advanced systems architecture with flight envelope protection. Fowler flaps; three-section leading-edge slats and five-section spoilers on each wing.

STRUCTURE: Common forgings for all versions; composites control surfaces, leading-edge slats and Fowler flaps, tail surfaces, rear fuselage and tailcone.

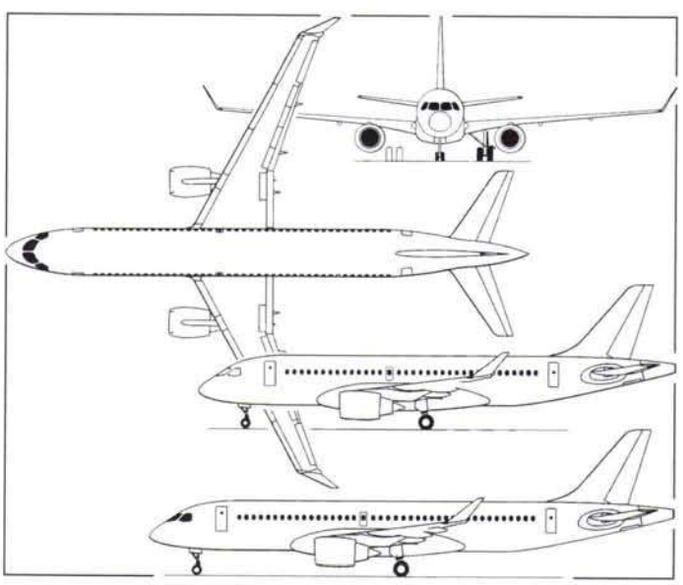
LANDING GEAR: Retractable tricycle type. Twin wheels on each unit. Main units retract inwards, nosewheel forward. Carbon brakes.

POWER PLANT: *CSeries 110-STD:* Two 82.3 kN (18,500 lb st) turbofans.

CSeries 110-ER: Two 91.6 KN (20,600 lb st) turbofans.

CSeries 130-STD: Two 91.2 KN (20,500 lb st) turbofans.

Artist's impression of projected Bombardier CSeries C110 1158919



Bombardier CSeries C130, with additional side view (upper) of C110 *(Paul Jackson)* 1158918

CSeries 130-ER: Two 103.6 kN (23,300 lb st) turbofans.

Selected power plant will offer highest bypass ratio for class and targeted at lowest life-cycle costs and Stage 5 noise compliance.

ACCOMMODATION: Two crew on flight deck and three or four cabin attendants. CSeries 110 accommodates 110 passengers at 81 cm (32 in) seat pitch in single class in 3+2 configuration; ATLAS standard galley fore and aft, each with dedicated service door on starboard side; two lavatories, one with access for handicapped passengers, and separate crew and passenger closets all standard. Optional two-class arrangements accommodate 16 in forward business class cabin, and 83 in economy class; or 125 in high-density.

CSeries 1 accommodates 130 passengers at 81 cm (32 in) pitch in single class configuration, or, in two-class arrangement, 14 passengers in forward business class cabin, and 108 in economy class; or 145 in high-density. Passenger doors on port side at front and rear of cabin. Overwing emergency exit on each side. Cabin design aims to provide at least one large window per row of seats on each side to maximise natural lighting and outside view.

SYSTEMS: Emphasis is on integrated aircraft/electrical systems.

DIMENSIONS, EXTERNAL:

Wing span: all	35.35 m (116 ft 0 in)
Length overall: A, B	35.56 m (116 ft 8 in)
C, D	38.76 m (127 ft 2 in)
Height overall: all	10.91 m (35 ft 9 in)
Passenger door (fwd, port):	
Height	1.88 m (6 ft 2 in)
Width	0.86 m (2 ft 10 in)
Passenger door (aft, port):	
Height	1.83 m (6 ft 0 in)
Width	0.76 m (2 ft 6 in)
Service doors (fwd and aft):	
Height	1.52 m (5 ft 0 in)
Width	0.76 m (2 ft 6 in)
Type III overwing exits, port and stbd:	
Height	1.04 m (3 ft 5 in)
Width	0.51 m (1 ft 8 in)

DIMENSIONS, INTERNAL:

Cabin:	
Max width, all	3.45 m (11 ft 4 in)
Height: max	2.21 m (7 ft 3 in)
above aisle	2.13 m (7 ft 0 in)
Aisle width: business	0.61 m (2 ft 0 in)
economy	0.58 m (1 ft 11 in)
Underfloor baggage/cargo hold:	
Width: at roof	2.21 m (7 ft 3 in)
at floor	1.09 m (3 ft 7 in)
Max height	1.08 m (3 ft 6½ in)

Volume: CSeries 110-STD/ER ..... 23.5 m³ (829 cu ft)
CSeries 130-STD/ER ..... 30.5 m³ (1,076 cu ft)
Overhead storage bins:
Length ..... 0.61 m (2 ft 0 in)
Height ..... 0.28 m (0 ft 11 in)
Depth ..... 0.36 m (1 ft 2 in)
Volume per passenger ..... 0.07 m³ (2.60 cu ft)
WEIGHTS AND LOADINGS:
Max payload: A, B ..... 13,971 kg (30,800 lb)
C, D ..... 16,556 kg (36,500 lb)
Max T-O weight: A ..... 54,705 kg (120,600 lb)
B ..... 60,420 kg (133,200 lb)
C ..... 59,785 kg (131,800 lb)
D ..... 66,225 kg (146,000 lb)
Max landing weight: A ..... 50,350 kg (111,000 lb)
B ..... 52,165 kg (115,000 lb)
C ..... 54,885 kg (121,000 lb)
D ..... 56,925 kg (125,500 lb)
PERFORMANCE (estimated: A, B, C, D, as above):
Max cruising speed, all M0.82
Normal cruising speed, all M0.78
Max operating altitude, all ..... 12,497 m (41,000 ft)
T-O balanced field length: A ..... 1,311 m (4,300 ft)
B ..... 1,615 m (5,300 ft)
C ..... 1,585 m (5,200 ft)
D ..... 2,012 m (6,600 ft)
Max range: A, C ..... 1,800 n miles (3,333 km; 2,071 miles)
B, D ..... 3,000 n miles (5,556 km; 3,452 miles)

BOMBARDIER AEROSPACE TORONTO OPERATIONS

Garratt Boulevard, Downsview, Ontario M3K 1Y5
Tel: (+1 416) 633 73 10
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VICE PRESIDENT AND GENERAL MANAGER, OPERATIONS: Alain Dugas
VICE PRESIDENT, DASH 8 SERIES 100/200/300 OPERATIONS: Rob Comand
VICE PRESIDENT, DASH 8 SERIES 400 OPERATIONS: Bruce Vannus
VICE-PRESIDENT, GLOBAL EXPRESS OPERATIONS: Trevor Anderson
VICE PRESIDENT, FINANCE: Colin Fernie
VICE PRESIDENT, HUMAN RESOURCES: Bernard Cormier
MANAGER, PUBLIC RELATIONS: Colin Fisher

Established 1928 as The de Havilland Aircraft of Canada Ltd, subsidiary of The de Havilland Aircraft Company Ltd, both absorbed 1961 by Hawker Siddeley Group; ownership transferred to Canadian government 26 June 1974; purchased by Boeing Company 31 January 1986 and made a division of Boeing of Canada Ltd; Boeing's intention to sell announced July 1990.

Sale to Bombardier Inc (51 per cent) and government of Ontario (49 per cent), signed 22 January 1992, supported by help from Ontario and federal governments, with Canadian Export Development Corporation to provide sales financing for Dash 8; all government support conditionally repayable. Bombardier acquired remaining 49 per cent of de Havilland in January 1997.

At its Downsview facility, Bombardier Aerospace Toronto manufactures Dash 8Q series, including spare parts and components, and also some components of the Bombardier Global Express; performs final assembly of Dash 8Q, Global Express and Global 5000; designed and builds wings for Learjet 45. Bombardier 415 assembly is in a 4,750 m² (51,000 sq ft) plant at North Bay, Ontario.

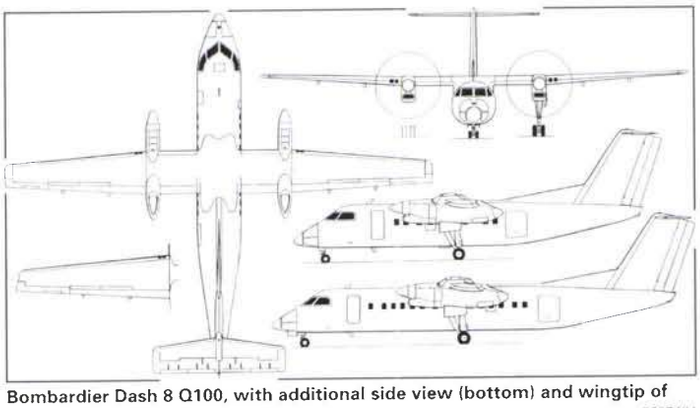
BOMBARDIER DASH 8 Q100 and Q200

TYPE: Twin-turboprop airliner.
PROGRAMME:

DEVELOPMENT MILESTONES

Announced	1980
First flight	20 Jun 83
Certification	28 Sep 84
First flight, production	3 Apr 84
First delivery (norOntair)	23 Oct 84
Entered service (norOntair)	Dec 84

Launched 1980; initially known as DHC-8; then Dash 8; then Dash 8Q. First flight of prototype (C-GDNK) 20 June 1983, second prototype (C-GGMP) 26 October 1983, third 22 December 1983; fourth aircraft, first with production P&WC PW120 engines, 3 April 1984. Certified to Canadian DoT, FAR Pts 25 and 36 and SFAR No. 27 on 28 September 1984, followed by FAA on 11 December 1984; also certified in Australia, Austria, Brazil, Cameroon, China, Colombia, Germany, Ireland, Italy, Maldives, Netherlands, New Zealand, Norway, Papua New Guinea, South Africa, Taiwan, UK and United Arab Emirates. First delivery (norOntair) 23 October 1984 followed by service entry in December; 500th Dash 8 (a Series 200, N355PH) delivered 21 November 1997 to Horizon Air, 600th of type delivered 6 March 2001 (see Q300). Total Dash 8 fleet time at June 2004 (not including Q400) was 13,796,700 hours and 16,713,423 cycles, with 99.4 per cent despatch reliability rate.



Bombardier Dash 8 Q100, with additional side view (bottom) and wingtip of Q300 *(Dennis Punnett)* 0507404

CURRENT VERSIONS: **Dash 8 Q**: Redesigned interior and noise and vibration suppression system (NVS) standard from second quarter of 1996, reducing cabin noise levels by 12 dB; all current production aircraft are equipped with NVS and known as Dash 8 Qs.

Dash 8 Series 100: Initial version, with choice of PW120A or PW121 engines; discontinued. Model 101 (PW120 or 120A engines; MTOW 14,968 kg; 33,000 lb) certified in 1984; Model 102 (PW120A or 121; MTOW 15,649 kg; 34,500 lb) certified by DoT 12 June 1986 and FAA 7 August 1986; Model 103 (PW121; MTOW as 102) 20 July 1987 and 30 November 1988, respectively; Model 106 (PW121; MTOW 16,465 kg; 36,300 lb) 20 November 1992 and 10 December 1993, respectively.

Dash 8 Series 100A: Introduced 1990; PW120A (or optional PW121) engines and restyled interior with 6.35 cm (2.5 in) more headroom in aisle; first delivery to Pennsylvania Airlines July 1990; discontinued.

Dash 8 Series 100B: Improved version from 1992; PW121 engines enhance airfield and climb performance; discontinued.

Dash 8 Q100: Introduced 1998; PW 120A or optional PW 121 in basic weight version. PW 121 standard in high gross weight (HGW) version.

Dash 8 Series 200A: Increased speed/payload version of Series 100A with PW 123C engines. Transport Canada certification March 1995; first delivery 19 April 1995; discontinued.

Dash 8 Series 200B: As 200A, but with PW123D engines for full power at higher ambient temperatures; discontinued.

Dash 8 Q200: Increased speed/payload version of Q100; increased OEI capability and greater commonality with Series 300. Same airframe as Q100, but PW 123C/D engines give 30 kt (56 km/h; 35 mph) increase in cruising speed, allowing airlines to increase frequencies or operational radius. PW 123D engine offers full power at higher ambient temperatures for improved hot-and-high airfield performance. Initial Model 201 (PW123C engines) certified by Canadian DoT 24 August 1995 and by FAA 4 January 1996; Model 202 (PW123D) 9 March and 19 April 1995, respectively.

Detailed description applies to Q200 except where indicated.

Dash 8 Q300 and Q400: *described separately.*

Dash 8M and Triton: Special missions versions, previously promoted, including Canadian **CC-142** and US Air Force **E-9A**.

CUSTOMERS: By 31 January 2006, orders received for 299 Srs 100 subvariants and 98 Srs 200s, of which 299 and 96 respectively had then been delivered (including military Dash 8Ms). Refer to table in Dash 8 Q400 entry.

The US Department of Homeland Security's Bureau of Immigration and Customs Enforcement has ordered two Q200s in Maritime Patrol Aircraft (MPA) configuration. Prime contractor is ATK Mission Research of Fort Worth, Texas, whose Aircraft Systems Division will install mission equipment including Raytheon Sea Vue surveillance radar, L-3 Wescam MX-15 electro-optical/infrared sensor and an integrated sensors and display system (ISADS) following airframe modification from airliner configuration by Field Aviation Company, Inc of Toronto that will include upgraded navigation and communications suites, mission workstations and observation windows.

Bombardier Dash 8 Q100 of Ryukyu Air Commuter 1153778

COSTS: Unit cost approximately USD12 million (2000)

DESIGN FEATURES: T tail, swept fin with large dorsal fin. Wing has constant chord inboard section and tapered outer panels; thickness/chord ratio 18 per cent at root, 13 per cent at tip; dihedral 2° 30' on outer panels; inboard leading-edges drooped; 3° washout at wingtips.

FLYING CONTROLS: Conventional and power-assisted. Fixed tailplane; horn-balanced elevator with four tabs; mechanically actuated horn-balanced ailerons with inset tabs; hydraulically actuated roll spoilers/lift dumpers forward of each outer flap; two-segment serially hinged rudder, hydraulically actuated; yaw damper; stall strips on leading-edges outboard of engines; two-section slotted Fowler flaps. Digital AFCS.

STRUCTURE: Fuselage near-circular section, flush riveted and pressurised; adhesive bonded stringers and cutout reinforcements; wing leading-edge, radome, nose bay, wing/fuselage and wingtip fairings, dorsal fin, fin leading-edge, fin/tailplane fairings, tailplane leading-edges, elevator tips, flap shrouds, flap trailing-edges and other components of Kevlar and Nomex; wing has tip-to-tip torsion box Wheel doors of Kevlar and other composites.

LANDING GEAR: Retractable tricycle type, by Dowty Aerospace, with twin wheels on each unit. Steer-by-wire nose unit retracts forward, main units rearward into engine nacelles. Goodrich mainwheels and brakes; Hydro-Aire Mk 3 anti-skid system. Tyres 26.5×8.0-13 (12 ply) or high flotation H31×9.75-13 (10 ply) on main units; 18×5.5 (10 ply) or 22×6.50-10 (12 ply) on nose unit. Standard tyre pressures: main 9.03 bar (131 lb/sq in), nose 5.52 bar (80 lb/sq in). Low-pressure tyres optional, pressure 5.31 bar (77 lb/sq in) on main units, 3.31 bar (48 lb/sq in) on nose unit.

POWER PLANT: *Q100:* Two 1,491 kW (2,000 shp) Pratt & Whitney Canada PW 120A turboprops, driving Hamilton Sundstrand 14SF-7 four-blade constant-speed fully feathering aluminium/glass fibre propellers with reverse pitch, standard on basic weight version. Two 1,603 kW (2,150 shp) PW 121s optional on this version and standard on High Gross Weight version.

Q200: Two 1,603 kW (2,150 shp) PW 123C/D turboprops, driving Hamilton Sundstrand 14SF-23 propellers; PW 123C is flat-rated for full power at up to 26°C; PW 123D maintains same power at up to 45°C.

Standard usable fuel capacity (in-wing tanks) 3,160 litres (835 US gallons; 695 Imp gallons); optional auxiliary tank system increases this to 5,700 litres (1,506 US gallons; 1,254 Imp gallons). Pressure refuelling point in rear of starboard engine nacelle; overwing gravity point in each outer wing panel. Oil capacity 21 litres (5.5 US gallons; 4.6 Imp gallons) per engine.

ACCOMMODATION: Crew of two on flight deck, plus cabin attendant. Dual controls standard Standard commuter layout provides four-abreast seating, with central aisle, for 37 passengers at 79 cm (31 in) pitch, plus buffet, lavatory and large rear baggage compartment. Wardrobe at front of passenger cabin, in addition to overhead lockers and underseat stowage, provides additional carry-on baggage capacity. Alternative 39-passenger, passenger/cargo or corporate layouts available at customer's option. Movable bulkhead to facilitate conversion to mixed traffic. Port side airstair door at front for crew and passengers; large inward-opening port side door aft of wing for cargo loading. Emergency exit each side, in line with wing leading-edge, and opposite passenger door on starboard side. Entire accommodation pressurised and air conditioned.

SYSTEMS: Pressurisation system with maximum differential 0.38 bar (5.5 lb/sq in). Normal hydraulic installation comprises two independent systems, each having an engine-driven variable displacement pump and an electrically driven standby pump; accumulator and hand pump for emergency use. Electrical system DC power provided by two starter/generators, two transformer-rectifier units, and two Ni/Cd batteries. Variable frequency AC power provided by two engine-driven AC generators and three static inverters. Ground power receptacles in port side of nose (DC) and rear of starboard nacelle (AC). Rubber-boot de-icing of wing, tailplane and fin leading-edges and nacelle intakes by pneumatic system; electric de-icing of propeller blades, pitot static ports, stall warning transducer, engine intake adaptor and elevator horn leading-edge. APU optional. Simmonds fuel monitoring system.

AVIONICS: Rockwell Collins and Honeywell com/nav.

Comms: Dual Rockwell Collins VHF-22; single Mode C transponder. Avtech audio integrating system. Telephonics PA system.

Radar: Primus P660 colour weather radar.

Flight: Rockwell Collins DME-42, ADF-60A, Honeywell Mk VIII EAPNS, Honeywell SPZ-8000 dual-channel digital AFCS with integrated fail-operational flight director/autopilot system, dual digital air data system. Optional FMS and GPS.

Instrumentation: Honeywell EFIS, Rockwell Collins/Flight Dynamics HGS 2000 head-up guidance system for Cat. IIIa operation optional.

DIMENSIONS, EXTERNAL:

Wing span	25.91 m (85 ft 0 in)
Wing aspect ratio	12.4
Length overall	22.25 m (73 ft 0 in)
Fuselage max diameter	2.69 m (8 ft 10 in)
Height overall	7.49 m (24 ft 7 in)
Elevator span	7.92 m (26 ft 0 in)
Wheel track (c/l of shock-struts)	7.87 m (25 ft 10 in)
Wheelbase	7.95 m (26 ft 1 in)
Propeller diameter	3.96 m (13 ft 0 in)
Propeller ground clearance	0.94 m (3 ft 1 in)
Propeller fuselage clearance	0.76 m (2 ft 6 in)
Passenger/crew door (fwd, port):	
Height	1.66 m (5 ft 5½ in)
Width	0.76 m (2 ft 6 in)
Height to sill	1.09 m (3 ft 7 in)
Baggage door (rear, port): Height	1.52 m (5 ft 0 in)
Width	1.27 m (4 ft 2 in)
Height to sill	1.09 m (3 ft 7 in)

DIMENSIONS, INTERNAL:

Cabin (excl flight deck): Length	9.14 m (30 ft 0 in)
Max width	2.49 m (8 ft 2 in)
Width at floor	2.03 m (6 ft 8 in)
Max height	1.96 m (6 ft 5 in)
Floor area	23.60 m² (254.0 sq ft)
Volume	37.6 m³ (1,328 cu ft)
Baggage compartment volume	8.5 m³ (300 cu ft)

AREAS:

Wings, gross	54.35 m² (585.0 sq ft)
Ailerons (total)	1.12 m² (12.1 sq ft)
Fin	9.81 m² (105.6 sq ft)
Rudder	4.31 m² (46.4 sq ft)
Tailplane	8.97 m² (96.5 sq ft)
Elevators (total)	4.97 m² (53.5 sq ft)

WEIGHTS AND LOADINGS:

Operating weight empty: Q100	10,433 kg (23,000 lb)
Q200	10,501 kg (23,151 lb)
Max usable fuel: standard	2,576 kg (5,678 lb)
optional	4,647 kg (10,244 lb)
Max payload: Q100	4,082 kg (9,000 lb)
Q200	4,195 kg (9,249 lb)
Payload with max fuel: Q100	3,475 kg (7,662 lb)
Q200	3,389 kg (7,471 lb)
Max T-O weight: Q100	15,649 kg (34,500 lb)
Q100 HGW, Q200	16,465 kg (36,300 lb)
Max landing weight: Q100	15,377 kg (33,900 lb)
Q200	15,649 kg (34,500 lb)
Max zero-fuel weight:	
Q100, Q200 JAA	14,515 kg (32,000 lb)
Q200	14,696 kg (32,400 lb)
Max wing loading: Q100	287.9 kg/m² (58.97 lb/sq ft)
Q100 HGW, Q200	303.0 kg/m² (62.05 lb/sq ft)
Max power loading: Q100	5.25 kg/kW (8.63 lb/shp)
Q100 HGW, Q200	5.14 kg/kW (8.44 lb/shp)

PERFORMANCE (at 95% standard MTOW, except where indicated):

Max cruising speed: Q100	265 kt (491 km/h; 305 mph)
Q100 HGW	270 kt (500 km/h; 311 mph)
Q200	290 kt (537 km/h; 334 mph)
Stalling speed, flaps down: all	72 kt (134 km/h; 83 mph)
Max rate of climb at S/L: all	450 m (1,475 ft)/min
Max certified altitude: all	7,620 m (25,000 ft)
Service ceiling: Q100	4,503 m (14,775 ft)
Q100 HGW	5,105 m (16,750 ft)
Q200	4,938 m (16,200 ft)
FAR Pt 25 T-O field length:	
Q100 (PW 121)	991 m (3,250 ft)
Q200	1,000 m (3,280 ft)
FAR Pt 25 landing field length at max landing weight:	
Q100	785 m (2,575 ft)
Q200	780 m (2,560 ft)
Range with 37 passengers:	
Q100	1,020 n miles (1,889 km; 1,173 miles)
Q200	925 n miles (1,713 km; 1,064 miles)

OPERATIONAL NOISE LEVELS (FAR Pt 36 Stage 3 and ICAO Annex 16):

T-O	80.5 EPNdB
Sideline	85.6 EPNdB
Approach	94.7 EPNdB

BOMBARDIER DASH 8 Q300

TYPE: Twin-turboprop airliner.

PROGRAMME:

DEVELOPMENT MILESTONES

Announced	mid-85
Programme launched	Mar 86
First flight	15 May 87
Certification	14 Feb 89
First delivery (TimeAir)	27 Feb 89

Dash 8 Series 300 announced mid-1985 as stretch of Series 200; launched March 1986; first flight (modified Series 100 prototype C-GDNK) 15 May 1987; Canadian DoT certification 14 February 1989; first delivery (Time Air) 27 February 1989; FAA type approval 8 June 1989; now also certified in Antigua, Argentina, Australia, Austria, Bahamas, Brazil, Chile, China, Colombia, Egypt, Germany, Ireland, India, Indonesia, Italy, Jordan, Malaysia, Maldives, Mexico, Netherlands, New Zealand, Norway, Romania, Senegal, South Africa, Spain, Taiwan, Thailand, United Arab Emirates and Zambia. Low-noise Dash 8 Q (see Series 200 for details) became standard version from 1996. A Q300 delivered to Air Nippon on 6 March 2001 was the 600th Dash 8.

CURRENT VERSIONS: **Series 300, 300A, 300B and 300E:** Initial versions, described in 1998–99 and earlier editions.

Q300: Introduced 1998; differs from Q200 in having extended wingtips; 3.43 m (11 ft 3 in) two-plug fuselage extension giving standard seating for 50 at 81 cm (32 in) pitch or 56 at 74 cm (29 in) pitch, plus second cabin attendant; also larger galley, galley service door, additional wardrobe, larger lavatory, dual air conditioning packs and optional Turbomach T-40 APU; powered by 1,775 kW (2,380 shp) P&WC PW123s driving Hamilton Standard 14SF-23 four-blade propellers standard in basic version; 1,864 kW (2,500 shp) PW 123Bs optional in basic and standard in high gross weight (HGW) versions provide increased mechanical power for improved take-off performance in low and cold conditions; optional 1,775 kW (2,380 shp) PW 123Es provide 5 per cent increase in thermodynamic power up to 40°C (96°F) for improved hot-and-high performance; fuel capacity as Q200; tyre pressures increased (mainwheels 6.69 bar; 97 lb/sq in, nosewheels 4.14 bar; 60 lb/sq in). NVS system standard on all aircraft produced from second quarter 1996.

Available as Model 301, as initially certified, MTOW 18,642 kg (41,100 lb); Model 311 (combi) and Model 315 have same weight, but option of 18,996 kg (41,880 lb) or 19,504 kg (43,000 lb) with emergency exit modifications embodied; certified 31 July 1990/14 September 1990 for Model 311 and 2 June 1995/28 June 1995 for Model 315.

CUSTOMERS: Firm orders for 243 by 31 January 2006, of which 223 then delivered. Refer to table in Dash 8 Q400 entry.

COSTS: USD14.3 million (2000).

DIMENSIONS, EXTERNAL (As for Q200 except):

Wing span	27.43 m (90 ft 0 in)
Wing aspect ratio	13.4
Length overall	25.68 m (84 ft 3 in)
Wheelbase	10.01 m (32 ft 10 in)

DIMENSIONS, INTERNAL (As for Q200 except):

Cabin (excl flight deck): Length	12.65 m (41 ft 6 in)
Floor area	30.57 m² (329.0 sq ft)
Volume	52.0 m³ (1,838 cu ft)
Baggage compartment volume:	
with 50 passengers	9.1 m³ (320 cu ft)
with 56 passengers	7.9 m³ (280 cu ft)

AREAS:

Wings, gross	56.21 m² (605.0 sq ft)
Ailerons (total)	1.87 m² (20.18 sq ft)
Tail surfaces	as for Series 100A/200A

Dash 8 Q300 operated by Royal Wings of Jordan 1153752

WEIGHTS AND LOADINGS:

Operating weight empty: basic	11,812 kg (26,042 lb)
HGW	11,793 kg (26,000 lb)
Max usable fuel: standard	2,576 kg (5,679 lb)
optional	4,646 kg (10,243 lb)
Max payload: basic	5,061 kg (11,158 lb)
HGW	6,124 kg (13,501 lb)
Payload with max fuel	5,106 kg (11,257 lb)
Max T-O weight: basic	18,642 kg (41,100 lb)
HGW	19,504 kg (43,000 lb)
Max landing weight: basic	18,144 kg (40,000 lb)
HGW	19,050 kg (42,000 lb)
Max zero-fuel weight: basic	16,873 kg (37,200 lb)
HGW	17,917 kg (39,500 lb)
Max wing loading: basic	331.7 kg/m² (67.93 lb/sq ft)
HGW	347.0 kg/m² (71.07 lb/sq ft)
Max power loading: basic	5.25 kg/kW (8.63 lb/shp)
HGW	5.49 kg/kW (9.03 lb/shp)

PERFORMANCE (at 95% standard MTOW except where indicated):

Max cruising speed: basic	287 kt (532 km/h; 330 mph)
HGW	285 kt (528 km/h; 328 mph)
Stalling speed, flaps down	77 kt (141 km/h; 88 mph)
Max rate of climb at S/L	549 m (1,800 ft)/min
Rate of climb at S/L, OEI	137 m (450 ft)/min
Max certified altitude	7,620 m (25,000 ft)
Service ceiling, OEI: basic	4,145 m (13,600 ft)
HGW	3,734 m (12,250 ft)
FAR Pt 25 T-O field length at S/L, ISA, 15° flap:	
basic	1,097 m (3,600 ft)
HGW	1,055 m (3,460 ft)
FAR Pt 25 landing field length at max landing weight:	
basic	1,010 m (3,315 ft)
HGW	1,040 m (3,415 ft)
Range, HGW with 50 passengers:	
standard fuel	924 n miles (1,711 km; 1,063 miles)
auxiliary fuel	1,098 n miles (2,033 km; 1,263 miles)

OPERATIONAL NOISE LEVELS (FAR Pt 36):

T-O	80 EPNdB
Sideline	86.9 EPNdB
Approach	93.3 EPNdB

BOMBARDIER DASH 8 Q400

TYPE: Twin-turboprop airliner.

PROGRAMME:

DEVELOPMENT MILESTONES

Programme launched	Jun 96
First prototype material cut	Dec 96
Rolled out	21 Nov 97
First flight	31 Jan 98
Certification	14 Jun 99
First delivery (SAS Commuter)	20 Jan 00
Entered service (SAS Commuter)	7 Feb 00

Launched June 1995 as stretch of Series 300; component manufacture began December 1996; engine first test flown in January 1997, mounted on nose of Pratt & Whitney Canada Boeing 720B testbed; roll-out 21 November 1997, first flight (C-FJJA) 31 January 1998; five aircraft participated in the 1,900 hour, 1,400 sortie flight test programme, based at the Bombardier Flight Test Centre in Wichita, Kansas, leading to Transport Canada CAR 525 Amendment 86 certification on 14 June 1999, JAA approval in December 1999 and FAA FAR Pt 25 approval on 8 February 2000. JAA approval for steep approach (5.5° glideslope) operations at London City Airport achieved 11 October 2001. First delivery (OY-KCA) to SAS Commuter 20 January 2000, followed by service entry 7 February on Copenhagen, Denmark, to Poznan, Poland route. Q400 fleet flight time totalled 154,800 hours and 177,000 cycles by November 2001. Mitsubishi joined programme as risk-sharing partner in October 1995, with responsibility for design, development and manufacture of fuselage and tail sections.

Dash 8 Q400 flight deck 1043855

CURRENT VERSIONS: **Dash 8 Q400**: Standard version *as described*.

Dash 8 Q402-MR: Multirole air tanker/firebomber version. Two used aircraft (c/n 4040 and 4043), ordered in April 2004 By France's Securité Civile to replace a similar number of Fokker F-27s, will be modified by Cascade Aerospace of Abbotsford, British Columbia, to incorporate mission avionics including Thales four-tube EFIS, HUD, VHF/FM/AM radios, GPS, satcom and WEB-Tracking system; and provisions for an external, demountable, 10,000 litre (2,642 US gallon; 2,200 Imp gallon) Aero Union RAF-2 fire retardant tank and delivery system. In transport configuration the aircraft will accommodate up to 64 passengers each with 40 kg (88 lb) of baggage, or in all-cargo arrangement up to 9,000 kg (19,842 lb) of freight on 14 pallets. First delivery (callsign 'Pelican 73') to the Securité Civile base at Marseilles-Marignane was scheduled for June 2005, followed by the second aircraft ('Pelican 74') in October 2005.

CUSTOMERS: Total of 151 firm orders by 30 September 2005, at which time 104 had been delivered; refer to table. Launch customer was Great China Airlines (now UNI Airways), which ordered six (since cancelled) in February 1996. US launch customer Horizon Air, which ordered 15 with 15 options, in June 1999, took delivery of its first aircraft on 8 January 2001. First for Changan handed over 27 October 2000. British European (now Flybe) received first on 23 November 2001; Widerøe deliveries began 16 November 2001. Recent customers include FlyBE, which ordered 17, plus 20 options, on 23 April 2003, for

BOMBARDIER Q SERIES ORDERS AND DELIVERIES
(at 31 October 2006)

Customer	Variant	Ordered	Delivered	Backlog
Abu Dhabi Aviation	200	2	2	
AGES/Worldwide	300	6	6	
Air Atlantic	100	15	15	
AirBC	100	12	12	
	300	6	6	
Air Creebec	100	1	1	
Air Dolomiti	300	3	3	
Air Maldives	200	1	1	
Air Manitoba	100	1	1	
Air New Zealand	300	17	11	6
Air Nippon Network/ANK	300	5	5	
Air Niugini	200	2	2	
Air Nostrum	300	19	19	
Air Nova	100	6	6	
Air Ontario	100	30	30	
	300	6	6	
Air Senegal International	300	1	1	
Air Wisconsin	100	5	5	
	300	7	7	
Alberta Government	100	1	1	
All Nippon Airways	400	14	13	1
ALM	300	2	2	
Amakusa	100	1	1	
America West	100	12	12	
Ansett New Zealand	100	2	2	
Augsburg Airways	200	2	2	
	300	7	7	
	400	5	5	
Australian Airlines	100	4	4	
Austrian arrows[1]	100	11	11	
	300	19	19	
	400	10	10	
Aviaco/Furlong	300	4	4	
Avline	300	4	4	
BPX Colombia	200	1	1	
Bahamasair	300	3	3	
British European	200	3	3	
	300	4	4	
	400	4	4	
Brymon Airways	300	10	10	
BWIA	300	4	4	
Canadian DND	100	6	6	
Caribbean Aircraft Leasing	300	4	4	
CCAir	100	2	2	
Changan	400	3	3	
City Express	100	4	4	
Contact Air	100	2	2	
	300	4	4	
DAC Air	300	1	1	
Eastern Australia	200	1	1	
Eastern Metro Express	100	8	8	
Elveden Investments	100	3	3	
	300	1	1	
Fairways Corp	100	1	1	
Field Aviation	300	3	2	1
Flybe[3]	400	41	20	21
Frontier	400	10		10
GPA Jetprop	100	16	16	
	300	14	14	
Hamburg Airlines	100	2	2	
	300	2	2	
Horizon Air	100	21	21	
	200	28	28	
	400	31	18	13
Hydro-Quebec	400	2	2	
Interot	100	2	2	
	300	1	1	
JAL/Japan Air Commuter	400	11	9	2
Jeju Air	400	5	3	2
LADS	200	1	1	
LIAT	100	5	5	
	300	3	3	
Luxair	900	3		3
MarkAir	300	2	2	
Mesa Air	200	12	12	
Mexican Navy	200	1	1	
Midroc Aviation	200	2	2	
Mobil Oil	100	1	1	
National Air Support	300	3	-	3
National Jet	200	6	6	
	300	2	2	
Norfolk Airlines	100	1	1	
norOntair	100	2	2	
Northwest Airlines	100	25	25	
Norwegian CAA	100	1	1	
Oriental Air Bridge	200	2	2	
Palestinian	300	2	2	
Petroleum Air Service	300	5	4	1
Porter Airlines	400	10	2	8
Qantas Airways	200	1	1	
	300	16	16	
	400	7	7	
Rheintalflug	100	3	3	
	300	3	3	
Royal Wings	300	1	1	
Ryukyu Air Commuter	100		4	

Customer	Variant	Ordered	Delivered	Backlog
	300	1		1
SAS Commuter	400	28	28	
Saeaga Airlines	200	1	1	
	300	1	1	
Saudi Aramco	200	3	3	
Schreiner Airways	100	1	1	
	300	2	2	
Sojitz/JCAB	300	1	1	
South African Express	300	12	12	
	400	2	2	
Talair	100	2	2	
Tassili	400	4		4
TAVAJ	200	2	2	
Time Air	100	4	4	
	300	10	10	
Transport Canada	100	2	2	
Tyco	400	1	1	
UNI Airways[2]	100	4	4	
	200	1	1	
	300	14	14	
USAF/Sierra	100	2	2	
USAir Express	100	56	56	
	200	19	19	
US Immigration and Customs	200	3	3	
Wideroe's	100	15	15	
	300	4	4	
	400	3	3	
Zhejiang Airlines	300	2	2	
undisclosed	100	3	3	
	200	7	3	4
	300	6	5	1
	400	2	1	1
Totals		**843**	**761**	**82**

Notes: Operators with leased Dash 8 aircraft include, but are not necessarily restricted to, the following: Air Alliance, ERA, Lloyd Aviation, Lufthansa CityLine, Sabena, TABA. US Airways operators include Piedmont Airlines and Allegheny Commuter.

[1] Formerly Tyrolean.
[2] UNI Airways received initial aircraft when named Great China Airlines.
[3] British European (now Flybe) received initial aircraft when named Jersey European Airways.

SUMMARY

	Ordered	Delivered	Backlog
Series 100	299	299	
Series 200	101	97	4
Series 300	247	234	13
Series 400	196	131	65
Totals	**843**	**761**	**82**

delivery from second quarter 2003. All Nippon Airways, which ordered two in February 2004 and four in April 2004, bringing its firm order total to 12. Total fleet time at August 2004 stood at 428,520 hours and 476,107 cycles, with 99.4 per cent despatch reliability rate.

COSTS: Flybe order for 17 aircraft, valued at USD362 million (2003). Direct operating cost in US currency, based on 70 passengers over 200 n mile (370 km; 230 mile) stage length: in USA 7.40 cents per seat-mile; in Europe 7.50 cents per seat-kilometre (both 2003).

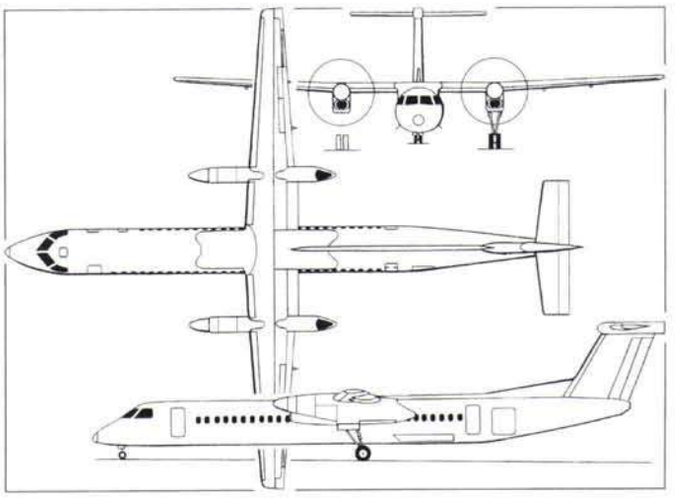
DESIGN FEATURES: Compared with Q300, fuselage stretched 6.83 m (22 ft 5 in) to seat up to 78. Other new features include engines; propeller; tapered inboard wing section increasing propeller/fuselage clearance to 1.09 m (3 ft 7 in); revised wing/fuselage fairings; ailerons, elevators and fin cap fairing; landing gear; baggage/service doors; upgraded avionics. Airframe designed for crack-free life of 40,000 flight hours/80,000 flight cycles and an economic life of 80,000 flight hours/160,000 flight cycles. Common type rating with Q100/200/300.

STRUCTURE: Generally as for Q100 and Q200. De Havilland Canada manufactures cockpit section and wing and performs final assembly; other participants in programme include AlliedSignal (electrical power system); Goodrich (brakes); Dowty Aerospace (propellers); Menasco (landing gear); Micro Technica (flap system); Mitsubishi (fuselage and tail sections); Parker Bertea Aerospace (hydraulics and fuel system); Pratt & Whitney Canada (engines); Sextant Avionique (avionics system); and Shorts (engine nacelles).

POWER PLANT: Two Pratt & Whitney Canada PW150A turboprops with FADEC, each flat rated to 3,781 kW (5,071 shp) at 37.4°C, driving Dowty R408 six-blade, slow-turning (1,020 rpm for T-O; 850 rpm cruise) composites propellers giving 15 per cent reduction in

Bombardier Dash 8 Q400 flown by Hydro-Québec 1043857

Dash 8 Q400 cabin interior 1043854



General arrangement of the Dash 8 Q400 ***(Paul Jackson)*** 1159828

T-O rpm and 6 to 19 per cent reduction in cruise rpm over Q100/300. Fuel capacity 6,526 litres (1,724 US gallons; 1,436 Imp gallons).

ACCOMMODATION: Variety of cabin configurations providing four-abreast seating, with central aisle, for 70 passengers at 84 cm (33 in) pitch, 74 passengers at 79 cm (31 in) pitch, 78 passengers at 76 cm (30 in), or two-class layout for 10 business class passengers at 86 cm (34 in) pitch and 62 economy class passengers at 79 cm (31 in); NVS system standard.

AVIONICS: Prime contractor, Thales.

Comms: Dual VHF nav/com and mode S transponder; solid-state FDR and cockpit voice recorder; ELT antenna. HF optional

Radar: Weather radar.

Flight: ADF and DME standard. Single or dual UNS-1E FMS, and dual radar altimeters. EGPWS, ACARS, QAR and vertical scale symbology, all optional.

Instrumentation: EFIS employs five 152 × 203 mm (6 × 8 in) LCDs. Optional Flight Dynamics HGS4100 (later HGS4200) head-up guidance system.

DIMENSIONS, EXTERNAL:

Wing span	28.42 m (93 ft 3 in)
Wing aspect ratio	12.8
Length overall	32.84 m (107 ft 9 in)
Fuselage max diameter	2.69 m (8 ft 10 in)
Height overall	8.36 m (27 ft 5 in)
Tailplane span	9.27 m (30 ft 5 in)
Wheel track	8.79 m (28 ft 10 in)
Wheelbase	13.94 m (45 ft 9 in)
Propeller diameter	4.11 m (13 ft 6 in)
Propeller ground clearance	0.97 m (3 ft 2 in)
Propeller fuselage clearance	1.10 m (3 ft 7¼ in)
Passenger/crew door (port, fwd):	
Height	1.66 m (5 ft 5½ in)
Width	0.76 m (2 ft 6 in)
Height to sill	1.22 m (4 ft 0 in)
Passenger/crew door (port, rear):	
Height	1.73 m (5 ft 8 in)
Width	0.71 m (2 ft 4 in)
Height to sill	1.52 m (5 ft 0 in)
Baggage door (port, rear): Height	1.55 m (5 ft 1 in)
Width	1.27 m (4 ft 2 in)
Height to sill	1.55 m (5 ft 1 in)
Baggage door (stbd, fwd): Height	1.45 m (4 ft 9 in)
Width	0.71 m (2 ft 4 in)
Height to sill	1.17 m (3 ft 10 in)
Service door (stbd, aft): Height	1.45 m (4 ft 9 in)
Width	0.71 m (2 ft 4 in)
Height to sill	1.52 m (5 ft 0 in)

DIMENSIONS, INTERNAL:

Cabin (excl flight deck): Length	18.80 m (61 ft 8 in)
Max width	2.51 m (8 ft 3 in)
Max height	1.95 m (6 ft 5 in)
Floor area	38.2 m² (411 sq ft)
Volume	77.6 m³ (2,740 cu ft)
Baggage volume: fwd	2.58 m³ (91.0 cu ft)
aft	11.6 m³ (411 cu ft)
total	14.2 m³ (502 cu ft)

AREAS:

Wings, gross	63.08 m² (679.0 sq ft)
Ailerons (total)	1.87 m² (20.18 sq ft)
Vertical tail surfaces (total)	14.12 m² (152.0 sq ft)
Horizontal tail surfaces (total)	16.72 m² (180.0 sq ft)

WEIGHTS AND LOADINGS:

Operating weight empty	17,186 kg (37,888 lb)
Max payload	8,670 kg (19,113 lb)
Payload with max fuel	6,831 kg (15,059 lb)
Max T-O weight: basic	27,986 kg (61,700 lb)
intermediate	28,998 kg (63,930 lb)
HGW	29,256 kg (64,500 lb)
Max landing weight	28,009 kg (61,750 lb)
Max zero-fuel weight	25,855 kg (57,000 lb)
Max wing loading: basic	443.7 kg/m² (90.87 lb/sq ft)
intermediate	459.7 kg/m² (94.15 lb/sq ft)
HGW	463.8 kg/m² (94.99 lb/sq ft)
Max power loading: basic	3.70 kg/kW (6.08 lb/shp)
intermediate	3.84 kg/kW (6.30 lb/shp)
HGW	3.87 kg/kW (6.36 lb/shp)

PERFORMANCE (at 95% of standard MTOW, except where indicated):

Max cruising speed	360 kt (667 km/h; 414 mph)
Max certified altitude	7,620 m (25,000 ft)
Service ceiling, OEI	5,334 m (17,500 ft)
FAR T-O field length at S/L, MTOW	1,300 m (4,265 ft)
FAR landing field length at S/L, MLW	1,287 m (4,221 ft)
Max range, 70 passengers, IFR reserves	1,360 n miles (2,518 km; 1,565 miles)

OPERATIONAL NOISE LEVELS (estimated, FAR Pt 36):

T-O	78.3 EPNdB
Sideline	84 EPNdB
Approach	94.3 EPNdB

BOMBARDIER 415

US marketing name: SuperScooper
Engineering designation: CL-215-6B11

TYPE: Twin-turboprop amphibian.

PROGRAMME: Introduced as product follow-on to piston-engined Canadair CL-215; given new designation Canadair 415 in 1991 to distinguish new production turboprop model from CL-215T retrofit, but engineering designation retained and new-build turboprop versions are CL-215-6B11. Launched officially 16 October 1991 with firm orders from France and (August 1992) Québec; first flight (C-GSCT) 6 December 1993, although preceded by initial CL-215T conversion (C-FASE), flown on 8 June 1989. Canadian certification 24 June 1994 in Restricted and Utility categories, FAA approval 14 October 1994 in Restricted category, RAI (Italy) approval 27 October 1994 in Restricted category. Fleet had achieved 50,000 flying hours and 190,000 scooping sorties by 31 March 2001. Final assembly relocated to North Bay, Ontario, in November 1998. Production suspended in October 2001 pending new orders (but see 415MP entry below). New designation Bombardier 415 adopted in February 2002.

CURRENT VERSIONS: Standard **415** and first production units are in **firefighting** configuration.

415MP: Multipurpose version incorporating FLIR, SLAR and nose-mounted search radar for missions such as search and rescue, coastal and border patrol, drug interdiction and environmental monitoring, while retaining firefighting capability. First flight (C-GHVX; 55th aircraft, destined for Greece) 6 March 2002, preceding a 200-hour flight test programme, and was delivered in late March 2004.

415MP can be modified for **maritime, SAR, utility transport, drug interdiction** and **special missions** .

415GR: Ordered by Greece, January 1999; based on 415MP; increased weights; boat handling and cargo hoisting provisions. Two (plus an optional third) will be configured for combat search-and-rescue (C-SAR) role, for which, during 2000, SAAB Nyge Aero of Sweden was awarded a three-year contract to install MSS 5000 mission equipment including SLAR (each side), wing-mounted FLIR Systems SeaFLIR, nose-mounted Honeywell Primus WX 660 weather/search radar, digital cameras, autopilot and provision for Have Quick secure radios and rescue beacon receivers. The aircraft will also have an enlarged cargo door to facilitate deployment of an inflatable rescue boat. The Hellenic Air Force C-SAR aircraft will be based at Elefsis AB; delivery was due in May 2003.

CUSTOMERS: See table. First French Canadair 415 delivered to CEV experimental unit 8 February 1995, but trials revealed need for modifications and acceptance delayed until 13 June 1995; deliveries completed June 1997. Ontario provincial government announced order for nine on 2 April 1998. Government of Malaysia expressed interest in acquiring two following demonstration flights in February 2002. Total 59 built by October 2001 production suspension; 60th registered in January 2002, and 62nd registered August 2003 and delivered (I-DPCH to Italy) early 2004. None in 2004. One delivered (to Italy) from stock in 2005; 63rd aircraft registered December 2005.

BOMBARDIER 415 CUSTOMERS
(at June 2004)

Customer	Qty	First aircraft	Delivered
Canada: Ontario province	9	C-GOGD	29 Apr 98
Québec govmt	8	C-GQBA	Jul 95
Bombardier (stock)	2	C-GILN	
Croatia[1]	4	9A-CAG	Feb 97
France: Sécurité Civile	12	F-ZBFS	8 Feb 95
Greek govmt[2]	10	2039	Jan 99
Italy: Protezione Civile[3]	18	I-DPCD	27 Jan 95
Total	**63**		

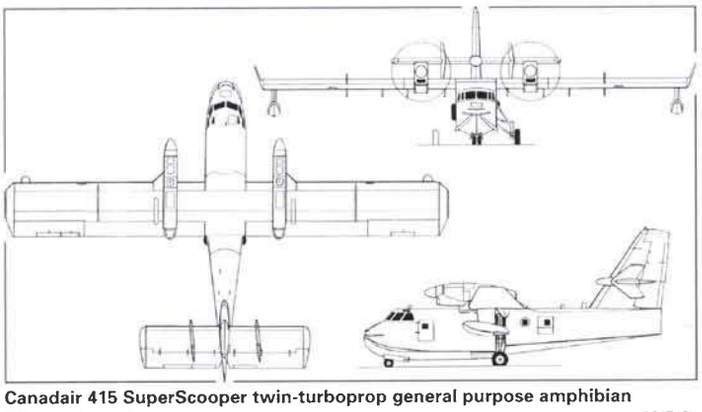
[1] Requirement for six
[2] Plus five options; order total includes two 415MP
[3] Order for two in February 2004 includes option to convert one to 415MP

COSTS: Approximately USD23 million in firefighting configuration (2000).

DESIGN FEATURES: Retains well-proven basic airframe of piston-engined CL-215 (thick wing with zero dihedral and 2° incidence; row of vortex generators on each wing outboard of fence; long stall strip inboard of starboard fence; leading-edge strakes and fences beside

Bombardier 415 twin-turboprop amphibian

1153748



Canadair 415 SuperScooper twin-turboprop general purpose amphibian
(Dennis Punnett)

0507126

engine nacelles; water scoops behind planing step; anti-spray channels in planing bottom chine) but incorporates upgrading modifications and improvements including higher operating weights for increased firefighting productivity; pressure refuelling; wing endplates for lateral stability; finlets and tailplane/fin bullet to recover longitudinal and directional stability affected by relocated thrust line, increased power and new propellers; powered rudder, ailerons and elevators; new electrical system; new 'glass' cockpit with air conditioning; enlarged four-tank firefighting drop system.

FLYING CONTROLS: Conventional and power-assisted. Hydraulically actuated ailerons, elevators and rudder, standard; manual reversion in event of hydraulic failure; geared tab in each aileron, spring tab in rudder and each elevator, plus trim tab in port aileron and port elevator. Hydraulically operated single-slotted flaps, each supported by four external hinges.

STRUCTURE: No-dihedral, no-twist high wing, of constant chord; one-piece structure with two conventional spars, extruded spanwise stringers and interspar ribs and aluminium alloy skins. All-metal, fail-safe, single-step boat-hull fuselage with numerous watertight compartments. Tail surfaces of aluminium alloy sheet and extrusions, with honeycomb panels on control surfaces.

LANDING GEAR: Hydraulically retractable tricycle type. Self-centring twin-wheel nose unit retracts rearward into hull and is fully enclosed by conformal doors. Nosewheel steering standard. Main gear legs retract into wells in sides of hull. Plate mounted on each main gear assembly encloses bottom of wheel well. Mainwheel tyres 15.00-16 (16 ply) tubeless, pressure 5.31 bar (77 lb/sq in); nosewheel tyres 6.50-10 (10 ply) tubed, pressure 6.55 bar (95 lb/sq in). Hydraulic disc brakes. Non-retractable stabilising floats, each carried near wingtip on pylon cantilevered from wing box structure, with breakaway provision.

POWER PLANT: Two 1,775 kW (2,380 shp) Pratt & Whitney Canada PW123AF turboprops, on damage-tolerant mounts capable of withstanding a breach of the compressor/turbine casing, each driving a Hamilton Sundstrand 14SF-19 four-blade constant-speed fully feathering reversible-pitch propeller. Two fuel tanks, each of eight identical flexible cells, in wing spar box, with total usable capacity of 5,796 litres (1,531 US gallons; 1,275 Imp gallons). Single-point pressure refuelling (rear fuselage, starboard side), plus gravity points in wing upper surface.

ACCOMMODATION: Normal crew of two side by side on flight deck, with dual controls. Additional station in maritime patrol/SAR versions for third cockpit member, mission specialist and two observers. For water bomber cabin installation, see Equipment paragraph. Combi layout offers cargo at front, full firefighting capability, plus 11 seats at rear. Other quick-change interiors available for utility/paratroop (up to 14 troop-type folding canvas seats in cabin) or other special missions according to customer's requirements. Flush doors to main cabin on port side of fuselage forward and aft of wings. Optional aft cargo door, height 1.33 m (4 ft 4½ in), width 1.46 m (4 ft 9½ in). Emergency exit on starboard side aft of wing trailing-edge. Crew emergency hatch in flight deck roof on starboard side. Mooring hatch in upper surface of nose. Provision for additional cabin windows.

SYSTEMS: Vapour cycle air conditioning system and combustion heater. Hydraulic system, pressure 207 bar (3,000 lb/sq in), utilises two engine-driven pumps (maximum flow rate 45.5 litres; 12.0 US gallons; 10.0 Imp gallons/min) to actuate nosewheel steering, landing gear, flaps, water drop doors, pickup probes, flight controls, main gear unlocking and wheel brakes. Hydraulic fluid (MIL-H-83282) in air/oil reservoir slightly pressurised by engine bleed air. Electrically driven third pump provides hydraulic power for emergency actuation of landing gear and brakes and closure of water doors. Electrical system includes two 800 VA 115 V 400 Hz static inverters, two 28 V 400 A DC engine-driven starter/generators and two 40 Ah Ni/Cd batteries. Pneumatic/electric intake de-icing system; airframe ice protection system optional.

AVIONICS: Dual Honeywell Primus 2 digital integrated VHF nav/com.

Comms: Global Wulfsberg VHF/UHF/AM/FM and Rockwell Collins HF radios with central control heads, ELT and dual transponders.

Radar: Search/weather radar optional.

Flight: Dual ADF, VOR/ILS, marker beacon receivers and single DME.

Instrumentation: Honeywell EDZ-605 EFIS with three-tube Integrated Instrument Display System for EADI and EHSI; dual Litef/Honeywell AHRS, dual air data computers, Honeywell radio altimeter.

EQUIPMENT (firefighter): Four integral water tanks in main fuselage compartment, near CG (combined capacity 6,137 litres; 1,621 US gallons; 1,350 Imp gallons), plus eight inward-facing seats in forward cabin. Tanks filled by two hydraulically actuated scoops aft of hull step, fillable also on ground by hose adaptor on each side of fuselage. Four independently openable water doors in hull bottom. Onboard foam concentrate reservoirs (capacity 680 kg; 1,500 lb) and mixing system. Improved drop pattern and drop door sequencing compared with CL-215. Optional spray kit can be coupled with firefighting tanks for large-scale spraying of oil dispersants and insecticides. In a typical firefighting mission, with a water source 6 n miles (11 km; 7 miles) from the fire, aircraft can remain on station for 3 hours, dropping 55,267 litres (14,600 US gallons; 12,157 Imp gallons)/h. Water tanks can be scoop-filled completely (ISA at S/L, zero wind) in 12 seconds over a water distance of 1,341 m (4,400 ft); partial water loads can be scooped on smaller bodies of water. Minimum safe water depth for scooping is only 1.40 m (4 ft 7 in).

EQUIPMENT (other versions): Stretcher kits, passenger or troop seats, cargo tiedowns, searchlight and other equipment according to mission and customer requirements. Bombardier 415 can be equipped with maritime surveillance radar and electro-optical sensors, precision navigation and communications equipment and autopilot.

DIMENSIONS, EXTERNAL (A: 415; B: 415MP):

Wing span	28.63 m (93 ft 11 in)
Wing chord, constant	3.54 m (11 ft 7½ in)
Wing aspect ratio	8.2
Length overall: A	19.82 m (65 ft 0½ in)
B	20.29 m (66 ft 7 in)
Beam (max)	2.59 m (8 ft 6 in)
Length/beam ratio	7.5
Height overall: on land	8.98 m (29 ft 5½ in)
on water	6.96 m (22 ft 10 in)
Draught: wheels up	1.12 m (3 ft 8 in)
wheels down	2.03 m (6 ft 8 in)
Tailplane span	10.97 m (36 ft 0 in)
Wheel track	5.25 m (17 ft 2¾ in)
Wheelbase	7.23 m (23 ft 8½ in)
Propeller diameter	3.97 m (13 ft 0¼ in)
Propeller fuselage clearance	0.59 m (1 ft 11¼ in)
Propeller water clearance	1.16 m (3 ft 9¾ in)
Propeller ground clearance	2.77 m (9 ft 1 in)
Forward door: Height	1.37 m (4 ft 6 in)[1]
Width	1.03 m (3 ft 4 in)
Height to sill	1.68 m (5 ft 6 in)
Rear door: Height	1.12 m (3 ft 8 in)
Width	1.02 m (3 ft 4 in)
Height to sill	1.83 m (6 ft 0 in)
Optional large rear cargo door:	
Height	1.12 m (3 ft 8 in)
Width	1.47 m (4 ft 10 in)
Height to sill	1.83 m (6 ft 0 in)
Water drop door: Length	1.60 m (5 ft 3 in)
Width	0.28 m (11 in)
Emergency exit: Height	0.91 m (3 ft 0 in)
Width	0.51 m (1 ft 8 in)

[1] *incl 25 cm (10 in) removable sill*

DIMENSIONS, INTERNAL:
Cabin, excl flight deck: Length 9.40 m (30 ft 10 in)
Max width 2.39 m (7 ft 10 in)
Max height 1.90 m (6 ft 3 in)
Floor area 19.7 m² (212 sq ft)
Volume 35.6 m³ (1,257 cu ft)
AREAS:
Wings, gross 100.33 m² (1,080.0 sq ft)
Ailerons (total) 8.05 m² (86.60 sq ft)
Flaps (total) 22.39 m² (241.00 sq ft)
Fin 11.22 m² (120.75 sq ft)
Rudder, incl tabs 6.02 m² (64.75 sq ft)
Tailplane 20.55 m² (221.20 sq ft)
Elevators (total, incl tabs) 7.88 m² (84.80 sq ft)
WEIGHTS AND LOADINGS:
Typical operating weight empty: A 13,608 kg (30,000 lb)
B 14,016 kg (30,900 lb)
Max internal fuel weight: A, B 4,649 kg (10,250 lb)
Max payload: A 6,123 kg (13,500 lb)
B 2,495 kg (5,500 lb)
Max ramp weight: A (land) 19,958 kg (44,000 lb)
A (water), B 17,236 kg (38,000 lb)
Max T-O weight: A (land, disposable load) 19,890 kg (43,850 lb)
(non-disposable load) 18,597 kg (41,000 lb)
B (land) 18,597 kg (41,000 lb)
B (water) 17,168 kg (37,850 lb)
Max touchdown weight for water scooping:
A 16,420 kg (36,200 lb)
Max flying weight after water scooping:
A 21,319 kg (47,000 lb)
Max landing weight:
A, B (land and water) 16,783 kg (37,000 lb)
Max zero-fuel weight: A 19,504 kg (43,000 lb)
B 16,511 kg (36,400 lb)
Max wing loading:
A: (land, disposable load) 198.2 kg/m² (40.60 lb/sq ft)
(non-disposable load) 185.4 kg/m² (37.96 lb/sq ft)
B (land) 185.4 kg/m² (37.96 lb/sq ft)
B (water) 171.1 kg/m² (35.05 lb/sq ft)
Max power loading:
A (land, disposable load) 5.61 kg/kW (9.21 lb/shp)
(non-disposable load) 5.24 kg/kW (8.61 lb/shp)
B (land) 5.24 kg/kW (8.61 lb/shp)
B (water) 4.84 kg/kW (7.95 lb/shp)
PERFORMANCE (at weights shown):
Max cruising speed at FL100 197 kt (365 km/h; 227 mph)
Long-range cruising speed at FL100 150 kt (278 km/h; 173 mph)
Patrol speed at S/L, AUW of 14,741 kg (32,500 lb) 130 kt (241 km/h; 150 mph)
Stalling speed: 15° flap, AUW of 21,319 kg (47,000 lb) 80 kt (149 km/h; 93 mph)
Max rate of climb at S/L: A, at 21,319 kg (47,000 lb) 396 m (1,300 ft)/min
B at 18,597 kg (41,000 lb) 488 m (1,600 ft)/min
T-O distance at S/L, ISA:
A: (land, disposable load) 844 m (2,770 ft)
(land, non-disposable load) 783 m (2,570 ft)
(water) 808 m (2,650 ft)
B: (land, AUW of 19,890 kg)/(43,850 lb) 823 m (2,700 ft)
(water, AUW of 17,168 kg)/(37,850 lb) 814 m (2,670 ft)
Landing distance at S/L, ISA:
B: land, AUW of 16,783 kg (37,000 lb) 671 m (2,200 ft)
water, AUW of 16,783 kg (37,000 lb) 665 m (2,180 ft)
Minimum water depth required 1.83 m (6 ft 0 in)
Scooping distance at S/L, ISA (incl safe clearance heights) 1,341 m (4,400 ft)
Scooping time to refill tanks 12 s
Typical time on station 3 h
Ferry range: A 1,310 n miles (2,426 km; 1,507 miles)
Patrol range: B 1,000 n miles (1,852 km; 1,150 miles)
Design *g* limits (15° flap) +3.25/−1

CLASS

CANADIAN LIGHT AIRCRAFT SALES AND SERVICES INC

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Formed in 1994, CLASS took over production of the previously named Cadi from designer Jean Edues Potvin and has recently expanded the range to provide six versions of the Bush Caddy as well as introducing the Kestrel in 2003, although this no longer appears to be marketed.

CLASS BUSH CADDY

TYPE: Four-seat kitbuilt.
PROGRAMME: Designed by Jean Edues Potvin, the original Cadi was first flown in first half of 1993. Kits of the refined Cadi were marketed from 1994. The re-engineered Bush Caddy appeared in 2000. Several new versions have been added to the range since then, using both Rotax and Lycoming power plants. In 2003, the company was developing a 149 kW (200 hp) Jabiru 5100 installation.
CURRENT VERSIONS: **R80:** Smallest aircraft in range and classified as ultralight in USA, Canada and Australia; two seats; designed for engines up to 59.7 kW (80 hp). Voyageur option can be converted from tailwheel to tricycle layout in a few hours, as hardpoints for both variants are provided as standard. 'R' in designation indicates Rotax engine. Sole version available also as flyaway, latter being offered as **Bush Caddy Sport** to US LSA rules, including Stratomaster 'glass cockpit' and Rotax 912S or Jabiru 3300 engine, at USD72,500 (2006).
Description below refers to R80, unless otherwise stated.
R60: Ultralight version of the above, intended for European market; due for launch during 2003, but no sales known.
R120: Engines in the 48.5 to 89.5 kW (65 to 120 hp) range; two seats. Introduced at AirVenture, Oshkosh, July 2001. Voyageur option available as for R80.
L160: Accepts engines up to 119 kW (160 hp). Seats two-plus-one. 'L' in designation indicates Lycoming engine.
L162: Two-plus-two version of L160. Three, including company prototype (displayed partly complete at AirVenture, July 2005), under construction by mid-2005. First customer's aircraft is non-standard, with 186 kW (250 hp) Subaru engine and 1,134 kg (2,500 lb) MTOW; extension to 1,270 kg (2,800 lb) being planned.
L164: Four-seat version, with 134 kW (180 hp) engine. Displayed statically at AirVenture 2001. Prototype (C-GJDK) first flew 8 September 2001. Two sub-variants: L164B passenger version and L164C 'cargo' version with extra door and removable bench seat rather than fixed seating.

CLASS Bush Caddy on Full Lotus floats 1037950

Rotax-powered Bush Caddy R120 1037951

CUSTOMERS: Over 110 of all versions sold by end 2005 of which more than 75 were then flying, including 25 in Canada.
COSTS: Basic kit costs (excluding engine, propeller and internal finishing): R80, USD17,878; R120, USD19,840; L160 USD23,359; L162, USD28,645; L164, USD31,251; quick build kits range from USD35,565 to USD48,618, according to version.
DESIGN FEATURES: Conventional lightplane; high, constant chord wing braced by V struts each side; sweptback cantilever tail surfaces.
Kit includes many preformed and welded parts. Quoted build time 1,000 hours. Fast-build kits are available in which wings and fuselage internal structures are complete and need only covering, which reduces quoted building time to 300 hours.
FLYING CONTROLS: Conventional and manual. No horn balances on control surfaces. Flaps standard on L160 and higher-powered versions and optional for R120.
STRUCTURE: All-metal construction throughout, two-spar wing has a modified Piper Super Cub aerofoil with flat lower surface and has twin 7.6 cm (3 in) extruded aluminium bracing struts and composites wingtips. Monocoque fuselage contains 6061-T6 bulkheads covered with sheet aluminium and has a composites cowling.
LANDING GEAR: Tailwheel type, fixed; R120 has quick-change option from tailwheel to tricycle. Two (optionally faired-in) side Vs hinged to lower longerons, plus half-axles sprung under centreline with bungee cord. Optional floats, amphibious floats and skis can be fitted. Cleveland mainwheels are 7.00–6, with McCreary tyres and Matco hydraulic brakes. Castoring tailwheel, size 2.50–4.
POWER PLANT: *R80:* One 59.6 kW (79.9 hp) Rotax 912 UL driving a two-blade Sensenich metal fixed-pitch propeller; options include 73.5 kW (98.6 hp) Rotax 912 ULS, 74.6 kW (100 hp) Jabiru 3300 and 84.6 kW (113.4 hp) Rotax 914 UL, and two- and three-blade Warp Drive propellers. Fuel capacity 91 litres (24.0 US gallons; 20.0 Imp gallons) in two wingroot tanks of welded metal. Sport version capacity optionally 136 litres (36.0 US gallons; 30.0 Imp gallons).

R120: 73.5 kW (98.6 hp) Rotax 912 ULS standard; engines up to 89.5 kW (120 hp) optional. Standard fuel capacity 100 litres (26.4 US gallons; 22.0 Imp gallons); optional increase to 155 litres (40.8 US gallons; 34.0 Imp gallons).

L160 and L162: One 119 kW (160 hp) Lycoming O-320 standard. Fuel capacity 173 litres (45.6 US gallons; 38.0 Imp gallons) in L160 and 227 litres (60.0 US gallons; 50.0 Imp gallons) in L162.

L164: One 134 kW (180 hp) Lycoming IO-360, driving Sensenich 76EM8 propeller, standard. At least one (C-GFXR) with 185 kW (248 hp) LOM M337C six-cylinder in-line engine. Fuel capacity as L160/L162.

ACCOMMODATION: Pilot and passenger in fully adjustable seats in R80 and R120; bench seat in rear of L160 and L162 for one and two extra passengers, respectively; L164 is full four-seat version and offers optional third door on port side for access to baggage area behind seats. Wraparound Lexan windscreen. Baggage locker behind cabin, with door on port side.

DIMENSIONS, EXTERNAL:

Wing span: R80, R120	9.75 m (32 ft 0 in)
L160, L162, L164	10.97 m (36 ft 0 in)
Wing chord, constant: all	1.60 m (5 ft 3 in)
Wing aspect ratio: R80, R120	6.1
L160, L162, L164	6.9
Length overall: R80, R120	6.73 m (22 ft 1 in)
L160, L162	7.26 m (23 ft 10 in)
L164	7.75 m (25 ft 5 in)
Height: R80, R120	2.01 m (6 ft 7¼ in)
L160	2.29 m (7 ft 6 in)
L164	2.32 m (7 ft 7¼ in)
Tailplane span	2.62 m (8 ft 7 in)
Wheel track	2.13 m (7 ft 0 in)
Wheelbase	4.44 m (14 ft 7 in)

DIMENSIONS, INTERNAL:

Cabin: Max width: R80, R120, L160	1.12 m (3 ft 8 in)
L164	1.19 m (3 ft 11 in)
Max height: R80, R120	1.12 m (3 ft 8 in)
L160	1.17 m (3 ft 10 in)
L164	1.33 m (4 ft 4½ in)
Baggage hold volume	0.42 m³ (15.0 cu ft)

AREAS:

Wings, gross: R80, R120	15.61 m² (168.0 sq ft)
L160, L162, L164	17.56 m² (189.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: R80	294 kg (648 lb)
Sport	308 kg (680 lb)
R120	373 kg (823 lb)
L160	498 kg (1,098 lb)
L164	562 kg (1,239 lb)
Baggage capacity	34 kg (75 lb)
Max T-O weight: R80, Sport	559 kg (1,232 lb)
R120	771 kg (1,700 lb)
L160, L162	998 kg (2,200 lb)
L164	1,134 kg (2,500 lb)
Max wing loading: R80	35.8 kg/m² (7.33 lb/sq ft)
R120	49.4 kg/m² (10.11 lb/sq ft)
L160, L162	56.8 kg/m² (11.64 lb/sq ft)
L164	64.6 kg/m² (13.23 lb/sq ft)
Max power loading: R80	9.38 kg/kW (15.42 lb/hp)
Sport	7.50 kg/kW (12.32 lb/hp)
R120	10.49 kg/kW (17.23 lb/hp)
L160, L162	8.37 kg/kW (13.75 lb/hp)
L164	8.45 kg/kW (13.89 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE):	113 kt (209 km/h; 130 mph)
L160	130 kt (241 km/h; 150 mph)
L164	139 kt (257 km/h; 160 mph)
Cruising speed at 75% power: R80	83 kt (153 km/h; 95 mph)
Sport	91 kt (169 km/h; 105 mph)
R120	87 kt (161 km/h; 100 mph)
L160	100 kt (185 km/h; 115 mph)
L164	117 kt (217 km/h; 135 mph)
Econ cruising speed at 60% power: R80, R120	78 kt (145 km/h; 90 mph)
L160	91 kt (169 km/h; 105 mph)
L164	104 kt (193 km/h; 120 mph)
Stalling speed, power off: R80	30 kt (55 km/h; 34 mph)
no flaps:	
R120, L160, L162, L164	37 kt (68 km/h; 42 mph)
flaps down: R120	28 kt (52 km/h; 32 mph)
L160, L162, L164	33 kt (62 km/h; 38 mph)
Max rate of climb at S/L: R80, L160	259 m (850 ft)/min
R120	274 m (900 ft)/min
L164	366 m (1,200 ft)/min
Service ceiling: all	3,960 m (13,000 ft)
T-O run: R80, Sport	61 m (200 ft)
R120	107 m (350 ft)
L160	110 m (360 ft)
L164	76 m (250 ft)
Landing run: R80	107 m (350 ft)
R120, L160	153 m (500 ft)
L164	183 m (600 ft)
Range: R80	450 n miles (833 km; 517 miles)
R120	500 n miles (926 km; 575 miles)
L160	625 n miles (1,157 km; 719 miles)
L164	800 n miles (1,481 km; 921 miles)
Endurance	more than 4 h
g limits: R80, R120	+6.2/–4.2
L160, L162, L164	+5.4/–3.2

CLASS KESTREL

TYPE: Side-by-side ultralight/kitbuilt; two-seat lightplane.

PROGRAMME: Epervier Aviation SA of Gosselies, Belgium, flew prototype Epervier (Sparrowhawk) in September 1990, initially as ultralight (ULM), registered OO-964; then as lightplane (ATL) OO-EPV with 11.15 m (36 ft 7 in) wingspan. One production Epervier ULM (OO-EPB) built before project terminated.

Rights acquired by CLASS in April 2003, together with OO-EPB and five incomplete airframes; renamed Kestrel and marketing began immediately to ensure early 2004 launch, but with changes dictated by feedback from potential customers; Rotax 912S or Jabiru 3300 engine; composites wing covering replacing fabric; was due to offer kit version in early 2005. Neither target was achieved; programme in suspension by mid-2005, pending selection of offshore production centre. No evidence of promotion in early 2006. Aircraft to have all-metal wing.

CLASS Kestrel static demonstrator, the former Epervier ULM *(Paul Jackson)*
1042718

CREATIVE FLIGHT

CREATIVE FLIGHT INC

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Factory floor area 929 m² (10,000 sq ft). Workforce in early 2006 stood at between five and eight.

CREATIVE FLIGHT AEROCAT

TYPE: Side-by-side kitbuilt; four-seat kitbuilt twin.

PROGRAMME: Project began 1997. Launched at AirVenture, Oshkosh, July 2000. Development prototype (C-GYCC) first flown in single-engine form 15 July 2001; exhibited at Oshkosh 24 to 30 July 2001. Reconfigured in twin-engine form and flown on 5 September 2002; first flight with floats attached (from land) 15 October 2002; water taxying trials begun 17 October 2002; total flight time stood at 40 hours in August 2003. First kit deliveries scheduled for late 2006.

CURRENT VERSIONS: **Aerocat-SR:** Single-engine version.
Aerocat-SRX: Floatplane/amphibian version of SR.
Aerocat-TR: Twin-engined version.
Aerocat-TRX: Floatplane/amphibian version of TR.

CUSTOMERS: Deposits paid for eight kits up to end of 2005.

COSTS: Basic kit, less engine, propeller, avionics, upholstery and finishing materials " in USD100,000 range" (2006).

DESIGN FEATURES: Designation indicates 'multi platform aircraft'. Kitplane meeting '51 per cent' rule for amateur construction; easily completed in single- or twin-engine configuration and with amphibian and seaplane landing gear.

Cabin pod, with broad outward visibility, mounted on cranked wings of two-stage taper and with sweptback tips. Engine(s) on arched cabane with central, vertical reinforcement strut. Twin tailbooms and high tailplane; forward boom sections contain main landing gear and attachment points for floats with cutouts for mainwheels when in amphibian mode. Production version has improved cabin aerodynamics including blunter nose reducing length by 15 cm (6 in) from prototype's 8.23 m (27 ft 0 in).

Wing section NLF-0215 (mod); dihedral 3°; twist –4°.

FLYING CONTROLS: Conventional and manual. Horn balances on elevator and rudders; flight-adjustable tab on starboard rudder and port aileron. Fowler flaps, max deflection 40°. Third flap, between booms, is independently actuated; potential advantages during take-off and landing are being assessed during trials. Flaps actuated by wires, with electric control; rudders wire-actuated, with manual control.

STRUCTURE: All structures manufactured by 'open layup, vacuum-formed' process. Fuselage, tailbooms, rudders, ailerons, flaps and floats of glass fibre/foam core construction. Wing spars and cabane of carbon fibre/foam core; nosewheel assembly of carbon fibre.

LANDING GEAR: Retractable tricycle type, hydraulically actuated. Mainwheels 6.00–6; castoring, forward retracting nosewheel, size 5.00–5; differential hydraulic mainwheel brakes. Adjustable air bag suspension. Optional Series 2500 composites floats, with or without wheeled gear. Float installation takes 45 minutes.

POWER PLANT: Prototype flown with single and twin 89 kW (120 hp) Jabiru 3300 flat-six(es) and ground-adjustable pitch propeller(s).

SR and SRX: One 157 kW (210 hp) Textron Lycoming IO-360 flat-four driving a three-blade, reversible MT propeller.

TR and TRX: Two 89 kW (120 hp) Jabiru 3300 flat-sixes, each driving a three-blade, constant-speed Airmaster propeller.

Fuel capacity (usable) 258 litres (68.0 US gallons; 56.7 Imp gallons), contained in tanks in wing struts and tailbooms.

Creative Flight Aerocat during flight trials in 2005 1153749

ACCOMMODATION: Two or four persons, according to version. Rear seats may be replaced by freight. Combined windscreen/gullwing door opening upwards and outwards each side of cabin. Dual controls.
SYSTEMS: Electrical power 12 V; electro-pneumatic pump 6.9 bar (100 lb/sq in) for landing gear actuation.
AVIONICS: To customer's requirements. Prototype has GPS, ELT and VHF radio.
DIMENSIONS, EXTERNAL:
Wing span 10.36 m (34 ft 0 in)
Wing aspect ratio 7.0
Length: fuselage 8.05 m (26 ft 4¾ in)
overall 8.23 m (27 ft 0 in)
Height overall 2.72 m (8 ft 11 in)
Propeller diameter: SR, SRX 1.83 m (6 ft 0 in)
DIMENSIONS, INTERNAL:
Cabin: Length 2.74 m (9 ft 0 in)
Max width 1.48 m (4 ft 9 in)
Max height 1.17 m (3 ft 10 in)
Float baggage compartment: (each) 0.28 m^3 (10.0 cu ft)
AREAS:
Wings, gross 15.33 m^2 (165.0 sq ft)
WEIGHTS AND LOADINGS:
Weight empty: SR, TR 726 kg (1,600 lb)
SRX, TRX 816 kg (1,800 lb)
Max fuel: all 186 kg (410 lb)
Max T-O weight: all 1,224 kg (2,700 lb)
Max wing loading: all 79.9 kg/m^2 (16.36 lb/sq ft)
Max power loading: SR, SRX 7.83 kg/kW (12.86 lb/hp)
TR, TRX 6.85 kg/kW (11.25 lb/hp)
PERFORMANCE:
Max level speed at S/L: SRX, TRX 143 kt (266 km/h; 165 mph)
SR, TR 161 kt (298 km/h; 185 mph)
Cruising speed, 65% power at FL70:
SRX, TRX 130 kt (241 km/h; 150 mph)
SR, TR 148 kt (274 km/h; 170 mph)
Stalling speed, flaps down: all 44 kt (81 km/h; 50 mph)
Max rate of climb at S/L: SRX, TRX 335 m (1,100 ft)/min
SR, TR 366 m (1,200 ft)/min
Service ceiling: all 4,267 m (14,000 ft)
T-O run: SR, TR 137 m (450 ft)
SRX, TRX, on land 152 m (500 ft)
SRX, TRX, on water 244 m (800 ft)
T-O to 15 m (50 ft): SR, TR 168 m (550 ft)
SRX, TRX, on land 183 m (600 ft)
SRX, TRX, on water 290 m (950 ft)
Landing run: SR, SRX, TR, TRX, on land 137 m (450 ft)
SRX, TRX, on water 152 m (500 ft)
Landing from 15 m (50 ft):
SR, SRX, TR, TRX, on land 168 m (550 ft)
SRX, TRX, on water 183 m (600 ft)
Range at S/L :
at 75% power: SRX, TRX 800 n miles (1,481 km; 920 miles)
SR, TR 900 n miles (1,666 km; 1,035 miles)
at 65% power: SRX, TRX 850 n miles (1,574 km; 978 miles)
SR, TR 950 n miles (1,759 km; 1,093 miles)
at 55% power: SRX, TRX 900 n miles (1,666 km; 1,035 miles)
SR, TR 1,000 n miles (1,852 km; 1,150 miles)

CUSTOM FLIGHT

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Custom Flight Components produces the North Star and more basic Bright Star two-seat kitplanes, both modelled on the Piper Super Cub. The North Star wing can also be bought as a separate kit and retrofitted to Piper Super Cub, Aeronca Champ and Bellanca Citabria aircraft. Completions continue at low rate.

Company plans include an eight-seat aircraft to be named Galaxie, as well as four- and six-seat versions of the North Star. A further version, the Lite Star, was introduced in 2005.

CUSTOM FLIGHT LITE STAR

TYPE: Side-by-side kitbuilt; two-seat lightplane.
PROGRAMME: Prototype (C-FEFP) completed and first flown in 2005.
CUSTOMERS: Prototype only by end 2005.
COSTS: Airframe kit USD22,000; ready-to-fly USD60,000 (2006).

Custom Flight Lite Star prototype 1037946

DESIGN FEATURES: Braced high-wing monoplane with V-struts and intermediate struts each side. Tailplane braced to fin and lower fuselage. Quoted build time 600 hours.
FLYING CONTROLS: Conventional and manual. Wide Frise ailerons; no flaps. No horn balances.
STRUCTURE: Fuselage is fabric-covered welded 4130 chromoly tube. Fabric-covered wing has aluminium I-beam spars and stamped aluminium ribs.
LANDING GEAR: Tailwheel type; fixed. Two faired-in side Vs hinged to lower longerons, plus half-axles sprung with rubber under centreline. Optional skis and floats.
POWER PLANT: Engines in the range 48.5 to 74.6 kW (65 to 100 hp) can be fitted, driving a ground-adjustable fixed-pitch propeller; however prototype has 82.0 kW (110 hp) converted. Corvair motorcar engine. Fuel in two wing tanks, total capacity 76 litres (20.0 US gallons; 16.7 Imp gallons).
ACCOMMODATION: Pilot and passenger side by side.
SYSTEMS: 12 V electrical system.
DIMENSIONS, EXTERNAL:
Wing span 9.30 m (30 ft 6 in)
Length overall 6.40 m (21 ft 0 in)
WEIGHTS AND LOADINGS (Corvair engine):
Weight empty 295 kg (650 lb)
T-O weight: Max 598 kg (1,320 lb)
Max power loading 7.30 kg/kW (12.00 lb/hp)
PERFORMANCE:
Max operating speed 109 kt (210 km/h; 125 mph)
Normal cruising speed 87 kt (161 km/h; 100 mph)
Stalling speed 40 kt (73 km/h; 45 mph)
Max rate of climb at S/L 305 m (1,000 ft)/min
T-O and landing run 61 m (200 ft)
Range 350 n miles (648 km; 402 miles)
Endurance 4 h 0 min

CUSTOM FLIGHT NORTH STAR

TYPE: Tandem-seat kitbuilt.
PROGRAMME: Re-creation of Piper Super Cub, but re-engineered for additional structural strength. Prototype North Star (C-FGYD) first flew in 1991 and made its public debut that year. Offered in kit form from 1992 onwards.
CURRENT VERSIONS: **North Star:** Standard version, *as described below.*
Bright Star: Basic version with no flaps, single one-piece door, leaf spring steel main landing gear, square-topped fin and fuel capacity of 87 litres (23.0 US gallons; 19.2 Imp gallons); introduced in 1996, but first aircraft had not flown by late 2002; optional tricycle or tailwheel versions. Accepts engines from 74.6 kW to 134 kW (100 to 180 hp).

Prototype Custom Flight North Star two-seat lightplane 0131799

North Star 4: Four-seat version, to be powered by engine in 108 to 194 kW (145 to 260 hp) range with a maximum take-off weight of around 1,134 kg (2,500 lb). Seeking launch customers and project reported to be on hold until North Star 6 established in production.

North Star 6: Six-seat version; maximum take-off weight of around 1,810 kg (4,000 lb). Engines between 194 and 265 kW (260 and 355 hp) can be installed.

Lite Star: *See separate entry.*

CUSTOMERS: Total of at least 34 kits sold by March 2006, of which 17 were then flying; in addition five of the six-seat version were under construction at the factory by late 2003.

COSTS: North Star: USD49,500; Bright Star: CAD19,602; North Star 6 USD70,000 (provisional) all excluding engine (2006).

DESIGN FEATURES: Strut-braced mainplanes; wire-braced tailplanes; raked wingtips. Easy maintenance/inspection covers. Quoted build time 1,200 hours.

Compared with Super Cub, has landing gear legs 8 cm (3 in) taller; flatter spine; squared wingtips, with ailerons moved outboard by 0.61 m (2 ft 0 in); aileron and flap chord increased 10 cm (4 in); flap span increased 0.60 m (2 ft 0 in); cockpit 6 cm (2½ in) wider. Aerofoil USA 35B.

FLYING CONTROLS: Conventional and manual. Horn-balanced rudder and elevators. Four-position flaps.

STRUCTURE: Welded 4130 chromoly tube, fabric-covered fuselage. Tubes injected with oil as anti-corrosion measure. Wing of prototype constructed of wood, but kit aircraft have I-beam spar, aluminium ribs and 2024-T3 leading-edges.

LANDING GEAR: Tailwheel type; fixed. Two faired-in side Vs, hinged to lower longerons, plus half-axles, each with hydraulic/coil-spring shock-absorber, attached to compression frame. Steerable tailwheel. Optional floats and skis. Mainwheel tyres 6.00–6 or 8.50–6; tailwheel 2.80–4 in.

POWER PLANT: One 112 kW (150 hp) Textron Lycoming O-320-E3D flat-four driving a McCauley two-blade fixed-pitch propeller. Fuel capacity 197 litres (52.0 US gallons; 43.3 Imp gallons) in two wing tanks.

ACCOMMODATION: Pilot and passenger in tandem within enclosed cockpit. Door on each side — upper half Perspex and lower half fabric-covered steel tubing. Baggage compartment reached through separate door on starboard side of fuselage.

Data estimated for Bright Star.

DIMENSIONS, EXTERNAL:

Wing span	11.07 m (36 ft 4 in)
Wing chord, average	1.60 m (5 ft 3 in)
Length overall: North Star	6.86 m (22 ft 6 in)
Bright Star	7.16 m (23 ft 6 in)
Height overall: North Star	2.08 m (6 ft 10 in)
Bright Star	2.29 m (7 ft 6 in)
Propeller diameter	2.08 m (6 ft 10 in)
Cabin door (each): Height	0.89 m (2 ft 11 in)
Width	1.17 m (3 ft 10 in)

DIMENSIONS, INTERNAL:

Cockpit max width	0.72 m (2 ft 4¼ in)

AREAS:

Wings, gross	17.65 m² (190.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: North Star	531 kg (1,170 lb)
Bright Star	476 kg (1,050 lb)
Baggage capacity	41 kg (90 lb)
Max T-O weight: North Star	997 kg (2,200 lb)
Bright Star	816 kg (1,800 lb)
Max wing loading: North Star	56.3 kg/m² (11.53 lb/sq ft)
Bright Star	46.3 kg/m² (9.47 lb/sq ft)
Max power loading (112 kW; 150 hp engine):	
North Star	8.93 kg/kW (14.67 lb/hp)
Bright Star	7.30 kg/kW (12.00 lb/hp)

PERFORMANCE:

Max level speed	122 kt (225 km/h; 140 mph)
Max cruising speed:	
North Star: landplane	100 kt (185 km/h; 115 mph)
floatplane	85 kt (158 km/h; 98 mph)
Bright Star	87 kt (161 km/h; 100 mph)
Normal cruising speed:	
North Star	85 kt (158 km/h; 98 mph)
Stalling speed, power off:	
flaps up	35 kt (65 km/h; 40 mph)
flaps down	31 kt (57 km/h; 35 mph)
Stalling speed, full power:	
flaps up	31 kt (57 km/h; 35 mph)
flaps down	22 kt (41 km/h; 25 mph)
Max rate of climb at S/L:	
North Star	335 m (1,100 ft)/min
Bright Star	305 m (1,000 ft)/min
Service ceiling	4,880 m (16,000 ft)
T-O run (half fuel): North Star	55 m (180 ft)
Bright Star	92 m (300 ft)
Landing run: North Star	61 m (200 ft)
Bright Star	84 m (275 ft)
Range	600 n miles (1,111 km; 690 miles)

DELASTEK

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Former Partenair company was formed in 1998 to develop the S44 Mystère, designed by Saleem Saleh and Frédéric Amblard. This evolved into the S45. In late 2003, Partenair was bought by Delastek, which intends to continue development of the S45; Partenair division operates independently of parent company in a 743 m² (8,000 sq ft) factory at Boucherville.

DELASTEK S45 MYSTERE

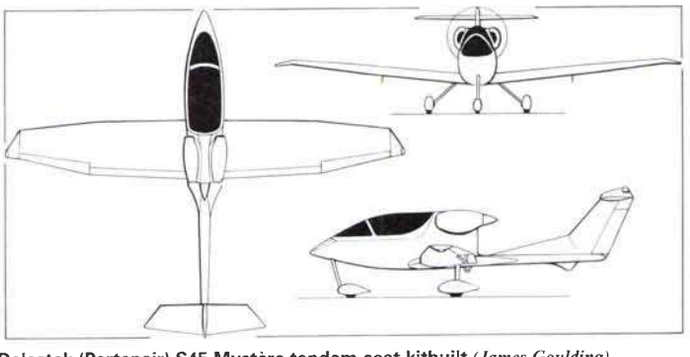
English name: Mystery

TYPE: Tandem-seat kitbuilt.

PROGRAMME: Design work on series began in 1991. Prototype (C-FZHP) first flew as Rotax 912-powered Partenair S44 on 16 November 1996, and as S45 in 1998; total 50 hours flown by July 2001, when second prototype (C-GGYY), with Textron Lycoming engine, exhibited complete, but unflown, at AirVenture, Oshkosh. First flight eventually accomplished 4 October 2001.

CURRENT VERSIONS: **Mystère Mark I:** Retrospective designation, since 2003, for original aircraft.

Delastek S45 Mystère second prototype *(Paul Jackson)* 1037965



Delastek (Partenair) S45 Mystère tandem-seat kitbuilt *(James Goulding)* 0526897

Mystère Mark II: Announced early 2003. Engine line raised 10 cm (4 in) to allow fitment of 1.78 m (5 ft 10 in) propeller; modified engine cowling. *As described.*

Mystère Mark III: Proposed retractable landing gear version, announced mid-2003.

CUSTOMERS: By end 2003, seven aircraft under construction (latest information received).

COSTS: Basic kit, excluding engine, propeller and avionics, USD27,900 (2005); can be purchased in three sub-kits.

DESIGN FEATURES: Configured to eliminate pitch-up associated with high thrust-line; horizontal stabiliser immediately above propeller slipstream counteracts thrust increases by exerting proportional pitch-down and additionally has increased effectiveness at lower airspeeds. Streamlined, pod-and-boom configuration, with T tail and sweptback fin with large fillet. Wings have constant-chord inboard sections and tapered outer panels. Engine and pusher propeller behind rear seat. Quoted build time 1,000 hours. Provision for 4 or 6° wing dihedral to be incorporated during manufacture. Wing airfoil NACA65215 on S44 and modified NACA65218 on S45. Wing washout 2° on S45.

FLYING CONTROLS: Conventional and manual. Aileron movements +30/−15°. Double slotted flaps, electrically actuated; positions 10/25/45°. Spade-type balance below each aileron. Flight-adjustable tab in elevator.

STRUCTURE: Generally of composites. Wing has C-shaped main spars plus glass fibre secondary spar at 75% chord.

LANDING GEAR: Tricycle type; fixed. Cantilever sprung main legs of 2024-T3 aluminium; trailing link nosewheel. Speed fairings on all wheels. Hydraulic Cleveland brakes. Mainwheels 5.00–5; Azusa nosewheel 11×4.00–5.

POWER PLANT: One 119.3 kW (160 hp) Textron Lycoming IO-320 flat-four, driving a Prince two-blade metal propeller with Q tips. Fuel capacity 208 litres (55.0 US gallons; 45.8 Imp gallons) of which 197 litres (52.0 US gallons; 43.3 Imp gallons) usable.

ACCOMMODATION: Two persons in tandem, beneath two-piece canopy/windscreen. Dual controls.

EQUIPMENT: Prototype S45 fitted with BRS parachute.

DIMENSIONS, EXTERNAL:
- Wing span: 7.13 m (28 ft 6 in)
- Wing chord: at root: 1.37 m (4 ft 6 in)
- at tip: 0.69 m (2 ft 3 in)
- Wing aspect ratio: 7.6
- Length overall: 7.32 m (24 ft 0 in)
- Height overall: 2.44 m (8 ft 0 in)
- Wheel track: 2.29 m (7 ft 6 in)
- Tailplane span: 2.62 m (8 ft 7 in)
- Propeller diameter: 1.78 m (5 ft 10 in)

DIMENSIONS, INTERNAL:
- Cabin max width: 0.76 m (2 ft 6 in)

AREAS:
- Wings, gross: 9.94 m² (107.0 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty: 522 kg (1,150 lb)
- Baggage capacity: 34 kg (75 lb)
- Max T-O weight: 873 kg (1,925 lb)
- Max wing loading: 87.84 kg/m² (17.99 lb/sq ft)
- Max power loading: 7.32 kg/kW (12.03 lb/hp)

PERFORMANCE:
- Never-exceed speed (VNE): 182 kt (338 km/h; 210 mph)
- Max cruising speed: 139 kt (257 km/h; 160 mph)
- Stalling speed: 48 kt (89 km/h; 55 mph)
- Max rate of climb at S/L: 427 m (1,400 ft)/min
- T-O and landing run: 183 m (600 ft)
- Max range: 1,000 n miles (1,852 km; 1,150 miles)
- g limits: +6/–3

DIAMOND

DIAMOND AIRCRAFT CORPORATION

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Diamond Aircraft Corporation incorporated 12 January 1992 and established 24,625 m² (265,000 sq ft) plant at London, Ontario in June 1994, to build DV 20 Katana light aircraft for the North American market.

An experimental design, the DA20-B1 (C-GKAT), was completed in June 1996, followed by the DA20-C1 prototype in February 1997. Series production of the DA20-C1 is currently under way, augmented from March 2002 onwards by the Diamond DA40-180 Star (of which an Austrian version is in parallel production by Diamond Aircraft Industries). A DA40 with fixed-pitch propeller was introduced in 2005.

DIAMOND DA20-C1

English name: Samurai Sword

TYPE: Two-seat lightplane.

PROGRAMME: Original Austrian-built Katana revealed following first flight on 16 March 1991 of proof-of-concept LF 2000 (OE-VPX); followed by LF 2 Katana predecessor (OE-CPU, first flight December 1991); DV20 prototype (OE-AKL, first flight 17 December 1992) developed from this by Dries and Volck and was representative of production aircraft; Austrian and German certification 26 April 1993; JAR-VLA certification received later in 1993; now also certified by Canada, UK and, on 9 December 1994, USA (FAA). Second production line opened in Canada, initially for the DA20-A1; European-built aircraft designated DV20. European manufacture of the DV20 ended in mid-1996.

The current C1 version, introducing minor airframe improvements, was announced at Aero '97 at Friedrichshafen, shortly after first flight of the Canadian prototype (C-FDVA); production of this version began in early 1998, with FAA certification on 6 April that year. Canadian variant introduced some 40 minor changes, including wider cabin, electric trim and doubled electrical capacity, but is unnamed. Exports of -C1s to USA began June 1998 with seventh production aircraft.

CURRENT VERSIONS: **DA20-C1:** *As described.* Certified by FAA 6 April 1998. Relaunched in two versions from early 2001: **Evolution** basically equipped trainer, capable of 135 kt (250 km/h; 155 mph) cruise at 1,830 m (6,000 ft) and **Eclipse**, featuring carpets, leather seats and other interior features for private owners. Chinese CAAC certification achieved 27 July 2004.

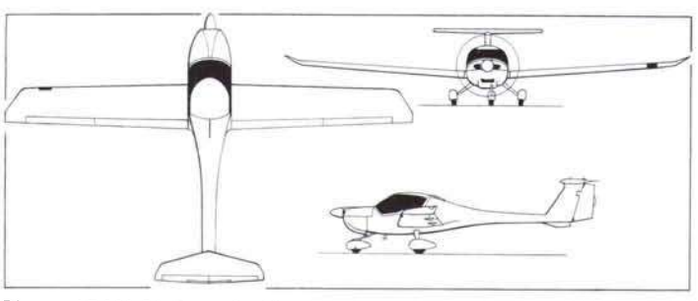
DA20-A2: Intended to have DA20-C's improved airframe, but retain DA 20-A's 59.7 kW (80 hp) Rotax 912 flat-four engine. Not launched.

DA20-W: Based on DA20C-1 airframe, but with 78.3 kW (105 hp) Diamond GIAE 110R rotary engine. To be built in Austria by Diamond Aircraft Industries GmbH.

CUSTOMERS: Total of some 845 DV/DA20s of all versions delivered by end 2005 from Austrian and Canadian production. European production of DV 20s terminated with the 160th aircraft in July 1996; last of 331 Canadian DA20 A1s completed in late 1998. Total of 354 C1s registered up to December 2005. Most to USA, but some to Canada and one each to New Zealand (in March 1999) and UK (July 1999). Katanas of all versions operated by training schools in Australia (one), Austria (six), Canada (11), Czech Republic (one), Finland (one), Germany (six), New Zealand (one), Sweden (one), South Africa (one), Switzerland (one), UK (two) and USA (32).

Customers include Embry-Riddle Aeronautical University, which has leased 35 C1s to fulfil a contract to provide basic flight training of USAF cadet pilots at the Air Force Academy in Colorado Springs. Total of 58 DA20-C1s delivered in 2004 and 54 in 2005.

Instrument panel of Diamond DA20-C1 Eclipse N153MA in 2004 *(Paul Jackson)* 1042603



Diamond DA20-C1 *(James Goulding)* 0044445

Diamond DA20-C1 Eclipse from Canadian production 1153777

COSTS: Evolution USD128,900; Eclipse USD139,990 (2004).

DESIGN FEATURES: Conventional, mid-wing, T-tail monoplane of composites construction. Wing section Wortmann FX-63-137/20; dihedral 4° at root, 27° at tip; sweepback 1°; incidence, 2° 30'. Fin sweepback 57°; tailplane incidence −2°.

FLYING CONTROLS: Conventional and manual. Ailerons and elevators are operated by push-pull tubes, rudder by cables; electrically actuated spring bias provides elevator trimming; electrically actuated flaps. Control surface movements: ailerons +16°/−13°; elevator +25°/−15°; rudder ±30°; flaps 15° for T-O, 45° landing.

STRUCTURE: Fuselage, with integral vertical fin, is mostly of GFRP construction with local CFRP reinforcement in high-stress areas, comprising two half-shells which are bonded together and incorporate transverse bulkheads in the cabin/centre-section area and three ring bulkheads in the tailcone. Wings comprise I-section spar of GFRP, with ribs providing mounting surfaces for control tubes and bellcranks; CFRP spar caps; centre section shear web is foam and fibre; wing skins are of GFRP/PVC foam/GFRP sandwich construction, as are the rudder and horizontal tail surfaces. Flaps and ailerons of GFRP.

LANDING GEAR: Fixed tricycle type, with fuselage-mounted cantilever self-sprung aluminium leg on each main unit and elastomeric suspension on nose leg; latter offset to starboard by 8 cm (3 in). Steering is provided by differential braking of the mainwheels and friction-damped castoring nosewheel. Speed fairings on all three wheels standard on Eclipse, optional on Evolution.

POWER PLANT: One 93 kW (125 hp) Teledyne Continental IO-240-B flat-four driving a Sensenich W69EK7-63 two-blade wood and composites propeller (W69EK-63 on first 149 aircraft). Alternatively, Hoffman HO-14HM-175-157 two-blade propeller. Fuel capacity 92.7 litres (24.5 US gallons; 20.4 Imp gallons), of which 91 litres (24.0 US gallons; 20.0 Imp gallons usable); oil capacity 5.7 litres (1.5 US gallons; 1.25 Imp gallons).

ACCOMMODATION: Two seats side by side, with baggage space to rear; leather seats and inertia reel safety harnesses optional. Canopy hinged at rear to open upward.

SYSTEMS: Electrical system includes 12 V 40 A alternator and 12 V 240 Ah battery.

AVIONICS: *Comms:* Eclipse has Garmin GMA 340 audio panel, GNS 430 comm/nav/GPS, GI 106A, and GTX 327 transponder, all as standard; other avionics to customer's choice include GNS 420, GPS 150XL, Bendix/King KMD 150 GPS and KI 208 VOR. Evolution has Bendix/King KX 155 nav/com, KI 209 VOR/LOC/GS indicator, KT 76C transponder and PM501 intercom as standard. AvPac 1 adds KLX 135A GPS/com and PMA 6000 audio panel/intercom with marker beacon receiver; AvPac 2 adds items as for AvPac 1, but with glideslope for KX 155.

Flight: Optional S-TEC 30 two-axis autopilot and slaved HIS in Eclipse.

EQUIPMENT: Evolution options include sheepskin seats, deluxe carpet, inertia reel harnesses, integral instrument lighting, electro luminexsent panel floodlight, pop-out vent windows, engraved aluminium throttle quadrant cover plates, external power receptacle, engine heater system, and heavy duty battery.

DIMENSIONS, EXTERNAL:

Wing span	10.87 m (35 ft 8 in)
Wing aspect ratio	10.2
Length overall	7.165 m (23 ft 6 in)
Height overall	2.18 m (7 ft 2 in)
Tailplane span	2.65 m (8 ft 8¼ in)
Wheel track	1.90 m (6 ft 2¾ in)
Wheelbase	1.72 m (5 ft 7¾ in)
Propeller diameter	1.75 m (5 ft 9 in)

AREAS:

Wing area, gross	11.61 m² (125.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	529 kg (1,166 lb)
Baggage capacity	20 kg (44 lb)
Max T-O weight: EASA	750 kg (1,653 lb)
FAA	800 kg (1,763 lb)
Max wing loading (EASA)	64.6 kg/m² (13.22 lb/sq ft)
Max power loading (EASA)	8.03 kg/kW (13.20 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	159 kt (294 km/h; 183 mph)
Cruising speed at 75% power at FL60	140 kt (259 km/h; 161 mph)
Manoeuvring speed	106 kt (196 km/h; 122 mph) CAS
Stalling speed: clean	47 kt (87 km/h; 54 mph)
in landing configuration	38 kt (71 km/h; 44 mph)
Max rate of climb at S/L	305 m (1,000 ft)/min
Service ceiling	5,365 m (17,600 ft)
T-O run	337 m (1,105 ft)
T-O to 15 m (50 ft)	448 m (1,470 ft)
Landing from 15 m (50 ft)	454 m (1,490 ft)
Landing run	390 m (1,280 ft)
Range, 45 min reserves: Eclipse	410 n miles (759 km; 471 miles)

DIAMOND DA40-180 DIAMOND STAR

TYPE: Four-seat lightplane.

PROGRAMME: Development by Diamond in Austria. Production of Lycoming-engined variant transferred to Canada in 2002.

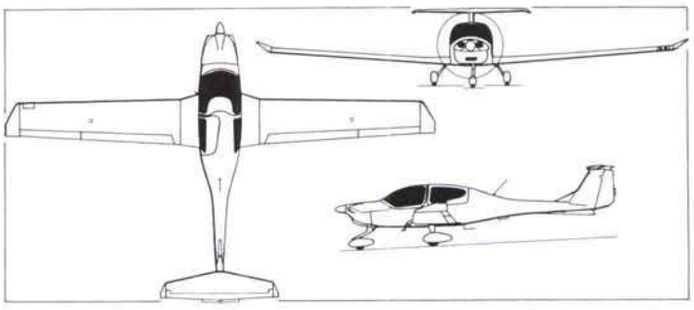
CURRENT VERSIONS: **DA40-180:** Baseline version with Lycoming IO-360 engine. Preparation for Canadian assembly (which see) began September 2001, and first from this source (C-GDFC, c/n 40201) delivered on 28 March 2002 to Academy Air Services, Ontario.

DA40: Powered by 99 kW (133 hp) Thielert Centurion 1.7 turbo-diesel; Austrian-built.

DA40-180 FP: Fixed-pitch propeller version; launched at Sun 'n' Fun, Lakeland, Florida, April 2004 certified by FAA (as DA 40F) 15 July 2005, following EASA on 15 April 2005. Features Sensenich 76EM8S10-0-63 Textron Lycoming O-360-A4M engine with two-blade fixed-pitch metal propeller, optional wheel fairings, single-cylinder EGT/CHT gauge; payload with max fuel 308 kg (680 lb); cruising speed more than 140 kt (259 km/h, 161 mph); max rate of climb at S/L more than 274 m (900 ft)/min; T-O to 15 m (50 ft) 411 m (1,350 ft).

DA40XL: Improved '2007 model' announced at NBAA Convention, Orlando, Florida, October 2006. Prototype C-FJPC (c/n 40665). Changes include 'scimitar' propeller, winglets and tuned exhaust, adding up to 12 kt (22 km/h; 14 mph) to top speed; additional 50 kg (110 lb) on MTOW; increased fuel as standard; GFC 700 autopilot; Avidyne TCAS; and redesigned interior and external paint scheme.

Winglet-equipped Diamond Star XL at its public debut *(Paul Jackson)* 1158861



Diamond DA40-180 Diamond Star (Lycoming IO-360) *(Paul Jackson)* 0092123

CUSTOMERS: Diamond Canada registered its 250th Diamond Star (N132DS) in November 2004.

COSTS: DA40-180 FP: Basic USD179,900; with Garmin G1000 package USD214,800; DA40-180; with Bendix/King avionics package USD194,600; with Bendix/King IFR avionics USD206,250; with Garmin avionics package USD196,600; with Avidyne FlightMax Entegra package USD236,500; with Garmin G1000 package USD229,500 (all 2004). DA40XL: USD329,800 (2007).

The description of the DA40D (which see) applies also to the DA40-180 except as follows:

POWER PLANT: One 134 kW (180 hp) Textron Lycoming IO-360-M1A flat-four with Lasar electronic ignition and self-adapting inlet cooling, driving an MTV-12-B/180-17 three-blade constant-speed (hydraulic) composites propeller; MTV-12-B/183-59b for DA40XL. Fuel in two wing tanks, standard capacity 156 litres (41.2 US gallons; 34.3 Imp gallons), of which 152 litres (40.1 US gallons; 33.4 Imp gallons) usable; optional 185 litres (48.8 US gallons; 40.7 Imp gallons), of which 181 litres (47.8 US gallons; 39.8 Imp gallons) usable. DA40XL fuel 182 litres (48.1 US gallons; 40.0 Imp gallons).

SYSTEMS: 28 V electrical system includes 70 A alternator.

AVIONICS: Choice of Bendix/King, Avidyne or Garmin packages.

Comms: Bendix/King Standard package includes KX 155 nav/com, KT 76A transponder with blind encoder, and PM 1000 II intercom; Deluxe package substitutes KX 155A for KX 155 and KT 76C for KT 76A, and adds KX 165A nav/com/glideslope, and KMA 28S audio panel with intercom and marker beacon receiver in place of PM 1000 II. Garmin Standard package includes GNS 430 nav/com/GPS/glideslope, GTX 327 transponder with blind encoder, and GMA audio panel with intercom. Deluxe package adds second GNS 430. GNS 530 nav/com/GPS optional in exchange for GNS 430.

Flight: Bendix/King Standard package includes KLN 94 GPS moving map and KI 208 VOR/LOC. Deluxe package substitutes KLN 94 GPS for VFR unit, and adds KI 209A VOR/GS. Further options include KAP 140 two-axis autopilot with altitude hold/preselect and electric pitch trim, KCS 55A slaved HSI (exchange for KI 209A) and MD-41 GPS/nav/annunciator. Garmin Standard package includes GI 106A VOR/LOC/GPS/GS indicator. Deluxe package adds second GI 106A. Further options include Bendix/King KAP 140 two-axis autopilot with altitude hold/preselect and electric pitch trim, KCS 55A slaved HSI (exchange for GI 106A), MD 41 GPS/nav/annunciator and Goodrich WX-500 Stormscope.

Instrumentation: Vision Microsystem VM 1000 engine control system comprising manifold pressure gauge, tachometer, engine hour meter, oil pressure gauge, oil/cylinder head temperature indicators, fuel flow indicator, ammeter and voltmeter; compass, ASI, altimeter, VSI, turn co-ordinator, artificial horizon, DG, OAT gauge, chronometer and alternate static port, all standard.

Avidyne FlightMax Entegra glass cockpit, with IFR-certified 26 cm (10.4 in) colour LCD PFD, EX5000 MFD, and E-max Total Engine Management System, introduced as an option in August 2003. Garmin G1000 integrated glass cockpit available as an option from first quarter 2004, comprising large format sunlight readable 25.4 cm (10 in) PFD and MFD; audio control system; dual integrated radio modules providing WAAS-capable IFR GPS, VHF/ILS and VHF comm functions with 8.33 kHz channel spacing; Mode S transponder with Traffic Information Service; solid state AHRS; digital air data computer; interface with Bendix/King KAP 140 two-axis autopilot; and optional weather and terrain data.

DIMENSIONS, EXTERNAL:

Wing span	11.63 m (38 ft 2 in)

WEIGHTS AND LOADINGS:

Weight empty	740 kg (1,631 lb)
Baggage capacity: normal	35 kg (77 lb)
optional	45 kg (100 lb)

For details of the latest updates to ***Jane's All the World's Aircraft*** online and to discover the additional information available exclusively to online subscribers please visit
jawa.janes.com

Canadian-built Diamond DA40-180 Diamond Star 1151721

Max T-O weight: DA40 ..... 1,150 kg (2,535 lb)
DA40XL ..... 1,200 kg (2,645 lb)
Max landing weight: DA40 ..... 1,092 kg (2,407 lb)
DA40F ..... 1,150 kg (2,535 lb)
Max wing loading ..... 85.2 kg/m^2 (17.45 lb/sq ft)
Max power loading ..... 8.58 kg/kW (14.10 lb/hp)
PERFORMANCE:
Never-exceed speed (VNE) ..... 173 kt (320 km/h; 199 mph) IAS
Max level speed: DA40 ..... 147 kt (272 km/h; 169 mph)
Cruising speed: at 75% power at 1,220 m (4,000 ft): DA40 . 145 kt (269 km/h; 167 mph)
DA40XL ..... 150 kt (278 km/h; 173 mph)
at 50% power at FL100: DA40 ..... 120 kt (222 km/h; 138 mph)
Stalling speed, flaps down: all ..... 49 kt (91 km/h; 57 mph)
Max rate of climb at S/L: DA40 ..... 326 m (1,070 ft)/min
DA40XL ..... 341 m (1,120 ft)/min
Max certified altitude: all ..... 5,000 m (16,400 ft)
T-O run, DA40XL ..... 314 m (1,030 ft)
T-O to 15 m (50 ft): DA40 ..... 351 m (1,150 ft)
DA40XL ..... 348 m (1,140 m)
Range, 45 min reserves: DA40: standard fuel ..... 570 n miles (1,055 km; 655 miles)
optional fuel ..... 740 n miles (1,370 km; 851 miles)
DA40XL: 75% power ..... 720 n miles (1,333 km; 828 miles)
55% power ..... 785 n miles (1,453 km; 903 miles)

DREAM

DREAM AIRCRAFT INC

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VICE-PRESIDENT: Yvan Desmarais
SALES MANAGER: Luc Prémont

Dream's debut as an aircraft manufacturer was at the April 2003 Sun 'n' Fun festival at Lakeland, Florida. By the following year, it was able to show a second prototype of the Tundra lightplane more representative of the production version. The company is a division of specialist engineering firm D&G Inc, which has a 2,790 m^2 (30,000 sq ft) manufacturing facility.

DREAM TUNDRA

TYPE: Four-seat kitbuilt.

PROGRAMME: Construction of the prototype started in 1998 and first flew (C-GIPN) at Bromont on 12 May 2001; experimental certification 7 June 2001; first flight from floats 3 October 2001; first public display at Sun 'n' Fun in April 2003 (when it had accumulated 120 hours) and, later, at AirVenture, Oshkosh, July 2003. Second prototype flown April 2004 (C-GAGH), displaying detail changes, including spring cantilever aluminium landing gear, double floor, thinner tailplane and rudder, redesigned engine cowling and higher-powered IO-360 engine; by February 2006 two prototypes had accumulated 625 flying hours. In November 2005, FAA approval under 51 per cent rule achieved.

Second prototype Dream Tundra *(Paul Jackson)* 1159104

CUSTOMERS: By April 2004, three sold and first set of wing and tail components had been delivered; 13 kits in production by June 2005. First customer-built aircraft (C-FFTI) flown 6 September 2005.

COSTS: Kit CAD43,990 (tailwheel) or CAD46,980 (nosewheel) (2006), excluding engine, propeller and avionics.

DESIGN FEATURES: Intended to carry four adults and baggage from short and semi-prepared runways. Designed on 3-D software and constructed of precision-drilled aluminium components. Wings braced by V struts; downturned tips; 2° washout; modified Riblett 660.15 aerofoil. Quoted build time 1,000 hours.

FLYING CONTROLS: Conventional and manual. Large, Horn-balanced elevators with flight-adjustable trim tab to port. Horn-balanced rudder. Four-position (0, 15, 25, 40°) Fowler flaps.

STRUCTURE: Aluminium throughout, except composites wing-, fin- and tailplane tips.

LANDING GEAR: Fixed; option of nosewheel or tailwheel type. Cantilever spring aluminium mainwheel legs. (Prototype has tailwheel and two faired-in side Vs hinged to lower longerons, plus half-axles spring under centreline with bungee cord). Grove mainwheels with 8.50×6 or 8.00–6 tyres; solid, steerable tailwheel. Optional floats or skis.

POWER PLANT: One 149 kW (200 hp) Textron Lycoming IO-360 flat-six (134 kW; 180 hp O-360-A in prototype), driving a Sensenich 76EM8-0-57 (prototype) or Hartzell two-blade, metal propeller; engines upto 175 kW (235 hp) can be fitted. Total fuel 220 litres (58.0 US gallons; 48.3 Imp gallons) in two wing tanks, of which 204 litres (53.9 US gallons; 44.9 Imp gallons) usable.

ACCOMMODATION: Four persons in two side-by-side pairs. Baggage space to rear. Upward-hinged door each side; cargo door on port fuselage side.

DIMENSIONS, EXTERNAL:
Wing span ..... 10.97 m (36 ft 0 in)
Wing chord (constant) ..... 1.55 m (5 ft 1 in)
Wing aspect ratio 7.1
Length overall ..... 7.77 m (25 ft 6 in)
Height overall ..... 3.05 m (10 ft 0 in)
Tailplane span ..... 3.23 m (10 ft 7 in)
Wheel track ..... 2.44 m (8 ft 0 in)
Propeller diameter (Hartzell) ..... 2.06 m (6 ft 9 in)
DIMENSIONS, INTERNAL:
Cabin: Length ..... 2.84 m (9 ft 4 in)
Max width ..... 1.12 m (3 ft 8 in)
AREAS:
Wings, gross ..... 17.06 m^2 (183.6 sq ft)
Horizontal tail surfaces ..... 3.62 m^2 (39.0 sq ft)
WEIGHTS AND LOADINGS (L: landplane, F: floatplane):
Weight empty: L ..... 658 kg (1,450 lb)
F ..... 767 kg (1,692 lb)
Max fuel weight: L, F ..... 158 kg (348 lb)
Max T-O weight: L ..... 1,156 kg (2,550 lb)
F ..... 1,270 kg (2,800 lb)

Max wing loading ..... 67.8 kg/m² (13.89 lb/sq ft)
Max power loading ..... 8.62 kg/kW (14.17 lb/hp)
PERFORMANCE:
Never-exceed speed (VNE): L, F ..... 140 kt (259 km/h; 161 mph)
Cruising speed: max: L ..... 122 kt (226 km/h; 140 mph)
F: ..... 109 kt (201 km/h; 125 mph)
at 75% power: L ..... 115 kt (213 km/h; 132 mph)
F: ..... 103 kt (190 km/h; 118 mph)
Stalling speed: flaps up: L ..... 37 kt (69 km/h; 43 mph)
F ..... 46 kt (84 km/h; 52 mph)
flaps down: L ..... 26 kt (49 km/h; 30 mph)
F ..... 40 kt (72 km/h; 45 mph)
Max rate of climb at S/L: L ..... 305 m (1,000 ft)/min
F ..... 183 m (600 ft)/min
Service ceiling ..... 4,265 m (14,000 ft)
T-O run: L ..... 122 m (400 ft)
F ..... 396 m (1,300 ft)
Landing run: L ..... 152 m (500 ft)
Range: L ..... 584 n miles (1,083 km; 673 miles)
F ..... 532 n miles (986 km; 613 miles)
Endurance: L, F ..... 5 h 12 min
g limits: L, F ..... +3.8/–1.7

FOUND

FOUND AIRCRAFT CANADA INC

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Web: www.foundair.com
SALES MANAGER: Andrew Hamblin

The present company of this name was established in 1996 to reinstate production of the FBA-2 Bush Hawk, beginning deliveries in mid-2000. An XP version was introduced in 2001 and at least 25 have now been built. The company operates from two facilities totalling 2,322 m² (25,000 sq ft) with access to both a hard runway and a freshwater lake.

Found FBA-2C1 Bush Hawk-XP on wheel landing gear *(Paul Jackson)* 1159046

FOUND FBA-2C BUSH HAWK

TYPE: Five-seat utility transport.

PROGRAMME: Original Found FBA-2C first flew on 9 May 1962. Production numbered 27, plus five improved Centenniel 100s before company ceased trading. In March 2006, eight FBA-2Cs and three Centenniels were active in North America.

Prototype of current FBA-2C1 (C-FSVD), converted from an existing aircraft with IO-540-D engine, and other improvements, flew at Georgian Bay Airport, Ontario, in November 1996 and completed test flying, on wheels and floats, during 1998 and 1999. New production was due to start in July 1997 but programme slipped; preproduction aircraft C-GDWO (c/n 28; IO-540-L engine) made first flight October 1998 and certified 5 March 1999; was followed by C-GDWQ in 1999; initial production Bush Hawk C-GDWS (c/n 30) flew 2 March 2000. FAA certificate A7EA reinstated 10 March 2000, covering both FBA-2C and FBA-2C1; uprated (224 kW; 300 hp) version added 1 May 2001.

CURRENT VERSIONS: **FBA-2C Bush Hawk-260:** 194 kW (260 hp) version; no longer available.

FBA-2C1 Bush Hawk-XP: 224 kW (300 hp) version demonstrator C-GDWC (c/n 31) built 2000; available from 2001.

FBA-2C2 Bush Hawk-XP: Introduced 2004; Canadian certificate issued 14 May 2004 and FAA 11 January 2005. Offers increased maximum take-off weight and Fowler flaps. Earlier versions can be modified to this standard.

Description and data apply to FBA-2C2 Bush Hawk-XP unless otherwise stated.

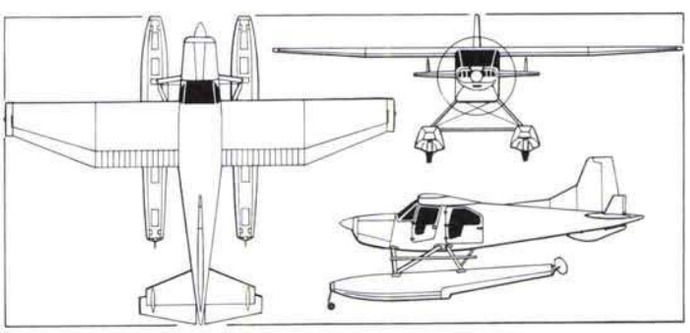
CUSTOMERS: By April 2006, 32 had been built. Initial production aircraft exported to USA 24 May 2001. Recent customers include the US Fish and Wildlife Agency.

COSTS: Bush Hawk-XP USD325,000 on wheels; USD412,750 on amphibious floats and USD373,750 on straight floats; hourly operating cost CAD63.40 (2005).

DESIGN FEATURES: Fully corrosion-proofed, all-metal construction for operation over all terrain.

High wing with constant chord to mid-span; outer panels unswept, with sharply swept forward trailing-edges. Sweptback fin with two-stage fillet; mid-mounted tailplane. Floatplane directional stability enhanced by underfin and auxiliary fins above and below tailplane at three-quarters span.

FLYING CONTROLS: Conventional and manual. Horn-balanced rudder and elevators. Fowler flaps extend to 30°. Control surface deflections: aileron +18/–12°; elevator +29.5/–21.5°; stabiliser +6/–4°; rudder 24° either side of neutral. Six vortex generators ahead of each aileron; optional retrofittable package comprising 72 along span, to be fitted in conjunction with two 30 cm (1 ft) winglets available since February 2006, offering improved slow speed control and more docile stall characteristics; allows removal of lower component of tailplane finlets, as previously required for floatplane.



Found FBA-2C1 Bush Hawk-XP five-seat utility transport *(James Goulding)* 1042473

STRUCTURE: Aluminium-covered steel tube front fuselage and semi-monocoque rear fuselage. Deep-section, low-drag, all-aluminium wing.

LANDING GEAR: Fixed. Prototype, preproduction and first production aircraft have tailwheel configuration; all following landplanes have tricycle layout with optional tailwheel layout. Sprung steel main legs with urethane shock-absorbers. Mainwheels 8.00–6, but 66 cm (26 in) 8.50–10 and 76 cm (30 in) Tundra tyres being evaluated. Steerable tailwheel. Other options include EDO 628-2960 or 249A-2870 (modified) floats, Wipaire 3450 floats or amphibious floats or Aerocet 3500 floats and Federal C-3200 or C-3600 retractable skis.

Extended wingtips, available from 2006, demonstrated by Found FBA-2C1 Bush Hawk-XP *(Paul Jackson)* 1159047

POWER PLANT: One 224 kW (300 hp) Textron Lycoming IO-540-L1C5 flat-six engine, driving a Hartzell HC-C3YR-1RF/F8468A-2R constant-speed three-blade metal propeller; Diesel engine (possibly 231 kW; 310 hp Thielert) under consideration for African markets. Fuel in two wing tanks, total capacity 378 litres (99.8 US gallons; 83.1 Imp gallons) of which 372 litres (98.3 US gallons; 81.8 Imp gallons) usable. Oil capacity 9.5 litres (2.5 US gallons; 2.1 Imp gallons).

ACCOMMODATION: Pilot and co-pilot, plus three passengers in cabin, with crew entrance through forward-hinged doors on each side of fuselage. Individual aft folding seats. Rear cabin typically holds four 204 litre (54.0 US gallon; 45.0 Imp gallon) drums and has large, forward-hinged door on each side; door sills are flush with floor; doors swing 180° to allow easy loading. Alternatively, one stretcher and attendant in rear cabin. Camera hatch can be fitted in cabin floor.

SYSTEMS: 24 V 10 Ah battery, 28 V 70 A alternator.

AVIONICS:

As customer's preference.

DIMENSIONS, EXTERNAL:

Wing span: standard	10.97 m (36 ft 0 in)
option	11.58 m (38 ft 0 in)
Wing aspect ratio	7.2
Length overall: landplane	7.98 m (26 ft 2 in)
floatplane	8.38 m (27 ft 6 in)
Height overall: landplane	2.77 m (9 ft 1 in)
floatplane	3.68 m (12 ft 1 in)
Propeller diameter	2.13 m (7 ft 0 in)
Cabin door: Max height	1.02 m (3 ft 4 in)
Max width	0.97 m (3 ft 2 in)

DIMENSIONS, INTERNAL:

Cabin (including baggage compartment):	
Length	4.01 m (13 ft 2 in)
Max width	1.12 m (3 ft 8¼ in)
Max height	1.27 m (4 ft 2 in)
Volume	3.40 m^3 (120 cu ft)

AREAS:

Wings, gross	16.72 m^2 (180.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: landplane	862 kg (1,900 lb)
floatplane	1,021 kg (2,250 lb)
Baggage capacity	113 kg (250 lb)
Max T-O weight: landplane	1,587 kg (3,500 lb)
floatplane	1,723 kg (3,800 lb)
Max wing loading: landplane	94.9 kg/m^2 (19.44 lb/sq ft)
floatplane	103.1 kg/m^2 (21.11 lb/sq ft)
Max power loading: landplane	7.10 kg/kW (11.67 lb/hp)
floatplane	7.71 kg/kW (12.67 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	158 kt (292 km/h; 181 mph) CAS
Cruising speed at 75% power:	
landplane	150 kt (278 km/h; 173 mph)
floatplane	130 kt (241 km/h; 150 mph)
Stalling speed, power off:	
flaps up: landplane	57 kt (106 km/h; 66 mph)
floatplane	58 kt (108 km/h; 67 mph)
flaps down: landplane	52 kt (97 km/h; 60 mph)
floatplane	54 kt (100 km/h; 62 mph)
Max rate of climb at S/L:	
landplane	341 m (1,120 ft)/min
floatplane	320 m (1,050 ft)/min
Service ceiling: landplane	5,485 m (18,000 ft)
floatplane	4,570 m (15,000 ft)
T-O run: landplane	229 m (750 ft)
floatplane	366 m (1,200 ft)
T-O to 15 m (50 ft): landplane	406 m (1,330 ft)
floatplane	580 m (1,900 ft)
Range with max fuel:	
landplane	757 n miles (1,402 km; 871 miles)
floatplane	652 n miles (1,207 km; 750 miles)
Endurance	7 h 30 min

INNOVATOR

INNOVATOR TECHNOLOGIES

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DIRECTOR/DESIGNER: John Uptigrove

Having originally been marketed as an open frame helicopter, the Innovator Mosquito was relaunched at Sun 'n' Fun, April 2004, with an enclosed cabin and structure as the Mosquito XE and XEL. A turbine-powered version is planned.

INNOVATOR MOSQUITO

TYPE: Single-seat ultralight helicopter kitbuilt.

PROGRAMME: First flight 2000 in form of unenclosed frame with tripod landing gear; total 130 hours of airborne time by July 2003. Holds Canadian amateur-builder's certificate of airworthiness. In March 2004, a prototype of an enclosed version, subsequently named Mosquito XE, was flown. This retained the tricycle landing gear, but a production-representative machine with twin skids was shown at the public launch at Sun 'n' Fun, Lakeland, Florida in April 2004. A turbine version powered by a Solar engine was due to fly in mid-2006.

CURRENT VERSIONS: **Mosquito Air:** Original, unenclosed version.

Mosquito XE: Enclosed version; marketed from 2004; meets FAA Experimental criteria.

Mosquito XEL: Ultralight float-equipped version of XE.

CUSTOMERS: By April 2006, 43 kits had been sold of which 28 were of the original unenclosed version; 15 had flown by that date.

COSTS: Kit USD28,500; or USD26,500 upon evidence of helicopter flying instruction; enclosed version; unenclosed version USD24,000 (2006). Floats USD1,000 extra.

DESIGN FEATURES: To FAR Pt 103 regulations. Vertically mounted engine driving main rotor via toothed belt as second-stage reduction gear. Tailboom supported by V strut.

Semi-rigid main rotor. Unique control system: main rotor control from floor-mounted stick and collective through control mixer at base of main mast, then through push tubes in main mast to base of swashplate; last-mentioned is contained within mast and supported by a pushrod in rotor shaft. Control rods each side of pushrod transmit inputs through rotor shaft to control lever on top of main shaft and down to blade pitch horns through pitch links. Tail rotor controlled by foot pedals through Bowden cable to actuating lever on tail rotor shaft.

Unenclosed version of Innovator Mosquito *(Paul Jackson)* 1159048

Prototype Innovator Mosquito XE Turbine before installation of engine and rotors *(Paul Jackson)* 1159049

Main rotor speed 520 rpm; tail rotor 2,500 rpm. Quoted build time 200 hours.

STRUCTURE: Frame of 6061-T6 aluminium; glass fibre tripod landing gear replaced by twin skids from 2004; carbon fibre tailboom and V struts. Composites cabin. Main rotor blades constructed upon aluminium spar bonded to wrapped aluminium sheet skin; foam sealer plugs both ends. Titanium main gearbox; aluminium fuel tanks.

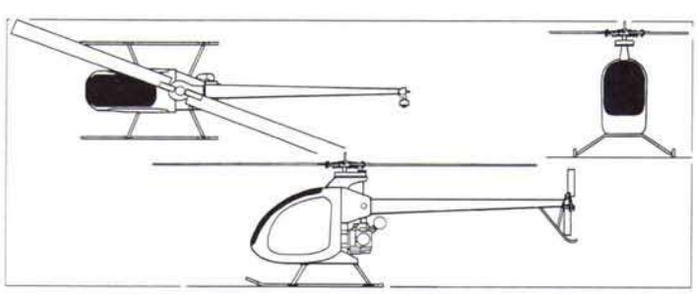
LANDING GEAR: XE has twin skids of bolted metal tube with wire bracing. Floats optional.

POWER PLANT: One 44.7 kW (60 hp) Zanzottera MZ202 two-cylinder two-stroke with electric starter and directly attached primary reduction gear. Centrifugal clutch and overspeed provision during autorotation. Flexible couplings and flexible driveshaft transmit power to tail rotor. Total fuel 19 litres (5.0 US gallons; 4.2 Imp gallons) in two tanks in Mosquito and Mosquito XEL; 45 litres (12.0 US gallons; 10.0 Imp gallons) in Mosquito XE.

SYSTEMS: 12 V DC battery, 180W alternator.

DIMENSIONS, EXTERNAL (A: Mosquito; B: Mosquito XE; C: Mosquito XEL):

Main rotor diameter: A	5.49 m (18 ft 0 in)
B, C	5.94 m (19 ft 6 in)
Tail rotor diameter: all	1.02 m (3 ft 4 in)
Length: frame: all	4.88 m (16 ft 0 in)
overall (excl main rotor): A	6.10 m (20 ft 0 in)
Max width: all	1.83 m (6 ft 0 in)



Innovator Mosquito XE *(Paul Jackson)* 1128973

Height overall: A ..... 2.11 m (6 ft 11 in)
B, C ..... 2.13 m (7 ft 0 in)
WEIGHTS AND LOADINGS:
Weight empty: A ..... 115 kg (254 lb)
B ..... 135 kg (298 lb)
C ..... 142 kg (312 lb)
Max T-O weight: A ..... 240 kg (530 lb)
B, C ..... 277 kg (610 lb)
PERFORMANCE:
Max level speed: A ..... 61 kt (113 km/h; 70 mph)
B, C ..... 65 kt (121 km/h; 75 mph)
Cruising speed ..... 56 kt (105 km/h; 65 mph)
Hovering ceiling: IGE: all ..... 2,440 m (8,000 ft)
OGE: A ..... 1,830 m (6,000 ft)
B, C ..... 1,980 m (6,500 ft)

MURPHY

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PRESIDENT: Darryl Murphy
SALES MANAGER: Stéphane Marois
MARKETING MANAGER: Dean Mueller

Formed in 1985, the company moved from initial 745 m² (8,000 sq ft) plant to new 4,925 m² (53,000 sq ft) premises in 1995 to accommodate increase in business. In mid-2000, Murphy opened a fast-build factory in the Philippines, which employs 40 staff to produce Mooses and float kits; by end 2002, five aircraft per month were being delivered. Subassemblies are built from Canadian parts which are then shipped back.

In 2005 the Canadian workforce numbered 22.

On 31 December 2004, more than 210 Murphy kitbuilt aircraft were currently registered in Canada.

MURPHY RENEGADE II

TYPE: Tandem-seat ultralight biplane kitbuilt.

PROGRAMME: Prototype Renegade II made first flight May 1985; first kits became available September that year. Ready assembled aircraft, plans and kits are available.

CUSTOMERS: By end-2005, 702 Renegade IIs and Renegade Spirit kits had been sold.

COSTS: Quick-build kit USD14,040; full materials kit USD9,880; partial parts kit USD3,744; plans USD376 (2006 prices).

DESIGN FEATURES: Sporting biplane of classic configuration. Conforms to TP101.41 ultralight regulations in Canada and some European countries. Optional wingtip extensions (for countries such as UK requiring lower wing loadings) increase gross area to 15.83 m² (170.4 sq ft). Optional extended wings and rounded tips; optional floats and parachute.

NACA 23012 wing section; 10° sweepback on upper wings; 3° dihedral on non-swept lower wings. Angle of incidence for both wings of 4°.

Kits in four standards ranging from partial parts kit to 300/400 working hour quick-build kit with all parts premanufactured plus partly assembled fuselage, wings and engine mounting.

FLYING CONTROLS: Conventional and manual. Differentially rigged Frise ailerons.

STRUCTURE: Fabric-covered aluminium tubing; rear fuselage top-decking of preformed glass fibre; two-spar wings have aluminium sheet leading-edges; glass fibre wingtips optional; wire-braced tail assembly.

LANDING GEAR: Tailwheel type; fixed. Two faired-in side Vs hinged to lower longerons, plus half-axles sprung under centreline with bungee cord. Tailwheel steerable.

POWER PLANT: One 34.0 kW (45.6 hp) Rotax 503 UL-1V two-cylinder two-stroke engine standard; 37.0 kW (49.6 hp) twin-carburettor Rotax 503 UL-2V optional. Alternative engines up to 59.6 kW (80 hp) can be fitted, including Rotax 582 and Teledyne Continental O-65, O-75 and O-85. Fuel capacity 53 litres (14.0 US gallons; 11.6 Imp gallons).

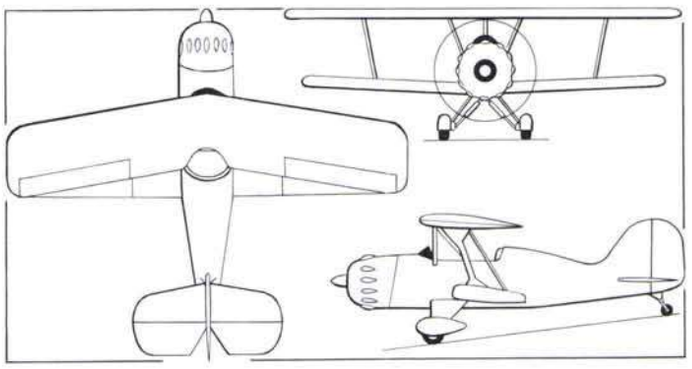
DIMENSIONS, EXTERNAL:
Wing span (normal): upper ..... 6.48 m (21 ft 3 in)
lower ..... 6.05 m (19 ft 10 in)
Length overall ..... 5.61 m (18 ft 5 in)
Height overall ..... 2.08 m (6 ft 10 in)
AREAS:
Wings, gross ..... 14.29 or 15.83 m² (153.8 or 170.4 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 170–236 kg (375–520 lb)
Max T-O weight, Rotax 503 ..... 431 kg (950 lb)
PERFORMANCE (Rotax 503 engine and two crew):
Never-exceed speed (VNE) ..... 104 kt (193 km/h; 120 mph)
Max level speed at 305 m (1,000 ft) ..... 70 kt (129 km/h; 80 mph)
Cruising speed at 75% power ..... 56 kt (105 km/h; 65 mph)
Stalling speed, power off ..... 33 kt (61 km/h; 38 mph)
Max rate of climb at S/L ..... 152 m (500 ft)/min
T-O and landing run ..... 92 m (300 ft)
Range at 75% power ..... 197 n miles (365 km; 227 miles)

MURPHY RENEGADE SPIRIT

TYPE: Tandem-seat ultralight biplane kitbuilt.

PROGRAMME: First flight (C-IJLW) 6 May 1987; kit production began a month later.

Murphy Renegade Spirit *(Paul Jackson)* 1159050



Murphy Renegade Spirit *(James Goulding)* 1047838

DESIGN FEATURES: Heavier variant of Renegade II, distinguished by round, helmeted cowling chosen by most builders. Alternative, more powerful, power plants; internal and external refinements.

COSTS: Fast-build kit USD16,754; materials kit USD11,733; partial parts kit USD4,457; plans USD376 (2006).

POWER PLANT: One 47.8 kW (64.1 hp) Rotax 582 in-line engine standard, in radial-type cowling; 59.7 kW (80 hp) Rotax 912 flat-four or Alvis rotary engine optional.

DIMENSIONS, EXTERNAL: As for Renegade II

AREAS: As for Renegade II

WEIGHTS AND LOADINGS:
Weight empty ..... 190–227 kg (420–500 lb)
Max T-O weight ..... 431 kg (950 lb)

PERFORMANCE (two crew and Rotax 582 engine):
As for Renegade II except:
Max level speed ..... 78 kt (145 km/h; 90 mph)
Cruising speed at 75% power ..... 63 kt (116 km/h; 72 mph)
Stalling speed ..... 35 kt (64 km/h; 40 mph)
Max rate of climb at S/L ..... 152 m (500 ft)/min
T-O and landing run ..... 107 m (350 ft)
Range at 75% power ..... 206 n miles (381 km; 237 miles)

MURPHY REBEL

TYPE: Three-seat kitbuilt.

PROGRAMME: Construction of prototype started October 1989; first flight 1990; building of production aircraft/kits began in October 1990. Rebel Elite introduced in 1996.

CURRENT VERSIONS: **Rebel:** Standard version, *as described.*

Rebel Elite: Modified tricycle landing gear version, with metal-covered split flaps and fin of increased chord; O-320 or optional 134 kW (180 hp) Lycoming O-360 engine; and increased maximum T-O weight to 816 kg (1,800 lb). First flight (C-FWSF) 29 February 1996.

Super Rebel and Maverick: *Described separately.*

CUSTOMERS: Some 806 complete aircraft or kits (including 82 Elites) ordered by 1 September 2005; over 513 then flying.

COSTS: Rebel kit without engine USD16,647; Elite kit without engine USD23,413 tailwheel, USD24,595 tricycle (2006). Available in three sub-component kits.

DESIGN FEATURES: High-wing, cabin monoplane for recreational, training, cross-country, border patrol and other roles; designed to conform to FAR Pt 23 and JAR (Utility category); STOL performance. Optional fin fillet required for floatplane version. Wings braced by single streamline strut each side (no intermediate struts); wings detachable and horizontal tail folds upward for transportation and storage. Quoted build time 800 to 1,000 hours.

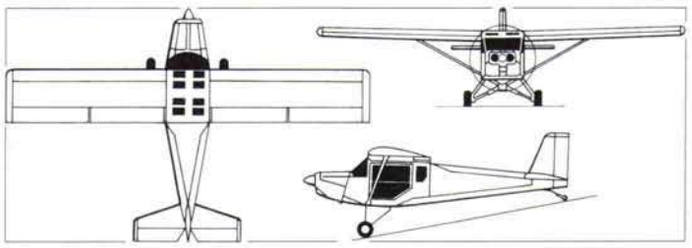
NACA 4415 (modified) wing section.

FLYING CONTROLS: Conventional and manual. Flaps. Elite has split flaps which droop up to 18° in 6° increments; metal-covered ailerons and cantilevered horizontal stabiliser.

STRUCTURE: Aluminium alloy, semi-monocoque fuselage; flaperons fabric covered; three-spar wings covered in aluminium sheet glass fibre wingtips. Tailplane also strut-braced and is symmetrical. Rebel Elite wing leading-edge 60 per cent thicker than Rebel.

LANDING GEAR: Tailwheel type; fixed. Optional tricycle gear (Rebel Elite), skis, or Murphy 1500 or 1800 straight or wheeled or Montana 2100 wheeled floats. 6.00-6 wheels with 18 in high-profile tyres are standard. Standard mainwheel configuration of two faired-in side Vs hinged to lower longerons, plus half-axles, each with bungee cord shock-absorber, attached to compression frame; optionally, fuselage-mounted aluminium cantilever mainwheel legs with optional wheel fairings.

Murphy Rebel flown in Australia *(Paul Jackson)* 1159051



Murphy Rebel *(Paul Jackson)*

POWER PLANT: One 59.6 kW (79.9 hp) Rotax 912 UL, or 86.5 kW (116 hp) Textron Lycoming O-235-N2C engine; 2.27:1 reduction gear with Rotax engine and direct drive with O-235. Elite has 119 kW (160 hp) Lycoming O-320; or optional 134 kW (180 hp) Lycoming O-360; ground-adjustable wooden two-blade propeller; three-blade propeller optional. At AirVenture '06, July 2006, the 82 kW (110 hp) Rotec 2800 seven-cylinder radial engine was added to the Rebel options. Standard fuel capacity 167 litres (44.0 US gallons; 36.6 Imp gallons) in wing tanks; optional extra 220 litre (58.0 US gallon; 48.3 Imp gallon) tank.

ACCOMMODATION: Pilot and two passengers. Door on each side of cabin, half- or fully glazed. Most aircraft feature rear quarterlights for third occupant.

DIMENSIONS, EXTERNAL:

Wing span: Rebel	9.14 m (30 ft 0 in)
Elite	9.25 m (30 ft 4 in)
Wing chord, constant	1.52 m (5 ft 0 in)
Wing aspect ratio	6.0
Length overall: Rebel	6.50 m (21 ft 4 in)
Elite	6.78 m (22 ft 3 in)
Fuselage max width	1.12 m (3 ft 8 in)
Height overall: Rebel, Elite (tailwheel)	2.03 m (6 ft 8 in)
Elite (tricycle)	2.39 m (7 ft 10 in)
Tailplane span	2.79 m (9 ft 2 in)
Wheel track: Rebel	2.18 m (7 ft 2 in)
Elite	2.32 m (7 ft 7½ in)
Wheelbase: Rebel, Elite (tailwheel)	4.93 m (16 ft 2 in)
Elite (tricycle)	1.70 m (5 ft 7 in)
Propeller diameter	1.78 m (5 ft 10 in)

AREAS:

Wings, gross: Rebel	13.94 m² (150.0 sq ft)
Elite	14.12 m² (152.0 sq ft)

WEIGHTS AND LOADINGS (A: Rotax 912, B: O-235, E: Elite, O-360):

Weight empty: A	295–317 kg (650–700 lb)
B	374–408 kg (825–900 lb)
E	445 kg (980 lb)
Baggage capacity	45.5–68 kg (100–150 lb)
Max T-O weight: A	657 kg (1,450 lb)
B	748 kg (1,650 lb)
E	816 kg (1,800 lb)
Max wing loading: A	47.2 kg/m² (9.67 lb/sq ft)
B	53.7 kg/m² (11.00 lb/sq ft)
E	57.8 kg/m² (11.84 lb/sq ft)
Max power loading: A	11.03 kg/kW (18.13 lb/hp)
B	8.66 kg/kW (14.22 lb/hp)
E	6.09 kg/kW (10.00 lb/hp)

PERFORMANCE (A, B, E as above):

Never-exceed speed (VNE):	
A	124 kt (230 km/h; 143 mph)
B	131 kt (243 km/h; 151 mph)
E	136 kt (252 km/h; 157 mph)
Max level speed: A	87 kt (162 km/h; 100 mph)
B	108 kt (201 km/h; 125 mph)
E	126 kt (233 km/h; 145 mph)
Cruising speed at 75% power:	
A	78 kt (145 km/h; 90 mph)
B	100 kt (185 km/h; 115 mph)
E	115 kt (212 km/h; 132 mph)
Stalling speed, power off, flaps up:	
A	35 kt (65 km/h; 40 mph)
B	39 kt (71 km/h; 44 mph)
E	40 kt (74 km/h; 46 mph)
Stalling speed, power off, flaps down:	
A	32 kt (58 km/h; 36 mph)
B	35 kt (65 km/h; 40 mph)
E	37 kt (68 km/h; 42 mph)
Max rate of climb at S/L: A	164 m (500 ft)/min
B	244 m (800 ft)/min
E	457 m (1,500 ft)/min
Service ceiling: B	3,960 m (13,000 ft)
T-O run: A	137 m (450 ft)
B	122 m (400 ft)
E	143 m (470 ft)
T-O to 15 m (50 ft): A, B	244 m (800 ft)
Landing run: A	92 m (300 ft)
B, E	122 m (400 ft)
Range with max fuel:	
A	764 n miles (1,416 km; 880 miles)
B	691 n miles (1,281 km; 796 miles)
E	593 n miles (1,099 km; 683 miles)
Endurance: B	7 h 36 min
E	5 h 12 min
g limits	+3.8/–2.5
	(+5.7/–3.8 ultimate)

MURPHY SUPER REBEL and MOOSE

TYPE: Six-seat kitbuilt.

PROGRAMME: Announced April 1995; prototype Super Rebel (then designated SR 2500) (C-GKSR), with initial MTOW of 1,134 kg (2,500 lb), first flew November 1995; parts shipments began in late 1995 with tail sections. Tricycle version first flew May 1997.

Murphy Moose floatplane *(Paul Jackson)* 1159052

Aerotek T-Moose turboprop conversion *(Paul Jackson)* 1159053

Murphy Super Rebel six-seat kitbuilt *(Paul Jackson)* 1159054

Increased gross weight Moose (originally SR 3500) introduced at Sun 'n' Fun 2001; prototype converted from Super Rebel demonstrator C-GBZD.

CURRENT VERSIONS: **Super Rebel:** Standard version.

Moose: Increased gross weight version, first flown 2 April 2001 (VOKBM engine); choice of two power plants. Tailwheel version only.

T-Moose: Turbine conversion by Aerotek Aviation (www.aerotekaviation.ca) employing overhauled, ex-military Pratt & Whitney Canada T74-CP700 (PT6-20) derated to 336 kW (450 shp) from 410 kW (550 shp). Engine kit cost USD94,500, excluding MT-Propeller or Hartzell constant-speed propeller. Also requires airframe reinforcement, increase in wing fuel capacity to 606 litres (160 US gallons; 133 Imp gallons) and installation of 19 litre (5.0 US gallon; 4.2 Imp gallon) header tank.

Prototype C-FDBN, on Wipline 4000 amphibious floats, first flew 5 July 2005 and exhibited at AirVenture, Oshkosh, later that month. Weight empty 925 kg (2,040 lb); cruising speed 135 kt (249 km/h; 155 mph).

CUSTOMERS: Some 299 of both versions sold by September 2005.

COSTS: *Super Rebel:* Basic kit less engine, propeller, instruments and avionics; tailwheel version USD26,500; tricycle version USD28,000 (2006).

Moose: Basic kit, less engine, propeller, instruments and avionics, USD36,516 (2006). Fast-build kit extra USD18,258.

T-Moose: Firewall forward package USD94,500 (2006).

DESIGN FEATURES: Development of Murphy Rebel (which see). All-metal construction. Quoted build time 1,400 to 1,800 hours. Fast-build kits had quoted build time of 800–1,000 hours; however, in 2004 company announced that improvements in some 70 components had reduced times by over 200 hours.

FLYING CONTROLS: Conventional and manual. Horn-balanced tail surfaces. Electric trim and three-stage (0, 18, 33°) flaps; ailerons deflect 20° up and 12° down; ailerons droop 12° when 33° flap deployed.

STRUCTURE: Wing is identical in shape to that of Rebel and Elite; aerofoil modified NACA 4415. Three-spar wing; leading-edge of 0.032 sheet aluminium.

LANDING GEAR: Tailwheel configuration is standard; tricycle also available. Optional hardpoints enable rapid conversion. Main and nose tyres 8.00-6 in; tailwheel has 9 in tyre. Dual brakes. Optional 3600 series floats.

POWER PLANT: *Super Rebel:* Prototype has 186 kW (250 hp) Textron Lycoming O-540-A4A5 driving two-blade (three-blade optional) constant-speed Hartzell propeller, but design accommodates engines from 134 to 224 kW (180 to 300 hp). Fuel in two wing tanks, total capacity 227 litres (60.0 US gallons; 50.0 Imp gallons). Optional larger tanks increase capacity by further 303 litres (80.0 US gallons; 66.6 Imp gallons).

Moose: Choice of 186 kW (250 hp) Textron Lycoming IO-540 or 265 kW (355 hp) VOKBM M-14P radial, latter driving two-blade wooden propeller. Fuel capacity as Super Rebel.

ACCOMMODATION: Pilot and up to five passengers in two pairs of side-by-side seats plus optional jump seat; dual controls. Rear bench seat can be removed to provide cargo capacity. Baggage compartment is reached by large cargo door on port side of fuselage, behind passenger door.

DIMENSIONS, EXTERNAL:

Wing span	10.97 m (36 ft 0 in)
Wing chord, constant	1.52 m (5 ft 0 in)
Wing aspect ratio	7.1
Length overall	7.01 m (23 ft 0 in)
Fuselage max width	1.12 m (3 ft 8 in)

Height overall: tailwheel ..... 1.98 m (6 ft 6 in)
tricycle ..... 2.67 m (8 ft 9 in)
Tailplane span ..... 3.30 m (10 ft 10 in)
Wheel track ..... 2.29 m (7 ft 6 in)
Wheelbase: tailwheel ..... 5.94 m (19 ft 6 in)
tricycle ..... 2.03 m (6 ft 8 in)
Propeller diameter: Super Rebel ..... 2.13 m (7 ft 0 in)
Moose with M-14P engine ..... 2.39 m (7 ft 10 in)
Passenger door: Height ..... 1.07 m (3 ft 6 in)
Width ..... 1.07 m (3 ft 6 in)
Baggage door: Height ..... 0.83 m (2 ft 8½ in)
Width ..... 0.93 m (3 ft 0½ in)

DIMENSIONS, INTERNAL:
Cabin: Length ..... 3.05 m (10 ft 0 in)
Max width ..... 1.12 m (3 ft 8 in)
Height ..... 1.30 m (4 ft 3 in)

AREAS:
Wings, gross ..... 16.91 m² (182.0 sq ft)
Ailerons (total) ..... 2.37 m² (25.50 sq ft)
Flaps (total) ..... 2.09 m² (22.50 sq ft)

WEIGHTS AND LOADINGS (Super Rebel with 186 kW; 250 hp engine, Moose with 265 kW; 355 hp engine):
Weight empty: Super Rebel ..... 748 kg (1,650 lb)
Moose ..... 816 kg (1,800 lb)
Baggage capacity ..... 113 kg (250 lb)
Max T-O weight: Super Rebel ..... 1,361 kg (3,000 lb)
Moose ..... 1,587 kg (3,500 lb)
Max wing loading:
Super Rebel ..... 80.5 kg/m² (16.48 lb/sq ft)
Moose ..... 93.9 kg/m² (19.23 lb/sq ft)
Max power loading:
Super Rebel ..... 7.30 kg/kW (12.00 lb/hp)
Moose ..... 6.00 kg/kW (9.86 lb/hp)

PERFORMANCE (engines as before):
Never-exceed speed (VNE):
Super Rebel ..... 153 kt (284 km/h; 177 mph)
Moose ..... 164 kt (304 km/h; 189 mph)
Max level speed:
Super Rebel ..... 139 kt (257 km/h; 160 mph)
Moose ..... 152 kt (282 km/h; 175 mph)
Max cruising speed at 70% power:
Super Rebel ..... 126 kt (233 km/h; 145 mph)
Moose ..... 135 kt (249 km/h; 155 mph)
Stalling speed, power off:
flaps up: Super Rebel ..... 46 kt (84 km/h; 52 mph)
Moose ..... 49 kt (91 km/h; 56 mph)
flaps down: Super Rebel ..... 40 kt (74 km/h; 46 mph)
Moose ..... 44 kt (81 km/h; 50 mph)
Max rate of climb at S/L:
Super Rebel ..... 305 m (1,000 ft)/min
Moose ..... 457 m (1,500 ft)/min
Service ceiling ..... 4,575 m (15,000 ft)
T-O run: Super Rebel, Moose ..... 183 m (600 ft)
Landing run: Super Rebel ..... 152 m (500 ft)
Moose ..... 183 m (600 ft)
Range:
with max standard fuel:
Super Rebel ..... 537 n miles (996 km; 619 miles)
Moose ..... 521 n miles (965 km; 600 miles)
with optional larger tanks:
Super Rebel ..... 729 n miles (1,350 km; 839 miles)
Endurance: Super Rebel ..... 4 h 15 min
Moose ..... 4 h 0 min
g limits (ultimate): both ..... +5.7/–3.8

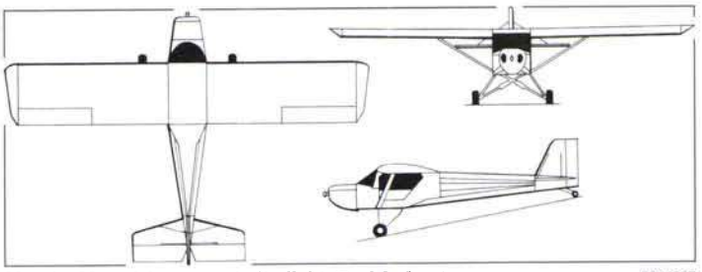
MURPHY MAVERICK

TYPE: Side-by-side ultralight kitbuilt.

PROGRAMME: Original design shelved in favour of Rebel, but revived in 1994 to meet Japanese ultralight restrictions; prototype/demonstrator G-MYSS used to gain UK BCAR Section S type approval in 1995.

CUSTOMERS: Total of 107 completed and flown by late 2005, at which time 135 kits had been sold.

COSTS: Kit: USD15,036 without engine (2006).



Murphy Maverick two-seat ultralight *(Paul Jackson)* 0064887

DESIGN FEATURES: Derivative of Rebel, with 40 per cent commonality of parts, including optional wingtip extensions.

FLYING CONTROLS: As Rebel, except cable-operated ailerons only instead of full-span flaperons.

STRUCTURE: Similar to Rebel, but with weight-saving features. Wings omit full-span stringers and are fabric covered; glass fibre engine cowling; tail surfaces also fabric covered.

LANDING GEAR: As Rebel.

POWER PLANT: One two-cylinder two-stroke engine (39.5 kW; 53 hp Rotax 503 DC or 47.8 kW; 64.1 hp Rotax 582 UL); GSC 68GA two-blade propeller. Testing with Hpower HKS-700E four-stroke engine completed in November 1999. Fuel capacity 18.9 litres (5.0 US gallons; 4.2 Imp gallons) standard, 53 litres (14.0 US gallons; 11.7 Imp gallons) in optional wing tanks.

DIMENSIONS, EXTERNAL:
Wing span: standard ..... 8.97 m (29 ft 5 in)
with extended tips ..... 9.88 m (32 ft 5 in)
Length overall, tail up ..... 6.30 m (20 ft 8 in)

AREAS:
Wings, gross: standard ..... 13.66 m² (147.0 sq ft)
with extended tips ..... 15.05 m² (162.0 sq ft)

WEIGHTS AND LOADINGS (standard span and Rotax 503 DC engine):
Weight empty ..... 179–191 kg (395–420 lb)
Max T-O weight ..... 431 kg (950 lb)

PERFORMANCE (standard span and Rotax 503 DC engine):
Max level speed ..... 82 kt (153 km/h; 95 mph)
Cruising speed at 75% power ..... 70 kt (129 km/h; 80 mph)
Stalling speed ..... 28 kt (52 km/h; 32 mph)
Max rate of climb at S/L ..... 183 m (600 ft)/min
T-O run ..... 46 m (150 ft)
Landing run ..... 61 m (200 ft)
Range with max fuel at 75% power ..... 243 n miles (450 km; 280 miles)
g limits ..... +5.7/–3.8

MURPHY JDM-8

TYPE: Single-seat ultralight kitbuilt.

PROGRAMME: Design commenced December 1998; initially shown in uncompleted form at Oshkosh in 2000. Prototype (C-IGTD) first flown 30 March 2001 and made public debut at Sun 'n' Fun the following month as 'conceptual' design to evaluate market response. Launched at AirVenture, Oshkosh, July 2001.

Following a customer survey undertaken in March 2003, the US legal ultralight production was superseded by the development of a homebuilt/advanced ultralight version. A decision to launch production had not been made by January 2006.

CUSTOMERS: Two prototypes registered by September 2003: one FAR Pt 103 compliant ultralight (C-IGTD) and one homebuilt/advanced ultralight example (C-IBFZ).

COSTS: Projected cost USD8,495 excluding engine and chemical agents.

DESIGN FEATURES: Murphy's first low-wing design. Wings fold upwards for storage. Enclosed cockpit optional.

FLYING CONTROLS: Conventional and manual. No aerodynamic balancing. Frise ailerons.

STRUCTURE: Semi-monocoque fuselage and constant-chord wings covered with aluminium sheet; wings comprise three C-channel spars and have NACA 4415 section. Ailerons have aluminium ribs; aluminium tube empennage with wire bracing; control surfaces fabric-covered.

LANDING GEAR: Tailwheel type; fixed. Standard two side Vs hinged to wingroots, plus half-axles, each with bungee cord shock-absorber; optional 4130 spring steel circular tube cantilever legs. 12.7 cm (5 in) mainwheels with 8.00-6 tyres and 8.8 cm (3½ in) tailwheel. Sealed ball bearings. Hydraulic brakes.

POWER PLANT: Design accepts most two- and four-stroke engines in the 37.3 to 59.7 kW (50 hp to 80 hp) range. Fuel capacity 75.7 litres (20.0 gallons; 16.7 Imp gallons). Optional 34 litre (9.0 US gallon; 7.5 Imp gallon) wing tanks.

Murphy Maverick built by a UK owner *(Paul Jackson)* 0589435

Murphy JDM-8 second prototype *(Paul Jackson)* 1042679

DIMENSIONS, EXTERNAL:
- Wing span ..... 6.10 m (20 ft 0 in)
- Width, wings folded ..... 2.44 m (8 ft 0 in)
- Length overall ..... 4.47 m (14 ft 8 in)
- Height overall ..... 1.63 m (5 ft 4 in)

DIMENSIONS, INTERNAL:
- Cabin max width ..... 0.66 m (2 ft 2 in)

AREAS:
- Wings, gross ..... 9.29 m² (100.0 sq ft)

WEIGHTS AND LOADINGS (44.7 kW; 60 hp HKS-700E):
- Weight empty ..... 136–204 kg (300–450 lb)
- Max T-O weight ..... 353 kg (780 lb)

PERFORMANCE:
- Never-exceed speed (VNE) ..... 100 kt (185 km/h; 115 mph)
- Normal cruising speed ..... 78 kt (145 km/h; 90 mph)
- Stalling speed ..... 31 kt (57 km/h; 35 mph)
- Max rate of climb at S/L ..... 305 m (1,000 ft)/min
- T-O run ..... 53 m (175 ft)
- Landing run ..... 91 m (300 ft)
- Endurance ..... 5 h
- g limits ..... ±3.8

MURPHY YUKON

TYPE: Four-seat kitbuilt.

PROGRAMME: Announced early 2006, when prototype under construction.

COSTS: Kit tailwheel USD34,995, nosewheel USD36,600 (2006).

DESIGN FEATURES: High-wing cabin monoplane, development of Rebel family, fitting in size between Rebel and Super Rebel. Wings braced by single strut each side.

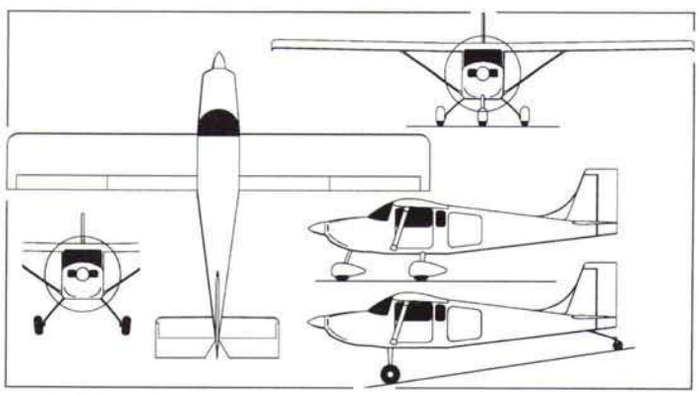
FLYING CONTROLS: Conventional and manual. Horn-balanced tail surfaces. Electric trim and flaps.

STRUCTURE: Aluminium alloy, semi-monocoque fuselage. Glass fibre tailplane fairing. Downturned wingtips.

LANDING GEAR: Fixed; choice of tailwheel or tricycle. Fuselage-mounted, spring aluminium cantilever mainwheel legs. Mainwheel tyres 8.0-6 in. Dual caliper disc brakes.

POWER PLANT: One 134 kW (180 hp) Textron Lycoming O-360. Standard fuel capacity 227 litres (60.0 US gallons; 50.0 Imp gallons) in two wing tanks; optional tanks increase capacity to 303 litres (80.0 US gallons; 66.6 Imp gallons).

ACCOMMODATION: Pilot and three passengers; individual front seats and rear bench seat. Cargo door on port side of fuselage behind cabin. Optional bubble windows.



Murphy Yukon tricycle variant, with additional side view and scrap nose view of tailwheel option *(Paul Jackson)* 1128974

DIMENSIONS, EXTERNAL:
- Cargo door: Height ..... 0.91 m (3 ft 0 in)

AREAS:
- Wings, gross ..... 17.65 m² (190.0 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty ..... 635 to 658 kg (1,400 to 1,450 lb)
- Max T-O weight ..... 1,156 kg (2,550 lb)
- Max wing loading ..... 65.5 kg/m² (13.42 lb/sq ft)
- Max power loading ..... 8.62 kg/kW (14.17 lb/hp)

PERFORMANCE:
- Never exceed speed (VNE) ..... 153 kt (284 km/h; 177 mph)
- Max operating speed ..... 122 kt (225 km/h; 140 mph)
- Cruising speed at 75% power ..... 113 kt (209 km/h; 130 mph)
- T-O run ..... 122 m (400 ft)
- Landing run ..... 153 m (500 ft)
- Range, standard fuel ..... 760 n miles (1,408 km; 875 miles)
- Endurance ..... 7 h 0 min
- g limits ..... +5.9/–3.8

NORDIC

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Previous products of Nordic have been the I, II, III, IV, V, VI and VII, of which II and VI versions remain available. Most recent addition is the Nordic 8 *(sic)*.

NORDIC 8 MINI EXPLORER

TYPE: Side-by-side ultralight kitbuilt.

PROGRAMME: Mini Explorer is third, and smallest, of a series of similar concept aircraft, begun with the twin-engined Explorer, produced by Hubert DeChevigny and Dean Wilson (the latter, designer of the Avid Flyer and other light aircraft). The single-engined Private Explorer (14.40 m; 47 ft 3 in span, 1,860 kg; 4,102 lb MTOW) flew in 1998 and was marketed as a kit from Idaho, USA. The sixth of the type was registered in Canada during September 2003.

First Mini Explorer (C-IGXF) was registered in November 2001; marketing began 2002. European marketing proceeding in parallel; first French-built aircraft was noted in 2003.

CUSTOMERS: At least four built in Canada and one in France by April 2006.

COSTS: Kit CAD34,500 less engine (2006).

DESIGN FEATURES: Rugged construction, with deep and wide fuselage to provide sleeping accommodation.

High, constant-chord wing with V bracing struts each side. Quoted build time 500 hours.

FLYING CONTROLS: Conventional and manual.

STRUCTURE: 4130 steel fuselage frame with fabric covering; wooden wings with geodesic ribs.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted cantilever mainwheel legs; levered nosewheel with helical spring shock-absorber.

POWER PLANT: One flat-four piston engine: 73.5 kW (98.6 hp) Rotax 912 ULS or 84.5 kW (113.3 hp) Rotax 914 UL. Fuel capacity 106 litres (28.0 US gallons; 23.3 Imp gallons).

ACCOMMODATION: Two persons, side by side. Floor to rear with space for (typically) utensil storage cupboard and hand-basin, plus bed.

DIMENSIONS, EXTERNAL:
- Wing span ..... 10.97 m (36 ft 0 in)
- Wing chord (constant) ..... 1.52 m (5 ft 0 in)
- Wing aspect ratio 7.2
- Length overall ..... 6.40 m (21 ft 0 in)
- Height overall ..... 1.47 m (4 ft 10 in)

DIMENSIONS, INTERNAL:
- Cabin: Max width ..... 1.22 m (4 ft 0 in)
- Floor area ..... 3.72 m² (40.0 sq ft)

Nordic/Euro Fly Aero Mini Explorer registered in the French ultralight series *(Geoffrey P Jones)* 0572154

AREAS:
Wings, gross ..... 16.72 m² (180.0 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 297 kg (654 lb)
Max T-O weight ..... 558 kg (1,232 lb)
PERFORMANCE:
Never-exceed speed (VNE) ..... 113 kt (209 km/h; 130 mph)
Cruising speed at FL50 ..... 74 kt (137 km/h; 85 mph)
Stalling speed ..... 33 kt (62 km/h; 38 mph)
Max rate of climb at S/L (solo) ..... 259 m (850 ft)/min
Service ceiling ..... 3,050 m (10,000 ft)
T-O run ..... 92 m (300 ft)
Landing run ..... 61 m (200 ft)
Range ..... 680 n miles (1,259 km; 782 miles)
Endurance ..... 7 h

RAF

ROTARY AIR FORCE MARKETING INC

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Web: www.raf2000.com
PRESIDENT: Don LaFleur

Incorporated in 1987, Rotary Air Force employs 14 people.

In May 2001, RAF announced that it would be expanding its activities into commercial applications, including agricultural spraying and paramilitary functions.

Since 2005, all RAF autogyros have been fitted with a stabilator as a safety aid.

RAF 2000

TYPE: Two-seat autogyro kitbuilt.

PROGRAMME: Introduced 1990, superseding earlier RAF 1000, conforms to 51 per cent homebuilt rules.

CURRENT VERSIONS: **2000 STD-SE:** Original version; no longer available.

2000 GTX-SE: Basic model; kit includes carburated version of engine, rotor brake, heater, dual controls and adjustable pitch and roll trim assembly.

Data refer to this version unless otherwise stated.

2000 GTX-SE FI: Fuel-injected version of GTX; choice of Subaru EJ22 or EJ25 engine.

CUSTOMERS: RAF autogyros sold in 46 countries. At least 630 believed completed and flown by end 2005, including 257 in North America.

COSTS: 2000 GTX-SE kit price USD24,900, including Subaru EJ22 engine (carb version); 2000 GTX-SE FI USD27,900, including injected Subaru EJ22; 2000 GTX-SE FI USD31,500, including fuel-injected Subaru EJ25 (all 2006).

DESIGN FEATURES: Pusher autogyro. Suitable for training, crop-spraying, power line inspection, predator control, stock mustering and aerial photography. Quoted build time 150–250 hours.

From 2005, fitted as standard with rotor stabilator, designed by Duane Hunn Sr, comprising horizontal stabliser attached to rear of torque tube via linear actuator and mounted at mid-point of rotor mast. Responding to up- or down-draughts, stabilator automatically corrects rotor angle to provide high precision trim control. Input variable by control in cockpit; also functions as roll trim.

STRUCTURE: Composites RAF rotor blade features 6061-T6 aluminium spar and foam filler with 5 cm (2 in) Kevlar strip on leading edge. Patented 5 × 10 cm (2 × 4 in) folding (two-part) rotor mast, rubber mast bushing and adjustable CG. Removable doors.

LANDING GEAR: Tricycle type; fixed; optional tailwheel speed fairings.

POWER PLANT: One 97 kW (130 hp) Subaru EJ22 16-valve four-cylinder liquid-cooled engine driving a ground-adjustable three-blade Warp Drive composites propeller through RAF cog

Current configuration of RAF 2000 autogyro *(Paul Jackson)* 1159055

Hinged stabilator now standard on RAF 2000s to provide automatic gust response *(Paul Jackson)* 1129225

belt reduction gear, ratio 2.10:1. Fuel capacity 95 litres (25.0 US gallons; 20.8 Imp gallons), of which 87 litres (23.0 US gallons; 19.2 Imp gallons) usable; tanks moulded into seats. Fuel consumption carburated version 20.1 litres (5.3 US gallons; 4.4 Imp gallons)/h, injected version 18.2 litres (4.8 US gallons; 4.0 Imp gallons)/h, both at 80 per cent power.

ACCOMMODATION: Pilot and passenger side by side in enclosed cabin. Can be flown with doors removed.

SYSTEMS: 35 A alternator, electric starter.

EQUIPMENT: Agricultural version has 114 litre (30.0 US gallon; 25.0 Imp gallon) tank, moulded to fit into back and bottom of cabin enclosure, supplying a 24-nozzle spraybar fitted behind and below the engine. Spray width 6.7 to 7.3 m (22 to 24 ft).

DIMENSIONS, EXTERNAL:

Rotor diameter	9.14 m (30 ft 0 in)
Rotor blade chord	0.22 m (8½ in)
Fuselage: Length	4.11 m (13 ft 6 in)
Max width	1.08 m (3 ft 6½ in)
Width over wheels	1.59 m (5 ft 2½ in)
Height overall: GTX-SE	2.58 m (8 ft 5½ in)
Propeller diameter	1.73 m (5 ft 8 in)
Wheel track	1.55 m (5 ft 1 in)
Wheelbase	3.91 m (12 ft 10 in)

DIMENSIONS, INTERNAL:

Cabin: Length	1.50 m (4 ft 11 in)
Max Width	1.09 m (3 ft 7 in)
Max Height	1.32 m (4 ft 4 in)

AREAS:

Rotor disc	65.67 m² (706.9 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: GTX-SE	363 kg (800 lb)
Max T-O weight	698 kg (1,540 lb)
Max disc loading	10.6 kg/m² (2.18 lb/sq ft)
Max power loading	7.21 kg/kW (11.85 lb/hp)

PERFORMANCE, POWERED (two occupants):

Max operating speed (VMO)	87 kt (161 km/h; 100 mph)
Cruising speed: GTX-SE	65 kt (121 km/h; 75 mph)
Unstick speed	26–35 kt (48–64 km/h; 30–40 mph)
Min flying speed	17–26 kt (32–48 km/h; 20–30 mph)
Max rate of climb at S/L	305 m (1,000 ft)/min
Service ceiling	3,050 m (10,000 ft)
T-O run	23–107 m (75–350 ft)
Landing run	Up to 3 m (10 ft)
Range with max fuel:	
GTX-SE	261 n miles (483 km; 300 miles)
GTX-SE FI	313 n miles (579 km; 360 miles)
Endurance with 30 min reserves:	
standard fuel: GTX-SE	3 h 30 min
optional fuel: GTX-SE FI	4 h 18 min

PERFORMANCE, UNPOWERED:

Glide ratio	4:1

SMITH

SMITH AVIATION

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DIRECTORS: Nick Smith Sr
Nick Smith Jr

This company is one of several specialising in manufacture of kits for the Piper PA-18 Super Cub and PA-18-95 Cub Special. It also offers similar services for the Piper PA-11 Cub Special, PA-12/14 Super Cruiser and Bushmaster/Super Pacer version of PA-20, now known as Tundra Boss.

SMITH PIPER PA-18 SUPER CUB

TYPE: Two-seat lightplane.

PROGRAMME: Description of Piper PA-18 appears in Cub Crafters entry in US section of *Jane's All the World's Aircraft*. Smith version generally similar, although with customer options and some detail improvements and modifications.

COSTS: Kit USD31,500, excluding engine and avionics (2006).

SMITH TUNDRA BOSS

TYPE: Four-seat kitbuilt.

PROGRAMME: Assembly of prototype began January 2005.

CUSTOMERS: Three ordered by late 2005.

COSTS: Kit USD37,500.

DESIGN FEATURES: Based on fuselage of Piper Pacer, but 10 cm (4 in) wider (1.07 m; 3 ft 6 in) at the cockpit and with wing pickups raised 8.5 cm (3⅜ in) to give additional headroom for occupants and allow use of Piper Super Cub V-struts for extended Cub wings with longer flaps (2.03 m; 6 ft 8 in) and ailerons (2.90 m; 9 ft 6 in) and 6061-T6 metal main spar. Landing gear and empennage from Super Cub. Stronger structure for increased MTOW includes lower longerons of increased gauge.

FLYING CONTROLS: Conventional and manual.

STRUCTURE: Welded steel tube fuselage with metal floor; wing of stamped aluminium ribs mounted on metal spar with sheet aluminium leading-edge; both with fabric covering.

LANDING GEAR: Tailwheel type; fixed. Two faired-in side Vs hinged to lower longerons, each with bungee cord shock absorber attached to compression frame.

POWER PLANT: One piston engine. Textron Lycoming O-540 of 194 kW (260 hp) in prototype; 224 kW (300 hp) Teledyne Continental IO-550, 265 kW (355 hp) VOKBM M-14 radial and Innodyn turboprop also specified by individual customers.

Standard fuel capacity 182 litres (48.0 US gallons; 40.0 Imp gallons) in inboard wing tanks and two 38 litre (10.0 US gallon; 8.3 Imp gallon) fuselage tanks; optional outboard wing tanks with additional total of 136 litres (36.0 US gallons; 30.0 Imp gallons).

ACCOMMODATION: Four adults with option for two additional children in place of baggage.

DIMENSIONS, EXTERNAL:

Wing span	9.86 m (32 ft 4 in)

DIMENSIONS, INTERNAL:

Cabin: Max width	1.07 m (3 ft 6 in)
Length behind front seats	2.44 m (8 ft 0 in)

WEIGHTS AND LOADINGS:

Weight empty	average 635 kg (1,400 lb)
Max T-O weight	1,315 kg (2,900 lb)

PERFORMANCE:

Never-exceed speed (VNE)	152 kt (281 km/h; 175 mph)
Max level speed	130 kt (241 km/h; 150 mph)
Cruising speed at 75% power	113 kt (209 km/h; 130 mph)
T-O run	183 m (600 ft)

Smith Piper Super Cub fitted with an Innodyn turboprop with which it first flew on 20 July 2005 *(Paul Jackson)* 1129292

ST JUST

ST JUST AVIATION INC

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PRESIDENT: Guy Cantin
DIRECTOR: Albert Beaudry

Original Avionerrie du Lac St John formed in 1991 to provide parts for Cessna 185 owners after that company removed the aircraft from its product line; later progressed to manufacturing kits of the Cyclone. Sold to St Just Aviation in 1997. Approximately 40 now flying.

ST JUST SUPER CYCLONE

TYPE: Four-seat kitbuilt.

PROGRAMME: Introduced in 1997; based on reverse engineering of the Cessna 180/185 (which see in *Jane's Aircraft Upgrades*).

CUSTOMERS: Total 71 sold and 39 flying by January 2006, including 23 in Canada and two in US.

COSTS: Basic kit USD59,950 (2006).

DESIGN FEATURES: Compared to Cessna 180/185, Super Cyclone has span increased by addition of 30 cm (1 ft) at each wingroot, which increases flap length, lowers stalling speed, enhances stability and increases maximum T-O weight. Quoted build time 2,000 hours.

FLYING CONTROLS: Conventional and manual. Flaps.

STRUCTURE: Single-strut braced, two-spar wing with constant-chord centre-section and tapered outer sections. Wing and empennage constructed of 2024 T-3 aluminium; composites engine cowling. Large fin fillet. Low-mounted tailplane.

Seaplane version of St Just Super Cyclone

0137973

LANDING GEAR: Tailwheel type, with sprung steel main legs; Federal wheel/skis and floats can be fitted. Mainwheels 6.00-6.

POWER PLANT: One 224 kW (300 hp) Teledyne Continental IO-520, flat-six engine, driving a three-blade, constant-speed McCauley propeller. Optional alternative engines between 149 and 261 kW (200 and 350 hp). Fuel capacity 341 litres (90.0 US gallons; 75.0 Imp gallons), of which 318 litres (84.0 US gallons; 70.0 Imp gallons) are usable.

ACCOMMODATION: Pilot and three passengers in two pairs of seats with upward-hinged door on each side of cabin. Additional baggage door on port side of fuselage behind cabin. Compared to Cessna 185, has a third cabin window each side.

AVIONICS: Full IFR panel available.

DIMENSIONS, EXTERNAL:

Wing span	11.58 m (38 ft 0 in)
Wing aspect ratio	7.2
Length overall	7.92 m (26 ft 0 in)
Height overall	2.41 m (7 ft 11 in)
Propeller diameter	2.18 m (7 ft 2 in)

DIMENSIONS, INTERNAL:

Cabin max width	1.07 m (3 ft 6 in)

AREAS:

Wings, gross	17.74 m² (191.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	839 kg (1,850 lb)
Baggage capacity	68 kg (150 lb)
Max payload	680 kg (1,500 lb)
Max T-O weight	1,587 kg (3,500 lb)
Max wing loading	89.5 kg/m² (18.32 lb/sq ft)
Max power loading	7.10 kg/kW (11.67 lb/hp)

PERFORMANCE:

Max operating speed	152 kt (281 km/h; 175 mph)
Max cruising speed	142 kt (263 km/h; 163 mph)
Stalling speed: flaps up	37 kt (68 km/h; 42 mph)
flaps down	33 kt (62 km/h; 38 mph)
Max rate of climb at S/L	488 m (1,600 ft)/min
Service ceiling	4,570 m (15,000 ft)
T-O run	69 m (225 ft)
Landing run	122 m (400 ft)
Range with max fuel	788 n miles (1,460 km; 907 miles)
g limits	+3.8/−1.5

SYMPHONY

SYMPHONY AIRCRAFT INDUSTRIES

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Fax: (+1 819) 377 79 28
Web: www.symphonyaircraft.com
PRESIDENT AND CEO: Paul Costanzo
VICE-PRESIDENT, ENGINEERING: Mirko Zgela
VICE-PRESIDENT, SALES AND MARKETING: Tim Baldwin

Symphony Aircraft Industries was formed in June 2004 to take over manufacture and marketing of former OMF Symphony (Germany) two- and four-seat aircraft in a 2,500 m² (26,900 sq ft) manufacturing facility originally built for OMF's Canadian subsidiary, OMF Aircraft at Trois-Rivières, Québec, Canada. Transfer formally took place on 15 February 2005. Production was set at 50 aircraft for 2005 (later revised to 40; 12 achieved) and 70 for 2006, and by October 2004 Symphony had 16 staff; this reached 75 by January 2006 and was expected to reach 125 by the end of 2006.

In June 2006, company went into protected status, similar to US Chapter 11 reorganisation, citing changes in the Canadian investment market, at which time it had delivered 15 SA 160s and had an order book for 20 more.

SYMPHONY SA 160

TYPE: Two-seat lightplane.

PROGRAMME: Redesign of Arlington Aircraft/Stoddard-Hamilton (now New GlaStar) GlaStar to JAR 23 certification standards began in May 1998 for production and marketing by OMF Flugzeugbau GmbH, Germany. First prototype (D-ETCW, c/n P1) was essentially unchanged and first flew May 1999; second prototype D-EMVP (c/n 0001), with modifications to meet JAR 23, first flown 7 October 1999; third aircraft (D-ENVG) had not flown by June 2000, when it made type's public debut at Berlin Air Show. LBA evaluation began mid-July 2000 and certification and production certificate both awarded 29 August 2000; FAA certificate A43CE awarded 9 April 2001; IFR certification issued June 2002.

Thirteenth Canadian-built Symphony SA 160, completed in 2006 colour scheme *(Paul Jackson)*

1159056

Customer deliveries began November 2001. Transport Canada certification awarded to Canadian subsidiary, OMF Aircraft, on 18 June 2003; production by OMF ceased late 2003.

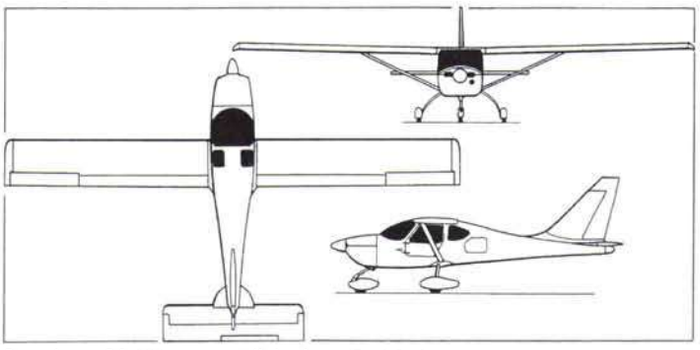
Transport Canada type certificate issued 18 March 2005 to Symphony Aircraft with new designation SA 160; first delivery of Canadian-built aircraft (C-GUSA; c/n S001); achieved 31 March 2005. FAA type certificate issued 2 May 2005.

CURRENT VERSIONS: **OMF-100-160 Symphony 160:** German production; now ended. Aircraft up to c/n 0012 limited to 889 kg (1,960 lb) MTOW; c/n 0013 to 0022 capable of upgrade to 975 kg (2,150 lb).

SA 160: Baseline two-seat version; *as described*.

Symphony 250: Four-seat version announced at Sun 'n' Fun, April 2003 (as Symphony 4); first flight then expected before end 2003, but delayed by bankruptcy. Data given are provisional. Has longer, tapered wing and longer cabin section with wider door. Decision on development made late 2005; in abeyance for forseeable future.

Symphony 135TDI: First flown, as modification of D-EMVP, June 2003; powered by diesel engine. A decision on development was made late 2005; in abeyance for forseeable future.



Symphony SA 160 two-seat lightplane *(Paul Jackson)* 1128975

CUSTOMERS: Total 42 (excluding non-conforming prototype, P1) of which one built by OMF Flugzeugwerke; all others by OMF Flugzeugbau by late 2003 when OMF manufacture ceased. OMF had a target production rate of 300 aircraft per year by 2008 before bankruptcy intervened. Total of 14 SA 160s registered by April 2006.

COSTS: Symphony 160 USD149,900 VFR equipped; USD207,900 IFR equipped (both 2006).

DESIGN FEATURES: Intended to be an inexpensive trainer and lightplane. Completely redesigned landing gear and wing; retains only some 10 per cent commonality with GlaStar. Crashworthy cockpit and seats. Around 60 per cent of aircraft built by Symphony; remainder sourced primarily from US. Service life of 18,000 hours. Braced, unswept high wing of constant chord. Tailplane has curved, leading-edge root strakes; tall, sweptback fin. Centre-section of top wing thickened in late 2001, increasing maximum T-O weight.

FLYING CONTROLS: Conventional and manual. Mass-balanced Frise ailerons with three hinges each (compared to GlaStar's two), travel up 23°/down 17°; electrically operated, metal, three-position Fowler flaps (0, 20 and 40°). horn-balanced, single-piece elevator with anti-balance tab, travel up 21°/down 20°; horn-balanced rudder, travels 21° in each direction. Two T-shape vortex generators added to wings in front of each aileron. Ailerons have end-fences: protruding above the surface at inboard end and below, outboard.

STRUCTURE: Welded 4130 steel tube fuselage structure consisting of fuselage cage and aft fuselage; former extends from firewall to tricycle landing gear truss, just aft of seats. Wings attach to cage at each spar using one attachment bolt at each spar. Wing struts attach to cage aft of doors and just above landing gear. Engine mount attaches to cage at five points. Aft fuselage extends from end of fuselage cage to horizontal tail aft attachment fitting. A non-structural glass/epoxy cell runs from the cowl split line to the tailcone.

Wings of aluminium skin, spar and rib construction; aluminium alloys exclusively used in wings and associated control surfaces.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring steel cantilever mainwheel legs with wheel fairings. Castoring nosewheel with speed fairing. Cleveland hydraulic brakes. All wheels 5.00-5. Nosewheel turning circle 6.7 m (22 ft).

POWER PLANT: *SA 160:* One 119 kW (160 hp) Textron Lycoming O-320-D2A flat-four, driving a two-blade fixed-pitch MT-186R-140-3D P-244-3 propeller. Fuel in two main tanks, each 58.5 litres (15.45 US gallons; 12.9 Imp gallons), and one 6 litre (1.6 US gallon; 1.3 Imp gallon) feeder tank, total capacity 123 litres (32.5 US gallons; 27.1 Imp gallons) of which 110 litres (29.0 US gallons; 24.2 Imp gallons) usable. Oil capacity 7.6 litres (2.0 US gallons; 1.7 Imp gallons).

ACCOMMODATION: Two persons side by side on leather-covered glass fibre-reinforced composites material seats capable of withstanding 26 *g* forward and 19 *g* vertical crash; front-hinged door each side; rear baggage compartment behind crew with separate door on port side as alternative access. Can be flown with doors removed.

SYSTEMS: Electric system 24 V 70 A DC. Vision Microsystems VM1000 engine monitoring system and EC-100 caution and advisory system.

AVIONICS: Standard IFR Suite includes Garmin GNS430 and GNC420 GPS/Nav/com, GMA340 audio panel, GTX327 transponder and GI-106A CDI.

EQUIPMENT: BRS parachute system developed as option for SA 160; first aircraft so equipped delivered 10 April 2006.

DIMENSIONS, EXTERNAL:

Wing span	10.67 m (35 ft 0 in)
Wing chord	1.12 m (3 ft 8 in)
Wing aspect ratio	9.5
Length overall	6.96 m (22 ft 10 in)
Max width of fuselage	1.22 m (4 ft 0 in)
Height overall	2.82 m (9 ft 3 in)
Tailplane span	3.08 m (10 ft 1¼ in)
Wheelbase	1.73 m (5 ft 8 in)
Propeller diameter	1.85 m (6 ft 1 in)
Propeller ground clearance	0.18 m (7 in)
Passenger door: Height	0.80 m (2 ft 7½ in)
Max width	0.81 m (2 ft 7¾ in)
Height to sill	0.84 m (2 ft 9 in)
Baggage door: Height	0.45 m (1 ft 5¾ in)
Max width	0.44 m (1 ft 5¼ in)
Height to sill	0.84 m (2 ft 9 in)

DIMENSIONS, INTERNAL:

Cabin: Length	1.22 m (4 ft 0 in)
Max width	1.10 m (3 ft 7¼ in)
Max height	1.14 m (3 ft 9 in)
Floor area	1.34 m² (14.4 sq ft)
Volume	1.53 m³ (54 cu ft)
Baggage compartment: volume	0.06 m³ (2.1 cu ft)

AREAS:

Wings, gross	11.93 m² (128.4 sq ft)
Ailerons (total)	1.26 m² (13.56 sq ft)
Flaps (total)	1.56 m² (16.79 sq ft)
Tailplane	1.52 m² (16.36 sq ft)
Elevators (total, incl tabs)	1.29 m² (13.89 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	658 kg (1,450 lb)
Max baggage weight: front	45 kg (99 lb)
rear	45 kg (99 lb)
combined	75 kg (165 lb)
Max T-O weight	975 kg (2,150 lb)
Max wing loading	81.8 kg/m² (16.74 lb/sq ft)
Max power loading	8.18 kg/kW (13.44 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	162 kt (300 km/h; 186 mph)
Max level speed	105 kt (194 km/h; 121 mph)
Max cruising speed at 75% power:	
160	128 kt (237 km/h; 147 mph)
Econ cruising speed at: FL 80	115 kt (213 km/h; 132 mph)
Stalling speed, power off:	
flaps up	57 kt (106 km/h; 66 mph)
flaps down	48 kt (89 km/h; 56 mph)
Max rate of climb at S/L	259 m (850 ft)/min
Service ceiling	5,000 m (16,400 ft)
T-O run	280 m (919 ft)
T-O to 15 m (50 ft)	350 m (1,150 ft)
Landing from 15 m (50 ft)	450 m (1,480 ft)
Landing run	230 m (755 ft)
Range with max fuel	370 n miles (685 km; 425 miles)
g limits	+3.8/−1.5

TAPANEE

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DESIGNER: Michel Lequin

The company's most recent known design is the Levitation 4, although the earlier Pégazair STOL bushplane remains available as kit or plans; 32 built by end 2005.

TAPANEE LEVITATION 4

TYPE: Four-seat kitbuilt.

PROGRAMME: Prototype (C-GJUY) flown 2002.

CUSTOMERS: Five kits sold by December 2004; three flying by December 2005.

COSTS: Kit CAD40,000 (2006).

Tapanee Levitation 4 *(Paul Jackson)* 1159057

DESIGN FEATURES: Extrapolation of Pégazair, with deeper fuselage. High-mounted, parallel-chord wings with V-strut bracing and STOL optimisation including Handley Page leading-edge slats. Large rear surfaces for low-speed control, including sweptback fin with large ventral fillet and tailplane attached below. Quoted build time 1,500 hours.

FLYING CONTROLS: Manual. Junkers flaperons. All-moving fin and tailplane, latter having two anti-balance tabs.

STRUCTURE: Welded steel tube with aluminium skin. All metal wing and horizontal tail.

LANDING GEAR: Tailwheel type; fixed. Two fared-in, hinged side Vs, plus half-axles sprung under centreline with rubber-in-compression shock-absorbers; steerable tailwheel. Mainwheels 8.00-6. Hydraulic brakes.

POWER PLANT: One 134 kW (180 hp) Textron Lycoming O-360 flat-six, driving a two-blade, Hartzell propeller. Fuel capacity 208 litres (55.0 US gallons; 45.8 Imp gallons); two optional 68 litre (18.0 US gallon; 15.0 Imp gallon) wing tanks can be fitted.

ACCOMMODATION: Four persons in two side-by-side pairs. Upward-hinged door each side. Large baggage compartment to rear, with large, external (port) door.

DIMENSIONS, EXTERNAL:

Wing span	10.21 m (33 ft 6 in)
Length overall	7.47 m (24 ft 6 in)
Height overall	2.44 m (8 ft 0 in)

DIMENSIONS, INTERNAL:

Cabin max width	1.22 m (4 ft 0 in)
Length	2.77 m (9 ft 1 in)
Baggage area	0.71 m³ (25.0 cu ft)

AREAS:

Wings, gross	16.72 m² (180.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	621 kg (1,368 lb)
Max T-O weight	1,133 kg (2,500 lb)
Max wing loading	67.8 kg/m² (13.89 lb/sq ft)
Max power loading	8.45 kg/kW (13.89 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	113 kt (209 km/h; 130 mph)
Cruising speed	100 kt (185 km/h; 115 mph)
Stalling speed, power on	31 kt (67 km/h; 35 mph)
Max rate of climb	213 m (700 ft)/min
T-O run	122 m (400 ft)
Landing run	91 m (300 ft)
Range	499 n miles (925 km; 575 miles)

ULTRAVIA

ULTRAVIA AERO INTERNATIONAL INC

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PRESIDENT: Jean-René Lepage

Ultravia was formed in 1982; began marketing the single-seat Pelican in 1983, adding the two-seat Pelican Club the following year. The Pelican PL was added to the Ultravia line in 1991, followed by the Pelican Sport in 1998. During 2003, the company announced a further model: the TuToR. Ultravia has a 1,486 m² (16,000 sq ft) factory near Ottawa-Gatineau Airport.

ULTRAVIA PELICAN

TYPE: Side-by-side kitbuilt.

PROGRAMME: Original Le Pelican first flown May 1982. The Pelican PL was introduced in 1991 and the Sport in 1998. Meets Transport Canada TP 10141 regulations. Pelican Sport also available as factory-finished aircraft.

CURRENT VERSIONS: **Pelican PL:** Standard ultralight version.

Pelican Sport: Redesigned wing with higher-lift aerofoil, longer span and STOL kit. Comes in three subvariants, depending on operating area: Sport 450 (Europe), Sport 500 (Brazil) and Sport 600 (US, Canada, Australia and Mexico).

Pelican TuToR: Derivative conforming to FAR Pt 23; certification under way during 2003 and expected to be completed in 2004; will also be certified to Canadian chapter 523-VLA standards. Construction of prototype (C-GOOI) began 1996.

Description applies to Pelican Sport 600 unless otherwise indicated.

CUSTOMERS: Over 350 Pelican PLs and 150 Pelican Sports completed and flown by December 2004. Ultravia had built nearly 800 Pelicans of all variants by January 2005, of which up to 40 exported to USA before association with Kolb.

COSTS: PL: standard CAD30,175; fast-build CAD39,425; Sport: standard CAD31,900; fast-build CAD41,350; factory-assembled (minus engine) CAD66,725 (2006).

DESIGN FEATURES: High-wing of constant chord, single bracing strut each side; sweptback fin, with constant-chord tailplane at base. Cantilever landing gear.

Fast-build kit, with 49 per cent of assembly completed, is also available. Quoted build time of standard kit 1,000 hours and of fast-build kit, 500 hours.

FLYING CONTROLS: Conventional and manual. Five position (0 to 45°) flaps. Pelican Sport ailerons droop 10° when full flap deployed. Mechanically operated elevator trim tab, ground-adjustable rudder and aileron tabs. Horn-balanced rudder.

Ultravia Pelican PL assembled by Gary Krysztopik of Newport, Rhode Island *(Paul Jackson)* 1159058

STRUCTURE: Composites, vacuum-moulded fuselage with rigid PVC core. Single-strut, single-spar, all-metal wing with aluminium-covered control surfaces. Cantilever horizontal tail surfaces. Landing gear legs of 4130 steel.

LANDING GEAR: Fixed tricycle version standard. Fuselage-mounted cantilever mainwheel legs with optional wheel fairings. Steerable nosewheel has bungee suspension and uses Azusa 15 cm (6 in) wheel. Optional tailwheel version uses a Matco WLT-6 or Kolb 10 cm (4 in) tailwheel. Cleveland 5.00–5 mainwheels with disc brakes on both versions. Optional floats and speed fairings.

POWER PLANT: Typically, one 73.5 kW (98.6 hp) Rotax 912 ULS four-cylinder four-stroke driving a three-blade Warp Drive ground-adjustable propeller (two-blade Hoffmann HO17FHM-175 fixed-pitch propeller on TuToR). Other engines can be fitted, including the 59.6 kW (79.9 hp) Rotax 912 UL and 84.6 kW (113.4 hp) Rotax 914 UL. Fuel capacity 91 litres (24.0 US gallons; 20.0 Imp gallons) in two wing tanks, of which 87 litres (23.0 US gallons; 19.2 Imp gallons) usable.

ACCOMMODATION: Pilot and passenger in side-by-side seating. Baggage area behind seats.

SYSTEMS: 12 V 250 W generator.

DIMENSIONS, EXTERNAL:

Wing span: PL	8.99 m (29 ft 6 in)
Sport, TuToR	9.75 m (32 ft 0 in)
Length overall: PL	6.02 m (19 ft 9 in)
Sport	6.07 m (19 ft 11 in)
TuToR	6.15 m (20 ft 2 in)
Height overall, nosewheel configuration	
PL	2.54 m (8 ft 4 in)
Sport	2.59 m (8 ft 6 in)
TuToR	2.62 m (8 ft 7 in)

AREAS:

Wings, gross: PL	10.03 m² (108.0 sq ft)
Sport, TuToR	10.89 m² (117.3 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: PL	363–386 kg (800–850 lb)
TuToR	386 kg (850 lb)
Sport	327–340 kg (720–750 lb)
Max T-O weight: PL, TuToR	635 kg (1,400 lb)
Sport	599 kg (1,320 lb)

PERFORMANCE (Rotax 912 ULS engine):

Never-exceed speed (VNE):	
PL	142 kt (263 km/h; 163 mph)
Sport	135 kt (250 km/h; 155 mph)
TuToR	136 kt (252 km/h; 157 mph)
Normal cruising speed: PL, Sport	115 kt (213 km/h; 132 mph)
TuToR	110 kt (204 km/h; 127 mph)
Stalling speed, flaps down: PL	44 kt (82 km/h; 51 mph)
Sport	39 kt (73 km/h; 45 mph)
TuToR	43 kt (80 km/h; 50 mph)
Max rate of climb at S/L: PL	366 m (1,200 ft)/min
Sport	411 m (1,350 ft)/min
TuToR	335 m (1,100 ft)/min
Service ceiling: PL, Sport	4,875 m (16,000 ft)
TuToR	4,570 m (15,000 ft)
T-O run: PL, TuToR	183 m (600 ft)
Sport	91 m (300 ft)
Landing run: PL	168 m (550 ft)
Sport	152 m (500 ft)
Range with max fuel:	
PL	695 n miles (1,287 km; 800 miles)
Sport	608 n miles (1,126 km; 700 miles)
TuToR	520 n miles (963 km; 598 miles)

UTIAS

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Development and modification of the Big Flapper ornithopter continued in 2005, including the incorporation of an auxiliary miniature jet engine and further runway test runs in July and August. Flight testing was resumed in July 2006.

UTIAS BIG FLAPPER

TYPE: Ornithopter.

PROGRAMME: Early research resulted 1985 in quarter-scale, hand-launched, engine-powered and radio-controlled flying model; this progressively improved into more efficient model flown 4 September 1991 and recognised by FAI as first successful engine-powered ornithopter. Feasibility study 1993–94 for full-scale prototype, construction of which began 1995; this aircraft (C-GPTR) began taxi tests October 1996 and by 1999 had demonstrated ability to accelerate under own power to more than 43 kt (80 km/h; 50 mph) and make a number of brief hops. Further activity suspended in third quarter 2002 due to a fractured weld and pending additional funding; main landing gear redesigned in 2003 to improve shock absorption. New gear delivered 15 September 2003, but this too late for that year's test season.

In addition to Toronto University, Project Ornithopter currently has some 16 sponsors including Canadian National Research Council, the Ken Molson Foundation and Toronto Aerospace Museum. Criterion for success is considered to be sustained flight of at least 11 seconds which, including take-off and landing runs, would cover the length of the runway.

During second quarter of 2004, consideration began to be given to adoption of a miniature turbojet to provide extra boost for take-off, it being felt that this could be achieved with a low flapping frequency, the jet then being shut down once airborne and flapping frequency increased to provide sustained flight. Accordingly, a suitable engine was ordered, and the remainder of the 2004 season was spent in devising a mounting and installing control wiring, electronic control unit, instrumentation and propane fuel tank. A successful static test of the new combined propulsion system was conducted in late 2004.

Further detail refinements were made in May and June 2005, leading to an initial runway test on 17 July. This was followed by further minor modifications and a second test run, at higher flapping frequency, on 3 August 2005. Pilot Jack Sanderson reported himself "very much in control" during these brief lift-offs. However, a further 2005 attempt, which it was hoped would achieve a 1.0 Hz flapping frequency and sustained flight, had to be postponed due to an ignition problem with the jet engine caused by electromagnetic radiation, and weather conditions then deteriorated.

During late 2005/early 2006, engine ignition underwent conversion by AMT Netherlands from digital to analogue system. Runway tests resumed on 8 July 2006. After a few brief hops, the aircraft remained airborne for a sustained (though still jet-assisted) flight of 14 seconds on its fifth lift-off that day, reaching a height of more than 1 metre (3.3 ft) and covering a distance of approximately one-third of a kilometre (0.2 miles) before roll divergence caused it to be landed for safety reasons, sustaining minor damage to the nose gear during the touchdown. At first, the roll divergence was thought to be due to rising crosswinds, but post-flight study of video revealed buckling of a portion of the port wing to be the cause. Despite this, the flight was described as " surprisingly smooth and stable". The company also points out that the present wing was optimised for a lower aircraft weight than that of the current demonstrator.

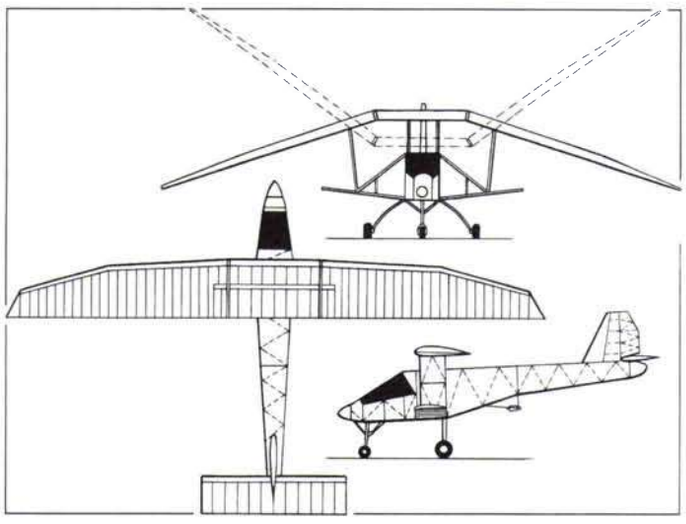
Further plans for 2006 were to display the aircraft in the Toronto Aerospace Museum.

COSTS: Development costs of full-size prototype GBP140,000 up to mid-2002.

DESIGN FEATURES: Conventional fuselage and tail unit. Flapping wings are hinged to a centre-section which is moved up and down by pylons connected to the drive train and pivot on the ends of vertical struts mounted on short outriggers attached to the base of the fuselage. Thus, when centre-section pushes up, wings flap down, and vice versa. The designed wing deflection is 53° 36', although compliance in the structure under flapping loads gives somewhat larger actual values. The wings are designed to flap 1.2 times per second.

Specially designed (by Prof Michael Selig) S 1020 wing aerofoil section.

UTIAS Big Flapper making a 14-second flight on 8 July 2006 1158650



General arrangement of the University of Toronto ornithopter
(James Goulding) 1158550

FLYING CONTROLS: All of thrust and most of lift created by mechanical flapping of wings. Thrust due mainly to low-pressure region around wing leading-edges, which creates suction. Wings also able to twist passively ('aeroelastic tailoring') to prevent airflow separation. Rudder provides control in roll as well as yaw, due to wing opposite direction of yaw gaining lift while that of other wing loses lift.

STRUCTURE: Fuselage frame of steel tube and aluminium; wings of Kevlar, carbon fibre and epoxy resin, plus wood and structural foam. Dacron overall covering. Original wing was optimised for 272 kg (600 lb) aircraft weight; to offset actual (higher) weight, a pair of small, fixed, auxiliary wings has been added as a temporary solution. Design study for larger replacement wing completed in mid-2003, but not yet funded.

LANDING GEAR: Tricycle type, fixed, with cantilever, self-sprung carbon fibre mainwheel bows; shock-absorption on nosewheel leg. Gear designed to give aircraft a nose-down attitude on ground, to minimise bounce during take-off run. New (2003) main gear has more 'bow-legged' appearance in order to reduce peel-stress concentrations in laminated carbon fibre construction.

POWER PLANT: One 17.9 kW (24 hp) König three-cylinder, two-stroke, fan-cooled semi-radial engine, with magneto ignition and 60:1 reduction gear drive to power wing centre-section. As latter requires more power on upstrokes than on downstrokes (outer wing panels operating in opposite direction), engine stores energy on flywheel between downstrokes.

Auxiliary take-off boost provided by 0.27 kN (60 lb st) AMT Olympus turbojet.

ACCOMMODATION: Pilot only.

DIMENSIONS, EXTERNAL (approx):

Wing span	12.3 m (40 ft 6 in)
Length overall	7.3 m (24 ft 0 in)
Height overall	2.7 m (9 ft 0 in)

WEIGHTS AND LOADINGS:

Weight empty (König engine only)	290 kg (640 lb)
Fuel weight (for König engine)	approx 4.5 kg (10 lb)
Olympus engine weight	2.5 kg (5.5 lb)
Max T-O weight	363 kg (800 lb)

PERFORMANCE:

Unstick speed (estimated) at flapping frequency of 1.0 Hz	50 kt (92 km/h; 57 mph)
Cruising speed (8 July 2006 flight)	48 kt (88.5 km/h; 55 mph)
Speed with max jet thrust achieved in 2005:	
flapping frequency 0.7 Hz	37 kt (69 km/h; 43 mph) IAS
flapping frequency 0.9 Hz	43 kt (80 km/h; 50 mph) IAS

VIKING

VIKING AIR LTD

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Formed in 1970 to undertake fixed- and rotary-wing aircraft parts fabrication, overhaul, modification and repair, including DHC-2 Beaver and DHC-6 Twin Otter. Plant covers 13,935 m² (150,000 sq ft).

On 22 February 2006, Viking announced it had acquired Type Certificates for seven out-of-production de Havilland Canada aircraft (DHC-1 to DHC-7) from Bombardier Aerospace on 31 January 2006. It then began assessing market interest in relaunched manufacture of Twin Otters, its spare parts support activities for this aircraft meaning that 35 per cent of the airframe remained in production at that time.

VIKING DHC-6 TWIN OTTER 400

TYPE: Twin-turboprop light transport.

PROGRAMME: Design started in January 1964 and construction in November of that year. Prototype (CF-DHC-X) flew in May 1965; Canadian certification 7 April 1966; first delivery in July 1966. Main production series were 100 (115 built, including prototypes), 200 (117 built) and 300 (612 built), last of which completed in December 1988. Some 550 remain in service.

Production rights acquired from Bombardier in 31 January 2006 and new Series 400 version offered. Assembly of first aircraft targeted for third quarter of 2008; work shared between facilities in Calgary and Vancouver.

CURRENT VERSIONS: **Series 400:** Revised version offered by Viking in 2006. P&WC PT6A-34 engines, upgraded avionics and systems.

CUSTOMERS: Production of first three series covered 844, including prototypes. No orders accepted for Viking version, pending formal launch.

COSTS: USD2 million (2007).

DESIGN FEATURES: High-set, constant-chord wing with streamlined strut bracing; cruciform empennage with sweptback fin and constant-chord tailplane.

Wing-section NACA 6A series mean line; NACA 0016 (mod) thickness distribution. Dihedral 3°.

FLYING CONTROLS: Conventional and manual. Double-slotted full-span trailing-edge flaps. Ailerons also droop for use as flaps. Electrically actuated tab in port aileron; geared trim tabs in port and starboard ailerons. Manually operated trim tabs in rudder and elevators. Geared tab is fitted to the rudder to lighten control forces and a tab fitted to the starboard elevator is linked to the flaps to control longitudinal trim during flap retraction and extension.

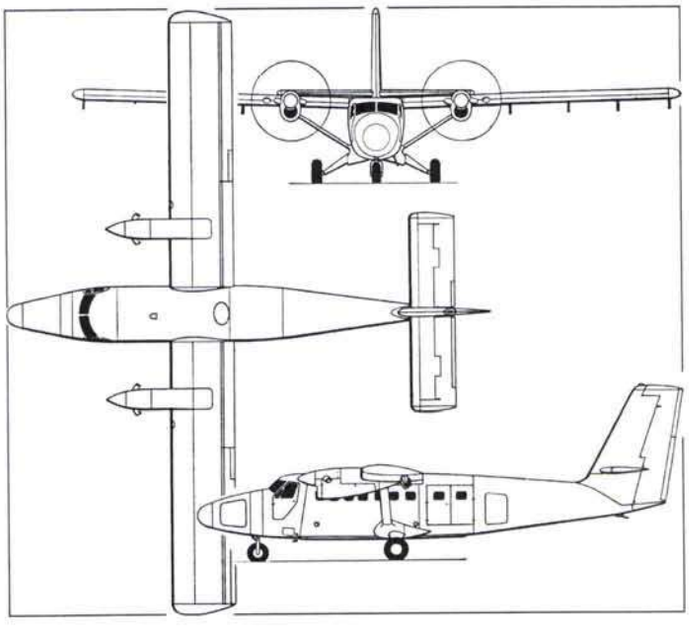
STRUCTURE: Generally of aluminium alloy. All-metal safe-life structure, each wing being attached to the fuselage by two bolts at the front and rear spar fitting and braced by a single streamline section strut on each side. Light-alloy riveted construction is used throughout except for the upper skin panels which have spanwise corrugated stiffeners bonded to them. Fuselage is a conventional semi-monocoque safe-life structure, in three sections. Primary structure of frames, stringers and skin of aluminium alloy. Windscreen and cabin windows of acrylic plastics. Cabin floor is of low-density aluminium-faced sandwich construction and is designed to accommodate distributed loads of up to 976 kg/m² (200 lb/sq in). Tail unit of high-strength aluminium alloys. Fin and fixed-incidence tailplane are bolted to rear fuselage.

LANDING GEAR: Tricycle type; fixed. Single wheel on each unit. Fully steerable nosewheel. Urethane compression-block shock-absorption on main units. Oleo-pneumatic nosewheel shock-absorber. Mainwheel tyre size 11.00-12; pressure 2.62 bars (38 lb/sq in). Nosewheel tyre size 8.9-12.50, pressure 2.28 bars (33 lb/sq in). Independent, hydraulically operated disc brakes on mainwheels. Alternatively, high-flotation wheels and tyres, for operation in soft field conditions, also available at option size 15-0-12.0 for nosewheel and mainwheels. Provision for alternative wheel-ski landing gear. Twin-float gear accompanied by added wing fences and small auxiliary fins.

POWER PLANT: Two 559 kW (750 shp) Pratt & Whitney Canada PT6A-34 turboprops, each driving a Hartzell HC-B3TN-3DY three-blade, reversible-pitch fully feathering metal propeller with Beta control (zero-pitch propeller on floatplane). Four-blade propellers under development in 2006. Two underfloor fuel tanks (eight cells), total capacity of 1,442 litres (381 US gallons; 317 Imp gallons). Long-range tank optional in fuselage, providing 337 litres (89.0 US gallons; 74.1 Imp gallons). Refuelling point for each tank on port side of fuselage. Oil capacity 9.1 litres (2.4 US gallons; 2.0 Imp gallons) per engine. Optional electric de-icing system for propellers and air intakes.

ACCOMMODATION: Two pilots on flight deck and up to 20 passengers, or equivalent freight. Flight deck access via forward-opening car-type door on each side or via passenger cabin.

de Havilland Canada DHC-6 Twin Otter from original production 1158817



de Havilland Canada DHC-6 Twin Otter *(Dennis Punnett)* 1158776

Dual controls standard. Windscreen demisting and defrosting standard. Cabin divided by bulkhead in top main passenger cabin for freight compartment and baggage compartment.

Standard interior is 20-seat commuter layout with Douglas track, carpets, double windows, individual air vents and reading lights and airstair door. Optional layouts include 18- or 19-seat commuter versions, and 13/20-passenger utility version with foldaway seats and double cargo doors with ladder. Access to cabin by door on each side of rear fuselage; airstair door on port side. Optional double door for cargo on port side instead of airstair door. Compartments in nose and aft of main cabin, each with upward-hinged door on port side, for 136 kg (300 lb) and 227 kg (500 lb) of baggage respectively; rear baggage hold accessible from cabin in emergency. Emergency exits near front of cabin on each side.

Heating of flight deck and passenger cabin by engine bleed air; ventilation via a ram air intake on the port side of the fuselage nose. No pressurisation. Oxygen system for crew and passengers optional. Executive, survey or ambulance interiors optional. Tie-down cargo rings standard for the freighter role.

SYSTEMS: Hydraulic system, pressure 103 bar (1,500 lb/sq in), for flaps, brakes, nosewheel steering and (where fitted) ski retraction mechanism. Hand pump in crew compartment provides emergency pressure for standby or ground operation if the electric pump is inoperative. Accumulators smooth the system pressure pulses and provide pressure for parking and emergency braking. Optional low-pressure pneumatic system (1.24 bars; 18 lb/sq in) for operation of autopilot or wing and tail de-icing boots, if fitted.

Primary electrical system is 28 V DC with one 24 A starter/generator on each engine. One 40 Ah 20-cell Ni/Cd battery (optional 36 Ah lead-acid battery) for emergency power and engine starting. Separate 3.6 Ah battery supplies independent power for engine starting relays and ignition. 250 VA main and standby static inverters provide 400 Hz AC power for instruments and avionics. External DC receptacle aft of port side cabin door permits operation of complete system on the ground. Optional boot de-icing equipment on wing. Optional pneumatic-boot de-icing of tailplane leading-edge.

DIMENSIONS, EXTERNAL:

Wing span	19.81 m (65 ft 0 in)
Wing chord, constant	1.98 m (6 ft 6 in)
Wing aspect ratio	10.1
Length overall: Landplane	15.77 m (51 ft 9 in)
Floatplane	15.09 m (49 ft 6 in)
Height overall: Landplane	5.94 m (19 ft 6 in)
Floatplane from waterline	6.05 m (19 ft 10 in)
Tailplane span	6.30 m (20 ft 8 in)
Wheel track: Landplane	3.71 m (12 ft 2 in)
Wheelbase: Landplane	4.53 m (14 ft 10½ in)
Length of floats: Floatplane	9.65 m (31 ft 8 in)
Width over floats: Floatplane	5.18 m (17 ft 0 in)
Seaplane track (c/l of floats)	4.06 m (13 ft 4 in)
Propeller diameter	2.59 m (8 ft 6 in)
Passenger door (port): Height	1.27 m (4 ft 2 in)
Width	0.76 m (2 ft 6 in)
Height to sill	1.32 m (4 ft 4 in)
Passenger door (stbd): Height	1.16 m (3 ft 9½ in)
Width	0.77 m (2 ft 6¼ in)
Height to sill	1.32 m (4 ft 4 in)
Baggage compartment door (nose)	
Mean height	0.69 m (2 ft 3¼ in)
Width	0.76 m (2 ft 6 in)
Height to sill	1.32 m (4 ft 4 in)
Baggage compartment door (port, rear):	
Max height	0.97 m (3 ft 2 in)
Width	0.65 m (2 ft 1½ in)
Height to sill	1.32 m (4 ft 4 in)

DIMENSIONS, INTERNAL:

Cabin, excl flight deck, galley and baggage compartment:	
Length	5.64 m (18 ft 6 in)
Max width	1.61 m (5 ft 3¼ in)
Max height	1.50 m (4 ft 11 in)
Floor area	7.45 m^2 (80.2 sq ft)
Volume	10.87 m^3 (384 cu ft)
Baggage compartment (nose):	
Volume	1.08 m^3 (38 cu ft)
Baggage compartment (rear):	
Length	1.88 m (6 ft 2 in)
Volume	2.49 m^3 (88 cu ft)

AREAS:

Wings, gross	39.02 m^2 (420 sq ft)
Ailerons (total)	3.08 m^2 (33.2 sq ft)
Trailing-edge flaps (total)	10.42 m^2 (112.2 sq ft)
Fin	4.46 m^2 (48.0 sq ft)
Rudder, incl tabs	3.16 m^2 (34.0 sq ft)
Tailplane	9.29 m^2 (100 sq ft)
Elevator, incl tabs	3.25 m^2 (35.0 sq ft)

WEIGHTS AND LOADINGS:

Basic weight	3,121 kg (6,881 lb)
Max payload:	
for 100 n miles (185 km; 115 miles)	1,941 kg (4,280 lb)
for 400 n miles (740 km; 460 miles)	1,474 kg (3,250 lb)
Max T-O weight	5,670 kg (12,500 lb)
Max landing weight:	
wheels and skis	5,579 kg (12,300 lb)

PERFORMANCE:

Max cruising speed: at S/L	170 kt (315 km/h; 196 mph)
at FL50	181 kt (335 km/h; 208 mph)
at FL100	182 kt (337 km/h; 209 mph)
Stalling speed: flaps up	74 kt (138 km/h; 86 mph)
flaps down	58 kt (108 km/h; 67 mph)
Max rate of climb at S/L	488 m (1,600 ft)/min
Rate of climb at S/L, OEI	104 m (340 ft)/min
Service ceiling	8,140 m (26,700 ft)
Service ceiling, OEI	3,530 m (11,600 ft)
T-O run: STOL	213 m (700 ft)
CAR Pt 3	262 m (860 ft)
T-O to 15 m (50 ft): STOL	366 m (1,200 ft)
CAR Pt 3	457 m (1,500 ft)
Landing from 15 m (50 ft): STOL	320 m (1,050 ft)
CAR Pt 3	591 m (1,940 ft)
Landing run: STOL	157 m (515 ft)
CAR Pt 3	290 m (950 ft)
Ferry range: normal tankage	775 n miles (1,435 km; 891 miles)
long-range tankage	980 n miles (1,815 km; 1,127 miles)

ZENAIR

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Founded in 1974, Zenair designs and develops light aircraft. Christophe Heintz was formerly chief engineer of Avions Pierre Robin in France. In 1992 Zénith Aircraft Company was formed to manufacture and market all versions except the CH 2000 in the USA, and in September 1996 reached full production status. In June 1999, Zenith announced that it was transferring production of the CH 2000 to a new, purpose-built 2,800 m² (30,000 sq ft) factory at Eastman, Georgia; Aircraft Manufacturing and Development Company was formed in the US to produce the aircraft, some of which have been assembled in Jordan by JAI.

Zenair has licensed representatives in Africa, South America, Belgium, Czech Republic (see entry for CZAW), France, Germany, Israel, Italy (see ICP), Spain and the UK.

Zenith Aircraft Company (Mexico, Missouri, USA) licenses kit production of Zenair designs. In addition to light aircraft, company constructs metal floats and amphibious floats.

Chile

ENAER

EMPRESA NACIONAL DE AERONÁUTICA DE CHILE

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PRODUCTS MANUFACTURING MANAGER: Juan Carlos Sandoval
MARKETING MANAGER: Marco Sciolla
COMMUNICATIONS MANAGER: Luis Filippi

State-owned company, formed 16 March 1984 from IndAer industrial organisation set up 1980 by Chilean Air Force (FACh); aircraft manufacture started 1979 with assembly of 27 Piper PA-28 Dakota lightplanes for Chilean Air Force and flying clubs. Covered plant area 45,000 m² (484,375 sq ft); workforce of 1,470 in early 2006.

Recent main programmes have mainly concerned various military upgrade programmes. Currently undertaking sole-source fin/tailplane manufacture of ERJ-135/140/145 (560 shipsets ordered) as Embraer risk-sharing partner, and subcontract manufacture of rear ramp and tail unit of EADS CASA CN-235 and C-295; also manufactures nose sections for Eclipse 500 and underfuselage fairings for Dassault Falcon 900 and 2000. Agreement signed in October 2005 for parts manufacture of unspecified aircraft for Hindustan Aeromautics Ltd. In same year, announced plans to become subcontractor on Airbus A400M. Engineering and maintenance activities are qualified to ISO 9001-2000 and AS 9100-2001 standards.

T-35 piston-engined Pillán military trainer, currently operated by eight air arms, continued to be marketed in 2006.

ENAER (ECH-51) T-35 PILLÁN

English name: Devil
Spanish Air Force designation: E.26 Tamiz (Grader)
TYPE: Basic prop trainer.
PROGRAMME: First two prototypes (first flight 6 March 1981) developed by Piper; followed by three Piper kits for ENAER assembly (first flight, by FACh s/n 101, 30 January 1982); then slight redesign, ENAER series production started September 1984; first flight of production T-35A, 28 December 1984. Deliveries to FACh began 31 July 1985; original export deliveries completed 1991. Increased-span Pillán 2000, proposed in 1998, did not materialise. Production resumed in November 1998 to build eight for Dominican Republic and again in 2002 to meet an Ecuadorean Navy order for four. Promotion of Turbo Pillán continued at FIDAE Air Show in April 2002, but no further orders by late 2003, when further six Pilláns (c/n 235 to 240) then on production line, presumably against unannounced or anticipated future orders.

Promotion to air forces of Argentina, Brazil, Colombia, Ecuador, South Africa and Tunisia continued in 2005, though no new orders announced by early 2006. Meanwhile, agreement signed in May 2004 provides for EADS to market Pillán in Europe, subject to wing and tail modifications to improve handling.

China

ACAC

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Shanghai Aircraft Industry Company (SAIC)
Shenyang Aircraft Corporation (SAC)
Xian Aircraft Design and Research Institute (XADRI)
Xian Aircraft Company (XAC)
CHAIRMAN: Yang Yuzhong
PRESIDENT: Zheng Qiang
VICE-PRESIDENTS:
Tao Zhihai
Chen Jin
PROJECT MANAGER: Ms Wang Lan

Six Chinese organisations formed a consortium in 1998 to study the prospects of launching, with risk-sharing foreign industrial partners, a programme for a new regional jet in the 70-seat class. Initial concepts were focused on 58-seat (NRJ 58) and 76-seat (NRJ 76) variants. However, the latter project received the designation ARJ21 (Advanced Regional Jet, 21st Century) in 2001 and State Council approval in June 2002.

ACAC was formed in October 2002 to manage this programme and is now a limited liability company with joint investment from AVIC I and 14 other aviation institutes and enterprises. Foundation stone laid 26 December 2005 for 18,000 m² (193,750 sq ft) customer service centre in Shanghai; completion due by June 2007. ACAC also plans new 54,000 m² (581,250 sq ft) headquarters and technical centre at Zizhu Science Based Industrial Park.

ACAC ARJ21

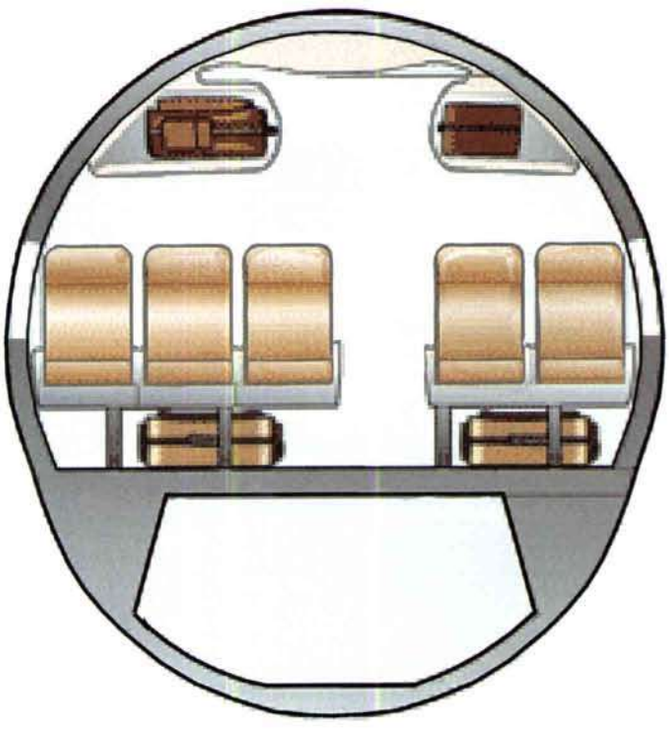
TYPE: Regional jet airliner.
PROGRAMME: Project officially launched by AVIC I on 7 November 2000 as USD700 million programme under the auspices of a newly created New Regional Jet Programme Management Company. Aircraft was renamed ARJ21 (Advanced Regional Jet, 21st century) in 2001 and allocated initial investments from AVIC I (CNY20 million); CAC, SAIC and XAC (each CNY5 million); and SAC (CNY3 million). Further investment is being sought from other Chinese and foreign companies. The parent company is responsible for defining airframe configuration; defining and subcontracting work-shares; schedule and quality control; final assembly, certification, marketing and customer support. Programme go-ahead approved by Chinese government June 2002; announced October 2002 with formation of ACAC and allocation of CNY5.2 billion (USD650 million) start-up funding; Boeing to provide engineering support. Manufacture at seven factories, including Xian and Shanghai; final assembly at Shanghai. Selection of General Electric CF34 announced 5 November 2002. Manufacture of components for static test prototype ARJ21-700 began simultaneously at Chengdu, Shanghai and Xian plants on 20 December 2003; first CAC-built nose section delivered in late December 2006; final assembly due to begin in March 2007. First flight targeted for March 2008 Chinese certification for September 2009 (with FAA to follow) and service entry by end of 2009.

Model of ACAC ARJ21-700 *(Paul Jackson)* 1153802

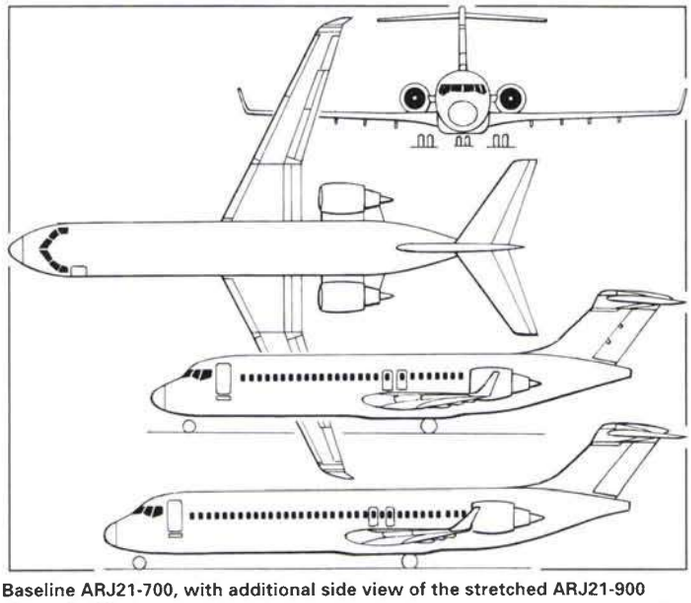
Stretched ACAC ARJ21-900 *(Paul Jackson)* 1153801

CURRENT VERSIONS: **ARJ21-700:** Baseline version, seating 78 to 90 passengers.
ARJ21-700F: Freighter version of -700. Capacity for five LD7 containers or PIP pallets.
ARJ21-700B: Corporate shuttle/large business jet variant of -700, typically configured for 20 passengers.
ARJ21-900: Stretched version, with seats for 98 to 105 passengers. Go-ahead anticipated in early 2007.
CUSTOMERS: Total of 41 ordered by June 2006, including Shandong Airlines (launch operator, 10), Shanghai Airlines (launch customer, five) and Shenzhen Financial Leasing Company (20). Estimated sale of 500 (350 domestic and 150 export) over 20 years. SE Leasing Company of Shanghai has option for 20; Xiamen Airlines has option for six.
DESIGN FEATURES: Low, swept wing (25° at quarter-chord) with winglets; engines pod-mounted to rear fuselage; all-swept T tail.
Supercritical wing section being designed and wind tunnel tested by Antonov design bureau. Wings 3° dihedral, tailplane 3° anhedral.

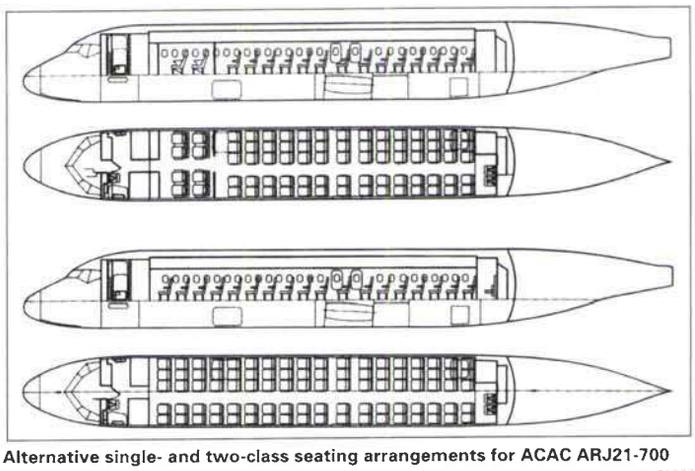
ARJ21 flight deck mockup 0558609



Cross-section of ACAC ARJ21 fuselage 1153800



Baseline ARJ21-700, with additional side view of the stretched ARJ21-900
(James Goulding) 1158975



Alternative single- and two-class seating arrangements for ACAC ARJ21-700
1151998

FLYING CONTROLS: Honeywell/Parker Aerospace electrically actuated (fly-by-wire) ailerons, elevators and rudder; no mechanical back-up. Three-segment leading-edge flaps. Two-segment trailing-edge flaps, with single spoiler/lift dumper forward of inboard flap and three-segment spoilers forward of each outer flap. Hamilton Sundstrand flap and slat actuation.

STRUCTURE: Wings and centre-fuselage by Xian (XAC); CAC (nose); SAC (Shenyang) (engine pylons and tailfin); tailplane and final assembly by Shanghai (SAMF). Design life 60,000 flight hours or 20 calendar years.

LANDING GEAR: Liebherr Aerospace and Aircraft Braking Systems retractable tricycle type, with twin wheels on each unit. Goodrich tyres and brakes.

POWER PLANT: *ARJ21-700:* Two 68.2 kN (15,332 lb st) rear-mounted General Electric CF34-10A turbofans with FADEC. Smiths Aerospace thrust reverser actuators. Standard fuel capacity 12,719 litres (3,360 US gallons; 2,798 Imp gallons).

ARJ21-900: CF34-10A engines rated at 75.9 kN (17,057 lb st), otherwise as for -700. Fuel capacity (-900STD) as for -700; increased by approx 5 per cent in -900ER.

ACCOMMODATION: Flight crew of two, plus two cabin attendants. Five-abreast seating for up to 90 (in ARJ21-700) or 105 (ARJ21-900) passengers in all-economy basic layout at 81 cm (32 in) pitch. Alternative mixed class configuration offers eight-seat business section (two rows, four abreast, at 96.5 cm; 38 in pitch) at front, with 70 and 90 economy class, respectively, to rear. Galleys (two), wardrobe, storage area and lavatory at front of cabin; second storage area and lavatory at rear. Type I passenger door at front on port side, with Type I service door opposite; two Type III emergency exits over wing on each side. Underfloor baggage door forward and aft of wing on starboard side. Large cargo door (forward, port) on 700F.

SYSTEMS: Parker Aerospace hydraulic and fuel systems. Hamilton Sundstrand APS 2300 APU, electrical power generation and distribution system (115 V AC from three 40 kVA generators; two engine-driven and one APU-driven), and emergency ram-air turbine. Liebherr Aerospace air conditioning, de-icing and bleed air systems. Sagem cabin systems; Kidde fire protection system.

AVIONICS: Pro Line 21 suite selected April 2003; first set delivered mid-2006; Rockwell Collins also serving as avionics system integrator. Suite includes VHF-4000 voice/data receiver, RIU-4000, five 254 × 203 mm (10 × 8 in) LCDs, EICAS, solid-state weather radar, TCAS, AHS-3000 and FMS-4500. Eaton Corporation flight deck panel assemblies and lighting controls.

DIMENSIONS, EXTERNAL (A: ARJ21-700, B: ARJ21-900):

Wing span over winglets: A, B	27.29 m (89 ft 6½ in)
Wing aspect ratio	9.3
Length overall: A	33.465 m (109 ft 9½ in)
B	36.36 m (119 ft 3½ in)
Fuselage length: A	30.43 m (99 ft 10 in)
B	33.325 m (109 ft 4 in)
Height overall: A, B	8.44 m (27 ft 8¼ in)
Tailplane span: A, B	10.495 m (34 ft 5¼ in)
Wheel track (c/l of shock-struts):	
A, B	4.68 m (15 ft 4¼ in)
Wheelbase: A	14.88 m (48 ft 9¾ in)
B	16.80 m (55 ft 1½ in)
Passenger door (fwd, port): Height	1.83 m (6 ft 0 in)
Width	0.86 m (2 ft 10 in)
Service door (fwd, stbd): Height	1.22 m (4 ft 0 in)
Width	0.69 m (2 ft 3 in)
Overwing emergency exits (four,each):	
Height	0.91 m (3 ft 0 in)
Width	0.51 m (1 ft 8 in)

DIMENSIONS, INTERNAL:

Passenger cabin: Max width	3.145 m (10 ft 3¾ in)
Aisle width	0.485 m (1 ft 7 in)
Max height	2.03 m (6 ft 8 in)
Cargo hold (700F):	
Length	19.035 m (62 ft 5½ in)
Volume	111.3 m³ (3,931 cu ft)

AREAS:

Wings, gross	79.86 m² (859.6 sq ft)

WEIGHTS AND LOADINGS:

Operating weight empty:	
700STD, 700ER	24,955 kg (55,016 lb)
700F	26,355 kg (58,103 lb)
700B	25,755 kg (56,780 lb)
900STD	26,270 kg (57,915 lb)
900ER	26,770 kg (59,018 lb)
Max standard fuel weight: 700STD, 700ER, 700F, 900STD	10,386 kg (22,897 lb)
700B	16,386 kg (36,125 lb)
900ER	10,886 kg (23,999 lb)
Max payload: 700STD, 700ER	8,935 kg (19,698 lb)
700F	10,150 kg (22,377 lb)
700B	3,000 kg (6,614 lb)
900STD, 900ER	11,246 kg (24,793 lb)
Max T-O weight:	
700STD	40,500 kg (89,287 lb)

700ER, 700F, 700B ..... 43,500 kg (95,901 lb)
900STD ..... 43,616 kg (96,156 lb)
900ER ..... 47,182 kg (104,018 lb)
Max ramp weight:
700STD ..... 40,589 kg (89,483 lb)
700ER, 700F, 700B ..... 43,589 kg (96,097 lb)
900STD ..... 43,706 kg (96,355 lb)
900ER ..... 47,272 kg (104,217 lb)
Max landing weight:
700STD ..... 37,665 kg (83,037 lb)
700ER, 700F, 700B ..... 40,455 kg (89,188 lb)
900STD ..... 40,563 kg (89,426 lb)
900ER ..... 43,879 kg (96,737 lb)
Max zero-fuel weight:
700STD, 700ER ..... 33,890 kg (74,715 lb)
700F ..... 36,505 kg (80,480 lb)
700B ..... 28,755 kg (63,394 lb)
900 STD ..... 37,516 kg (82,709 lb)
900ER ..... 38,016 kg (83,811 lb)
Max wing loading:
700STD ..... 507.1 kg/m^2 (103.87 lb/sq ft)
700ER, 700F, 700B ..... 544.7 kg/m^2 (111.56 lb/sq ft)
900STD ..... 546.2 kg/m^2 (111.86 lb/sq ft)
900ER ..... 590.8 kg/m^2 (121.01 lb/sq ft)
Max power loading:
700STD ..... 297 kg/kN (2.91 lb/lb st)
700ER, 700F, 700B ..... 319 kg/kN (3.13 lb/lb st)
900STD ..... 287 kg/kN (2.82 lb/lb st)
900ER ..... 311 kg/kN (3.05 lb/lb st)

PERFORMANCE (estimated):
Max operating Mach number (Mmo): all 0.82
Max operating speed (Vmo): all ..... 330 kt (611 km/h; 379 mph) CAS
Max operating altitude: all ..... 11,900 m (39,040 ft)
Service ceiling, OEI: all ..... 6,200 m (20,340 ft)
T-O field length at S/L, ISA:
700STD ..... 1,700 m (5,580 ft)
700ER ..... 1,900 m (6,235 ft)
900STD ..... 1,750 m (5,740 ft)
900ER ..... 1,950 m (6,400 ft)
Landing field length at MLW at S/L, ISA:
700STD ..... 1,550 m (5,085 ft)
700ER ..... 1,650 m (5,415 ft)
900STD ..... 1,600 m (5,250 ft)
900ER ..... 1,700 m (5,580 ft)
Range with max payload:
700STD, 900STD ..... 1,200 n miles (2,222 km; 1,380 miles)
700ER ..... 2,000 n miles (3,704 km; 2,301 miles)
900ER ..... 1,800 n miles (3,333 km; 2,071 miles)
Range with 85% payload:
700F ..... 1,800 n miles (3,333 km; 2,071 miles)
700B ..... 3,300 n miles (6,111 km; 3,797 miles)

AVIC

CHINA AVIATION INDUSTRY CORPORATION (ZHONGGUO HANGKONG GONGYE ZONGGONGSI)

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Fax: (+86 10) 84 97 10 88
e-mail: webmaster@catic.com.cn
Web: www.catic.com.cn
PRESIDENT: Fushu La
VICE-PRESIDENT, EXPORTS: Ding Shiqing
DIRECTOR, PUBLIC RELATIONS: Bi Jianfa

Present Chinese aviation industry created in 1951 and has since manufactured some 14,000 aircraft (including more than 10,000 military), more than 50,000 aero-engines and 10,000 air-to-air and tactical missiles. Some 700 aircraft have been exported, approximately 10 per cent of them civil types.

Former Ministry of Aero-Space Industry abolished 1993 and AVIC created on 26 June 1993 as economic entity to develop market economy and expand international collaboration in aviation programmes. CATIC Group formed 26 August 1993, with CATIC (founded January 1979) as its core company, to be responsible for import and export of aero and non-aero products, subcontract work and joint ventures.

Xian, Chengdu, Shanghai, Shenyang, Harbin and other factories carry out subcontract work on Airbus A300/318/320; ATR 72; Boeing 737/747/757; Bombardier Dash 8Q; and Bombardier 415. Licensed manufacture of Sukhoi Su-27s is undertaken at Shenyang. Co-development with UK/France/Italy and Singapore of AE-100 regional airliner abandoned in 1998 and replaced by AVIC I's ARJ21 project (managed by ACAC); AVIC II programme for smaller regional jet now being met by co-production of Embraer ERJ-135/140/145 family by Harbin Embraer Aircraft Industry (HEAI).

Total workforce of aerospace industry was reduced to about 500,000 in 1998, when about 34,000 workers were made redundant and some 14,000 others transferred to non-aerospace activities. AVIC's President announced plans at Airshow China in November 1998 to restructure aircraft industry into two "competing and co-operating" groups in the near future. Draft organisation plan submitted to State Council in February 1999, resulting in division of AVIC into two separate companies (AVIC I and II) with effect from July 1999. Each of these companies has a 50 per cent shareholding in China Aviation Supply and Marketing Corporation (CASM) and CATIC.

AVIC I comprises 47 industrial enterprises (236,000 workforce) and 31 research institutes (45,000 workforce), plus 22 other specialised companies or institutions. Activities include more than 3,000 non-aerospace products in eight categories, including industrial gas turbines; cars; motorcycles; refrigeration equipment; and environmental materials. It also undertakes aircraft leasing, general aviation services, and management of national aircraft verification and flight testing.

AVIC I principal aviation entities:

AVIC I Commercial Aircraft Company (ACAC) (ARJ21)
Chengdu Aircraft Design Institute
Chengdu Aircraft Industries Group (J-7/F-7, FC-1/JF-17 and J-10)
China Air-to-Air Missile Research Institute
China Flight Test Establishment
China Gas Turbine Establishment
Guizhou Aviation Industries Group (JJ-7/FT-7; JL-9/CY-1/FC-16; jet engines; missiles)
Shanghai Aero-Engine Manufacturing Plant
Shanghai Aircraft Manufacturing Factory
Shanghai Aircraft Research Institute
Shanghai Aviation Industries Group (airliner subcontracts)
Shenyang Aero-Engine Research Institute
Shenyang Aircraft Industries Group (J-8/F-8, J-11/Su-27 and 'J-X'; civil subcontracts)
Shenyang Aero-Engine Research Institute
Shenyang Liming Engine Manufacturing Corporation
Xian Aero-Engine Corporation (WP8 and WS9)
Xian Aircraft Design and Research Institute
Xian Aircraft Industries Group (JH-7/FBC-1, WJ and MA60)

AVIC II, by comparison, owns a total of 81 subordinate industrial enterprises, research institutes and other organisations which between them have produced more than 6,100 aircraft (including about 660 helicopters), 23,600 aero-engines and some 10,000 tactical missiles since 1951, in addition to large numbers of road vehicles and other non-aeronautical products. Its aviation activities are undertaken by five divisions, respectively specialising in aircraft; aero-engines; helicopters; airborne equipment; and civil aircraft market development.

AVIC II was stated in mid-2002 to have government approval to float its non-military business on the Hong Kong Stock Exchange; to this end, new company AviChina Industry and Technology created in 2003; in October 2003, a 5 per cent stake in this company was acquired by EADS. In same year, new MoU signed with Antonov, to pursue possibility of producing An-70 and An-124-300 in China. MoU with Eurocopter in 2004 for joint development of a new 7,000 kg (15,432 lb) class helicopter (EC 175, provisional designation Z-12) as replacement for Sikorsky S-70C-2 Black Hawk.

AVIC II principal aviation entities:

Baoding Propeller Factory
Changhe Aircraft Industries Group (Z-8 and Z-11)
Changzhou Aircraft Factory
Chengdu Engine Company (WP7 and WP13)
China Helicopter Research and Development Institute (Z-10 and 'Z-12')
Dongan Engine Company (WJ5)
Harbin Aircraft Industries Group (Hafei Z-9,'Z-X' and Y-12)
Hongdu Aviation Industries Group (JL-8/K-8 and L-15)
Shaanxi Aircraft Industries Group (Y-8 and Y-9)
Shijiazhuang Aircraft Industry Corporation (Y-5, LE-500 and LE-800)
South Aero-Engine Company (HS5, WJ6 and WZ8)
Zhuzhou Aviation Power Plant Research Institute

CAC

CHENGDU AIRCRAFT INDUSTRY GROUP (CHENGDU FEIJI GONGYE GONGSI) (SUBSIDIARY OF AVIC I)

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Web: www.cac.com.cn
CHAIRMAN AND PRESIDENT: Luo Ronghuai
DEPUTY GENERAL MANAGER: Li Shaoming
DEVELOPMENT DIRECTOR: Li Pei
DIRECTOR, INTERNATIONAL CO-OPERATION DIVISION: Wang Yinggong

Major centre for fighter development and production, founded 1958; has since built over 2,000 fighters of more than 10 models or variants; current facility occupies site area of 462 ha (1,142 acres). Production continues of some variants of J-7/F-7 fighter series; newer J-10 and FC-1 fighters currently under development and/or early production and service. Chengdu also thought to be in concept stage of an advanced combat aircraft, possibly to the same 'XXJ' outline requirement as SAC (Shenyang). CAC design reportedly in conjunction with No. 611 Institute; possibly of tail-less delta planform, with canards. In 2001, CAC was named as a risk-sharing partner in the ACAC ARJ21 regional jet programme.

Subcontract work includes passenger doors for the Airbus A320; wing components for Boeing 737/747; rear fuselages and tail surfaces for Boeing 757 (with 787 rudder to follow); and fuselage components for Dassault Falcon 2000EX. Non-aerospace products account for a large percentage of current output.

CAC J-7

Chinese name: Jianjiji-7 (Fighter aircraft 7)
Westernised designation: F-7

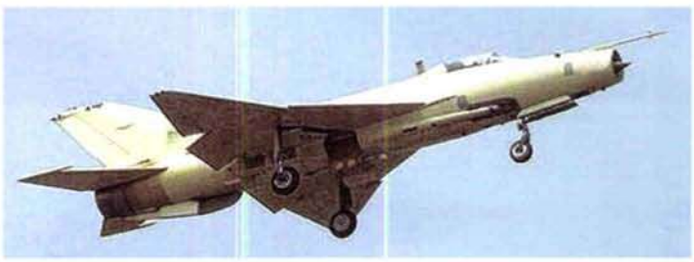
TYPE: Multirole fighter.

PROGRAMME: Origins of MiG-21 licensed manufacture in China (1961–67) detailed in earlier editions. Chengdu production of J-7 I began June 1967 (first flight 16 June 1969 but not accepted in large numbers); development of J-7 II began 1975, followed by first flight 30 December 1978 and production approval September 1979; development of F-7M and J-7 III started 1981; J-7 III first flight 26 April 1984; F-7M (first flight 31 August 1983) revealed publicly October 1984, production go-ahead December 1984, named Airguard early 1986; first F-7P deliveries to Pakistan 1988; first F-7MPs to Pakistan mid-1989; F-7MG public debut November 1996; J-7FS revealed September 1998 and F-7MF November 2000. Latest reported domestic version is J-7G, first flown June 2002.

CURRENT VERSIONS (DOMESTIC): **J-7B (originally J-7 II)**: Modified and improved J-7 I; WP7B turbojet of increased thrust (43.2 kN; 9,700 lb st dry, 59.8 kN; 13,450 lb st with afterburning); 720 litre (190 US gallon; 158 Imp gallon) centreline drop tank for increased range; brake-chute relocated at base of rudder to improve landing performance and shorten run; rear-hinged canopy, jettisoned before ejection seat deploys; new Chengdu Type II seat operable at zero height and speeds down to 135 kt (250 km/h; 155 mph); and new Lanzhou compass system. Small batch production (typically, 14 in 1989), notwithstanding advent of J-7 III and J-7E.

J-7C (originally J-7 III): Chinese equivalent of MiG-21MF, with blown flaps and all-weather, day/night capability. Main improvements are change to WP13 engine with greater power; additional fuel in deeper dorsal spine; JL-7 (J-band) interception radar, with correspondingly larger nose intake and centrebody radome; sideways-opening (to starboard) canopy, with centrally located rearview mirror; improved HTY-4 low-speed/zero height ejection seat; more advanced fire-control system; twin-barrel 23 mm gun under fuselage (with HK-03D optical gunsight); broader-chord vertical tail surfaces, incorporating antennas for LJ-2 omnidirectional RWR in hemispherical fairing each side at base of rudder; increased weapon/stores capability (four underwing stations), similar to that of F-7M; and new or additional avionics (which see). Joint development by Chengdu and Guizhou (GAIC); entered AFPLA service from 1992, but reportedly limited production and use only (15th and 19th Divisions).

J-7D (originally J-7 IIIA): Further (early 1990s) attempt to improve upon J-7 III; first flight August 1991; 71.6 kN (16,094 lb st) WP13F1 engine, JL-7A J-band interception radar, RWR antennas atop vertical fin; HK-13A HUD, Tacan and ADC; weapons upgrade to include PL-8 AAMs. Believed to equip two night fighter regiments of 15th and 29th Divisions, but production (1995-99) reportedly limited to 32 aircraft.



Unofficial photograph purporting to show CAC J-7G 0573878

J-7E: Upgraded version of J-7B with modified, double-delta wing, retaining existing leading-edge sweep angle of 57° inboard but reduced sweep of only 42° outboard; span increased by 1.17 m (3 ft 10 in) and area by 1.88 m² (20.2 sq ft), giving 8.17 per cent more wing area; four underwing stations instead of two, outer pair each plumbed for 480 litre (127 US gallon; 106 Imp gallon) drop tank; new WP7F version of WP7 engine, rated at 44.1 kN (9,921 lb st) dry and 63.7 kN (14,330 lb st) with afterburning; armament generally as listed for F-7M, but capability extended to include PL-8 (Python 3) air-to-air missiles; *g* limits of 8 (up to M0.8) and 6.5 (above M0.8); avionics include HUD and ADC. Believed to have made first flight in April 1990 and entered service 1993. Operators include 1st, 2nd, 3rd, 4th, 14th and 37th AFPLA Divisions and Navy 4th Division. Production reported to have ended in 2002, after 263 built, in favour of J-7G. PLA Navy version designated **J-7EH**.

J-7EB: Unarmed version of J-7E equipping AFPLA 'August 1st' aerobatic team (nine in 1998 display season); fitted with smoke canisters for display purposes. Replaced by J-7GB in 2005.

J-7FS: Technology demonstrator, modified from standard J-7 II, with new chin-mounted intake and central splitter plate under reconfigured ogival nosecone; more powerful (73.4 to 78.3 kN; 16,502 to 17,604 lb thrust class with afterburning) Liyang (LMC) WP13F II turbojet. Began 22 month flight test programme on 8 June 1998. Enlarged nose avionics bay able to accept 60 cm (23.6 in) diameter multimode pulse Doppler radar believed to be under development in China. Development work formed basis for new F-7MF export variant (which see). Planned future changes were to include wing modifications based on J-7E/F-7MG double-delta configuration.

J-7G: Further upgrade of J-7E; maiden flight June 2002. New KLJ-6E Falcon fire-control radar, PL-8 IR-guided AAMs and updated cockpit with new HUD and Type III IFF; intended for Chinese air force and naval units. Deliveries to AFPLA reportedly began in early 2003; further 16 in October 2004.

J-7GB: Unarmed J-7G for 'August 1st' display team, replacing J-7EB from 2005 season. Wraparound windscreen.

JJ-7: Tandem two-seat operational trainer, based on J-7 II and MiG-21US; developed at Guizhou by GAIC.

CURRENT VERSIONS (EXPORT): **F-7A**: Export counterpart of J-7 I/J-7A, supplied to Albania and Tanzania.

F-7B: Export version of J-7 II/J-7B, with R550 Magic missile capability; supplied to Egypt and Iraq in 1982–83 and also to Sudan. Some supplied to Air Force of Zimbabwe (known locally as F-7 II) appear to be of this version.

F-7BG: Designation of 12 F-7MGs ordered (plus four FT-7s, June 2005) by Bangladesh Air Force; to equip Nos. 5 and 35 Squadrons; first eight in service 4 April 2006.

F-7BS: Hybrid version supplied to Sri Lanka 1991; has F-7B fuselage/tail and Chinese avionics (no HUD), combined with four-pylon wings of F-7M. Equips No. 5 Squadron of SLAF. Zimbabwe also has some four-pylon aircraft with its No. 5 Squadron; these known locally as the F-7 IIN.

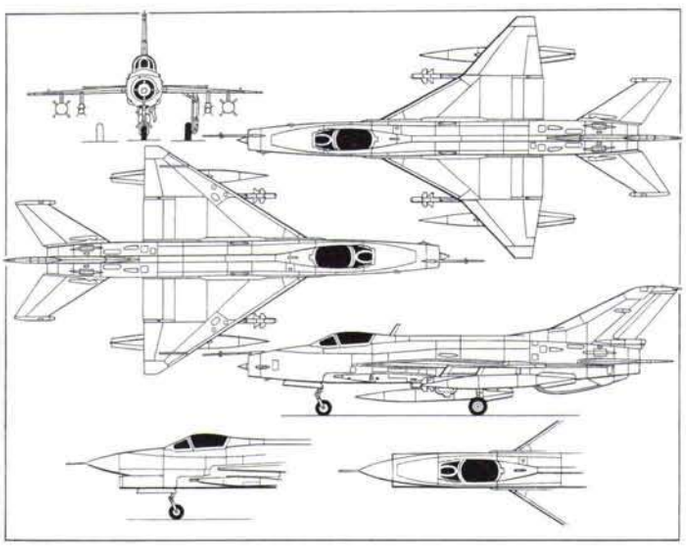
F-7M Airguard: First upgraded export version, developed from J-7B; new avionics imported from May 1979 included Marconi HUDWAC (head-up display and weapon aiming computer); new ranging radar, air data computer, radar altimeter and IFF; more secure com radio; improved electrical power generation system for the new avionics; two additional underwing stores points; improved WP7B(BM) engine; birdproof windscreen; strengthened landing gear; ability to carry PL-7 air-to-air missiles; nose probe relocated from beneath intake to top lip of intake, offset to starboard. Exported to Iran and Myanmar.

Description applies to F-7M version, except where indicated.

F-7MB: Variant of F-7M; mentioned in 1996 F-7MG brochure. Customer believed to be Bangladesh (16); one planned to be equipped with reconnaissance pod.

CAC J-7 single-seat fighter of PLA Navy's 8th Division 1153776

CAC J-7GBs of the 'August 1st' aerobatic team 1153775



CAC F-7M Airguard single-seat fighter and close support aircraft; upper plan view shows modified outer wings of J-7E and F-7MG; lower scrap views of J-7FS nose in profile and plan *(Mike Keep)* 0126688

F-7MF: Debut at Airshow China, November 2000; further development of J-7FS and F-7MG for export market. Larger 'solid' nose; shorter, rectangular intake located farther back under nose; small, shoulder-mounted canards just forward of wingroot leading-edge; WP13F engine; 1553B databus; avionics to include 43 n mile (80 km; 50 mile) range pulse Doppler radar (possibly Elta EL/M-2032), single HUD and dual HDDs; 3,000 kg (6,614 lb) external stores load.

Wind tunnel testing completed; first flight then targeted for late 2001/early 2002, but most recently forecast for second half of 2003, though not reported by March 2004. Performance expectations include M1.8 top speed, 16,000 m (52,500 ft) ceiling, 650 m (2,135 ft) T-O run and 1,403 n mile (2,600 km; 1,615 mile) ferry range. Possibly testbed for some features of J-10.

F-7MG: Improved version of F-7M (G suffix indicates *gai:* modified), combining double-delta wings of J-7E with Grifo MG radar, other upgraded avionics, uprated (WP13F) engine and leading/trailing-edge manoeuvring flaps. Said to have 45 per cent better manoeuvrability than F-7M. Public debut (aircraft 0142 and 0144) at Airshow China, Zhuhai, November 1996. Pakistan (see F-7PG) only customer until 2005, when 12 ordered by Bangladesh (see F-7BG); Zimbabwe said to be interested in enough for two squadrons.

F-7MP: Further modified variant of F-7P; improved cockpit layout and navigation system incorporating Rockwell Collins AN/ARN-147 VOR/ILS receiver, AN/ARN-149 ADF and Pro Line II digital DME-42. Avionics (contract for up to 100 sets) delivered to China from early 1989. FIAR (now Galileo) Grifo MG fire-control radar (range of more than 30 n miles; 55 km; 34 miles) for F-7P and MP ordered 1993, to replace Skyranger; flight trials began May 1996 and completed in 1997.

F-7N: Variant of F-7M; mentioned in 1996 F-7MG brochure, but no details given. Possibly an alternative designation for Zimbabwe F-7 IIN (see F-7BS paragraph above).

F-7NI: Version ordered by Nigerian Air Force (12) in 2005, together with three FT-7NI trainers.

F-7P Airguard: Variant of F-7M (briefly called Skybolt), embodying 24 modifications to meet specific requirements of Pakistan Air Force, including ability to carry four air-to-air missiles (Sidewinders) instead of two and fitment of Martin-Baker Mk 10L ejection seat. Delivered 1988–91. Equip No. 14 Squadron at Kamra-Minhas, Nos. 18 and 19 at Mianwali and No. 2 at Masroor.

F-7PG: Pakistan Air Force designation of F-7MG; 57 (plus six FT-7PGs) ordered in late 2000. Deliveries to Nos. 17 and 23 Squadrons at Samungli, replacing Shenyang F-6s, completed by second quarter 2002; third squadron is No. 20 at Rafiqui. Grifo 7PG radars (still awaiting firm contract) would be produced by KARF factory of Pakistan Aircraft Complex.

FT-7: Export designation of GAIC JJ-7 two-seat trainer.

CUSTOMERS: Several thousand built for Chinese air forces; Air Divisions currently equipped with J-7 variants comprise Nos. 1, 2, 3, 4, 9, 12, 14, 15, 18, 21, 24, 26, 29, 33, 35, 42 and 44, plus Naval 4th, each with two or three Regiments totalling up to 100 aircraft; Nos. 7, 17, 31 and 32 believed disbanded.

More than 400 exported to Albania (12 F-7A), Bangladesh (16 F-7MB and 12 F-7BG), Egypt (approximately 90 F-7B?), Iran (18 or more F-7M), Iraq (approximately 90 F-7B?), Myanmar (24 F-7M), Nigeria (12 F-7NI and three FT-7NI), Pakistan (20 F-7P and 100 F-7MP, all designated F-7P by PAF; followed by 57 F-7PG), Sri Lanka (four F-7BS), Sudan (22 F-7B); Tanzania (16 F-7A) and Zimbabwe (approximately 12 F-7B/F-7IIN variants).

DESIGN FEATURES: Typical mid-1950s design of fighter, incorporating diminutive delta wing (double-delta on J-7E/EB, J-7G/GB and F-7MG/PG), with clipped tips to mid-mounted wings, plus all-moving horizontal tail; circular-section fuselage with dorsal spine; nose intake with conical centrebody; swept tail, with large vertical surfaces and ventral fin.

Wing anhedral 2° from roots; incidence 0°; thickness/chord ratio approximately 5 per cent at root, 4.2 per cent at tip; quarter-chord sweepback 49° 6' 36" (reduced on J-7E/EB, J-7G/GB and F-7MG/PG outer panels); no wing leading-edge camber.

FLYING CONTROLS: Manual operation, with autostabilisation in pitch and roll; hydraulically boosted inset ailerons; plain trailing-edge flaps, actuated hydraulically; forward-hinged door-type airbrake each side of underfuselage below wing leading-edge; third, forward-hinged airbrake under fuselage forward of ventral fin; airbrakes actuated hydraulically; hydraulically boosted rudder and all-moving, trimmable tailplane. Leading/trailing-edge manoeuvring flaps on J-7E/EB, J-7G/GB and F-7MG/PG.

STRUCTURE: All-metal; wings have two primary spars and auxiliary spar; semi-monocoque fuselage, with spine housing control pushrods, avionics, single-point refuelling cap and fuel tank; blister fairings on fuselage above and below each wing to accommodate retracted mainwheels.

LANDING GEAR: Inward-retracting mainwheels, with 600×200 tyres (pressure 11.50 bar; 167 lb/sq in) and LS-16 disc brakes; forward-retracting nosewheel, with 500×180 tyre (pressure 7.00 bar; 102 lb/sq in) and LS-15 double-acting brake. Nosewheel steerable ±47°. Minimum ground turning radius 7.04 m (23 ft 1¼ in). Tail braking parachute at base of vertical tail.

POWER PLANT: *F-7M:* One LMC (Liyang) WP7B(BM) turbojet (43.2 kN; 9,700 lb st dry, 59.8 kN; 13,448 lb st with afterburning).

Total F-7M internal fuel capacity 2,385 litres (630 US gallons; 525 Imp gallons), contained in six flexible tanks in fuselage and two integral tanks in each wing. Provision for carrying a 500 or 800 litre (132 or 211 US gallon; 110 or 176 Imp gallon) centreline drop tank, and/or a 500 litre drop tank on each outboard underwing pylon. Maximum internal/external fuel capacity 4,185 litres (1,105 US gallons; 921 Imp gallons).

J-7C: LMC WP13 turbojet (40.2 kN; 9,039 lb st dry, 64.7 kN; 14,550 lb st with afterburning).

J-7E/EB: See Current Versions.

J-7FS: See Current Versions.

F-7MF/MG/PG: WP13F (44.1 kN; 9,921 lb st dry, 64.7 kN; 14,550 lb st with afterburning).

ACCOMMODATION: Pilot only, on CAC zero-height/low-speed ejection seat operable between 70 and 459 kt (130 and 850 km/h; 81 and 528 mph) IAS; or TY6 series zero/zero seat. Martin-Baker Mk 10L seat in F-7P/MP/PG. One-piece canopy, hinged at rear to open upward. J-7C canopy opens sideways to starboard.

SYSTEMS: Improved electrical system in F-7M, using three static inverters, to cater for additional avionics. Jianghuai YX-3 oxygen system.

AVIONICS: *Comms:* BAE Systems AD 3400 UHF/VHF multifunction com, Chinese Type 602 IFF transponder; Type 605A ('Odd Rods' type) IFF in J-7C.

Radar: BAE Systems Type 226 Skyranger ranging radar in F-7M; Chinese JL-7 fire-control radar in J-7C, JL-7A in J-7D; Galileo (formerly FIAR) Grifo MG in F-7P/MP/MG/PG (look-down, shoot-down and track-while-scan capability).

Flight: Navigation function of BAE Systems HUDWAC includes approach mode. WL-7 radio compass, XS-6A marker beacon receiver, Type 0101 HR A/2 radar altimeter and BAE Systems air data computer in F-7M.

Beijing Aeronautical Instruments Factory KJ-11 twin-channel autopilot and FJ-1 flight data recorder in J-7C.

J-7D has HK-13A HUD, JD-311 Tacan and Type 563B INS; JT-1 HUD, JD-3 Tacan in J-7E; GPS receiver added in J-7EB/GB.

F-7MG/PG suite includes VOR/DME/INS and Tacan.

Instrumentation: BAE Systems Type 956 HUDWAC (head-up display and weapon aiming computer) in F-7M provides pilot with displays for instrument flying, with air-to-air and air-to-ground weapon aiming symbols integrated with flight-instrument symbology. It can store 32 weapon parameter functions, allowing for both current and future weapon variants. In air-to-air combat its four modes (missiles, conventional gunnery, snapshoot gunnery, dogfight) and standby aiming reticle allow for all eventualities. Improved weapons management system in J-7D.

VCR and infra-red cockpit lighting in F-7MG/PG, for which licence-built Russian helmet sight, slaved to PL-9 AAM, is also in production.

Self-defence: Skyranger ECCM in F-7M. Chinese LJ-2 RWR and GT-4 ECM jammer in J-7C; BM/KJ 8602 RWR, RKL-800 ECM and RKZ-404E chaff/flare dispenser in J-7D.

ARMAMENT (F-7M): Two 30 mm Type 30-1 belt-fed cannon, with 60 rds/gun, in fairings under front fuselage just forward of wingroot leading-edges. Two hardpoints under each wing, of which outer ones are wet for carriage of drop tanks. Centreline pylon used for drop tank only. Each inboard pylon capable of carrying a PL-2, -2A, -5B, -7 or -8 (Python 3) missile (and PL-9 on F-7MG/PG) or, at customer's option, an R550 Magic; one 18-tube pod of Type 57-2 (57 mm) air-to-air and air-to-ground rockets; one Type 90-1 (90 mm) seven-tube pod of air-to-ground rockets; or a 50, 150, 250 or 500 kg bomb. Each outboard pylon can carry one of above rocket pods, a 50 or 150 kg bomb, or a 500 litre drop tank.

ARMAMENT (J-7C and later): One 23 mm Type 23-3 twin-barrel gun in ventral pack. Five external stores stations can carry up to four PL-2 or PL-5B air-launched missiles or two PL-8; two or four Qingan HF-16B 12-round launchers for Type 57-2 or seven-round pods of Type 90-1 rockets; or two 500 kg, four 250 kg or ten 100 kg bombs, in various combinations with 500 litre (one centreline and/or one under each wing) or 800 litre (underfuselage station only) drop tanks.

DIMENSIONS, EXTERNAL:

Wing span: except J-7E/F-7MG	7.15 m (23 ft 5½ in)
J-7E/F-7MG	8.32 m (27 ft 3½ in)
Wing chord: at root	5.51 m (18 ft 0¾ in)
at tip (except J-7E/F-7MG)	0.46 m (1 ft 6¼ in)
Wing aspect ratio: except J-7E/F-7MG	2.2
J-7E/F-7MG	2.8

Length overall: excl nose probe ..... 13.945 m (45 ft 9 in)
incl nose probe ..... 14.885 m (48 ft 10 in)
Fuselage: Length ..... 12.175 m (39 ft 11½ in)
Max diameter ..... 1.34 m (4 ft 4¾ in)
Height overall ..... 4.105 m (13 ft 5½ in)
Tailplane span ..... 3.74 m (12 ft 3¼ in)
Wheel track ..... 2.69 m (8 ft 10 in)
Wheelbase ..... 4.805 m (15 ft 9¼ in)

AREAS:

Wings, gross: except J-7E/F-7MG ..... 23.00 m² (247.6 sq ft)
J-7E/F-7MG ..... 24.88 m² (267.8 sq ft)
Ailerons (total): except J-7E/F-7MG ..... 1.18 m² (12.70 sq ft)
Trailing-edge flaps (total) ..... 1.87 m² (20.13 sq ft)
Fin ..... 3.48 m² (37.46 sq ft)
Rudder ..... 0.97 m² (10.44 sq ft)
Tailplane ..... 3.94 m² (42.41 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: F-7M ..... 5,275 kg (11,629 lb)
F-7MF ..... 5,500 kg (12,125 lb)
F-7MG ..... 5,292 kg (11,667 lb)
Normal T-O weight with two PL-2 or PL-7 air-to-air missiles:
F-7M ..... 7,531 kg (16,603 lb)
J-7C ..... 8,150 kg (17,967 lb)
F-7MG ..... 7,540 kg (16,623 lb)
Max T-O weight: F-7MG ..... 9,100 kg (20,062 lb)
Wing loading at normal T-O weight:
F-7M ..... 327.4 kg/m² (67.06 lb/sq ft)
J-7C ..... 354.3 kg/m² (72.56 lb/sq ft)
Max wing loading: F-7MG ..... 365.8 kg/m² (74.91 lb/sq ft)
Power loading at normal T-O weight:
F-7M, J-7C ..... 126 kg/kN (1.23 lb/lb st)
Max power loading: F-7MG ..... 141 kg/kN (1.38 lb/lb st)

PERFORMANCE (F-7M at normal T-O weight with two PL-2 or PL-7 air-to-air missiles, except where indicated):

Never-exceed speed (VNE) above 12,500 m (41,010 ft) ..... M2.35 (1,346 kt; 2,495 km/h; 1,550 mph)
Max level speed between 12,500 and 18,500 m (41,010–60,700 ft) ..... M2.05 (1,175 kt; 2,175 km/h; 1,350 mph)
Unstick speed ..... 167–178 kt (310–330 km/h; 193–205 mph)
Touchdown speed ..... 162–173 kt (300–320 km/h; 186–199 mph)
Max rate of climb at S/L ..... 10,800 m (35,435 ft)/min
Acceleration from M0.9 to M1.2 at 5,000 m (16,400 ft) ..... 35 s
Max sustained turn rate: M0.7 at S/L ..... 14.7°/s
M0.8 at 5,000 m (16,400 ft) ..... 9.5°/s
Service ceiling ..... 18,200 m (59,720 ft)
Absolute ceiling ..... 18,700 m (61,360 ft)
T-O run ..... 700–950 m (2,300–3,120 ft)
Landing run with brake-chute ..... 600–900 m (1,970–2,955 ft)
Typical mission profiles:
combat air patrol at 11,000 m (36,080 ft) with two air-to-air missiles and three 500 litre drop tanks, incl 5 min combat ..... 45 min
long-range interception at 11,000 m (36,080 ft) at 351 n miles (650 km; 404 miles) from base, incl M1.5 dash and 5 min combat, stores as above
hi-lo-hi interdiction radius, out and back at 11,000 m (36,080 ft), with three 500 litre drop tanks and two 150 kg bombs ..... 324 n miles (600 km; 373 miles)
lo-lo-lo close air support radius with four rocket pods, no external tanks ..... 200 n miles (370 km; 230 miles)
Range:
two PL-7 missiles and three 500 litre drop tanks . 939 n miles (1,740 km; 1,081 miles)
self-ferry with one 800 litre and two 500 litre drop tanks, no missiles ..... 1,203 n miles (2,230 km; 1,385 miles)
g limit ..... +8

PERFORMANCE (J-7C at normal T-O weight):

Max operating Mach No. (MMO) 2.1
Unstick speed with afterburning ..... 173 kt (320 km/h; 199 mph)
Touchdown speed with flap blowing ..... 146 kt (270 km/h; 168 mph)
Min level flight speed ..... 140 kt (260 km/h; 162 mph)
Max rate of climb at S/L ..... 9,000 m (29,525 ft)/min
Service ceiling ..... 18,000 m (59,060 ft)
Acceleration from M1.2 to M1.9 at 13,000 m (42,660 ft) ..... 3 min 27 s
Air turning radius at 5,000 m (16,400 ft) at M1.2 ..... 5,093 m (16,710 ft)
T-O run with afterburning ..... 800 m (2,625 ft)
Landing run with flap blowing, drag-chute and brakes deployed ..... 550 m (1,805 ft)
Range: on internal fuel ..... 518 n miles (960 km; 596 miles)
with 800 litre belly tank ..... 701 n miles (1,300 km; 807 miles)
with 800 litre belly tank and two 500 litre underwing tanks ..... 1,025 n miles (1,900 km; 1,180 miles)
g limits: up to M0.8 ..... +8.5
above M0.8 ..... +7

PERFORMANCE (F-7MG):

Max operating Mach No. (MMO) 2.0
Max level speed ..... 648 kt (1,200 km/h; 745 mph) IAS
Min level speed ..... 114 kt (210 km/h; 131 mph) IAS
Max rate of climb at S/L ..... 11,700 m (38,386 ft)/min
Max instantaneous turn rate ..... 25.2°/s
Sustained turn rate: at 1,000 m (3,280 ft) ..... 16°/s
at 5,000 m (16,400 ft) ..... 11°/s
at 8,000 m (26,240 ft) ..... 8°/s
Service ceiling ..... 17,500 m (57,420 ft)
Theoretical ceiling ..... 18,000 m (59,060 ft)
T-O run, with afterburning, and landing run ..... 600–700 m (1,970–2,300 ft)
Operational radius:
air superiority (hi-hi-hi) with two AIM-9P AAMs and three 500 litre drop tanks, incl 5 min combat with afterburner ..... 459 n miles (850 km; 528 miles)
air-to-ground attack (lo-lo-hi) with two Mk 82 bombs and two 500 litre drop tanks ..... 297 n miles (550 km; 342 miles)
Ferry range ..... 1,187 n miles (2,200 km; 1,367 miles)
g limits ..... +8/–3

CAC FC-1 XIAOLONG

English name: Thunder Dragon
Pakistan Air Force designation: JF-17 Thunder

TYPE: Attack fighter.

PROGRAMME: Fighter China (FC) programme launched 1991 following cancellation of US participation in development of Chengdu Super-7. Some design assistance from MiG OKB, possibly based on (then-designated MiG-33) mid-1980s project for single-engined variant of the MiG-29. (Sources at MiG experimental bureau quoted as saying that FC-1 was designed there to a military specification as Izd (*Izdeliye*: article) 33 and later offered for Chinese production following cancellation of Russian requirement.) Collaboration with Pakistan began with 1995 MoU, leading to joint development and production contract in June 1999, but avionics selection for Pakistan bedevilled by sanctions and technology transfer concerns, and this aspect separated from airframe development progress in early 2001.

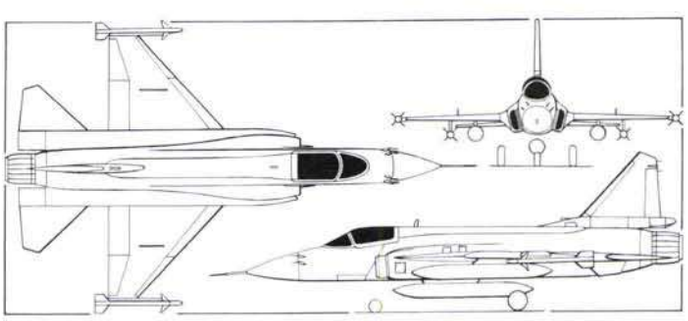
Full-scale mockup completed 2001 and exhibited at Zhuhai November 2002. First five prototypes (including 02 for static and 05 for fatigue test, and 04 earmarked as avionics and weapon systems testbed) under construction by then, with oft-postponed maiden flight targeted for mid-2003. First batch of RD-93 engines, to power 01, 03 and 04, received in 2002. Formal approval for production, at CAC's No. 132 factory, reported in January 2003. Pakistan renamed Super-7 as JF-17 (Joint Fighter) Thunder in 2003.

First FC-1 rolled out 31 May 2003 and began low-speed taxying trials 27 June, followed by eight-minute maiden flight (first of two that day) on 25 August, and first 'official' flight, by then also bearing JF-17 markings, 3 September 2003, all at Chengdu's Wenjiang Airport. Pakistan news reports at that time indicated following timetable (not achieved) for that country's participation: finalise MoU September 2003; sign contract December 2003; low-rate initial production by Pakistan Aeronautical Complex from June 2004 to December 2005; begin full rate production January 2006.

Maiden flight of second flight test prototype (03, also known as PT3) occurred on 9 April 2004. Pakistan Air Force test pilots flew PT1 first prototype for first time two days earlier. By end of 2004, cumulative total of more than 300 hours had been flown. Contract to supply 100 RD-93 engines, manufactured by Klimov (30) and Chernyshev Machine Building Enterprise (70) and reportedly valued at USD267 million, announced April 2005; option to purchase up to 500 more. At first, these prohibited from use in JF-17 version, but this decision revoked in November 2006. Two competing Chinese radars being tested during 2005. Pakistan production formally launched at PAC Kamra on 6 April 2005. Modifications introduced on third flying prototype (04, aka PT4) include enlarged engine air intake, wingroot strakes extended, taller tailfin topped by (RWR ?) fairing; flight testing began 28 April 2006 as avionics and weapon systems integration prototype; two further prototypes to this configuration; two additional aircraft to be completed in 2006.

CUSTOMERS: Envisaged for air forces of China and Pakistan initially, but costed to be competitive in wider export market. Promoted to Bangladesh, Egypt and Nigeria in 2003;

CAC FC-1 PT4 showing enlarged LERX 1040444



CAC FC-1 attack fighter *(James Goulding)* 1121595

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PT4/04, third flying FC-1 prototype, lands after a 2006 test flight 1040443

Third flying CAC FC-1 '04' 1040445

mid-2004 reports of Zimbabwean order for 12 proved to be erroneous. Seen as potential replacement for Shenyang J-6, Chengdu J-7, Nanchang Q-5, Northrop F-5 and Dassault Mirage III/5. Chinese domestic requirement for the FC-1 (AFPLA and possibly PLA Navy) is said to be for several hundred aircraft; Pakistan requirement is initially for 150, including a two-seat tactical/trainer version.

Preproduction batch of 16 to be built (eight for each partner country), of which CAC and PAC will each assemble four of those for each customer; first eight deliveries (from CAC) scheduled for mid-2007, and second eight (by PAC) by end of 2007. Hand-over of first two (Chinese-built) JF-17s to Pakistan Air Force scheduled for 10 March 2007, in time for military parade on 23 March.

COSTS: Development investment of some USD150 million by mid-2001.

DESIGN FEATURES: Agile light fighter. Mid-mounted delta wing with 42° sweepback and narrow wingroot strakes at leading-edge; leading-edge manoeuvring flaps; single turbofan engine; side-mounted twin intakes, with splitter plates; large intake trunks provide space for considerable internal fuel capacity. Large main fin with dorsal fairing; two smaller, uncanted ventral fins.

FLYING CONTROLS: Conventional hydraulic servo-operated control of ailerons, rudder and all-moving tailplane initially, with single analogue fly-by-wire system for back-up; provision for FBW to become primary system later. Trailing-edge and leading-edge flaps.

STRUCTURE: Primary structure conventional aluminium and steel alloy semi-monocoque. Some components may be manufactured in Pakistan.

LANDING GEAR: Retractable tricycle type, with single wheel and oleo shock-absorber on each unit. Mainwheels retract upward into engine intake trunks; nosewheel retracts rearward.

POWER PLANT: One Klimov RD-93 (RD-33 derivative) turbofan (81.4 kN; 18,298 lb st with afterburning). Substantial internal fuel capacity (see Weights and Loadings below). Provision for external fuel tanks. Pakistan Air Force plans eventual installation of in-flight refuelling probe.

ACCOMMODATION: Single Jianghan TY6 zero/zero ejection seat under one-piece canopy. Two-seat, combat-capable training version also planned.

AVIONICS: Chinese avionics in prototypes include ring laser gyro INS/GPS, IR search and track system, HUD and NVG-capable instruments. Pakistan aircraft to have Chinese (J-10 standard) avionics, following inconclusive evaluation of bids from BAE Systems, SAGEM and Thales; all avionics interfaced with 1553-standard, PC-based mission computer.

Radar: Prototype 01 and 03 variously reported as having Chinese NRIET KLJ-10 and/or Israeli Elta EL/M-2032 pulse Doppler fire control radar; 05 planned to evaluate KLJ-10 versus Aviation Radar and Electrical Equipment Institute (AREEI; ex-LETRI) SY-80 competitor during 2005. Pakistan reported in late 2004 to have abandoned its original choice of Galileo Grifo S-7 and agreed to accept Chinese radar in first batch of aircraft.

ARMAMENT: Underfuselage centreline station for 23 mm GSh-23-2 twin-barrel cannon or other store; two attachments under each wing and one at each wingtip. Weapons can include advanced AAMs, ASMs, anti-runway and laser-guided bombs, gun and rocket pods, or other stores. Mockup seen in November 2002 mounting the AMRAAM-class No. 607 Institute SD-10 (PL-12) BVR, active radar homing AAM (lock-on range 20 km; 12.4 miles).

DIMENSIONS, EXTERNAL:

Wing span, to c/l of AAMs	9.50 m (31 ft 2 in)
Wing aspect ratio	3.7
Length overall	14.70 m (48 ft 2¾ in)
Height overall	4.80 m (15 ft 9 in)
Wheel track	2.30 m (7 ft 6½ in)
Wheelbase	5.14 m (16 ft 10¼ in)

AREAS:

Wings, gross	24.40 m² (262.6 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	6,450 kg (14,220 lb)
Max external stores load	3,600 kg (7,937 lb)
Max internal fuel weight	2,300 kg (5,071 lb)
T-O weight:	
normal (wingtip AAMs only)	9,100 kg (20,062 lb)
max	12,400 kg (27,337 lb)
Max wing loading	520.5 kg/m² (106.61 lb/sq ft)
Max power loading	156 kg/kN (1.53 lb/lb st)

PERFORMANCE (estimated):

Max level speed at altitude, clean	M1.8
Service ceiling	16,000 m (52,495 ft)
T-O run	450 m (1,480 ft)
Landing run	750 m (2,460 ft)
Combat radius:	
fighter	648 n miles (1,200 km; 745 miles)
ground attack	378 n miles (700 km; 435 miles)
Max range on internal fuel	971 n miles (1,800 km; 1,118 miles)
Ferry range	1,619 n miles (3,000 km; 1,864 miles)
g limit	+8

CAC J-10

English name: Vigorous Dragon
Chinese name: Jianjiji-10 (Fighter aircraft 10)
Westernised designation: F-10

TYPE: Multirole fighter.

PROGRAMME: Reports of the existence of this new Chinese fighter began to emerge in October 1994, following the detection by a US intelligence satellite of a prototype at Chengdu. In the weight and performance class of the Eurofighter Typhoon and Dassault Rafale, the J-10 bears a close external resemblance to the cancelled IAI Lavi of the late 1980s, despite Israeli government statements that fears of unauthorised technology transfer are unfounded. A photograph, released in 1996 by the People's Liberation Army, of a wind tunnel model of the J-10 showed it to be outwardly identical to the Lavi in all essential respects, apart from slightly raised foreplanes and the addition of wingroot trailing-edge extensions.

This was confirmed in January 2001 when an unauthorised source posted a photograph of prototype 1001 on the Worldwide Web (although it was rapidly removed). The photograph showed the artist's impression first published in the 1997–98 *Jane's All the World's Aircraft* to be accurate in all respects, except that it was larger, and fin chord was some 20 per cent greater from root to tip.

It now appears that go-ahead for what became the J-10 was given in September 1988, development by No. 611 Research Institute beginning in the following month. An all-metal

CAC J-10 apparently in AFPLA service

1153771

Line-up of 44th Air Division CAC J-10s at Mengzi

1040449

mockup was completed by late 1993, but poor performance predictions, coupled with a requirement change from air superiority to multirole, caused some redesign and consequent delays in the programme.

In late 1995, Russian sources indicated that the first flight, then expected during the early part of 1996, would be powered by a single AL-31FN turbofan; first prototype 1001 is said to have achieved this milestone in mid-1996. Russian avionics manufacturer Phazotron offered its Zhuk (Beetle) radar (already selected for the F-8 IIM upgrade programme) and the more capable Zhemchug (Pearls) and RP-35 as alternatives to the Elta EL/M-2035 or a derivative.

In late 1997, the slightly modified prototype 1002 was lost in a fatal accident. Two further prototypes (1003 and 1004) had been completed, and designation J-10 bestowed, during that year; the officially announced 'first' flight date of 23 March 1998 apparently referred to resumption of flight testing by one of these aircraft. According to China-based sources, 10 AL-31FN engines had been imported by end 1997 and four J-10 prototypes completed. An unofficial CAC source in mid-1999 stated that two prototypes (evidently 1001 and 1003) were then flying, with four others undergoing static test, still being assembled or only just completed; of these, 1004 and/or 1005 may have been static/fatigue test aircraft. Chinese sources at Zhuhai in November 2000 stated that between five and eight J-10s then built and more than 140 test flights made; nine aircraft identified by mid-2002, of which 1007 to 1009 may be further prototypes or preproduction aircraft, one having made a 'first' flight on 28 June 2002. Meanwhile, unconfirmed reports in late 2002/early 2003 indicated that 10 J-10s had been deployed with the Nanjing Military Region in August 2002 for operational evaluation or familiarisation training; and that manufacture of the first two two-seat examples would begin in 2003 and would have enhanced air-to-ground and maritime attack capability. Maiden flight of two-seater reported as occurring on 26 December 2003, with photographs appearing on Internet at that time. First (preproduction or serial production) J-10As delivered to AFPLA training unit on 23 February 2003, according to Chinese Xinhua news agency. Serial numbers 1015 and 1016 seen during that year.

The J-10 failed to make its widely predicted public debut at Zhuhai in November 2002, but it emerged shortly after the show that CAC and the No. 611 Institute had completed conceptual design work on two advanced variants of the J-10: one single- and one twin-engined, both having twin vertical tailfins and embodying stealth characteristics. Both also featured a redesigned and more angular nose section. It has also been noted that in 2002 the *China People's Daily* referred to the J-10 as *Qiang Shi* (Attack 10), rather than the *Jian* (Fighter) title that might have been expected. This appears to support the belief that the aircraft is viewed as a J-7/Q-5 replacement rather than a rival to the Su-27/J-11 to replace the Shenyang J-8. In September 2004, the C-in-C of the Pakistan Air Force indicated that test pilots would be sent to China 'soon' to fly the J-10. First official acknowledgement that J-10 was in operational service with AFPLA was made on state television news 29 December 2006.

CURRENT VERSIONS: **J-10A:** Single-seat fighter.

J-10S: Two-seat conversion/continuation trainer and potential attack or 'Wild Weasel' ECM aircraft. First flight 26 December 2003. Observed serials 1021 and 1023 believed to identify prototypes 01 and 03; others seen subsequently include 1106 and 1108. Deep dorsal spine housing avionics displaced by second cockpit.

J-10B: Advanced version, reported in early 2006 to have more powerful (AL-31FN M1) engine, thrust-vector control, strengthened airframe and passive phased-array radar. Known serials include 10541 and 50756, latter indicating 76th production aircraft.

CUSTOMERS: Reports have suggested an AFPLA requirement for up to 300. Identified in use by 3rd Test Flight Regiment in 2004, unit being based at CAC's factory airfield, Wenjiang, Chengdu. By 2005, 44th Air Division at Mengzi, Yunnan, reportedly operating 32 J-10s. Now also with 3rd Air Division. On 12 April 2006, Pakistan government authorised Pakistan Air Force to begin negotiations for purchase of a quantity (reportedly, up to 36) of J-10s as part of its fighter force expansion plans.

DESIGN FEATURES: Tail-less delta wing and close-coupled foreplanes; single sweptback vertical tail with twin outward-canted ventral fins; single, rectangular ventral engine air intake.

FLYING CONTROLS: All-moving foreplanes; inboard and outboard elevons; single-piece rudder; wing leading-edge manoeuvring flaps.

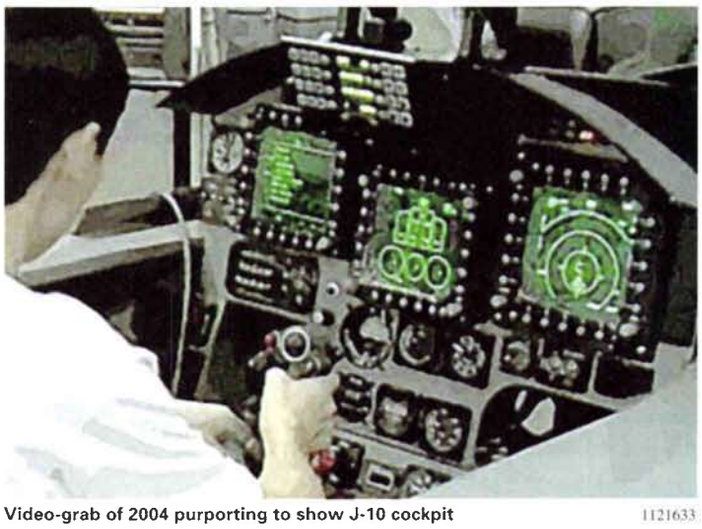
LANDING GEAR: Retractable tricycle type. Main units retract forwards, twin-wheel nose unit rearwards.

POWER PLANT: One Saturn/Lyulka AL-31FN turbofan (79.4 kN; 17,857 lb st dry and 122.6 kN; 27,558 lb st with afterburning) in prototypes and initial production aircraft; total 54 engines delivered by MMPP Salyut 2001–2003, according to Moscow-based Jane's source; contract completed in January 2004. Non-approval of manufacturing licence for this engine indicated possibility of change to domestic (WS10A?) power plant in later aircraft, or upgrade to more powerful AL-31-117C. However, in December 2005 Salyut revealed USD300 million order for 100 132.4 kN (29,762 lb st) AL-31FN M1 versions of AL-31, said to have been purposely developed for 'Super-10' and having FADEC and four-way swivelling exhaust nozzle.

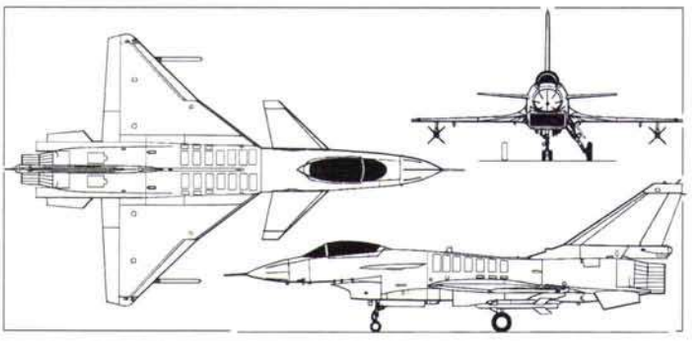
Fuel capacity reported to be in region of 3,175 litres (839 US gallons; 698.5 Imp gallons) in wings and 1,775 litres (469 US gallons; 390.5 Imp gallons in fuselage), giving total internal capacity of 4,950 litres (1,308 US gallons; 1,089 Imp gallons). Provision for auxiliary fuel tanks on centreline and inboard underwing stations.

CAC J-10S two-seat trainer 1040450

CAC J-10 at an official presentation 1153770



Video-grab of 2004 purporting to show J-10 cockpit 1121633



Provisional general arrangement of J-10 fighter *(Paul Jackson)* 1151999

ACCOMMODATION: Pilot only, on zero/zero ejection seat (apparently Martin-Baker in prototypes; possibly domestic Jianghan TY6 planned later).

AVIONICS: Reportedly equipped with Type 634 quadruplex digital fly-by-wire FCS, GPS/INS navigation, HOTAS controls, a wide field of view HUD, one colour and two monochrome liquid crystal MFDs (weapons, RWR/navigation and radar information), air data computer, 1553B-standard databus and a helmet-mounted weapon sight. FCS based on active control technology developed in F-8 II ACT testbed. Pulse Doppler radar apparently yet to be selected; quoted candidates include Phazotron Zhuk or Zhemchug, domestic (LETRI) JL-10A, Elta EL/M-2035 and FIAR Grifo 2000. Prototypes and initial production J-10As reported to have domestic Type 1473 radar.

In early 2006, *Jane's* sources reported that China had received three Zhemchug units, with no further examples ordered; and was then working with an alternative Russian manufacturer, Tikhomirov NIIP, which had supplied one or more derivatives of its Pero passive phased-array radar for consideration.

ARMAMENT: Released photographs indicate 11 external stores points, including one on centreline, tandem pairs on fuselage sides and three under each wing, the outboard wing stations each carrying PL-8 (Python 3) or later AAMs such as PL-11 or PL-12. Other potential weapons could include Vympel R-73 and R-77 AAMs; C-801 or C-802 ASMs; YJ-8K (anti-ship) or YJ-9 (anti-radiation) missiles; and laser-guided or free-fall bombs. Internally mounted 23 mm cannon on port side of nosewheel; provision for a Chinese-developed (Luoyang Filat?) IR/laser navigation and targeting pod.

Following estimated data have not been confirmed.

DIMENSIONS, EXTERNAL:

Wing span	8.78 m (28 ft 9¾ in)
Length overall	14.57 m (47 ft 9½ in)
Height overall	4.78 m (15 ft 8¼ in)

AREAS:

Wings, gross	33.1 m² (356.3 sq ft)
Foreplanes (total)	5.45 m² (58.66 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	9,750 kg (21,495 lb)
Max internal fuel	4,500 kg (9,921 lb)
Max external stores load	4,500 kg (9,921 lb)
Max T-O weight with external stores	18,500 kg (40,785 lb)

PERFORMANCE:

Max level speed: at altitude	M1.85
at S/L	M1.2
Service ceiling	18,000 m (59,050 ft)
T-O run, clean	350 m (1,150 ft)
Combat radius	250–300 n miles (463–555 km; 287–345 miles)
Ferry range with max internal and external fuel	1,000 n miles (1,850 km; 1,150 miles)
g limits	+9/–3

CHAIG

CHANGHE AIRCRAFT INDUSTRIES GROUP (CHANGHE FEIJI GONGYE GONGSI) (SUBSIDIARY OF AVIC II)

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PRESIDENT: Wang Bin

CHAIG (formerly Changhe Aircraft Factory), which occupies a 484 ha (1,196 acre) site at Jingdezhen, was formed in 1969 and is now one of the 500 largest industries in China, with assets of 6.9 billion yuan. It had a 2004 workforce of more than 11,000 and began producing coaches, minivans, cars and other commercial road vehicles in 1974. These and other automotive products still account for most of output, but batch-produced helicopters include the Z-8 and Z-11.

CHAIG is responsible for manufacture of the tailcone, vertical fin and horizontal stabiliser of the Sikorsky S-92 helicopter. The tail for the first S-92 was delivered to Sikorsky in May 1997. Changhe has also become the centre for Chinese licensed assembly and parts manufacture of the AgustaWestland A 109E Power, as the result of an agreement signed in November 2004. Under this, a new joint venture company known as Jiangxi Changhe Helicopter Company, owned 60 per cent by CHAIG and 40 per cent by AgustaWestland, is responsible for all A 109 sales activities in China, where it is known as the CA 109. In November 2006, Sikorsky announched an MoU with AVIC II under which Jiangxi Changhe Helicopter Co will also manufacture airframe assemblies for the Schweizer 300 CBi light helicopter.

CHAIG Z-8

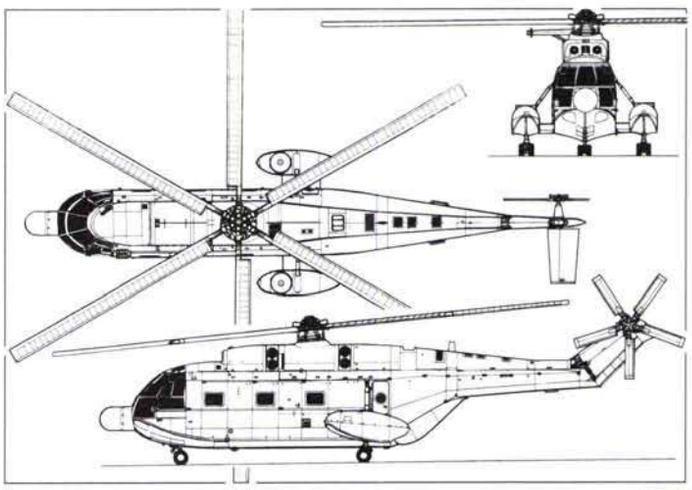
Chinese name: Zhishengji-8 (Vertical take-off aircraft 8)

TYPE: Naval combat helicopter.

PROGRAMME: Design work begun 1976, but suspended from 1979 to mid-1984; initial flight of first prototype 11 December 1985, second prototype October 1987; domestic type approval awarded 8 April 1989; first Z-8 handed over to PLA Naval Aviation for service trials 5 August 1989; initial production approved; final design approval granted 12 November 1994. Applications include troop transport, ASW/ASV, search and rescue, minelaying/sweeping, aerial survey and firefighting. Small-scale production apparently continues.

Changhe Z-8 fitted with rescue hoist 1153757

CHAIG Z-8A army transport helicopter 1153759



Changhe Z-8 (three WZ6 turboshafts) *(Paul Jackson)* 1152000

CURRENT VERSIONS: **Z-8:** Standard version, *as described*.

Z-8A: Designation of upgraded tactical transport version, with Turbomeca Makila 2A engines matched to Turmo gearbox. Two reportedly delivered to PLA Army Aviation for evaluation in 2001; camouflaged; seen with and without nose radome and side-mounted floats. Reports indicate that production deliveries began in November 2002, with about seven in service by late 2003.

Z-8F: Improved and more powerful version, for which the 1,380 kW (1,850 shp) P&WC PT6B-67A turboshaft was selected in November 2002. First flight expected in second quarter 2004, but postponed when engines returned to Canada for modification. Engines returned and reinstalled mid-2004; maiden flight reported to have taken place on 28 August 2004; certification, as 30-passenger civil transport, targeted for 2007. Additional 671 kW (900 shp) of power expected to enhance 'hot-and-high' performance, including increase in service ceiling to 4,700 m (15,420 ft) at MTOW and increased payload capacity. Other improvements said to include new (composites) main rotor blades, with anti-icing; new avionics and mission equipment. Duties envisaged are search and rescue, general utility missions and logistics support.

CUSTOMERS: Up to 20 standard Z-8s delivered to PLA Navy by end of 1999; upgraded versions still being promoted by CATIC in 2004. Sole operating naval unit is Shipborne Helicopter Group within East Sea Fleet at Dachang (Shanghai). Z-8s have serial numbers in range 9007 to 9097 and 9107 to 9197, while Super Frelons serialled in ranges 9406 to 9496 and 9506 to 9596. Army Z-8As numbered in LH-97800 range.

DESIGN FEATURES: Chinese equivalent of Aerospatiale Super Frelon, of which 16 supplied to PLA Navy in 1977-78. Six-blade main rotor and five-blade tail rotor; boat-hull fuselage with watertight compartments inside planing bottom; stabilising float at rear each side, attached to small stub-wing; small, strut-braced fixed horizontal stabiliser on starboard side of tail rotor pylon. Search radar in nose 'thimble' on SAR version.

FLYING CONTROLS: Pitch control fitting at root of each main rotor blade; drag and flapping hinges for each blade mounted on rotor head starplates; each main blade also has a hydraulic drag damper. Fully redundant flight control system, with Dong Fang KJ-8 autopilot.

STRUCTURE: Stressed skin metal fuselage, with riveted watertight compartments; gearboxes manufactured by Zhongnan Transmission Machinery Factory,CCXLI

LANDING GEAR: Non-retractable tricycle type, with twin wheels and low-pressure oleo-pneumatic shock-absorber on each unit. Small tripod tailskid under rear of tailboom. Boat hull and side floats permit emergency water landings and take-offs.

POWER PLANT: Three Changzhou (CLXMW) WZ6 turboshafts, each with maximum emergency rating of 1,156 kW (1,550 shp) and 20 per cent power reserve at S/L, ISA. Two engines side by side in front of main rotor shaft and one aft of shaft. Transmission rated at 3,072 kW (4,120 shp).

Standard internal fuel capacity 3,900 litres (1,030 US gallons; 858 Imp gallons), in flexible tanks under floor of centre-fuselage. Auxiliary fuel tanks can be carried inside cabin for extended-range or self-ferry missions, increasing total capacity to 5,800 litres (1,532 US gallons; 1,276 Imp gallons).

ACCOMMODATION: Crew of two or three on flight deck. Accommodation in main cabin for up to 27 fully armed troops, or 39 without equipment; up to 15 stretchers and a medical attendant in ambulance configuration; a BJ-212 Jeep-type vehicle and its crew; or other configurations according to mission. Entire accommodation heated, ventilated, soundproofed and vibration-proofed. Forward-opening crew door on each side of flight deck. Rearward-sliding door at front of cabin on starboard side. Hydraulically actuated rear-loading ramp/door.

EQUIPMENT: Equipment for SAR role can include 275 kg (606 lb) capacity hydraulic rescue hoist and two five-person liferafts. Can also be equipped with sonar, sonobuoys, search radar, or equipment for oceanography, geological survey and forest firefighting.

ARMAMENT: Can be equipped with Yu-7 torpedoes, anti-shipping missiles, or gear for minelaying (eight 250 kg mines) or minesweeping.

DIMENSIONS, EXTERNAL:

Main rotor diameter	18.90 m (62 ft 0 in)
Tail rotor diameter	4.00 m (13 ft 1½ in)
Length overall, rotors turning	23.035 m (75 ft 7 in)
Height overall, rotors turning	6.66 m (21 ft 10¼ in)
Width over main gear sponsons	5.20 m (17 ft 0¾ in)

AREAS:

Main rotor blades (each)	5.10 m² (54.90 sq ft)
Tail rotor blades (each)	0.56 m² (6.03 sq ft)
Main rotor disc	280.48 m² (3,019.1 sq ft)
Tail rotor disc	12.57 m² (135.3 sq ft)

WEIGHTS AND LOADINGS:

Manufacturer's weight empty	6,980 kg (15,388 lb)
Weight empty, equipped	7,550 kg (16,645 lb)
Max cargo payload: internal	4,000 kg (8,818 lb)
on external sling	5,000 kg (11,023 lb)
Max T-O weight: standard fuel	10,592 kg (23,351 lb)
with auxiliary fuel	13,000 kg (28,660 lb)
Max disc loading:	
standard fuel	37.8 kg/m² (7.73 lb/sq ft)
auxiliary fuel	46.35 kg/m² (9.49 lb/sq ft)
Transmission loading at max T-O weight and power:	
standard fuel	3.45 kg/kW (5.67 lb/shp)
auxiliary fuel	4.23 kg/kW (6.96 lb/shp)

Makila-engined Z-8A of the Chinese PLA 1153758

PERFORMANCE (A: at T-O weight of 9,000 kg; 19,841 lb. B: at 11,000 kg; 24,251 lb. C: at 13,000 kg; 28,660 lb):

Never-exceed speed (VNE):

A	170 kt (315 km/h; 195 mph)
B	159 kt (296 km/h; 183 mph)
C	148 kt (275 km/h; 170 mph)
Max cruising speed: A	143 kt (266 km/h; 165 mph)
B	140 kt (260 km/h; 161 mph)
C	134 kt (248 km/h; 154 mph)
Econ cruising speed: A	137 kt (255 km/h; 158 mph)
B	132 kt (246 km/h; 153 mph)
C	125 kt (232 km/h; 144 mph)
Rate of climb at S/L (15° 30' collective pitch, OEI):	
A	690 m (2,263 ft)/min
B	552 m (1,811 ft)/min
C	396 m (1,299 ft)/min
Service ceiling: A	6,000 m (19,680 ft)
B	4,900 m (16,080 ft)
C	3,050 m (10,000 ft)
Hovering ceiling IGE: A	5,500 m (18,040 ft)
B	3,600 m (11,800 ft)
C	1,900 m (6,240 ft)
Hovering ceiling OGE: A	4,400 m (14,440 ft)
B	2,300 m (7,540 ft)
Range with max standard or auxiliary fuel, OEI, no reserves: A	232 n miles (430 km; 267 miles)
B	442 n miles (820 km; 509 miles)
C	431 n miles (800 km; 497 miles)
Ferry range with auxiliary fuel tanks, OEI, no reserves: C	755 n miles (1,400 km; 870 miles)
Endurance with max standard or auxiliary fuel, OEI, no reserves: A	2 h 31 min
B	4 h 43 min
C	4 h 10 min

CHAIG Z-11

Chinese name: Zhishengji-11 (Vertical take-off aircraft 11)

TYPE: Light utility helicopter.

PROGRAMME: First details officially released at China Air Show in Zhuhai November 1996, together with photographs showing one or two Z-11s in flight. Development by Chinese Helicopter R&D Institute (CHRDI) began in 1991; quoted first flight date of 22 December 1994 thought to refer to re-engined modification of two second-hand ex-US AStars (Ecureuils) acquired earlier that year. In early 1997, a Chinese government agency announced that the Z-11 had flown for the first time on 26 December 1996.

The Z-11 appears identical externally to Eurocopter AS 350B Ecureuil except for nose contours, but CHAIG publicity in mid-2001 stated that "China owns its independent intellectual property rights". Eurocopter (which sold eight Ecureuils to China in 1996) declines to comment on its provenance. Project reportedly launched in 1989, with development work beginning in 1992. Technical appraisal was completed in 1996, and small batch production began in 1997, first customer deliveries being made in September 1998. Test programme included flights totalling 719 n miles (1,332 km; 827 miles) in temperatures from −43 to +6°C (−41.7 to 42.8°F), including a 2-hour sortie cruising at −38°C (−38.9°F). Design was finalised in December 2000, and the Z-11 received CAAC certification in April 2001. CAAC approval for series production for civilian use was announced on 23 December 2002.

A twin-engined version was planned, for which the Rolls-Royce 250 and Turbomeca Arrius 1A were in contention in 2002–03, but no further news of this had emerged by early 2006.

CURRENT VERSIONS: **Civil:** Applications include public security; powerline inspection and maintenance; geological survey; forest fire protection; emergency medical service; aerial seeding and crop-spraying; touring and sightseeing.

Military: Quoted roles include reconnaissance; control and communications; frontier patrol; law enforcement; executive transport; and crew training.

Z-11J: Public security version, reported by Xinhua news agency in mid-November 2005, following 'recent' maiden flight. Two to six seats, searchlight(s), electric winch and other mission equipment. Roles include patrol, emergency rescue and disaster relief.

Z-11MB1: Made its first flight on 7 March 2003 powered by a 632 kW (848 shp) Turbomeca Arriel 2B1A turboshaft. Changhe hoped to receive certification of this version by the end of 2003, but not reported by end of following year.

Z-11W: Reported designation of armed version, equipped with cannon, ATMs, unguided rockets and a roof-mounted low-light/infra-red sight, first flown 27 December 2004.

CUSTOMERS: Eight said to have been completed by late 1996, of which four had been delivered. All photographs released before late 1998 showed Z-11 in military camouflage with PLA insignia. One report from Aviation Expo China in October 1997 stated that the PLA had ordered 20 military Z-11s, these apparently going to Army Aviation's training school and 4th Army Aviation Regiment. Production amounted to 'several dozen' by mid-2001, at which time some 10,000 hours flown and 50,000 take-offs and landings. According to one estimate, about 59, including some armed examples, were in PLA Army Aviation service by late 2003.

Chongqing Three Gorges General Aviation Airlines (one ordered) reported as first civil customer in mid-2001; China Central Television of Jiangxi Province received one on 25 August 2002. One Z-11MB1 reportedly sold and delivered to (unidentified) Chinese customer by September 2003.

POWER PLANT: One 510 kW (684 shp) WZ8D turboshaft (licence-built Turbomeca Arriel 1D), reportedly produced by Liming engine factory.

EQUIPMENT: Breeze-Eastern HS-29700 electric rescue hoist optional.

DIMENSIONS, EXTERNAL:

Main rotor diameter	10.69 m (35 ft 0¾ in)
Tail rotor diameter	1.86 m (6 ft 1¼ in)
Length overall, main rotor turning	13.01 m (42 ft 8¼ in)
Fuselage: Length	11.24 m (36 ft 10½ in)
Max width	1.80 m (5 ft 10¾ in)
Height: over tailfin	3.02 m (9 ft 11 in)
to top of rotor hub	3.14 m (10 ft 3½ in)
Tailplane span	2.53 m (8 ft 3½ in)
Skid track	2.09 m (6 ft 10¼ in)
Fuselage/ground clearance beneath cabin	0.39 m (1 ft 3¼ in)

WEIGHTS AND LOADINGS:

Weight empty	1,120 kg (2,469 lb)
Fuel weight (standard)	423 kg (933 lb)
Max T-O weight	2,200 kg (4,850 lb)

PERFORMANCE:

Max level speed	150 kt (278 km/h; 172 mph)
Cruising speed	130 kt (240 km/h; 149 mph)
Hovering ceiling IGE	5,240 m (17,200 ft)
Hovering ceiling OGE:	
Z-11	4,500 m (14,760 ft)
Z-11MB1	6,000 m (19,680 ft)
Max range	324 n miles (600 km; 372 miles)
Endurance	3 h 54 min

Changhe Z-11s at a PLA Aviation school. Serial numbers have been removed by the Chinese censor 1154396

CHRDI

CHINESE HELICOPTER RESEARCH AND DEVELOPMENT INSTITUTE (ZHONGGUO ZHISHENGJI SHEJI YANGJIUSO) (SUBSIDIARY OF AVIC II)

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CHIEF DESIGNER: Wu Ximing
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This institute (workforce approximately 2,000) is the overall design authority for Chinese domestic helicopter programmes. Few additional details yet available of Z-10; other projects include 10 tonne helicopter, of which a model showing a provisional configuration was displayed at the November 2006 Airshow China in Zhuhai. At that time, a government go-ahead for this programme was still awaited, and the helicopter had received no official Chinese designation.

November 2006 model showing a possible configuration for a future 10 tonne civil and military helicopter *(Robert Hewson)* 1154688

CHRDI Z-10

Chinese name: Zhishengji-10 (Vertical take-off aircraft 10)

TYPE: Multirole medium helicopter.

PROGRAMME: Thought to have been initiated in about 1994; Nos. 602 and 608 Institutes reported to have taken part in airframe design. Eurocopter France became partner in programme 15 May 1997 with USD70 million to USD80 million, nine-year contract to assist in developing rotor system; joined 22 March 1999 by Agusta (now AgustaWestland) with contract (approximately Lit50 billion; USD30 million) to be responsible for transmission system and vibration analysis. Nomenclature of Chinese Medium Helicopter (CMH) introduced by AgustaWestland in July 2000; officially linked with Z-10 designation by Chinese sources by mid-2002. Reports suggest three transmission sets built in Italy and four, collaboratively, for assembly in China.

In size and weight class of Bell 412 and Sikorsky S-76 (MTOW variously reported as 5, 5.5 or 6 tonnes; 11,023 to 13,227 lb), with capacity for two crew and up to 14 passengers or troops. Z-10 first flight said to have taken place in first half of 2003 (29 April, by c/n 02, quoted by one apparently reliable Chinese source), following start of ground tests in May 2002. Resumed flight testing early 2004 after unspecified modifications; second prototype also flown by that time. Further six aircraft reportedly completed during 2004, of which at least one flown by mid-2005; prototype hours reportedly exceeded 400 by October 2005. One aircraft with China Flight Test Establishment (CFTE) at Yanliang and two with AFPLA unit at Jingdezhen AB at that time. Flight testing planned to end in 2006; eventual production reportedly to be entrusted to Changhe.

CURRENT VERSIONS: **WZ-10:** Attack version; designation **WZ-10M** also seen. Two prototypes thought to be flying by early 2005. Stepped, tandem cockpits (gunner in front), narrow fuselage; stub-wings; fixed, tailwheel-type landing gear; 30 mm undernose cannon. TV/FLIR/laser rangefinder/designator nose turret, with smaller (pilot's night vision?) one above it. Provision for rocket pod and four ATMs (HJ-9 or -10) or AAMs under each stub-wing.

Z-10: CMH commercial transport version; fixed, tricycle landing gear. *As described.*

DESIGN FEATURES: Intended to fulfil tactical military transport, attack helicopter and commercial transport roles. Five-blade, clockwise rotating main and four-blade, starboard side, 'scissors' tail rotors. Lord Corporation elastomeric mounts, bearings and dampers. Intention of both military and civil use suggests that such aspects as composites construction, crashworthy airframe and seats, rotor system ballistic tolerance, engine run-dry capacity and ability to carry slung loads are likely, depending upon version.

POWER PLANT: Two turboshafts. Pratt & Whitney Canada 1,268 kW (1,700 shp) PT6C-67C selected in mid-2001 (10 ordered) to power prototypes; first set of these delivered by end of that year, and all 10 by early 2004; further batch to follow. Production aircraft may later be powered by domestic SAEC WZ9 turboshaft, development of which currently behind schedule.

Photograph from unofficial source, claiming to be third (?) prototype Z-10, in WZ-10 combat helicopter configuration 1133943

GAIC

GUIZHOU AVIATION INDUSTRY GROUP (GUIZHOU HANGKONG GONGYE GONGSI) (SUBSIDIARY OF AVIC I)

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VICE-PRESIDENT: Zhang Shangdao
DIRECTOR OF PROGRAMMES: Hu Xupir

The Guizhou Aviation Industry Group incorporates many enterprises, factories and institutes engaged in various aerospace and non-aerospace activities; Group employment totals some 51,000 (2004), with assets of CNY10.6 billion; aerospace workforce is about 6,000. Main aircraft manufacturing plants are named Honghu, Honglin, Longyan, Shuangyang and Yunma; other major aerospace companies include Liyang Aero Engine Corporation and Fenglei Armament Factory. Aviation programmes include JL-9 fighter trainer, WP7 and WP13 turbojets, air-to-air missiles and rocket launchers, plus participation in Chengdu (CAC, which see) production of J-7/F-7. GAIC also manufactures maintenance jigs and tools for the Airbus airliner family.

In late 2003, GAIC was negotiating with Aeromot of Brazil with regard to licensed production of a retractable landing gear version of the AMT-600 Guri and possible later manufacture of AMT-200/300 Super Ximango motor gliders. A joint project for a four-seat lightplane was also mentioned. No further news of these projects had emerged by early 2006.

GAIC FTC-2000 SHANYING, CY-1 and LFC-16

English name: Plateau Eagle

TYPE: Advanced jet trainer.

PROGRAMME: Revealed, as FTC-2000, in model form at Airshow China, November 2000, and as full-size mockup two years later. Proposed as lead-in fighter trainer for CAC FC-1 (which see) and SAC J-8D/F-8D, and as replacement for CAC JJ-7/FT-7. Wind tunnel testing completed by late 2000. Three prototypes under construction by September 2003, first of which then nearing completion; maiden flight (c/n JL90001, serial 421) 13 December 2003. Second prototype (JL90003/422, '02 being static test airframe) flown 3 April 2004, and some 200 hours in 300 flights completed by these two aircraft by June 2005. Pre-series batch of four to six FTC-2000s planned to begin manufacture in 2005 for delivery to AFPLA in 2006. Funding for series production due during 2006-10 Five-Year Plan; if ordered for AFPLA, designation would be **JL-9**, as indicated by prototype's constructor's number.

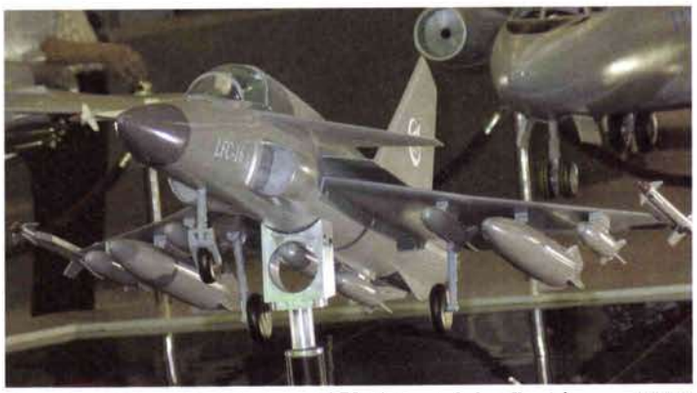
Rear aspect of GAIC FTC-2000 1153782

CURRENT VERSIONS: **FTC-2000:** Tandem-seat trainer version; *as described.*

CY-1/LFC-16: Modified version, designed by Beijing SuperWing Technology Research Institute and displayed in model form (marked **CY-1**) at November 2002 Airshow China in Zhuhai; would be produced by GAIC if go-ahead received. Features sweptback, shoulder-mounted foreplanes plus what were described as 'side-plate canards' comprising narrow rectangular surface each side of fuselage from just below foreplane trailing-edge to extreme tail, where there are small, rectangular, downward-canted tailfins with small leading-edge strakes. Similar (but single-seat light fighter) model shown in November 2004, with designation **LFC-16**. At that time, GAIC stated to have completed two one-seventh-scale models of LFC-16 for wind tunnel testing and to have plans to begin building first of two prototypes within two years.

CUSTOMERS: None announced by early 2006.

COSTS: Predicted at USD2.4 million, excluding radar.



November 2004 model of single-seat LFC-16 *(Jane's/Robert Karniol)* 0590215

Prototype FTC-2000 after painting 1121755

DESIGN FEATURES: Upgraded derivative of JJ-7/FT-7, having J-7E double-delta wings, lateral intakes and 'solid' nose to permit installation of fire-control radar. Airframe otherwise similar to JJ-7/FT-7.

FLYING CONTROLS: Conventional mechanical (hydraulic actuation).

LANDING GEAR: Retractable tricycle type, actuated hydraulically. Mainwheels retract inwards, nosewheel forwards.

POWER PLANT: One LMC (Liyang) WP13F (C) turbojet in JL-9/FTC-2000 (43.15 kN; 9,700 lb st dry, 63.25 kN; 14,220 lb st with afterburning). Gravity and pressure refuelling. In-flight refuelling probe (detachable) on starboard side of nose, common with that of J-8D/F-8D. Underfuselage and inboard underwing stations 'wet' for carriage of drop-tanks.

LFC-16 said to have uprated (WS14) turbofan engine providing 76.5 kN (17,196 lb st) with afterburning.

ACCOMMODATION: Crew of two in tandem, on stepped TY6D zero/zero ejection seats. Individual starboard-hinged cockpit canopies; wraparound windscreen.

AVIONICS: *Comms:* Com radio, IFF and ATC transponder.

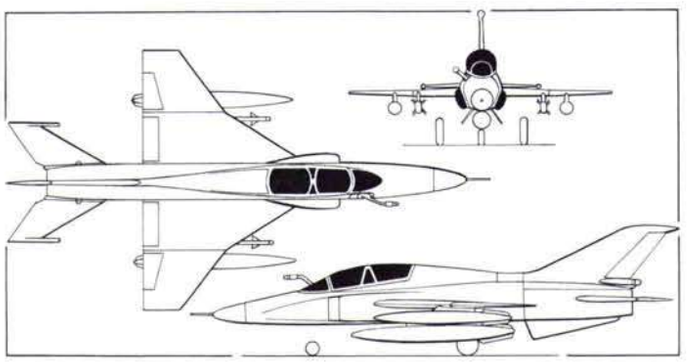
Radar: Pulse Doppler fire-control radar.

Flight: EFIS with HOTAS controls; GPS/INS.

Instrumentation: Two MFDs in each cockpit; HUD in front cockpit, with HUD repeater, rear; air data computer; mission computer; radio compass; radar altimeter; Tacan; marker beacon receiver; RWR; all linked via GJB289A databus.

Mission: Stores management system; video system.

ARMAMENT: Internal gun. Stores attachments under fuselage (one) and wings (two each side). Shown with PL-9 AAMs on outer wing stations and PL-8s inboard.



Provisional drawing of GAIC FTC-2000/JL-9 Shanying *(James Goulding)* 0589197

Following details all provisional:

DIMENSIONS, EXTERNAL:

Wing span	8.32 m (27 ft 3½ in)
Wing aspect ratio	2.6
Length overall	14.555 m (47 ft 9 in)
Height overall	4.105 m (13 ft 5½ in)
Wheel track	2.69 m (8 ft 10 in)
Wheelbase	4.87 m (15 ft 11¾ in)

AREAS:

Wings, gross	26.15 m² (281.5 sq ft)

WEIGHTS AND LOADINGS (FTC-2000):

Fuel weight: internal	2,060 kg (4,542 lb)
external	1,302 kg (2,870 lb)
T-O weight: clean	7,800 kg (17,196 lb)
max	9,800 kg (21,605 lb)
Max wing loading	374.8 kg/m² (76.76 lb/sq ft)
Max power loading	155 kg/kN (1.52 lb/lb st)

WEIGHTS AND LOADINGS (LFC-16, estimated):

Max weapon load	3,500 kg (7,716 lb)
Max T-O weight	9,000 kg (19,841 lb)

PERFORMANCE (FTC-2000, estimated):

Operating Mach number (MMO)	1.6
Max level speed	648 kt (1,200 km/h; 757 mph) IAS
Unstick speed	135–146 kt (250–270 km/h; 155–168 mph)
Touchdown speed	124–135 kt (230–250 km/h; 143–155 mph)
Min flying speed	114 kt (210 km/h; 131 mph)
Max rate of climb at S/L	15,600 m (51,181 ft)/min
Service ceiling	16,000 m (52,500 ft)
T-O distance	400–500 m (1,315–1,640 ft)
Landing distance	500–600 m (1,640–1,970 ft)
Ferry range with max internal and external fuel	1,349 n miles (2,500 km; 1,553 miles)
Operational endurance	2 h
g limit	+8

PERFORMANCE (LFC-16, estimated):

Max level speed	M1.8
Unstick speed	124–135 kt (230–250 km/h; 143–155 mph)
Touchdown speed	114–124 kt (210–230 km/h; 131–143 mph)
Service ceiling	17,000 m (55,775 ft)
T-O run	440 m (1,445 ft)
Landing run	490 m (1,610 ft)
Max (ferry) range	1,511 n miles (2,800 km; 1,739 miles)
Endurance	3 h 30 min

HAI

HAFEI AVIATION INDUSTRY COMPANY (HAFEI HANGKONG GONGYE GONGSI) (SUBSIDIARY OF AVIC II)

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CHAIRMAN: Wang Bin
PRESIDENT: Cui Xuewen
GENERAL MANAGER: Qu Jingwen
EXECUTIVE DEPUTY GENERAL MANAGER: Xu Zhanbin
PUBLIC RELATIONS OFFICER: Li Changjun

Established as Harbin Aircraft Manufacturing Corporation (Harbin Feiji Zhizao Gongsi; HAMC) 1952, subsequently producing H-5 light bomber (Soviet-designed Il-28) and Z-5 helicopter (Soviet-designed Mi-4) in large numbers, as well as smaller quantities of Chinese-designed SH-5 flying-boat and Y-11 agricultural light twin (NATO reporting name 'Chan-A'). Now a core company of Harbin Aircraft Industry Group (HAIG, which see), along with its sister company Hafei Motor. Occupies 514 ha (1,270 acre) site, including 350,000 m² (3,767,400 sq ft) of workshop space. Workforce in 1998 (latest figure provided) numbered approximately 18,000.

Currently producing own-design Y-12 utility light twin and licence-manufacturing Eurocopter Dauphin 2 as Z-9; also developing new 'Z-X' helicopter. Subcontract work includes Dauphin doors for Eurocopter.

HAI (24 per cent) is partnered by Eurocopter (61 per cent) and Singapore Technologies Aerospace (15 per cent) in the Eurocopter EC 120 Colibri programme, for which it was previously subcontracted to build the cabin module (200th shipset handed over 5 September 2000). This participation was enlarged by an agreement of 20 November 2003 under which HAI was to begin co-production and full local assembly of this helicopter, with a capability to complete 20 aircraft per year for the Chinese market. The official contract was signed in Paris on 11 June 2004, and the first Hafei-assembled EC 120 (Chinese designation **HC 120**) was expected to roll off the line by the end of that year; the Chinese government has reportedly ordered an initial batch of eight, with a further 50 on option. The agreement has potential to be extended to cover other Eurocopter types such as the AS 355 and EC 135. HAI is also (with CHAIG) a candidate for co-development and co-production of the Eurocopter EC 175, under a contract concluded in 2005 between AVIC II and the European manufacturer.

Under a 10 June 2004 agreement between Boeing and AVIC II, Boeing announced that it was "developing additional opportunities" for Hafei to produce metallic and composites parts and assemblies for various Boeing airliners, including the 787 Dreamliner.

In September 2003, HAI concluded an agreement with Bell Helicopter Textron for sole-source manufacture of the cabin module, tailboom and other components for the Bell 430; first batch of components had been completed by September 2005 and were due to be shipped to Canada for final assembly at Mirabel, Québec, starting in March 2006.

HAI (EUROCOPTER) Z-9 HAITUN

Chinese name: Zhishengji-9 (Vertical take-off aircraft 9)
English name: Dolphin

TYPE: Light utility helicopter.

PROGRAMME: Licence-built Eurocopter AS 365N Dauphin 2. Licence agreement (Aerospatiale/CATIC) signed 2 July 1980; first (French-built) example made initial acceptance flight in China 6 February 1982; Chinese parts manufacture began 1986; initial agreed batch of 50, last of which delivered January 1992. Production continuing under May 1988 domestic contract. Plans to introduce Arriel 2C announced mid-2001, following delivery of two of these engines in April; first flight achieved in September 2001.

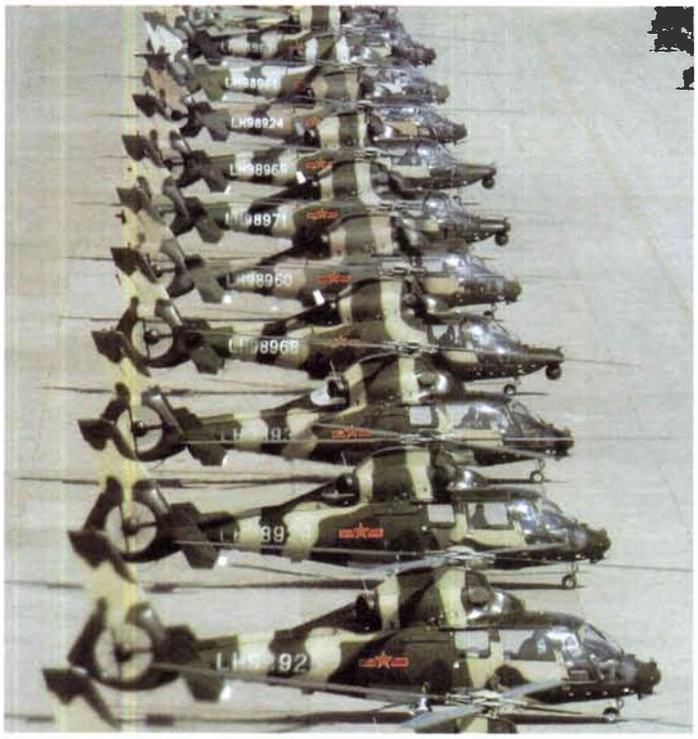
ECT Industries (France) signed contract to convert up to 50 Z-9s with NVG-compatible cockpits.

CURRENT VERSIONS: **Z-9:** Initial Chinese version, equivalent to French AS 365 N1 and assembled from French-built kits; 28 completed. Used mainly as troop transport.

Z-9A: Follow-on version, to AS 365N2 standard, built from CKD kits. Final 22 of first 50 were of this version. Some equipped to carry machine gun pods or rocket launchers, but lack roof-mounted sight of more fully armed WZ-9 version.

HAI approached in early 2004 by Dirgantara with proposal to produce Z-9A in Indonesia to meet an Indonesian Army requirement; not taken up by mid-2006.

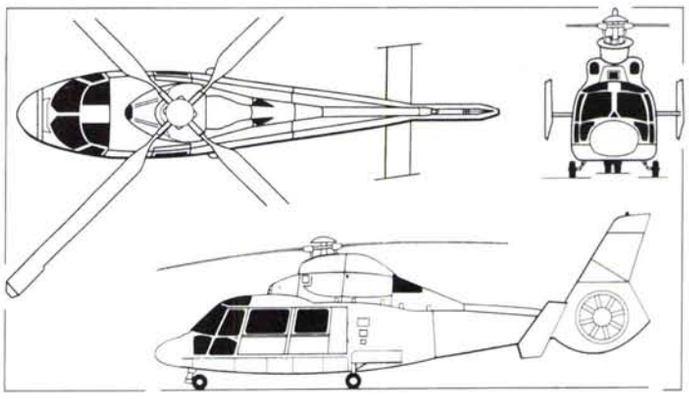
Unidentified WZ-9 variant with chin-mounted sensor turret, first noted in 2006
1158098



HAI WZ-9s of 9th Army Aviation Regiment, Beijing region, of which new examples LH98968, '969 and '971 have chin turrets 1158099

Z-9G armed helicopter 1153756

Z-9G in anti-tank configuration 1153755



HAI Z-9A light utility helicopter *(Paul Jackson)* 1158035

Data apply to Z-9A except where indicated.

Z-9A C²: Reported designation of command and control (command post) version for artillery fire direction.

Z-9A-100: Effectively, prototypes for domestic licence-built version, with WZ8A engines and much increased local manufacture (72.2 per cent of airframe and 91 per cent of engine). Two built; first flight 16 January 1992; flight test programme completed 20 November 1992 after almost 200 flight hours (408 flights); Chinese type approval received 30 December 1992.

Z-9B: First indigenous production version, based on Z-9A-100. Modified Fenestron with 11 wider-chord, all-composites blades instead of 13 metal blades as in AS 365N1. Principal unarmed PLA version for SAR, artillery direction, EW, troop transport (accommodates eight), communications and other utility duties. Certified also for domestic commercial operations 19 April 2001.

Z-9EC: Version for PLA Naval Aviation (6th Naval Independent Regiment) for deployment aboard certain older classes of destroyers and frigates; known to be flying by late 2000; Arriel 2C/WZ8C engines. Believed to be equivalent to Eurocopter AS 565MA Panther, but equipped with Thales HS-12 dipping sonar and KLC-1 I/J-band (Chinese version of Agrion 15) surface search radar; armament includes two Yu-7 torpedoes or TV-guided C-701 anti-surface vessel missiles. May have entered limited production by late 2003.

DZ-9: Reported designation of electronic warfare version (also reported as **Z-9EW**) for communications jamming.

WZ-9: Armed (*wuzhuang*) version (also reported as **Z-9W**); four Norinco HJ-8A (*Hongjian:* Red Arrow) wire-guided anti-tank missiles, twin 12.7 mm machine gun or 23 mm cannon pods, or twin 57 or 90 mm rocket pods, and gyrostabilised, roof-mounted optical sight. First flight thought to have been in early 1989; in production. Export designation **Z-9G**, available with or without roof-mounted sight.

At Zhuhai in November 2004, HAI showed a Z-9G model armed with eight ATMs, but with sighting turret positioned below the nose.

A photograph shown on an Internet website has illustrated a model of a dedicated attack helicopter, clearly based on the Z-9 airframe but having a modified nose embodying a side-by-side two-person cockpit. Armament and equipment includes up to four HJ-8A anti-tank missiles or TY-90 IR-guided short-range AAMs, nose-mounted FLIR and roof-mounted optical sighting system.

H410A: Version with 626 kW (840 shp) Arriel 2C (WZ8C) turboshafts for improved 'hot-and-high' performance. (Designation signifies 4.10 tonne MTOW.) First flight September 2001; CAAC certification 10 July 2002. Initial orders for eight.

H425: Further-improved (4.25 tonne MTOW) development of H410A. Retains Arriel 2C engines, but features 200 mm (7¾ in) wider cabin, redesigned main rotor blade tips, Rockwell Collins 'glass cockpit' avionics, crashworthy fuel system and structure, and improved interior layout. First flight 30 December 2003; targeted to achieve certification by end of 2004.

H450: Projected (4.50 tonne MTOW) development of H425: further improvements to rotors, transmission and control system.

CUSTOMERS: Total 180 (all versions) reportedly built by late 2003; eight H410As ordered mid-2002 by Far Eastern Leasing Company, China State Oceanic Administration and Zhoushan Civil Aviation Development Company.

Most early production for Chinese armed services (People's Naval Aviation and Army Aviation) and, more recently, People's Armed Police (four delivered 12 September 2001). Entered service with two PLA army groups January and February 1988 (Beijing and Shenyang Military Regions respectively); units include 6th, 8th and 9th Army Aviation Regiments. Also with AFPLA unit in Hong Kong. According to one estimate in late 2003, Army then had some 61 Z-9/9As and 31 WZ-9s in service. People's Naval Aviation believed to use Z-9A for commando transport as well as shipboard communications. Ten based at former Royal Air Force airfield at Sek Kong in third quarter of 1997, following 1 July handover of Hong Kong by UK. First export made in late 2000 (two Z-9As to Mali Air Force). Mauritanian Air Force received two Z-9As in 2003; at least one other to Mali for military use. Pakistan Navy a prospective customer in 2004-05 for four Z-9Cs.

Civil models used for various duties including offshore oil rig support and air ambulance (four stretchers/two seats or two stretchers/five seats). In 1992, Flying Dragon Aviation received two (late production Z-9s, augmenting an Aerospatiale Dauphin) which are operated on behalf of the Ministry of Forestry. Five civil Z-9s ordered by Shenzhen Financial Leasing Company (SFLC) in 2001. One Z-9A deployed to Arctic regions in mid-1999, on scientific survey ship.

STRUCTURE: Transmission manufactured by Dongan Engine Manufacturing Company at Harbin, hubs and tail rotor blades by Baoding Propeller Factory.

POWER PLANT: Two 526 kW (705 shp) Turbomeca Arriel 1C1 turboshafts, produced by SAEC at Zhuzhou as WZ8A. From 2001, H410A and H425 powered by 626 kW (840 shp) Arriel

Z-9G scout version 1153754

HAI Z-9 with Chinese Army serial number censored 1153753

2Cs as WZ8C. Contract signed 5 December 2005 between AVIC II and Turbomeca parent Safran for supply of 200 Arriel 2 engines, plus a partial production licence, for installation in H425.

Fuel capacities 1,158 litres (306 US gallons; 255 Imp gallons) in Z-9A and Z-9G; 1,058 litres (279.5 US gallons; 233 Imp gallons) in Z-9; and 1,136 litres (300 US gallons; 250 Imp gallons) in H425. Option for 180 litre (47.5 US gallon; 39.6 Imp gallon) auxiliary tank.

ACCOMMODATION: One/two pilots and 12/13 passengers standard.

EQUIPMENT: Can include Breeze-Eastern HS-20200 electric hoist, external sling, searchlight and loudhailer.

ARMAMENT (WZ-9): Up to four HJ-8A or HJ-8E ATMs (range 1.6 n miles; 3 km; 1.9 miles); twin 12.7 mm or 23 mm gun pods; or two pods of 57 or 90 mm rockets. Possible other weapons include TY-90 IR-guided AAM (already test-flown on Z-9 in 1998; range of 3.2 n miles; 6 km; 3.7 miles) and C-701 TV-guided anti-ship missile (8.1 n miles; 15 km; 9.3 miles).

DIMENSIONS, EXTERNAL:

Main rotor diameter: Z-9	11.94 m (39 ft 2 in)
H425	12.00 m (39 ft 4½ in)
Tail rotor diameter	1.10 m (3 ft 7¼ in)
Length overall, rotors turning	13.68 m (44 ft 10½ in)
Fuselage length: Z-9A, Z-9G	11.63 m (38 ft 1¾ in)
Z-9C	12.085 m (39 ft 7¾ in)
H425	12.04 m (39 ft 6 in)
Height: to top of rotor hub	3.49 m (11 ft 5½ in)
overall (tip of tailfin)	3.97 m (13 ft 0¼ in)
Tail unit span	3.21 m (10 ft 6½ in)
Wheel track	2.02 m (6 ft 7½ in)
Wheelbase	3.64 m (11 ft 11¼ in)
Ground clearance: beneath cabin	0.40 m (1 ft 3¾ in)
beneath Fenestron	0.58 m (1 ft 10¾ in)

AREAS:

Main rotor disc: Z-9	112.0 m² (1,205.6 sq ft)
H425	113.1 m² (1,217.4 sq ft)
Tail rotor disc	0.95 m² (10.23 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, equipped: Z-9A and EC	2,050 kg (4,519 lb)
Z-9G	2,462 kg (5,428 lb)
Standard fuel weight: Z-9A and G	900 kg (1,984 lb)
Max payload: Z-9A and EC	2,038 kg (4,493 lb)
H425	2,088 kg (4,603 lb)
Max load on cargo sling: Z-9A and EC, H425	1,600 kg (3,527 lb)
Max load on rescue hoist: H425	270 kg (595 lb)
Max T-O weight, internal or external load:	
Z-9A, EC and G, H410A	4,100 kg (9,039 lb)
H425	4,250 kg (9,369 lb)

PERFORMANCE:

Never-exceed speed (VNE): Z-9A and G, H425	170 kt (315 km/h; 195 mph)
Z-9EC	159 kt (296 km/h; 183 mph)
Max cruising speed at S/L: Z-9A, H425	151 kt (280 km/h; 174 mph)
Z-9EC	134 kt (249 km/h; 155 mph)
Z-9G	138 kt (255 km/h; 158 mph)
Max vertical rate of climb at S/L:	
Z-9A	252 m (827 ft)/min
Z-9EC	168 m (551 ft)/min
Z-9G	more than 240 m (787 ft)/min
Max forward rate of climb at S/L:	
Z-9A	396 m (1,299 ft)/min
Z-9EC	492 m (1,614 ft)/min
Z-9G	more than 480 m (1,575 ft)/min
H425	462 m (1,516 ft)/min
Service ceiling: Z-9A	4,570 m (15,000 ft)
Z-9EC	4,300 m (14,100 ft)
Z-9G	5,000 m (16,400 ft)
H425	6,000 m (19,680 ft)
Hovering ceiling:	
IGE: Z-9A	2,150 m (7,050 ft)
Z-9EC	2,250 m (7,380 ft)
Z-9G	3,400 m (11,150 ft)
H425	2,672 m (8,765 ft)
OGE: Z-9A	1,150 m (3,770 ft)
Z-9EC	1,050 m (3,445 ft)
Z-9G	2,500 m (8,200 ft)
H425	1,320 m (4,330 ft)

Max range at 135 kt (250 km/h; 155 mph) normal cruising speed, no reserves:
standard tanks:
Z-9A and G ..... 464 n miles (860 km; 534 miles)
Z-9EC ..... 236 n miles (438 km; 272 miles)
H425 ..... 432 n miles (800 km; 497 miles)
with auxiliary tank:
Z-9A ..... 539 n miles (1,000 km; 621 miles)
Endurance: Z-9G ..... 4 h 20 min

HAI 'Z-X'

TYPE: Light utility helicopter.

PROGRAMME: The new light utility helicopter previously known only by this designation has now been identified as the Z-15. A joint venture with Eurocopter (as the EC 175), it is accordingly now described under that combined heading in the International section of *Jane's All the World's Aircraft*.

HAI Y-12

Chinese name: Yunshuji-12 (Transport aircraft 12)

TYPE: Twin-turboprop light transport.

PROGRAMME: Y-12 (II) initiated as uprated version of Y-12 (I); first flight 16 August 1984. Y-12 (IV) (B-569L, first flight 30 August 1993) received production approval September 1995. Currently certified in Australia, Canada, China, France, New Zealand, UK and USA.

CURRENT VERSIONS: **Y-12 (II):** Major production version; higher-rated engines, no leading-edge slats and smaller ventral fin. Certified by CAAC 25 December 1985 and UK CAA (BCAR Section K) 20 June 1990.

Detailed description applies to Y-12 (II) except where indicated.

Y-12 (IV): Improved version with sweptback wingtips; modifications to control surface actuation, main gear and brakes; redesigned seating for 18 to 19 passengers; starboard side rear baggage door; maximum payload and maximum T-O weight increased. Further changes include Rockwell Collins or Honeywell com/nav for both VFR and IFR, plus optional colour weather radar, GPS, Omega navigation, wing and tail de-icing, and oxygen system. Domestic certification received 3 July 1994 and FAR Pt 23 approval on 26 March 1995; Indonesian certification 16 November 2000. Sichuan Airlines order for 20 (7 November 2000) assumed to be of this version.

Y-12E Harbinger: Next-generation version for Chinese market; PT6A-135A engines and four-blade lightweight propellers for improved 'hot and high' performance, plus strengthened structure, reduced noise levels and improved avionics. Announced at Airshow China, November 2000; passed CAAC preliminary design review 16 November 2000. First flight (B-610L) August 2001; award of CAAC type certificate announced 26 February 2002; FAA certification 2 August 2006; launch customer Sichuan Airlines (option for 10). Twelve engines for Y-12E delivered by February 2004; three aircraft said to be in service in China at that time.

Y-12AEW: Being promoted in 2004; bulged nose housing Racal Skymaster AEW and maritime surveillance radar.

Y-12F: Concept study for version with pressurised fuselage and retractable landing gear.

Y-12G: In design stage 2002–03 as dedicated cargo version with large side door and capacity for three LD3 containers. No subsequent reports seen.

CUSTOMERS: See table. According to a CATIC announcement in August 2001, sales then totalled 130, of which 114 had been delivered. In February 2004, Pratt & Whitney Canada confirmed shipment of some 300 PT6A-27 engines since beginning of Y-12 programme. In November 2004, CATIC announced purchase of 20 Y-12s against possible further export sales, though none reported by end 2006.

COSTS: Batch of 15 PT6-engined aircraft valued at US$58 million (1999).

DESIGN FEATURES: Designed to standards of FAR Pts 23 and 135 Appendix A and developed to improve upon modest payload/range of piston-engined Y-11. Constant-chord high braced wings, with small stub-wings at cabin floor level supporting mainwheel units; basically rectangular-section fuselage, upswept at rear; non-swept tail surfaces; large dorsal fin; ventral fin under tailcone.

Wing section LS(1)-0417; thickness/chord ratio 17 per cent; dihedral 1° 41'; incidence 4°.

FLYING CONTROLS: Conventional and manual. Drooping ailerons, horn-balanced elevators and rudder; trim tab in starboard aileron, rudder and each elevator. Control surface movement: ailerons 25° up/18° down; aileron trim tab 20° up/down; elevator 25° up/10° down; elevator trim tab 7° up/20° down; rudder 22° left/right; rudder trim tab 9° left/right. Electrically actuated two-segment double-slotted flaps (deflection angles 10 and 20°) on each wing trailing-edge.

STRUCTURE: Conventional all-metal structure with two-spar fail-safe wings and stressed skin fuselage; Ziqiang-2 resin bonding on 70 per cent of wing structure and 40 per cent of fuselage; integral fuel tankage in wing spar box; bracing strut from each stub-wing out to approximately one-third span.

LANDING GEAR: Non-retractable tricycle type, with oleo-pneumatic shock-absorber in each unit. Single-wheel main units, attached to underside of stub-wings. Single trailing-link, non-steerable nosewheel. Mainwheel tyres size 640×230, pressure 5.50 bar (80 lb/sq in); nosewheel tyre size 480×200, pressure 3.50 bar (51 lb/sq in). Hydraulic brakes. Minimum ground turning radius 16.75 m (54 ft 11½ in).

POWER PLANT: *Y-12 (II) and (IV):* Two Pratt & Whitney Canada PT6A-27 turboprops, each flat-rated at 462 kW (620 shp) and driving a Hartzell HC-B3TN-3B/T10173B-3 or -NB3 three-blade constant-speed reversible-pitch metal propeller.

Y-12E: Two 559 kW (750 shp) Pratt & Whitney Canada PT6A-135A turboprops, derated to 462 kW (620 shp) and driving Hartzell HC-D4N-3N/D9511FK four-blade constant-speed, reversible-pitch, metal propellers.

All fuel in tanks in wing spar box, total capacity 1,630 litres (431 US gallons; 359 Imp gallons), with overwing gravity filling point each side. Oil capacity 17.5 litres (4.62 US gallons; 3.85 Imp gallons).

No recent news of domestic WJ9 turboprop (442 to 520 kW; 593 to 697 shp), said to have been under development for Y-12 and other aircraft.

ACCOMMODATION: Crew of two on flight deck, with access via forward-opening door on port side. Four-way adjustable crew seats. Dual controls. Main cabin can accommodate up to 19 passengers (218 in Y-12E) in commuter configuration, in three-abreast layout (with aisle), at seat pitch of 71 cm (28 in). Alternative layouts for up to 15 parachutists, or all-cargo configuration with 11 tiedown rings. Air ambulance (six stretchers plus four patient or medical attendant seats) and VIP layouts also available. Passenger/cargo double door on port side at rear, rear half of which opens outward and forward half inward; foldout steps in passenger entrance. Emergency exit on each side at front of cabin and opposite passenger door on starboard side at rear. Baggage compartment in nose and at rear of passenger cabin.

SYSTEMS: Hamilton Sundstrand R70-3WG environmental control system. Hydraulic system (operating pressure 118 to 147 bar; 1,711 to 2,132 lb/sq in) for mainwheel brakes. Two 6 kW DC starter/generators, two 600 VA 400 Hz single-phase static inverters and one 43 Ah Ni/Cd battery for electrical power. Goodrich Type 29S-7D 5178 anti-icing system optional for wing, tailplane and fin leading-edges. Oxygen system optional.

AVIONICS: *Comms:* VHF-251 and HF-230 radio, AUD-251A intercom and TDR-950 transponder.

Radar: Honeywell 1400C, RDS-81 or RDS-82 colour weather radar optional.

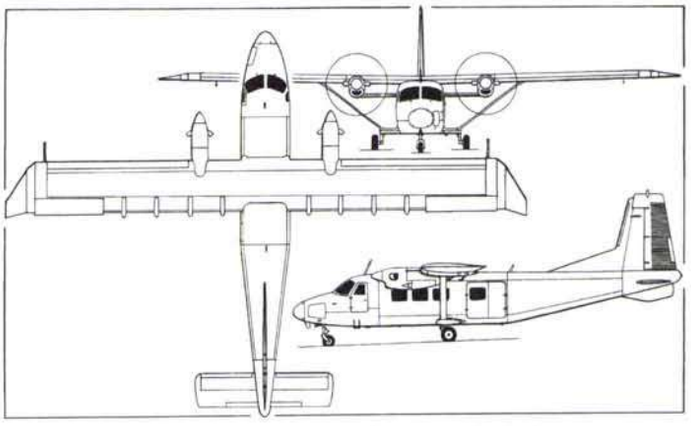
Flight: ALT-50 radio altimeter, DME-451, ADF-650A, MKR-350 marker beacon receiver, KLN 90 GPS receiver (optional), VIR-351 VOR, GLS-350 glideslope receiver and PN-101 pictorial navigation display. Doppler navigation with satellite responder (Y-12 (IV), Omega nav) optional (for example, in mineral detection role).

Instrumentation: 20025-11324 airspeed indicator, 510-8D10 horizon, 101420-11934 encoding altimeter, 30230-11101 vertical speed indicator, 9551-BN541 bank indicator, LC-2 magnetic compass, ZWH-1 outside air temperature indicator, and ZEY-1 flap position indicator; dual engine torquemeters, interturbine temperature indicators, gas generator tachometers, oil temperature and pressure indicators, fuel pressure and quantity indicators; 309W clock; and XDH-10B warning light box. Flight data recorder and GPWS optional on Y-12E.

EQUIPMENT: Hopper for 1,200 litres (317 US gallons; 264 Imp gallons) of dry or liquid chemical in agricultural version. Appropriate specialised equipment for firefighting, geophysical survey (for example, long, kinked sensor tailboom) and other missions.

DIMENSIONS, EXTERNAL:
Wing span: Y-12 (II) ..... 17.235 m (56 ft 6½ in)
Y-12 (IV), Y-12E ..... 19.20 m (63 ft 0 in)
Wing chord, constant ..... 1.96 m (6 ft 5¼ in)
Wing aspect ratio: Y-12 (II) 8.7
Y-12 (IV), Y-12E 10.0
Length overall ..... 14.86 m (48 ft 9 in)
Height overall ..... 5.675 m (18 ft 7½ in)
Elevator span ..... 5.365 m (17 ft 7¼ in)
Wheel track ..... 3.61 m (11 ft 10¼ in)

HAI Y-12 cockpit 1153768



HAI Y-12 (IV) twin-turboprop STOL general purpose transport
(James Goulding) 1158757

HAI Y-12 (IV) light transport 1158862

Y12 (I) AND Y-12 (II) DELIVERIES
(at mid-2002)

Country[2]	Operator	Quantity	First Aircraft
Domestic (mostly Y-12 (I))			
China	AVIC (No. 630 Institute)	1	B-3820
	China General Aviation	5	B-3810
	China Southwest Airlines	4	B-3811
	Flying Dragon Aviation	9	B-3802
	Guizhou Aviation Corporation	1	B-3809
	State Oceanic Administration	1	?
	Subtotal	**21**	
Export			
Australia	Aviex	1	VH-LLK
Bangladesh	Aero Bengal Airlines	2	?
Cambodia	Air Force	2	XU-016
Egypt	Air Force	2	?
Eritrea	Air Force	3	ER 800
	Red Sea Air[1]	1	E3-AAI
Fiji	Fiji Air	3	DQ-FHF
Guyana	Defence Force	1	8R-GDS
Iran	Air Force	9	15–2245
Kenya	Air Force	12	128?
Kiribati	Air Kiribati	1	T3-ATI
Laos	Lao Aviation	7	RDPL-34115
Malaysia	Berjaya Air Charter	2	9M-TAB
Mauritania	Air Force	2	5T-MAE
Mongolia	Mongolian Airlines	6	D-0064
Namibia	Defence Force	2	NDF97-600
Nepal	Nepal Airways	5	9N-ACD
Pakistan	Air Force	2	96–035
	Army	4	045
Peru	Air Force	6	333
	National Police	3	224
Philippines	Philippine Eagle Airlines	3	RP-C1518
Sri Lanka	Air Force	9	CR-851
Tanzania	Air Force	2	JW9029
Zambia	Air Force	4	AF214
	Subtotal	**94**	
Total		**115**	

[1] Unclear if aircraft is ex-military
[2] CATIC also reports sales to Argentina, Bolivia, Canada, Cuba and Sudan

Wheelbase ..... 4.70 m (15 ft 5 in)
Propeller diameter: PT6A-27 ..... 2.49 m (8 ft 2 in)
PT6A-135A ..... 2.44 m (8 ft 0 in)
Propeller ground clearance ..... 1.325 m (4 ft 4¼ in)
Distance between propeller centres ..... 4.94 m (16 ft 2½ in)
Fuselage ground clearance ..... 0.65 m (2 ft 1½ in)
Crew door: Height ..... 1.12 m (3 ft 8 in)
Width ..... 0.65 m (2 ft 1½ in)
Passenger/cargo door: Height ..... 1.38 m (4 ft 6¼ in)
Width (passenger door only) ..... 0.65 m (2 ft 1½ in)
Width (double door) ..... 1.45 m (4 ft 9 in)
Emergency exits (three, each): Height ..... 0.68 m (2 ft 2¾ in)
Width ..... 0.68 m (2 ft 2¾ in)
Baggage door (nose, port): Max height ..... 0.56 m (1 ft 10 in)
Width ..... 0.75 m (2 ft 5½ in)

DIMENSIONS, INTERNAL:

Cabin, excl flight deck and rear baggage compartment:
Length ..... 4.82 m (15 ft 9¾ in)
Max width ..... 1.46 m (4 ft 9½ in)
Aisle width ..... 0.23 m (9 in)
Max height ..... 1.70 m (5 ft 7 in)
Floor area ..... 7.0 m² (75.8 sq ft)
Volume ..... 12.9 m³ (455 cu ft)
Baggage compartment volume:
nose ..... 0.77 m³ (27.2 cu ft)
rear ..... 1.89 m³ (66.7 cu ft)

AREAS:

Wings, gross: Y-12 (II) ..... 34.27 m² (368.9 sq ft)
Y-12 (IV), Y-12E ..... 36.90 m² (397.2 sq ft)
Ailerons (total, incl tab) ..... 2.88 m² (31.00 sq ft)
Trailing-edge flaps (total) ..... 6.00 m² (64.58 sq ft)
Fin, incl dorsal fin ..... 2.24 m² (24.11 sq ft)
Rudder, incl tab ..... 3.34 m² (35.95 sq ft)
Tailplane ..... 3.10 m² (33.37 sq ft)
Elevators (total, incl tabs) ..... 4.06 m² (43.70 sq ft)

WEIGHTS AND LOADINGS (A: Y-12 (II), B: Y-12 (IV), C: Y-12E):

Max usable fuel weight: A, B, C ..... 1,230 kg (2,712 lb)
Max payload: A ..... 1,700 kg (3,748 lb)
B, C ..... 1,984 kg (4,374 lb)
Baggage compartment weight (A, B, C):
fwd ..... 100 kg (220 lb)
rear ..... 260 kg (573 lb)
Max T-O weight: A ..... 5,300 kg (11,684 lb)
B, C ..... 5,670 kg (12,500 lb)
Max ramp weight: A ..... 5,330 kg (11,750 lb)
B, C ..... 5,700 kg (12,566 lb)
Max landing weight: A ..... 5,300 kg (11,684 lb)
B, C ..... 5,400 kg (11,905 lb)
Max zero-fuel weight: A ..... 4,900 kg (10,803 lb)
B, C ..... 5,188 kg (11,438 lb)
Max cabin floor loading (cargo): A, B ..... 750 kg/m² (154 lb/sq ft)
Max wing loading: A ..... 145.9 kg/m² (29.90 lb/sq ft)
B, C ..... 153.7 kg/m² (31.47 lb/sq ft)
Max power loading: A ..... 5.74 kg/kW (9.42 lb/shp)
B, C ..... 6.14 kg/kW (10.08 lb/shp)

PERFORMANCE (A, B and C as above):

Max operating speed (VMO) at FL100:
A at FL100 ..... 177 kt (328 km/h; 204 mph) TAS
B, C ..... 162 kt (300 km/h; 186 mph) CAS
Max cruising speed at FL100: A ..... 157 kt (292 km/h; 181 mph)
Econ cruising speed at FL100: A ..... 135 kt (250 km/h; 155 mph)
B ..... 140 kt (260 km/h; 162 mph)
C ..... 146 kt (270 km/h; 168 mph)
Max manoeuvring speed (VA): B, C ..... 126 kt (234 km/h; 145 mph) CAS
Max speed for flap extension (VFE): B, C ..... 104 kt (192 km/h; 119 mph) CAS
Min control speed (VMC): B ..... 69 kt (127 km/h; 79 mph) CAS
C ..... 70 kt (129 km/h; 80 mph) CAS
Max rate of climb at S/L: A ..... 486 m (1,594 ft)/min
B, C ..... 468 m (1,535 ft)/min
Rate of climb at S/L, OEI: A ..... 84 m (275 ft)/min
B ..... 90 m (295 ft)/min
C ..... 87 m (285 ft)/min
Max operating altitude: A, B, C ..... 7,000 m (22,960 ft)
Service ceiling, OEI, 15 m (50 ft)/min rate of climb, max continuous power:
A ..... 3,000 m (9,840 ft)
C ..... 4,145 m (13,600 ft)
T-O run, 15° flap: normal: A ..... 340 m (1,115 ft)
B ..... 370 m (1,215 ft)
C ..... 450 m (1,480 ft)
STOL: A ..... 230 m (755 ft)
C ..... 360 m (1,180 ft)
T-O to 15 m (50 ft), 15° flap: normal: A ..... 420 m (1,380 ft)
B ..... 490 m (1,610 ft)
STOL: A ..... 370 m (1,215 ft)
Landing from 15 m (50 ft), 20° flap: with braking and propeller reversal:
normal: A ..... 480 m (1,575 ft)
STOL: A, B ..... 370 m (1,215 ft)
C ..... 320 m (1,050 ft)
with brakes only: normal: A ..... 620 m (2,035 ft)
B ..... 630 m (2,070 ft)
C ..... 590 m (1,935 ft)
STOL: A ..... 200 m (660 ft)
Landing run, 20° flap:
with braking and propeller reversal: A ..... 200 m (660 ft)
with brakes only: A, B ..... 340 m (1,120 ft)
C ..... 330 m (1,085 ft)
Range at econ cruising speed at FL100 with max fuel, 45 min reserves:
A, C ..... 723 n miles (1,340 km; 832 miles)
B ..... 707 n miles (1,310 km; 814 miles)
Endurance, conditions as above: A ..... 5 h 12 min
B ..... 5 h 15 min

HAIC

HONGDU AVIATION INDUSTRY GROUP (HONGDU HANGKONG GONGYE GONGSI) (SUBSIDIARY OF AVIC II)

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Web: www.hongdu.com.cn
PRESIDENT: Jiang Liang
DEPUTY GENERAL MANAGER, CIVIL AIRCRAFT DIVISION: Huang Xuejun

Following the division of AVIC's responsibilities in 1999, Hongdu Aviation Industry Group became the parent organisation of the former Nanchang Aircraft Manufacturing Company (NAMC). HAIC, which had a 2003 workforce of 5,600, also manufactures motorcycles, textile machinery and a range of other non-aerospace products.

NAMC, which became a core unit of HAIC in 1998, was created in 1951 as the state-owned Hongdu Machinery Building Factory; it built 379 CJ-5s (licence Soviet Yak-18s) between 1954 and 1958, and in 1960s shared in large production programme for J-6 fighter (Chinese development of MiG-19); also built (1957–68) 727 Y-5 (Chinese An-2) biplanes. Current programmes include L-15 and JL-8/K-8 jet trainers. Agreements with and via Canadian Aerospace Group in 1998 provided for North American assembly and marketing of N-5A agricultural aircraft in return for option to build CAG Windeagle and Monitor Jet in China; however, Canadian project subsequently foundered. Also built prototype of NLA AC-500 Air Car. Assembly of MD 500/600 helicopters is delegated to HMDH subsidiary (which see).

The company occupies a 500 ha (1,235 acre) site, with 10,000 m^2 (107,600 sq ft) of covered space, and delivered its 4,000th aircraft in 1993.

HAIC Q-5J

TYPE: Advanced jet trainer.

PROGRAMME: Q-5 (Western A-5) attack fighter first flew in 1965, but derived from earlier F-6/MiG-19. Believed now to be obsolete, although HAIC showed a model of a tandem-seat, armed "JQ-5J" at the Zhuhai Air Show in November 2004. A prototype flew on 25 February 2005, the designation now being unofficially quoted as Q-5J. Fin height has been increased to offset the addition of a second cockpit. In view of the more advanced aircraft designs now available to the PLAAF, the rationale of this belated version is not immediately apparent, except as a replacement for the even older JJ-6 trainers used for instruction and flight-checking by Q-5 regiments.

POWER PLANT: Two jet engines, each 44.3 kN (9,950 lb st) with afterburning. Provision for two drop-tanks, each 760 litres (201 US gallons; 167 Imp gallons).

ACCOMMODATION: Two in tandem beneath individual, starboard-hinged canopies; separate windscreen.

DIMENSIONS, EXTERNAL:

Wing span	9.70 m (31 ft 10 in)
Length overall	17.11 m (56 ft 1½ in)
Height overall	4.815 m (15 ft 9½ in)

PERFORMANCE:

Max level speed	659 kt (1,220 km/h; 758 mph)
Landing speed	160 kt (297 km/h; 185 mph)
Max rate of climb at S/L	8,100 m (26,575 ft)/min
Service ceiling	14,800 m (48,560 ft)
T-O run	645 m (2,120 ft)
Landing run	867 m (2,845 ft)
Range with max two drop-tanks	873 n miles (1,617 km; 1,004 miles)
Endurance with two drop-tanks	2 h 10 min
g limits	+7.5

Prototype of tandem-seat Hongdu/Nanchang Q-5J 1151016

HAIC CJ-6A

Chinese name: Chuji Jiaolianji-6A (Basic training aircraft 6A)
Westernised designation: PT-6A

TYPE: Basic prop trainer.

PROGRAMME: Design initiated at Shenyang in second half of 1957 as Chinese-engineered successor to CJ-5 (licence Yak-18; see 1991–92 and earlier editions); first flight of first prototype (108 kW; 145 hp Mikulin M-11ER engine) 27 August 1958, but trials disappointing; modified version with 194 kW (260 hp) Ivchenko AI-14R made first flight 18 July 1960. Responsibility subsequently transferred to Nanchang, further redesign by NAMC (now HAIC) preceding first flight of production-standard prototype 15 October 1961; production go-ahead for aircraft January 1962, for HS6 engine (Chinese AI-14R) June 1962. Despite regular reports of production termination, low rate manufacture appeared to be proceeding in 2005, as suggested by continued promotion under Western name of 'Swallow'.

CURRENT VERSIONS: **CJ-6A:** Standard version from December 1965, with uprated HS6A engine.

CJ-6B: Armed version; 10 built 1964–66.

Haiyan A: Prototype of civil agricultural version, described in 1991–92 and earlier editions. Programme superseded by N-5A.

CUSTOMERS: Total of 1,796 (all versions) built by end of 1986 (or perhaps earlier), mainly for PLA Air Force but including well over 200 for foreign military customers. Exported to Albania (20), Bangladesh (36), Cambodia, North Korea, Sri Lanka (10), Tanzania and Zambia (10). Large numbers of ex-PLA aircraft disposed of to civilian owners in Australia (from 1991), UK, US and elsewhere. Main production at factory No. 320 in 52 batches from 1962 to about 1992; no evidence of batches 53 to 63, but aircraft of batch 64 have included 6432033 and 6432034 to US in 2001 and 6432041 and 64032042 to Australia in 2004. Factory No. 512 also built some 300 in five batches (numbered 27 to 31) 1970 to 1976.

HAIC JL-8

Chinese name: Jiaolianji 8 (Training aircraft 8)
Export designation: K-8 Karakoram

TYPE: Basic jet trainer/light attack jet.

PROGRAMME: Launched publicly (as NAMC L-8) at 1987 Paris Air Show as proposed export aircraft to be developed jointly with international partner. Subsequently proposed to be co-developed with Pakistan as partner (25 per cent share); aircraft then redesignated K-8 and named after mountain range forming part of China/Pakistan border. Pakistan decided 1994 against own assembly line, but agreed to reconsider if subcontracting share (12 per cent initially, but being increased to 25 per cent in mid-2001 by addition of front fuselage) should later increase to 45 per cent.

Manufacture of four prototypes started January 1989; three flying prototypes: 001 (first flight 21 November 1990), 003 (first flight 18 October 1991) and 004; 002 is static and fatigue test aircraft.

First preproduction aircraft (1001/L8 320101) used as demonstrator. Preproduction batch of six for Pakistan Air Force evaluation (ordered 9 April 1994) handed over in China on 21 September 1994 and delivered to PAF on 10 November that year; PAF evaluation (approximately 1,200 hours) completed in August 1995; aircraft reported subsequently in use from Air Academy, Risalpur. China importing Progress AI-25 turbofans for use in domestic JL-8 version (see under Power Plant). One aircraft in use from 1997 by China Flight Test Establishment as variable stability testbed (K-8VSA) with fly-by-wire flight control system.

According to PAC spokesman early 2005, company then planning to increase annual output of components for K-8, but due to slow rate of acquisition from China had abandoned all intention of in-country final assembly and decided to restrict total PAF procurement to 39 aircraft.

CURRENT VERSIONS: **K-8:** Initial version with TFE731 engine; *as described.*

K-8E: TFE731-powered version for Egyptian Air Force, 80 of which ordered under contract signed on 27 December 1999. First 10 Chinese-built (first flight 5 July 2000); Arab Organisation for Industrialisation (AOI) then assembling batches of 15 and 10 from CKD kits of medium-sized and smaller components respectively before progressing to 90 per cent local manufacture of final 45; first kit-assembled K-8E completed mid-2001 and final example in December 2005. Chinese Certificate of Recognition for Phase 2 of co-production programme awarded August 2005. Total of 33 items newly selected, developed or upgraded for this version include instrument panels and consoles; com/nav systems; fire-control system; fuel system; environmental control system; hydraulic system; and landing gear.

JL-8: Designation of Chinese domestic version fitted with AI-25 engine.

K-8VSA: In-flight variable stability testbed (serial number 320203), in use from 1997 by China Flight Test Establishment (CFTE). Equipped with digital fly-by-wire AFCS, sidestick controller and data acquisition system.

CUSTOMERS: Total of 12 preproduction K-8s (six each to AFPLA and Pakistan Air Force) delivered by end of 1996. Second batch of six delivered to Pakistan Air Force in late 2003. Original joint venture agreement reportedly involved up to 75 for Pakistan Air Force, but Pakistan Secretary for Defence Production quoted in early 1996 as saying up to 100 needed eventually to replace Cessna T-37; however, SLEP for T-37 postponed main K-8 requirement to 2005, when further 27 approved on 30 June 2005, with designation **K-8P** and

HAIC CJ-6A in Chinese markings, but owned by a US operator *(Paul Jackson)* 1158005

Zambian Air Force HAIC K-8 1195782

Chinese Air Force HAIC K-8 jet trainers of 13th Flying Academy at Bengbu 1151990

K-8 EXPORT ORDERS
(at May 2006)

Country	Qty
Egypt	80
Ghana	4
Morocco	?[3]
Myanmar	12[1]
Namibia	12
Pakistan	39
Sri Lanka	9
Zambia	8[2]
Zimbabwe	12
Undisclosed	8
Total	**184+**

[1] Reported total requirement for 30
[2] Reported option for further 8
[3] To replace approximately 14 Cessna T-37Bs; total has been reported as 20, but deliveries not confirmed

two-screen 'glass cockpit'. AFPLA originally had requirement for several hundred, of which 25 to 30 delivered by late 1999 and at least 40 confirmed by late 2003; equip at least No. 4 Flying Training School at Shijiazhuang and No. 13 FTS; AFPLA now widely reported to have abandoned plans for full adoption but Navy's Air Academy partly equipped by 2006; aircraft in blue and white colours. Myanmar Air Force last three of 12 delivered in September 1999. Zambian Air Force eight, and Namibian Air Force first four, also delivered in 1999. Three of Sri Lanka six (No. 14 Squadron) destroyed in Tamil Tiger attack on Katunayake AB, 24 July 2001; three replacements delivered 25 July 2005. Six of Zimbabwean 12 delivered by April 2005. Egyptian Air Force had received about 45 (of 80) of K-8E version by late 2002, to replace Aero L-29. Interest also reported from Bangladesh, Cambodia, Eritrea, Laos and Thailand.

COSTS: USD3 million to USD3.5 million flyaway (1996) with TFE731 and Western avionics. Egyptian Air Force (80 aircraft) contract USD347.4 million (1999).

DESIGN FEATURES: Intended for full basic flying training plus parts of primary and advanced syllabi, but capable also of light ground attack missions. Sweptback vertical/non-swept horizontal tail surfaces.

Tapered low wings, with NACA 64A-114 (mod) root and NACA 64A-412 tip sections; sweepback 2° 13' 8" at quarter-chord, 1° 30' incidence at root, 3° dihedral from roots; −2° twist.

FLYING CONTROLS: Conventional and power-assisted; ailerons have hydraulic boost and artificial feel; variable incidence tailplane; electrically operated trim tab in rudder and port elevator. Aileron travel ±18°, elevators 16° up/28° down, rudder ±28°. Two-position Fowler flaps (23° for T-O, 35° for landing), and split airbrake under fuselage just aft of mainwheel doors, are hydraulically actuated.

STRUCTURE: All-metal damage-tolerant main structure; ailerons of honeycomb; fin and rudder of composites (aluminium on PAC-built aircraft). Service life 8,000 hours. PAC share (initially only tailplane and elevators) increased to include fin, rudder, rear fuselage and engine cowling/access panels. First Pakistan-built subassemblies delivered to China in mid-1997; planned output by PAC of 12 tail units and three front fuselages in 2001; 24 and 12 respectively in 2002; 36 tails and undecided number of front fuselages in 2003. However, first PAC-built front fuselage not handed over until 5 November 2002, at which time two more under construction.

LANDING GEAR: Hydraulically retractable tricycle type, with single wheel and oleo-pneumatic shock-absorber on each unit. Main units retract inward into underside of fuselage; nosewheel, which has hydraulic steering, retracts forward. Mainwheel tyres size 561×169, pressure 6.90 bar (100 lb/sq in). Chinese hydraulic disc brakes. Anti-skid units. Minimum ground turning radius 6.69 m (21 ft 11½ in).

POWER PLANT: Including prototypes, all except JL-8 have one 16.01 kN (3,600 lb st) Honeywell TFE731-2A-2A turbofan with Lucas Aerospace FADEC, mounted in rear fuselage. Production JL-8 for China powered by 16.87 kN (3,792 lb st) ZMKB Progress AI-25TLK turbofan, ordered in 1997; initial batch of 58 imported; further 42 being negotiated in 2004.

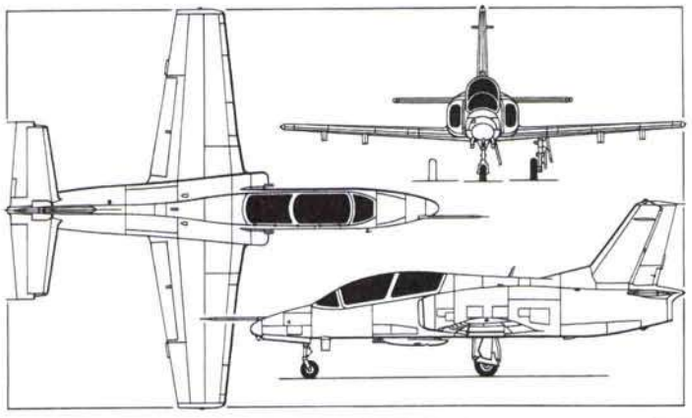
Fuel in two flexible tanks and one inverted flight tank in fuselage and one integral tank in wing centre-section, combined capacity 1,000 litres (264 US gallons; 220 Imp gallons); single refuelling point in fuselage. Provision for carrying one 250 litre (66.0 US gallon; 55.0 Imp gallon) drop tank on outboard pylon under each wing. Oil capacity 4 kg (8.8 lb).

ACCOMMODATION: Instructor and pupil in tandem, on Jianghan TY7A zero/zero ejection seats (Martin-Baker Mk 10L in Pakistan aircraft); rear seat elevated 28 cm (11 in). One-piece wraparound windscreen; two-piece canopy opens sideways to starboard. Cockpits pressurised and air conditioned.

SYSTEMS: Honeywell ECS 51833 air conditioning and pressurisation system, with maximum differential of 0.27 bar (3.9 lb/sq in). Hydraulic system, pressure 207 bar (3,000 lb/sq in), for operation of landing gear extension/retraction, wing flaps, airbrake, aileron boost, nosewheel steering and wheel brakes. Flow rate 15 litres (3.96 US gallons; 3.30 Imp gallons)/min, with air-pressurised reservoir, plus emergency back-up hydraulic system. Abex AP09V-8-01 pump. Electrical systems powered by 12 kW, 28.5 V DC generator (primary) and 24 V DC (auxiliary), with 115/26 V single-phase AC and 36 V three-phase AC available from 40 Ah Ni/Cd battery and two static inverters, both at 400 Hz. Liquid oxygen system for occupants. Demisting of cockpit transparencies.

AVIONICS: *Comms:* Bendix/King KTR 908 VHF or KTR 909 UHF; intercom; FJ-20 flight data recorder.

Flight: Bendix/King KNR 634A VOR/glideslope/MKR with KA 26 beacon receiver, ADF 462, Type 265 radio altimeter, HZX-4A AHRS, SS/SC-5 air data computer and KTU 709 Tacan or WL-7A radio compass.



JL-8/K-8 jet trainer and light attack aircraft *(Mike Keep)* 1158574

Instrumentation: Rockwell Collins EFIS-86T in first 100 aircraft, incorporating CRT primary flight and navigation displays for each crew member plus dual display processing units and selector panels for tandem operation. Blind-flying instrumentation standard. Standby flight instruments include ASI, rate of climb indicator, barometric altimeter, emergency horizon and standby compass.

Chinese (Sicong Group) upgrade for domestic and export aircraft expected to enter production in 2005, includes one HUD, three multifunction display systems (MDS), mission computer, digital video recorder, up-front control panel and data transfer card. Systems, which began testing in September 2004, said to include GPS, Tacan and radio compass navigation, and to function as a fire-control system for 23 mm gun, PL-5E AAM, 57 mm rockets and other weapons.

ARMAMENT (optional): One 23 mm gun pod under centre-fuselage; self-computing optical gunsight in cockpit, plus gun camera. Two external stores points under each wing. Twin ejector racks on inboard stations can carry total of four 6, 11.5 or 50 kg practice bombs; single-store outboard stations can each carry a PL-5E air-to-air missile, a 12-round pod of 57 mm rockets, a 200 kg, 250 kg or BL755 bomb, or a drop fuel tank.

DIMENSIONS, EXTERNAL:

Wing span	9.63 m (31 ft 7¼ in)
Wing mean aerodynamic chord	1.85 m (6 ft 0¾ in)
Wing aspect ratio	5.4
Length overall: incl nose pitot	11.60 m (38 ft 0¾ in)
excl nose pitot	10.40 m (34 ft 1½ in)
Height overall	4.21 m (13 ft 9¾ in)
Elevator span	4.20 m (13 ft 9½ in)
Wheel track	2.54 m (8 ft 4 in)
Wheelbase	4.44 m (14 ft 6¾ in)

AREAS:

Wings, gross	17.02 m² (183.2 sq ft)
Ailerons (total, incl tab)	1.095 m² (11.80 sq ft)
Trailing-edge flaps (total)	2.65 m² (28.55 sq ft)
Fin	1.92 m² (20.67 sq ft)
Rudder, incl tab	1.115 m² (12.02 sq ft)
Tailplane	2.84 m² (30.57 sq ft)
Elevators (total, incl tab)	1.32 m² (14.21 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, equipped	2,757 kg (6,078 lb)
Max fuel: internal	780 kg (1,720 lb)
external (two drop tanks)	388 kg (855 lb)
Max external stores load	943 kg (2,080 lb)
T-O weight: clean	3,700 kg (8,157 lb)
with two 250 litre drop tanks	4,204 kg (9,268 lb)
Max T-O weight with external stores	4,332 kg (9,550 lb)
Max wing loading	254.5 kg/m² (52.13 lb/sq ft)
Max power loading (TFE731)	271 kg/kN (2.65 lb/lb st)

PERFORMANCE (at clean T-O weight):

Never-exceed speed (VNE)	512 kt (950 km/h; 590 mph) IAS
Max level speed at S/L	432 kt (800 km/h; 497 mph)
Unstick speed	100 kt (185 km/h; 115 mph)
Approach speed	108 kt (200 km/h; 124 mph)
Touchdown speed, 35° flap	86 kt (160 km/h; 99 mph)
Stalling speed, 35° flap	81 kt (150 km/h; 94 mph)
Max rate of climb at S/L	1,800 m (5,905 ft)/min
Service ceiling	13,600 m (44,620 ft)
T-O run	440 m (1,445 ft)
T-O to 15 m (50 ft)	600 m (1,970 ft)
Landing from 15 m (50 ft)	518 m (1,700 ft)
Landing run	530 m (1,740 ft)
Range:	
max internal fuel	842 n miles (1,560 km; 969 miles)
max internal/external fuel	1,155 n miles (2,140 km; 1,329 miles)
Endurance: max internal fuel	3 h 12 min
max internal/external fuel	4 h 12 min
g limits (clean)	+7.33/–3.0

HAIC L-15

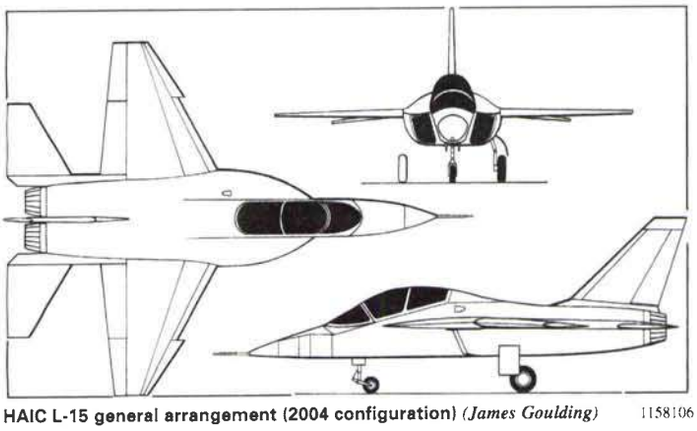
English name: Flying Lion

TYPE: Advanced jet trainer/light attack jet.

PROGRAMME: Revealed as feasibility study at Aviation Expo 2001, Beijing, September 2001 and displayed in model form at Zhuhai November 2002. International partner(s) sought. Parallel design study undertaken by Yakovlev OKB, revealed at MAKS air show in August 2003 and due to be presented to AVIC II by end of that year. However, by September 2003, when details of the L-15 were again made available at an air show in Beijing, the aircraft's appearance had changed significantly, becoming more like the Yak-130, especially in profile. Yakovlev confirmed in mid-2004 that collaboration on the L-15 was continuing. Three prototypes planned, of which first fuselage delivered 14 August 2005; rolled out 23 September 2005; maiden flight 13 March 2006. Competing with GAIC FTC-2000 for selection as supersonic trainer for J-10 and J-11.

L-15 front cockpit with up-front control panel 1158004

Twin MFDs in L-15 rear cockpit 1158001



HAIC L-15 general arrangement (2004 configuration) *(James Goulding)* 1158106

DESIGN FEATURES: Shoulder-mounted wings with curved, leading-edge wingroot strakes; dog-tooth leading-edge with two-section manoeuvring slats on entire leading-edge; tandem cockpits; twin engines; single vertical fin. High AoA manoeuvring capability (more than 30° estimated). Service life 10,000 hours or 30 years.

Following details provisional:

FLYING CONTROLS: Three-axis, quad-redundant digital fly-by-wire. All-moving tailplane. Large, door-type dorsal airbrake.

POWER PLANT: Twin 20.6 kN (4,630 lb st with afterburning) ZMKB Progress AI-222K-25F or 17.0 kN (3,825 lb st) class SAEC WS11 turbofans originally proposed. AI-222 reportedly selected in November 2004, but latest (February 2006) literature quotes PS/ZMK DV-2 as alternative.

ACCOMMODATION: Two zero/zero ejection seats in tandem. One-piece canopy, opening sideways to starboard.

AVIONICS: HOTAS controls, HUD, up-front control panel and two MFDs; stores management system.

DIMENSIONS, EXTERNAL:

Wing span	9.48 m (31 ft 1¼ in)
Length overall	12.27 m (40 ft 3 in)
Height overall	4.81 m (15 ft 9¼ in)

WEIGHTS AND LOADINGS:

Normal T-O weight, clean	6,800 kg (14,991 lb)
Max T-O weight	9,800 kg (21,605 lb)

HAIC L-15 prototype after repainting 1158103

Touchdown by HAIC L-15 prototype 1158105

Prototype HAIC L-15 1158104

PERFORMANCE (estimated):

Max level speed	more than M1.4
Rate of climb at S/L: at MTOW	9,000 m (29,530 ft)/min
with 50% internal fuel	15,000 m (49,200 ft)/min
Service ceiling	16,500 m (54,130 ft)
Max (self-ferry) range	1,673 n miles (3,100 km; 1,926 miles)
g limits	+8/−3

HAIC N-5

Chinese name: Nongye Feiji 5 (Agricultural aircraft 5)

TYPE: Agricultural sprayer.

PROGRAMME: Design began November 1987; first details revealed at Farnborough Air Show September 1988; first of three prototypes (B-501L) made first flight 26 December 1989; CAAC type certificate awarded July 1992 and production certificate June 1995. Marketing in Canada under name AG Dragon in late 1990s failed to materialise. At least nine N-5As in operation in China in 2001.

A report from Beijing in mid-2004 indicated that Hongdu had begun ground testing of an upgraded version of the (formerly NAMC) N-5A, designated N-5B and powered by either an Orenda piston engine or a Walter turboprop. First flight was then targeted for March 2005, though it had not been reported by early 2006. Improvements expected from the re-engining include an increased payload of 1,500 kg (3,307 lb) and a service ceiling of 8,000 m (26,250 ft). Although little evidence has been seen of much production of the Lycoming-engined N-5A, the same report declared that this version "will continue to be manufactured".

A model of the N-5B displayed at Airshow China, Zhuhai, in November 2006 showed the N-5B to have been reconfigured to a tailwheel-type landing gear.

CURRENT VERSIONS: **N-5A:** Initial production version; 298 kW (400 hp) Textron Lycoming IO-720-D1B flat-six engine; fixed, tricycle type landing gear. Currrent status uncertain; last described in 2002-03 *Jane's All the World's Aircraft*.

November 2006 display model of the turboprop-powered, tailwheel-gear N-5B *(Robert Hewson)* 1040446

N-5B: Turboprop-powered, tailwheel-gear current version; *main differences from N-5A as described below.*

LANDING GEAR: Tailwheel type; fixed.

POWER PLANT: One 579 kW (777 shp) Walter M 601F turboprop; three-blade variable-pitch propeller.

DIMENSIONS, EXTERNAL:

Wing span	13.295 m (43 ft 7½ in)
Length overall (flying attitude)	10.485 m (34 ft 4¾ in)
Height overall	3.88 m (12 ft 8¾ in)
Wheel track	3.53 m (11 ft 7 in)

DIMENSIONS, INTERNAL:

Hopper capacity	1.60 m^3 (56.5 cu ft)

WEIGHTS AND LOADINGS:

Max payload	1,500 kg (3,307 lb)

PERFORMANCE:

Max level speed	128 kt (237 km/h; 147 mph)
Stalling speed, flaps down	60 kt (111 km/h; 69 mph)
Max rate of climb at S/L	360 m (1,181 ft)/min
Service ceiling	6,000 m (19,680 ft)
T-O run	251 m (825 ft)
Landing run	198 m (650 ft)
Chemical dispersal: liquid	5 kg/m^2 (1.02 lb/sq ft)
granular	15 kg/m^2 (3.07 lb/sq ft)
Max range	545 n miles (1,010 km; 627 miles)
Endurance	6 h

HAIG

HARBIN AIRCRAFT INDUSTRIES GROUP (HARBIN FEIJI GONGYE GONGSI) (SUBSIDIARY OF AVIC II)

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Fax: (+86 451) 650 22 73
PRESIDENT AND GENERAL MANAGER: Cui Xuewen
VICE-PRESIDENT: Xu Zhanbin
PUBLIC RELATIONS: Chen Xiaoyi

SUBSIDIARY:
Harbin Embraer Aircraft Industry Company (HEAI)
PRESIDENT: Roberto Rossi
VICE-CHAIRMAN: Guan Dongyuan
GENERAL MANAGER: Marcelo Ramon Ferroni

HAIG at Harbin is the parent organisation of Hafei Aviation Industry Company. It has overall responsibility for HAI's participation in the Eurocopter EC 120 programme, which is assembled in China from imported kits under the local designation HC 120. Harbin is also now involved in the prospective Eurocopter EC 175 (Chinese designation Z-15).

Contract, signed 2 December 2002, to create new company (Harbin Embraer Aircraft Industry Co Ltd; HEAI) for co-production of ERJ-145 regional jet; Embraer 51 per cent holding, HAIG and HAI 24.5 per cent each; workforce 180 at 18 January 2006. Embraer investing USD25 million in new 24,000 m^2 (258,330 sq ft) production facility for ERJ-145 programme; ERJ-135/140 could also be built. Facility inaugurated August 2003. Initially, Harbin contributes parts manufacture only, importing Brazilian-built major subassemblies for mating in China. Starting with fuselage frames, gradual progress is to be made towards more substantial component manufacture.

Launch order for six from China Southern Airlines, delivered between June 2004 and January 2005. Second customer is China Eastern Airlines, which ordered five ERJ-145s in March 2005, with deliveries starting 29 August 2005. Refer to table of production. Eventual capacity for 24 aircraft per year.

Chinese-built Embraer ERJ-145LI B-3066 1153804

CHINESE ERJ-145 PRODUCTION

c/n	Registration		Type	Delivered	Customer	Remarks
	Brazilian	Chinese				
145701	PT-SGF	B-3060	ERJ-145LI	28 Jun 04	China Southern	First flight 16 Dec 03
145755	PT-SNA	B-3061	ERJ-145LI	28 Jun 04	China Southern	
145781	PT-SNB	B-3062	ERJ-145LI	3 Sep 04	China Southern	
14500804		B-3063	ERJ-145LI	24 Dec 04	China Southern	
14500815		B-3065	ERJ-145LI	Dec 04	China Southern	
14500823	PT-SXL	B-3066	ERJ-145LI	Jan 05	China Southern	
14500839	PT-SOA	B-3049	ERJ-145LI	Sep 05	China Eastern (Jiangsu)	
14500848	PT-SOB?	B-3050	ERJ-145LI	Sep 05	China Eastern (Jiangsu)	
14500882	PT-SOC	B-3053	ERJ-145LI	Dec 05	China Eastern (Jiangsu)	
14500898	PT-SOD	B-3051	ERJ-145LI			
14500905	PT-SOE	B-3052	ERJ-145LI			
14500921			ERJ-145LI			
14500928			ERJ-145LI		China Eastern (Jiangsu)	
14500932			ERJ-145LI			
			ERJ-145LR	Due Nov 06	China Eastern (Wuhan)	
			ERJ-145LR		China Eastern (Wuhan)	
			ERJ-145LR		China Eastern (Wuhan)	
			ERJ-145LR		China Eastern (Wuhan)	
			ERJ-145LR	Due Jan 07	China Eastern (Wuhan)	

HMDH

HONGDU MD HELICOPTERS

Nanchang, Jiangxi
CEO: Albert H Haider

New joint venture created in early 2003 by RDM Holdings (60 per cent) and Hongdu Aviation Industries Group (40 per cent), with initial USD10 million investment by RDM, under which HMDH assembles MD 500 and 600 series helicopters from US-supplied kits, first of which were delivered in March 2003. Programme launch planned for October 2003, with three MD 500s and one MD 600 to be completed by year-end. Initial commitments for about 30 helicopters reported by that time. However first locally assembled helicopter, an MD 600N, was shown at Zhuhai in November 2004, having apparently been completed only in the preceding month. One each of MD 500E, 530F, 520N then said to be due for completion within next few months, but not confirmed by early 2006.

At its formation, HMDH had received commitments from local law enforcement and tourist agencies. Future plans envisage gradual progression towards an increased share in the manufacturing process.

HTATC

HUZHOU TAIXIANG AVIATION TECHNOLOGY COMPANY

Huzhou, Zhejiang

Company formed 29 November 2001 as joint venture between Jinjiang Medicine Company and Aitas Enterprise Corporation of USA with total investment of USD29.9 million and registered capital of USD20 million. Is assembling ASII (Sportscopter) Ultrasport, Rotorway Exec, a three-seat helicopter and an unspecified fixed-wing aircraft from imported kits. First deliveries (five aircraft, including one Ultrasport and one Exec) made in September 2002. HTATC aimed to achieve output of 150 in its first two years of operation and full local manufacture, except for engines, by end of third year. No progress has been reported since 2002, although an 'ultralight helicopter UAV' bearing some resemblance to the ASII Ultrasport was exhibited at Airshow China, Zhuhai, in November 2006.

NLA

NANJING LIGHT AIRCRAFT COMPANY

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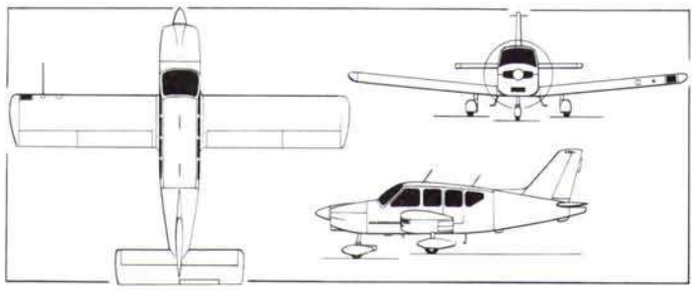
Fax: (+86 25) 489 16 37
e-mail: njqf@pub.jlonline.com
PRESIDENT: Wo Dingzhu
VICE-GENERAL ENGINEER: Pan Jia Zheng

NLA was created in 1998 by Nanjing University of Aeronautics and Astronautics (NUAA), the municipality of Nanjing, the provincial government of Jiangsu and other business interests. It has its headquarters on the NUAA campus and is responsible for the five-seat AC-500, which made its first flight in May 2004.



NLA AC-500 light aircraft *(James Goulding)* 0126689

NLA AC-500 AIR CAR

Alternative name: Air Sedan

TYPE: Five-seat lightplane.

PROGRAMME: Revealed at Airshow China in November 1998; chief designer Pan Jia Zheng; joint development by NUAA and NLA. Prototype originally targeted to fly in 2000; built and rolled out at HAIG plant, Nanchang, in third quarter of 2000 and exhibited at Airshow China in November 2000. Maiden flight not achieved until May 2004 at the No. 320 Plant in Nanchang. Three examples completed at that time; a second aircraft (c/n 0004) flew for the first time on 3 December 2004 (official first flight on 7 December), this being in trainer configuration, equipped with dual controls. Aircraft B-660L and B-662L have been noted. FAR Pt 23 certification is intended; national certification trials conducted between 4 and 8 December 2005; total 181 sorties; production was due to have begun in March 2006.

CUSTOMERS: Total 22 ordered by individual customers in Wenzhou in 2005.

COSTS: CNY3.6 million; export USD500,000 (2006).

DESIGN FEATURES: General appearance similar to that of Piper and Socata types in same weight/performance category. Constant-chord, low-mounted wings with upturned tips; sweptback vertical tail and small underfin.

Said to be intended mainly for business flights by senior government and industry officials; and for forestry protection, mail delivery, agricultural, environmental monitoring, remote sensing and other activities. Design life 16,000 hours and 65,000 landings.

FLYING CONTROLS: Conventional and manual; flaps fitted. One-piece horn-balanced elevator; ground-adjustable tab on rudder.

STRUCTURE: All-metal main structure; some non-load-bearing components manufactured from composites.

LANDING GEAR: Tricycle type; fixed. Single wheel on each unit.

POWER PLANT: One 194 kW (260 hp) Textron Lycoming IO-540 flat-six engine, driving a Hartzell three-blade propeller. (Teledyne Continental in prototype, according to one report.) Quoted in 2005 as 224 kW (300 hp) engine of unspecified type.

ACCOMMODATION: Pilot and co-pilot or passenger in front, with two rearward-facing seats behind and a forward-facing single seat aft of these. Crew door each side of cockpit, plus passenger door aft of wing on port side.

DIMENSIONS, EXTERNAL:

Wing span	10.20 m (33 ft 5½ in)
Length overall	8.40 m (27 ft 6¾ in)
Fuselage max width	1.20 m (3 ft 11¼ in)
Height overall	3.20 m (10 ft 6 in)
Wheel track	2.80 m (9 ft 2¼ in)
Wheelbase	2.18 m (7 ft 1½ in)
Propeller diameter	1.96 m (6 ft 5 in)

WEIGHTS AND LOADINGS:

Weight empty	1,117 kg (2,463 lb)
Max baggage weight	65 kg (143 lb)
T-O weight	1,540 kg (3,395 lb)
Max power loading	7.95 kg/kW (13.06 lb/hp)

PERFORMANCE (estimated):

Max level speed	156 kt (289 km/h; 179 mph)
Max cruising speed	135 kt (250 km/h; 155 mph)
Stalling speed	60 kt (110 km/h; 69 mph)
Service ceiling	5,500 m (18,040 ft)
Landing run	300 m (985 ft)
Range	540 n miles (1,000 km; 621 miles)
Endurance	4 h

NLA AC-500 Air Car No. 4, second to fly *(NUAA)* 1153751

SAC (SHAANXI)

SHAANXI AIRCRAFT COMPANY (SHAANXI FEIJI GONGSI) (SUBSIDIARY OF AVIC II)

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PRESIDENT: Hu Xiaofeng
PRESIDENT: Bai Songbai
MARKETING MANAGER: Li Yousen

Founded by executive order of November 1969; occupies a 300 ha (741 acre) site and had 2003 workforce of more than 10,000; covered workspace includes largest final assembly building in China. Status raised to Industry Group in 2001. Main aircraft programme, recently receiving increased development/upgrading effort, is Y-8 transport; non-aerospace products include coaches and small trucks.

SAC Y-8

Chinese name: Yunshuji-8 (Transport aircraft 8)

TYPE: Medium transport/multirole.

PROGRAMME: Redesign, as Chinese development of Antonov An-12B, started at Xian March 1969; first flight of first (Xian-built) prototype 25 December 1974, followed by second (c/n 001802, first built by SAC) 29 December 1975; production go-ahead given 11 February 1980; certified 28 December 1989. Pressurised Y-8C made first flight 17 December 1990. Production rate was approximately five per year during first half of 1990s; new (mainly freighter) designations introduced with Y-8F100 and F200 from 1997; further F-prefixed variants revealed November 2000, reflecting current manufacturing standard; three-person flight crews resulting from use of modernised avionics; now seen to have more future in cargo and military roles. Antonov design input acknowledged in recent special missions testbeds.

Y-8F200 four-turboprop medium transport 1151049

CURRENT VERSIONS: **Y-8:** Prototype and baseline military transport.

Y-8A: Helicopter carrier. Main cabin height increased by 120 mm (4.72 in) by deleting internal gantry; downward-opening rear ramp/door, as in Y-8C. Deliveries began 1987. In service.

Y-8B: Mainly unpressurised civil transport. First deliveries 1986; CAAC certification 1993. Military equipment deleted; empty weight reduced by 1,720 kg (3,792 lb); some avionics differ. In service.

Y-8C: First fully pressurised version, developed with Lockheed collaboration. Changes included redesigned (downward-opening ramp-type) cargo loading door and main landing gear; handling system for standard freight containers and pallets; improved com/nav/ATC equipment, air conditioning and oxygen systems; additional emergency exits. First flight 17 December 1990 (SAC 182, converted from first Shaanxi prototype); CAAC certification 1993. Five delivered by January 1994; apparently superseded by Y-8F200/F400.

Y-8CB: CFTE testbed; *see entry for Y-8/Y-9 Special Mission versions.*

Y-8D: Export baseline version, with main avionics by Rockwell Collins and Litton. Later versions designated **Y-8D II**. Deliveries began 1987 (Y-8D) and 1992 (Y-8D II); eight delivered by early 1997; none reported since then.

Y-8 (DZ): Special mission version; *described separately.*

Y-8E: Drone carrier version of baseline Y-8 for WZ-5 Chang Hong (Long Rainbow) UAV. Forward pressure cabin accommodates drone controller's console; carrier/launch trapeze for one UAV under each outer wing panel. First flight 1989; first deliveries later that year, replacing obsolete Tu-4s. In service.

Y-8F: Livestock carrier version of baseline Y-8, with cages to hold up to 500 sheep or goats. First flight early 1990; first deliveries later that year; CAAC type approval 25 December 1993. In service.

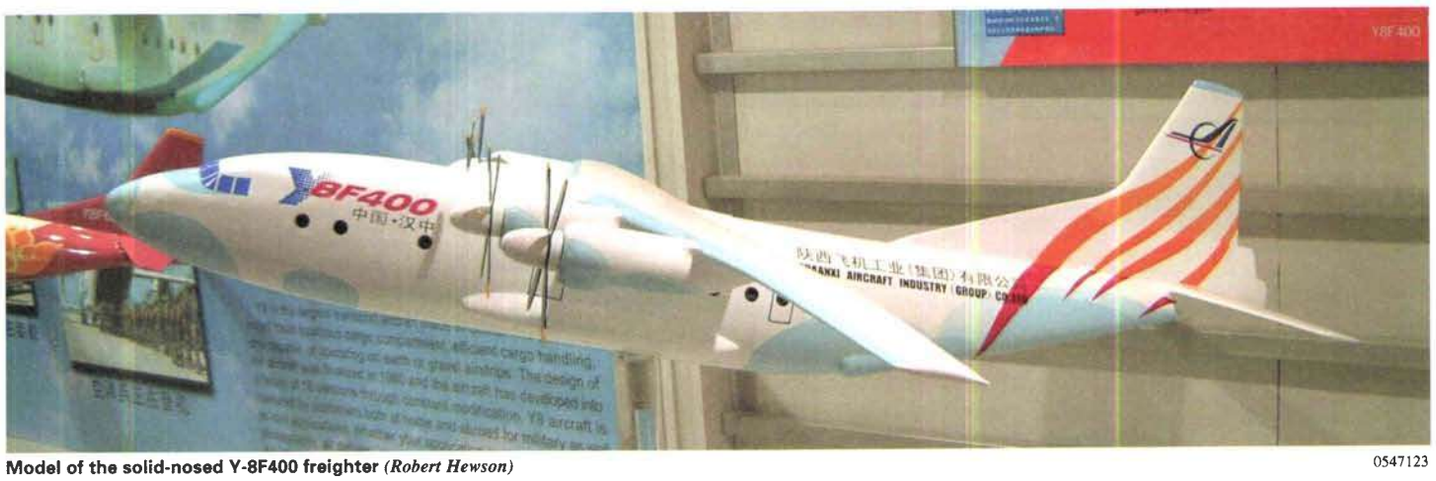
Y-8F100: Upgraded cargo version. Modernised avionics (colour weather radar, EFIS, VOR/ILS, DME, GPS navigation, FDR, HF and VHF radios and ATC transponder) and redesigned loading system. Launch customer China Postal Airlines (three); delivered 11 May 1996 with WJ6A engines. Crew of five. Now the baseline part-unpressurised version.

Y-8F200: Pressurised version of F100, certified by CAAC 17 November 1997. Increased internal passenger/cargo volume. Two delivered to Tanzanian Air Force 26 October 2003.

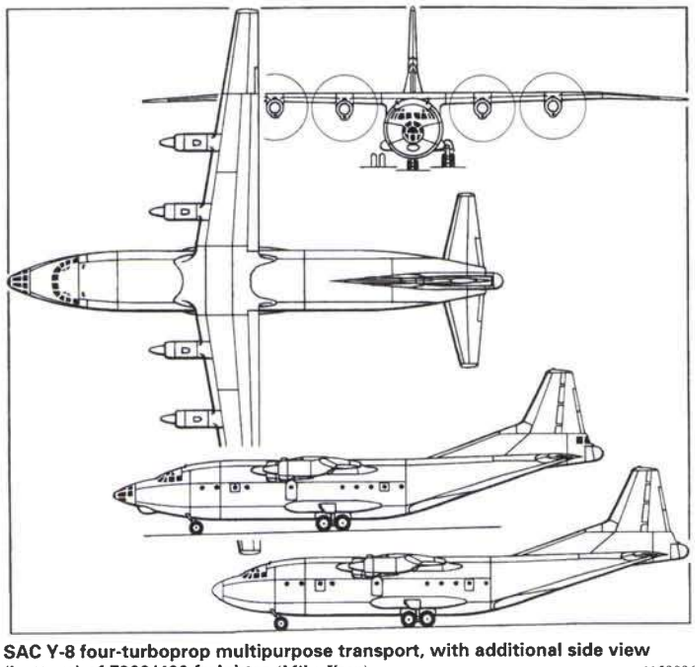
Detailed description applies to F-100/200 unless otherwise indicated.

Y-8F300: Freighter. Generally as Y-8F100, but with shorter fuselage, 'solid' nose and reduced (three-person) flight crew. Not currently being promoted.

Y-8F400: Pressurised freighter. Generally as Y-8F200, but with shorter fuselage, 'solid' nose and reduced (three-person) flight crew. Maiden flight 25 August 2001; certified by CAAC 26 August 2002; passed acceptance review 27 November 2002. China Postal Airlines suggested as possible launch customer. Said to be scheduled for refit with PW150A engines.



Model of the solid-nosed Y-8F400 freighter *(Robert Hewson)* 0547123



SAC Y-8 four-turboprop multipurpose transport, with additional side view (bottom) of F300/400 freighter *(Mike Keep)* 1159096

Y-8F600: Further Westernised, shorter fuselage, 'solid'-nosed pressurised freighter version, with Pratt & Whitney Canada PW150B turboprops and Dowty R408 six-blade composites propellers, Honeywell Primus Epic avionics suite, two-person flight crew; Smiths Aerospace integrated standby instrument system (ISIS); otherwise generally similar to Y-8F400. Development approved by Defence and Industry Commission November 2001; co-development agreement with Antonov design bureau 4 November 2002. Two under construction late 2000; first flight originally expected by end of 2001, but first engine deliveries not made until late 2005. According to SAC President at November 2004 Airshow China, was then 'on schedule' to fly in July 2005, with certification targeted for 2006. However, by September 2005 company spokesman indicated one-year programme stretch, with first flight and certification/service entry re-targeted for 2006 and 2007 respectively due to preoccupation with 'other projects' (see separate entry for Special Missions versions). Most recent estimate (by SAC Vice-President in November 2006, at which time F600 was in final assembly) was that maiden flight would take place in January or February 2007, with certification by end of that year.

Y-8F800: Early designation quoted for what later became known as Y8-X and in 2005 as Y-9 (which see).

Y-8H: Special mission version; *described separately.*

Y-8J: Special mission version; *described separately.*

Y-8X: Special mission version; *described separately.*

Y8-X: Designation (2002) for much-enhanced derivative; redesignated Y-9 in 2005; *described separately.*

CUSTOMERS: Total of about 90, including exports, reportedly delivered (of which 50 can be confirmed) by late 2002. In service in China with China Postal Airlines (five Y-8F100s delivered from 11 May 1996) and PLA Air Force (AFPLA); eight military exports (Y-8D) to air forces of Myanmar (four, of which first two delivered 14 July 1994), Sri Lanka (three, of which first two delivered 9 December 1987) and Sudan (two delivered 2 and 13 November 1991). First two Sri Lankan aircraft modified locally for use as bombers (both since lost). Two (Y-8F100) leased to BonAir of Iran from 14 March 1998; two (Y-8F200) exported to Tanzania 26 October 2003. Reported receipt of letters of intent for 36 Y-8F600s from Chinese airlines (including China Postal, five) by August 2005, at which time military exports also being negotiated.

DESIGN FEATURES: High-mounted wing; circular-section fuselage (forward section and tail turret pressurised), upswept at rear; angular tail surfaces with large dorsal fin. More pointed nose transparencies than An-12, probably from Chinese H-6 (Tu-16) production; shorter, 'solid' nose replaces this glazing in F300/400/600.

Wing sections C-5-18 at root, C-3-16 at rib 15 and C-3-14 at tip, final two digits indicating thickness/chord ratio; incidence 4°; 1° dihedral on intermediate panels, 4° anhedral on outboard panels; 6° 50' sweepback at quarter-chord; fixed-incidence tailplane.

FLYING CONTROLS: Conventional and manual. Aerodynamically balanced differential ailerons, elevators and rudder, each of which has inset trim tab; two-segment, hydraulically actuated double-slotted Fowler flaps on each wing trailing-edge; comb-shaped spoilers forward of flaps.

STRUCTURE: All-metal (aluminium alloy) conventional semi-monocoque/stressed skin; wings, tailplane and fin are all two-spar box structures; landing gear and all hydraulic components manufactured by Shaanxi Aero-Hydraulic Component Factory (SAHCF).

LANDING GEAR: Hydraulically retractable tricycle type, with Shaanxi (SAHCF) nitrogen/oil shock-struts on all units. Four-wheel main bogie on each side retracts inward and upward into blister on side of fuselage. Twin-wheel nose unit, hydraulically steerable to ±35°, retracts rearward. Mainwheel tyres size 1,050×300, pressure 28.40 bar (412 lb/sq in); nosewheel tyres size 900×300, pressure 16.70 bar (242 lb/sq in). Hydraulic disc brakes and Xingping inertial anti-skid sensor. Minimum ground turning radius 13.75 m (45 ft 1½ in).

POWER PLANT: *Except F600:* Four 3,126 kW (4,192 shp) SAEC (Zhuzhou) WJ6A turboprops, each driving a Baoding four-blade J17-G13 constant-speed fully feathering propeller.

F600: Four 3,781 kW (5,071 shp) Pratt & Whitney Canada PW 150B turboprops, each driving a Dowty six-blade all-composites propeller.

All fuel (F100/F300) in two integral tanks and 29 bag-type tanks in wings (20,102 litres; 5,310.5 US gallons; 4,422 Imp gallons) and fuselage (10,075 litres; 2,661.5 US gallons; 2,216 Imp gallons), giving total capacity of 30,177 litres (7,971.5 US gallons; 6,638 Imp gallons). Reduced fuel load in F200/F400 (see under Weights and Loadings). Refuelling points in starboard side of fuselage (between frames 14 and 15), mainwheel fairing, and in wing upper surface.

ACCOMMODATION: Flight crew of five (pilot, co-pilot, navigator, engineer and radio operator) in early versions and F100/F200; three crew only in F300/F400, two in F600. Forward portion of fuselage in F100/F300 is pressurised, and can accommodate up to 14 passengers in addition to crew. Cargo compartment (between frames 13 and 43) is unpressurised in these versions. Pressurised volume increased in F200/F400; effective length of cargo hold extended internally by 2.00 m (6 ft 6¾ in). Maximum accommodation for up to 96 troops; or 80 paratroops; or up to 92 casualties with three medical attendants; or two 'Liberation' army trucks, plus Jeep-sized vehicle on loading ramp. Drive on/drive off vehicle loading, using auxiliary ramp.

Short-hold freighter versions (Y-8F100 and Y-8F300) can accommodate optimum eight 2.24 × 1.37 m (88 × 54 in), four 2.24 × 2.74 m (88 × 108 in), three 2.44 × 3.18 m (96 × 125 in), or three 88 × 125 in with one 88 × 108 in and one 88 × 54 in standard cargo pallets; or 17 LD3 containers. Larger (Y-8F200 and Y-8F400) hold can accept optimum four 2.24 × 3.18 m (88 × 125 in), four 2.44 × 3.18 m (96 × 125 in) pallets or 19 LD3s. F600 hold capacity, five 96 × 125 or seven 88 × 108 in pallets. Individual cargo items of up to 7,400 kg (16,315 lb) can be airdropped.

Crew door and two emergency exits in forward fuselage. Three additional emergency exits in cargo compartment, access to which is via a large rear-loading ramp/door in underside of rear fuselage.

SYSTEMS: Forward fuselage of F100 pressurised to maintain a differential of 0.20 bar (2.8 lb/sq in) at altitudes above 4,300 m (14,100 ft). (F200/F400/F600 fully pressurised.) Two independent hydraulic systems, with operating pressures of 152 bar (2,200 lb/sq in) (port) and 147 bar (2,130 lb/sq in) (starboard), plus hand and electrical standby pumps, for actuation of landing gear extension/retraction, nosewheel steering, flaps, brakes and rear ramp/door. Electrical DC power (28.5 V) supplied by eight 12 kW generators, an 18 kW (24 hp) Xian Aero Engine Company APU (mainly for engine starting) and four 28 Ah batteries. Four 12 kVA alternators provide 115 V AC power at 400 Hz. Gaseous oxygen system for crew. Electric de-icing of windscreen, propellers and fin/tailplane leading-edges; hot air de-icing for wing leading-edges. WDZ-1 APU.

AVIONICS (Y-8F300/400): *Comms:* Rockwell Collins VHF-42B and HF-9000 com radios and TDR-94 ATC transponder.

Radar: Rockwell Collins TWR-850 colour weather radar.

Flight: Universal Avionics UNS-1K flight management system; Rockwell Collins VOR-432, DME-442, AHS-85E AHRS and EFIS-86E; Honeywell ED-55 flight data recorder.

Instrumentation: Honeywell Mk V nav display.

EQUIPMENT (freighter versions): Electric winch, tow, and 2,300 kg (5,070 lb) capacity hoist for cargo loading and unloading. Roller system for containerised or palletised cargo handling. Cargo tiedowns and barrier net.

DIMENSIONS, EXTERNAL (all versions, except where indicated):

Wing span	38.00 m (124 ft 8 in)
Wing chord: at root	4.73 m (15 ft 6¼ in)
at tip	1.69 m (5 ft 6½ in)
mean aerodynamic	3.45 m (11 ft 3¾ in)
Wing aspect ratio	11.9
Length overall: F100, F200	34.02 m (111 ft 7¼ in)
F300, F400	32.93 m (108 ft 0½ in)
Fuselage max diameter (circular section)	4.10 m (13 ft 5½ in)
Height overall	11.16 m (36 ft 7½ in)
Tailplane span	12.195 m (40 ft 0¼ in)
Wheel track (c/l of shock-struts)	4.92 m (16 ft 1¾ in)
Wheelbase (c/l of main bogies)	9.575 m (31 ft 5 in)
Propeller diameter: except F600	4.50 m (14 ft 9¼ in)
F600	4.115 m (13 ft 6 in)
Propeller ground clearance: except F600	1.89 m (6 ft 2½ in)
Crew door: Height	1.455 m (4 ft 9¼ in)
Width	0.80 m (2 ft 7½ in)

Rear-loading hatch: Length ..... 7.67 m (25 ft 2 in)
Width: min ..... 2.65 m (8 ft 8¼ in)
max ..... 3.10 m (10 ft 2 in)
Emergency exits (each): Height ..... 0.55 m (1 ft 9¾ in)
Width ..... 0.60 m (1 ft 11½ in)

DIMENSIONS, INTERNAL:

Cabin (incl flight deck, galley and toilet):
Length: F100, F300 ..... 13.70 m (44 ft 11¼ in)
F200, F400 ..... 15.70 m (51 ft 6 in)
F600 ..... 18.00 m (59 ft 0¾ in)
Width: min ..... 3.00 m (9 ft 10 in)
max ..... 3.50 m (11 ft 5¾ in)
Height: min ..... 2.25 m (7 ft 4½ in)
max ..... 2.60 m (8 ft 6½ in)
Floor area: F100, F300 ..... 55.0 m² (592 sq ft)
Volume: F100, F300 ..... 123.3 m³ (4,354 cu ft)
F200, F400 ..... 137.6 m³ (4,859 cu ft)
F600 ..... 170.0 m³ (6,003 cu ft)

AREAS:

Wings, gross ..... 121.86 m² (1,311.7 sq ft)
Ailerons (total) ..... 7.84 m² (84.39 sq ft)
Trailing-edge flaps (total) ..... 26.91 m² (289.66 sq ft)
Rudder ..... 6.535 m² (70.34 sq ft)
Tailplane ..... 27.05 m² (291.16 sq ft)
Elevators (total) ..... 7.10 m² (76.42 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, equipped: F100 ..... 34,500 kg (76,060 lb)
F200 ..... 34,760 kg (76,635 lb)
F400 ..... 34,000 kg (74,955 lb)
F600 ..... 33,500 kg (73,855 lb)
Max fuel load: F100, F300 ..... 22,909 kg (50,505 lb)
F200, F400 ..... 14,600 kg (32,187 lb)
F600 ..... 19,000 kg (41,888 lb)
Max payload:
containerised: all versions ..... 15,000 kg (33,069 lb)
bulk cargo: F100, F200, F600 ..... 20,000 kg (44,090 lb)
Max airdroppable cargo: total ..... 13,200 kg (29,100 lb)
single piece ..... 7,400 kg (16,315 lb)
Max T-O weight: F100, F200 ..... 61,000 kg (134,480 lb)
F600 ..... 65,000 kg (143,300 lb)
Max ramp weight: F100, F200 ..... 61,500 kg (135,585 lb)
Max landing weight: F100, F200 ..... 58,000 kg (127,870 lb)
F600 ..... 65,000 kg (143,300 lb)
Max zero-fuel weight:
F100, F300 ..... 55,278 kg (121,865 lb)
F200, F400 ..... 55,538 kg (122,440 lb)
Max wing loading: F100, F200 ..... 500.6 kg/m² (102.53 lb/sq ft)
F600 ..... 533.4 kg/m² (109.25 lb/sq ft)
Max power loading: F100, F200 ..... 4.88 kg/kW (8.02 lb/shp)
F600 ..... 4.30 kg/kW (7.06 lb/shp)

PERFORMANCE:

Max level speed at FL230:
F100, F300 ..... 357 kt (662 km/h; 411 mph)
F200, F400 ..... 345 kt (640 km/h; 397 mph)
F600 ..... 351 kt (650 km/h; 403 mph)
Max cruising speed at FL262:
except F600 ..... 297 kt (550 km/h; 342 mph)
F600 ..... 308 kt (570 km/h; 354 mph)
Econ cruising speed at FL262:
all versions ..... 286 kt (530 km/h; 329 mph)
Unstick speed ..... 129 kt (238 km/h; 148 mph)
Touchdown speed at MLW ..... 130 kt (240 km/h; 150 mph)
Max rate of climb at S/L ..... 473 m (1,552 ft)/min
Rate of climb at S/L, OEI ..... 231 m (758 ft)/min
Service ceiling, AUW of 51,000 kg (112,435 lb):
F100, F300 ..... 10,400 m (34,120 ft)
F200, F400 ..... 10,050 m (32,970 ft)
F600 ..... 10,300 m (33,800 ft)
Service ceiling, OEI, AUW of 51,000 kg (112,435 lb) ..... 8,100 m (26,580 ft)
Runway ACN 15
T-O run: except F600 ..... 1,270 m (4,170 ft)
F600 ..... 1,540 m (5,050 ft)
FAR T-O field length ..... 1,900 m (6,235 ft)
T-O to 15 m (50 ft) ..... 3,007 m (9,870 ft)
Landing from 15 m (50 ft) at MLW ..... 2,174 m (7,135 ft)
FAR landing field length ..... 1,650 m (5,415 ft)
Landing run at MLW: except F600 ..... 1,058 m (3,475 ft)
F600 ..... 1,510 m (4,955 ft)
Range with max payload:
F100 ..... 687 n miles (1,273 km; 791 miles)
F600 ..... 1,079 n miles (2,000 km; 1,242 miles)
Range with max fuel:
F100 ..... 3,032 n miles (5,615 km; 3,489 miles)
F200, F400 ..... 1,857 n miles (3,440 km; 2,137 miles)
F300 ..... 2,861 n miles (5,300 km; 3,293 miles)

SAC Y-8/Y-9 (SPECIAL MISSION VERSIONS)

TYPE: Various.

PROGRAMME: China has for many years sought to develop its maritime surveillance, AEW&C/AWACS and sigint-gathering capability, initially with imported platforms and equipment. Earlier efforts have involved, and still do, modified versions of such aircraft as the Ilyushin Il-76 and Tupolev Tu-154, but increasingly since 2000 use has been made of so-called 'Y-8 Category III' airframes as platforms for developing, testing and evaluating new surveillance, early warning and intelligence-gathering systems. Examples seen as of early 2006 are summarised here. At that time, indications were that any such systems selected for service entry would utilise airframes brought up to Y-9 standard; pending clarification, Y-8 designations have been retained in the variant descriptions which follow. Further details of the equipment carried by some of these aircraft can be found in *Jane's Electronic Mission Aircraft* and/or *Jane's Radar and Electronic Warfare Systems*.

SAC Y-8 (AWACS version) development aircraft T0518 1158095

SAC Y-8 '2504' (sigint version) with fintip and ventral antennas, faired-in tail turret and cheek radomes 1037985

Presumed sigint SAC Y-8 in primer colours 1158881

SAC Y-8(DZ) AEW version 1037981

SAC Y-8J maritime patrol/AEW version 1037986

CURRENT VERSIONS: **Y-8CB**: Radar and systems testbed (serial 079) used by China Flight Test Establishment (CFTE) at Yanliang; first flight August 1999. Nose adapted for modular installation of various types of fire control radar. Also seen during 2005 testing six-blade propeller (possibly JL-4 destined for Y-8F600 and Y-9) on port inner engine.

Y-8(DZ): Reported designation (*dianzi zhencha*: electronic intelligence) of elint/AEW version (serial number 9361) first seen in Shanghai area in mid-2004. Recognition points include cylindrical wingtip pods, a large chin radome and two dorsal antenna fairings (one above forward fuselage and the other just in front of fin fillet), plus several smaller fairings beneath fuselage and at tip of nose. According to Chinese sources, elint equipment is a CEIEC KZ800 (*kongzhong zaoqi*: airborne early warning) system operating in the 1 to

The AWACS Y-8 T0158 viewed from rear, showing added auxiliary fins and other features 1158648

A Y-8X 'under escort' by an F/A-18 Hornet 1151031

Underside view of 'sigint' SAC Y-8 1158882

Y-8F400 phased array radar testbed 1151033

Possible command post Y-8 variant 1151032

18 GHz frequency band and requiring a mission crew of at least three. As of late 2005, this aircraft believed to be still undergoing evaluation by PLA Navy.

Y-8H: Aerial survey version; received CAAC approval 18 June 1992. Believed two built. No other details known.

Y-8J: Believed to be designation of maritime surveillance and AEW version, more capable than Y-8X and first flown (November ?) 1998. Two known PLA Navy examples to date (serial numbers 9281 and 9301), one of which reported to have downlinked target information to a ship-based HAI Z-9C ASW helicopter during a late 2000 naval exercise. Nose glazing replaced by bulbous and slightly drooped radome housing 360° scan Skymaster X-band (10 GHz) pulse Doppler radar (range more than 200 n miles; 370 km; 230 miles), about six to eight of which purchased from Racal Defence Electronics (now part of Thales) in 1996.

Y-8X: Maritime patrol version (*sans* surveillance); Litton AN/APS-504(V)3 surface search radar (range 100 n miles; 185 km; 115 miles) in undernose radome. Prototype (B-4101) received type approval 1 September 1985. Possibly four others built (serials 9261, 9271, 9281 and 9291); in service since mid-1980s; most recently noted with North Sea Fleet's 3rd Independent Air Regiment at Laiyang. Limited surveillance capability; 9281 later converted to Y-8J. Details in earlier editions. (Designation reappeared 2002, though typographically different as Y8-X, for new-generation, enlarged Y-8 derivative, but latter received new identity in September 2005 as Y-9, which see).

Y-8 (phased array radar version): As of early 2006, no Chinese designation had been suggested for this alternative AEW version, at least two examples of which had been noted, each carrying a dorsally mounted, fore and aft 'plank' or 'balance beam' antenna similar in shape and size to that of the Ericsson Erieye radars fitted to some Western surveillance aircraft. First aircraft seen, noted at Hefei in October 2004 and under test at CFTE by year-end, was a converted Y-8F200 airframe, said to have made maiden flight 8 November 2001 and have radar developed by No. 38 Institute.

Second aircraft, based on shorter-fuselage, solid-nosed Y-8F400, has redesigned vertical tail, six-blade propellers, no tail turret and no rear loading ramp; may represent intended production version. Said to have made maiden flight 14 January 2005.

For details of the latest updates to *Jane's All the World's Aircraft* online and to discover the additional information available exclusively to online subscribers please visit
jawa.janes.com

Y-8 (sigint version): First seen during visit to SAC by Chinese Vice-Premier in April 2005. Has redesigned nose with reduced glazing, four-blade propellers and large, bulged, rectangular 'cheek' antenna fairing each side just aft of flight deck windows, in position normally occupied by forward cabin door. Slender box fairing atop the tailfin, possibly housing radar warning receiver.

Y-8 (new EW version): One aircraft (incomplete serial number 20*1*) first seen in vicinity of Nanjing in July 2005. Main external features are canoe-shaped fairing beneath forward fuselage and cluster of smaller blade antennas protruding from underside of (apparently sealed) rear loading ramp. Some reports suggest recent entry into service. Chinese designation not yet known.

Y-8 (AWACS version): Exhibition models depicting a Y-8 AWACS configuration employing a saucer-shaped, strut-mounted dorsal dome antenna housing appeared in the mid-1990s and, more recently (April 2005), with the smaller Y-7 as potential platform aircraft. First sight of a flying example occurred at the CFTE later in 2005, the aircraft being one of the solid-nosed Y-8 variants, most probably an F400. Later images revealed this aircraft to have diamond-shaped auxiliary endplate fins and serial number T0518. Other Chinese-sourced information suggests involvement of No. 14 Institute and/or No. 603 Institute with the radar, the nature of which was still undetermined at the time of closing for press. Dorsal radome may be non-rotating, suggesting instead a three-antenna triangular internal arrangement to provide 360° coverage.

Y-8 (command post (?) version): Exact purpose of this version, first seen in poor-quality and possibly retouched photograph on Chinese Internet in October 2005, was uncertain at time of going to press; a possible submarine communications role has also been suggested. Aircraft has glazed nose with small 'thimble' fairing; hemispherical (possible satcom) fairing atop fuselage immediately aft of wing trailing-edge; four-blade propellers; faired-in tail turret; and fintip box fairing. Some of these features are shared with a Boeing 737-300 (B-4052) recently converted by XAC for C³I duties. According to Jane's sources in early 2006, numerous external HF antennas are "enough.....to support at least 10 airborne controllers".

SAC Y-9

Chinese Name: Yunshuji-9 (Transport aircraft 9)

TYPE: Medium transport/multirole.

PROGRAMME: Development (then as Y8-X) reportedly began 2001 as enlarged Y-8 successor; revealed in model form November 2002, with provisional specification, at Airshow China, Zhuhai; design understood to have benefited from SAC/Antonov agreement on Y-8F600 signed at that show. Revised details released at Aviation Expo Beijing in September 2005 revealed design to have been downsized to that of Y-8 and now renamed with previously unused designation Y-9, although still referred to by some Chinese sources as 'Y-8 Category III'.

DESIGN FEATURES: Retains general configuration and structure of Y-8, but with uprated engines, modernised 'glass cockpit' avionics and other improvements. Design lifetime target of 50,000 flight hours, 20,000 sorties or 30 calendar years.

Cutaway model of Y-9 displayed at Dubai air show in late 2005
(Robert Hewson) 1158866

SAC brochure picture of projected Y-9 1151987

Following (design estimate) details compare current Y-9 proposal with earlier Y8-X concept.

POWER PLANT: *Y8-X:* Four 4,847 ekW (6,500 ehp) turboprops of unspecified type; six-blade composites propellers.

Y-9: Four SAEC (Zhuzhou) 'improved' WJ6C turboprops (rating not stated); six-blade Baoding JL-4 composites propellers.

ACCOMMODATION: *Y8-X:* Up to 132 paratroops; or eight 3.175 × 2.44 m (125 × 96 in) or nine 2.74 × 2.24 m (108 × 88 in) ISO pallets.

Y-9: Up to 98 paratroops or minor casualties; up to 72 serious casualties plus three medical attendants; equivalent cargo such as vehicles and weapons; or one 6 m, three 4 m or 13 1 m size pallets. Rapid loading/unloading system. Single or multiple airdrops of cargo, including low-altitude extraction. Flight crew of four.

AVIONICS: Advanced com/nav, radar, EFIS, EIS, FMS and GPS/INS.

DIMENSIONS, INTERNAL:

Cabin (Y-9): Length	16.20 m (53 ft 1¾ in)
Max width	3.20 m (10 ft 6 in)
Max height	2.35 m (7 ft 8½ in)
Cabin volume: Y8-X	180.0 m³ (6,357 cu ft)

WEIGHTS AND LOADINGS:

Operating weight empty: Y8-X	39,000 kg (85,980 lb)
Internal fuel weight: Y-9	23,000 kg (50,706 lb)
Normal payload: Y8-X	25,000 kg (55,115 lb)
Y-9	20,000 kg (44,092 lb)
Max payload: Y8-X	30,000 kg (66,139 lb)
Max load for airdrop: Y8-X	20,000 kg (44,092 lb)
Y-9	13,200 kg (29,101 lb)
Max single airdrop load: Y8-X	10,000 kg (22,046 lb)
Y-9	8,200 kg (18,078 lb)
Normal max T-O weight: Y8-X	77,000 kg (169,755 lb)
Y-9	65,000 kg (143,300 lb)
Overload max T-O weight: Y8-X	81,000 kg (178, 575 lb)
Max landing weight: Y8-X	77,000 kg (169,755 lb)

PERFORMANCE:

Max level speed: Y8-X	356 kt (660 km/h; 410 mph)
Y-9	351 kt (650 km/h; 403 mph)
Max cruising speed: Y8-X	308 kt (570 km/h; 354 mph)
Y-9	297 kt (550 km/h; 342 mph)
Max operating altitude: Y8-X	9,000 m (29,530 ft)
Y-9	8,000 m (26,250 ft)
Service ceiling: Y8-X	11,500 m (37,730 ft)
Y-9	10,100 m (33,140 ft)
T-O and landing distance: Y-9	1,350 m (4,430 ft)
Range with max payload: Y8-X	1,349 n miles (2,500 km; 1,553 miles)
Y-9	540 n miles (1,000 km; 621 miles)
Range with max fuel: Y8-X	3,606 n miles (6,680 km; 4,150 miles)
Max endurance: Y8-X	12 h

SAC (SHENYANG)

SHENYANG AIRCRAFT CORPORATION (SHENYANG FEIJI GONGSI) (SUBSIDIARY OF AVIC I)

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Pioneer Chinese fighter design centre, founded 29 June 1951; built 767 examples of J-5 (licence MiG-17F) from 1956–59 and from 1963 was major producer of several thousand of J-6 series (reverse-engineered MiG-19), including 634 JJ-6 tandem-seat fighter trainers; initiated development and early production of J-7 (see under CAC). On 29 June 1994, SAC became core enterprise in newly formed Shenyang Aircraft Industries Group (SAIG). Occupies site area of more than 800 ha (1,976 acres) and has workforce of about 30,000; only some 30 per cent of current activities are in aerospace.

Principal programme is J-8 II/J-8B fighter, currently the subject of various upgrade programmes. Also engaged in major assembly/co-production programme of Sukhoi Su-27 variants as J-11 for PLA Air Force (AFPLA) and Navy. Also responsible for tail units, engine pylons and electrical subassemblies of ACAC ARJ21 regional jet.

Aerospace subcontract manufacture, begun at various dates since 1985, has included doors for Bombardier Dash 8Q, cargo doors for Boeing 757, wing ribs and emergency exits for Airbus A319 and A320, tailcone/landing gear door/pylon components for Lockheed Martin C-130, rear fuselage and tail components for Boeing 737-700, floors and bulkheads for Boeing 747, and other machined parts for BAE, Boeing and EADS. Collaboration with Hellenic Aerospace Industry Ltd announced in February 1997 on formation of Shenyang Hellenic Aircraft Repair Company. Agreement September 2005 with Dutch Stork Aerospace to collaborate in developing and manufacturing commercial aircraft aerostructures.

SAC J-8

Chinese name: Jianjiji-8 (Fighter aircraft 8)
Westernised designation: F-8
NATO reporting name: Finback

TYPE: Multirole fighter.

PROGRAMME: Development of original J-8 (with nose air intake) started 1964; first flight 5 July 1969; initial production authorised July 1979, began December 1979. All-weather J-8 I made maiden flight 24 April 1981 and production approved July 1985; ended 1987 after between 100 and 150 J-8s and J-8 Is.

Present baseline configuration is improved J-8 II (now J-8B 'Finback-B'), on which design work began 1980; maiden flight of first of four prototypes took place 12 June 1984. Peace Pearl programme, to upgrade J-8 II with Western avionics, embargoed by US government mid-1989 and cancelled by China 1990; replaced by alternative domestic upgrade programmes. Trials with some parts of structure covered in Xikai SF18 radar-absorbent material were reported in early 1999.

CURRENT VERSIONS: **J-8** ('Finback-A'): Initial clear-weather day fighter. Single-piece forward-opening canopy; simple ranging radar in nose centrebody; single-barrelled gun on each side of nosewheel bay, with PL-2 AAMs on inboard wing pylons and provision for external tanks outboard.

J-8 I ('Finback-A'): Improved (all-weather) version of J-8. Same power plant, but fitted from outset with Sichuan SR-4 fire-control radar in intake centrebody; single twin-barrelled 23 mm cannon on each side of lower front fuselage. Production completed. Approximately 54 in service in mid-2001, by which time apparently redesignated **J-8A**; figure includes some converted to reconnaissance role (see JZ-8 paragraph). Units have included AFPLA 1st and 3rd Regiments of 1st Fighter Division at Anshan; some (including reconnaissance versions) remain in use with 70th Fighter Regiment at Yangkun.

J-8B ('Finback-B'): All weather version (originally J-8 II), some 70 per cent redesigned compared with J-8 I. Main configuration change is to 'solid' nose and twin lateral air intakes, providing more nose space for fire-control radar and other avionics, plus increased airflow for more powerful WP13A II turbojets. Manufactured in small economic batches rather than continuous production.

Late-production ('Block 02') J-8Bs have an upgraded (KLJ-1 ?) fire-control radar with a lookdown/shootdown mode compatible with PL-8 (Python 3) IR-guided and PL-11

SAC J-8Ds wearing new identity markings of 9th Air Division, AFPLA

1128922

Detail of SAC J-8F rear during construction

1128923

semi-active radar-guided AAMs, plus a new KJ-8602 RWR antenna on the fintip. New avionics, some possibly of Israeli design or origin, include an HK-13E HUD, Type 563B INS, JD-3 II Tacan and an RKL-800A integrated ECM suite. In service with PLA Air Force and Navy.

Detailed description applies to J-8B except where indicated.

J-8 II ACT: Active Control Technology (fly-by-wire) testbed. First flew 29 December 1996; completed 49th and last sortie 21 September 1999; shown in model form at Airshow China, November 2000. Full-authority quad-redundant, three-axis digital AFCS; small canards mounted high on air intakes to induce instability; two 1553B-standard flight computers with databus interface; integrated servo actuators for all moving control surfaces.

J-8C: New variant (originally J-8 III), development of which apparently began around 1990, but existence not noted until 2001. First prototype (c/n 8301, serial 510) reportedly flew 1992 but powered by WP13B engines instead of intended WP14 Kunlun. Elta EL/M-2034 fire control radar initially, Chinese Type 1471 later; integrated with new (Type 1785A ?) stores management system; IR-guided PL-8 or radar-guided PL-11 AAMs. Airframe changes included in-flight refuelling probe and additional fence on each wing. Reported digital fly by wire flight controls and redesigned cockpit with HUD and two MFDs. At least one other prototype completed (serial 511) but, although certified circa 1995, development delays with WP14 turbojet caused production plans to be abandoned. However, some upgrade technology graduated into later J-8F and J-8H variants.

J-8D ('Finback-B Mod'): Designation (originally J-8 IV) of J-8Bs built or modified for in-flight refuelling; non-retractable (but removable) probe on starboard side of cockpit; combat radius increased to 648 n miles (1,200 km; 745 miles). Avionics upgrades include Type 208B fire control radar, Type 563B INS, JD-3 II Tacan, KJ-8602 radar warning receiver, RKL-800A ECM and HK-13E HUD; PL-8 AAMs. In service with PLA Air Force and Navy from 1996.

J-8F: Developed from 1999; first flight 2000. Continues development started with J-8C, retaining detachable refuelling probe and additional wing fences; powered by uprated (approx 68.7 kN; 15,432 lb st) WP13B II turbojets and equipped to launch PL-12 (SD-10) AAMs, using improved Type 1493 fire control radar. Cockpit avionics may also have been further upgraded. Possibly now in limited AFPLA service with 3rd Regiment of 1st Division.

J-8H: Further development of J-8D (preceding J-8F). Programme reportedly began 1995 and variant approved 1999. Retains twin pairs of wing fences and removable refuelling probe; WP13B engines; KLJ-1 (Type 1492) radar; PL-11 AAMs; possibly also YJ-91 anti-radiation ASMs. Flying controls and avionics include HOTAS, INS/GPS and integrated ECM. Limited AFPLA service from 2002 including 21st Division; may be earmarked for upgrade to J-8F standard.

JZ-8: Reconnaissance version (also reported as **J-8E** and **J-8 V**), believed to be converted from J-8A; at least six known. Retains gun armament; undernose sensor package similar to that fitted to some Su-17/20/22 variants; centreline pod similar in appearance to that carried by MiG-21R, incorporating large rectangular camera window or SLAR antenna. In service with PLA Air Force. Note that a JZ-8 conversion of the original J-8 I also exists.

F-8 IIM: Upgraded J-8B; outgrowth of earlier proposals for F-8 II export version. Developed primarily for export, but none ordered; however, improvements now being adopted as upgrade for in-service AFPLA J-8Bs. Main differences from J-8B are more powerful engine, improved avionics and modernised cockpit with HOTAS controls. Developed jointly by SAC and Shenyang Aircraft Research Institute (SARI); first flight 31 March 1996, two years after delivery of drawings; flight testing of aircraft and WP13B engine completed 19 January 1998. Second F-8 IIM completed by late 1998. Additional proposed upgrades revealed by then included No. 607 Institute Blue Sky low-altitude navigation pod; Southwest China Electronic Equipment Research Institute KG 300G airborne self-protection jammer pod; No. 613 Institute FLIR/laser targeting pod; and a triple redundant digital fly-by-wire flight control system. These would presumably be similar to the systems quoted for the J-8 II ACT.

CUSTOMERS: PLA Air Force and Navy.

CHINESE J-8 OPERATORS

Service	Air Division	Air Regiment	Base	Variant
PLA AF	1st	3rd	Anshan	J-8F
	2nd	4th	Suixi	J-8B
	9th	27th	Foshan	J-8D
	12th	n/k	Shandong	J-8
	18th	54th	n/k	J-8D
	21st	61st	Mudanjiang	J-8H
	24th	70th[1]	Yangkun	J-8A/E
	24th	71st	Zunhua	J-8
	24th	72nd	Zunhua	J-8A
	26th	76th	Chongming	J-8B
	nil	4th Independent	Yuhong	JZ-8[2]
PLA Navy	5th	15th	Qingdao	J-8A
	9th	25th	Lingshui	J-8B/D

[1] Previously equipped with J-8

[2] Only first-generation (nose air intake) JZ-8 conversions confirmed

Notes: 30th Air Division (three regiments based on Dandong) has disbanded

DESIGN FEATURES: Extension of late 1950s Soviet heavy fighter theory. Thin-section, mid-mounted delta wings and all-sweptback tail surfaces; fuselage has area rule 'waisting', detachable rear portion for engine access, and dorsal spine fairing. Large ventral fin under rear fuselage, main portion of which folds sideways to starboard during take-off and landing, provides additional directional stability; small fence on each wing upper surface near tip; small airscoops at foot of fin leading-edge and at top of fuselage each side, above tailplane. Sweepback 60° on wing and tailplane leading-edges; wings have slight anhedral.

FLYING CONTROLS: Hydraulically boosted ailerons, rudder and low-set all-moving tailplane; two-segment single-slotted flaps on each wing trailing-edge, inboard of aileron; four door-type underfuselage airbrakes, one under each engine air intake trunk and one immediately aft of each mainwheel well.

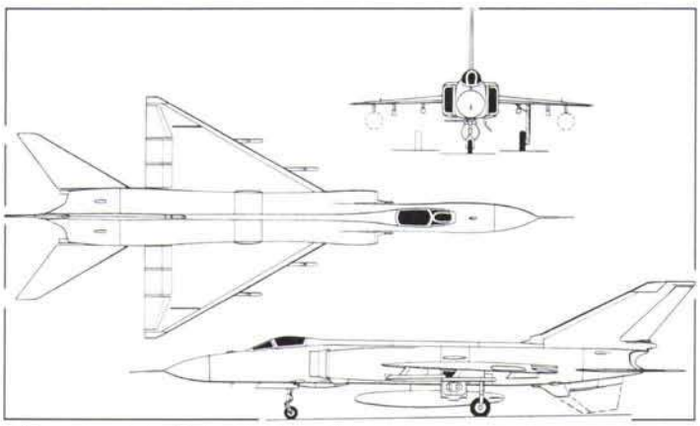
STRUCTURE: Conventional aluminium alloy semi-monocoque/stressed skin construction, with high-tensile steel for high load-bearing areas of wings and fuselage and titanium in high-temperature fuselage areas; ailerons, rudder and rear portion of tailplane are of aluminium honeycomb with sheet aluminium skin; dielectric skins on nosecone, tip of main fin, and on non-folding portion of ventral fin leading-edge.

LANDING GEAR: Hydraulically retractable tricycle type, with single wheel and oleo-pneumatic shock-absorber on each unit. Steerable nose unit retracts forward, main units inward into centre-fuselage; mainwheels turn to stow vertically inside fuselage, resulting in slight overwing bulge. Brake-chute in bullet fairing at base of rudder.

POWER PLANT: *J-8B*: Two LMC (Liyang) WP13A II turbojets, each rated at 42.7 kN (9,590 lb st) dry and 65.9 kN (14,815 lb st) with afterburning, mounted side by side in rear fuselage with pen-nib fairing above and between exhaust nozzles. Lateral, non-swept air intakes, with automatically regulated ramp angle and large splitter plates similar in shape to those of MiG-23. Internal fuel capacity (four integral wing tanks plus fuselage tanks) approximately 5,400 litres (1,426 US gallons; 1,188 Imp gallons). Single-point pressure refuelling. Provision for auxiliary fuel tanks on fuselage centreline and each outboard underwing pylon. J-8D retrofitted with probe for in-flight refuelling from Xian H-6 (Tu-16) bombers converted as aerial tankers.

F-8 IIM: Two LMC (Liyang) WP13B turbojets, each rated at 47.1 kN (10,582 lb st) dry and 68.7 kN (15,432 lb st) with afterburning.

ACCOMMODATION: Pilot only, on zero/zero ejection seat under one-piece canopy hinged at rear and opening upward. Cockpit pressurised, heated and air conditioned. Heated windscreen.



J-8B version of the 'Finback' twin-jet fighter *(Dennis Punnett)* 0507133

SYSTEMS: Two simple air-cycle environmental control systems, one for cockpit heating and air conditioning and one for radar cooling; cooling air bled from engine compressor. Two 207 bar (3,000 lb/sq in) independent hydraulic systems (main utility system plus one for flight control surfaces boost), powered by engine-driven pumps. Primary electrical power (28.5 V DC) from two 12 kVA engine-driven starter/generators (15 kVA in F-8 IIM), with two 6 kVA alternators for 115/200 V three-phase AC at 400 Hz. Pneumatic bottles for emergency landing gear extension. Pop-out ram air emergency turbine under fuselage.

AVIONICS (J-8B): *Comms:* VHF/UHF and HF/SSB radios; 'Odd Rods'-type IFF.

Radar: Obsolete Type 208 monopulse radar in nose. To be retrofitted with Phazotron Zhuk-8 II multimode fire-control radar (100 ordered in June 2001).

Flight: ILS, Tacan, marker beacon receiver, radio compass, radar altimeter, autopilot.

Mission: Gyro gunsight and gun camera.

Self-Defence: RWR (antenna in fintip); chaff/flare dispensers in tailcone.

Enlarged avionics bays in nose and fuselage provide room for modernised fire-control system and other upgraded avionics of later versions.

AVIONICS (F-8 IIM): *Comms:* Advanced com/nav radios; IFF.

Radar: Phazotron Zhuk-8 II multifunction, look-up/look-down pulse Doppler radar, with 38 n mile (70 km; 43.5 mile) detection range for approaching targets and 21.5 n mile (40 km; 25 mile) range for receding targets (both targets assumed to have 3 m^2; 32.3 sq ft radar cross-section). N010 Zhuk-27 being flight tested by late 1998, presumably in second aircraft.

Flight: Include Tacan and datalink; locally developed HUD and INS/GPS navigation; MFDs; HOTAS controls; ARINC 429 databus.

Self-defence: Omnidirectional RWR; rear hemisphere noise jammer against threat (including pulse Doppler) radars; chaff/flare dispenser.

ARMAMENT (J-8B): One 23 mm Type 23-3 twin-barrel cannon, with 200 rounds, in underfuselage pack immediately aft of nosewheel doors. Seven external stations (one under fuselage and three under each wing) for a variety of stores which can include PL-2B IR air-to-air missiles, PL-7 medium-range semi-active radar homing air-to-air missiles, Qingan HF-16B 12-round pods of 57 mm Type 57-2 unguided air-to-air rockets, launchers for 90 mm air-to-surface rockets, bombs, or (centreline and outboard underwing stations only) auxiliary fuel tanks.

ARMAMENT (F-8 IIM): Internal cannon as for J-8II. Up to six Chinese PL-5 or PL-9 short-range AAMs on underwing stations, or two Russian R-27R1 (AA-10 'Alamo') medium-range AAMs; up to four seven-round pods of 90 mm Type 90-1 rockets; up to 10 anti-runway bombs or 10 Type 250-III or 250-IV low-drag bombs (four under wings and six under fuselage); or eight anti-tank bombs; or five 500 kg low-drag bombs.

DIMENSIONS, EXTERNAL:

Wing span	9.345 m (30 ft 8 in)
Wing aspect ratio	2.1
Length overall: excl nose probe	20.53 m (67 ft 4¼ in)
incl nose probe	21.39 m (70 ft 2¼ in)
Height overall	5.41 m (17 ft 9 in)
Wheel track	3.74 m (12 ft 3¼ in)
Wheelbase	7.335 m (24 ft 0¾ in)

AREAS:

Wings, gross	42.20 m^2 (454.2 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: J-8B	9,820 kg (21,649 lb)
F-8 IIM	10,371 kg (22,864 lb)
Normal fuel load	4,200 kg (9,259 lb)
Max external stores load	4,500 kg (9,921 lb)
Normal T-O weight: J-8B	14,300 kg (31,526 lb)
F-8 IIM	15,288 kg (33,704 lb)
Max T-O weight: both	18,879 kg (41,621 lb)
Max wing loading: both	447.4 kg/m^2 (91.63 lb/sq ft)
Max power loading: J-8B	143 kg/kN (1.40 lb/lb st)
F-8 IIM	138 kg/kN (1.35 lb/lb st)

PERFORMANCE (J-8B):

Max operating Mach No. (MMO)	2.2
Design max level speed	701 kt (1,300 km/h; 808 mph) IAS
Unstick speed	175 kt (325 km/h; 202 mph)
Touchdown speed	156 kt (290 km/h; 180 mph)
Max rate of climb at S/L	12,000 m (39,370 ft)/min
Acceleration from M0.6 to M1.25 at 5,000 m (16,400 ft)	54 s
Service ceiling	18,000 m (59,050 ft)
T-O run with afterburning	670 m (2,200 ft)
Landing run, brake-chute deployed	1,000 m (3,280 ft)
Combat radius	432 n miles (800 km; 497 miles)
Ferry range	1,025 n miles (1,900 km; 1,180 miles)
g limit in sustained turn at 5,000 m (16,400 ft)	+4.83

PERFORMANCE (F-8 IIM): As J-8B except:

Unstick speed	179 kt (330 km/h; 206 mph)
Touchdown speed	162 kt (300 km/h; 186 mph)
Level acceleration:	
M0.7 to M1.0 at 1,000 m (3,280 ft)	21 s
M0.6 to M1.25 at 5,000 m (16,400 ft)	55 s
Max rate of climb at M0.9:	
at 1,000 m (3,280 ft)	13,440 m (44,094 ft)/min
at 5,000 m (16,400 ft)	9,600 m (31,496 ft)/min
T-O run with afterburning	630 m (2,070 ft)
Landing run with brake-chute	900 m (2,955 ft)
Typical mission radius:	
air-to-air interception, out and back at M0.8:	
at 500 m (1,640 ft) with 3 min combat	189 n miles (350 km; 217 miles)
at 11,000 m (36,080 ft) with 5 min combat	540 n miles (1,000 km; 621 miles)
combat air patrol, incl 10 min patrol and 5 min combat, out at M0.8 at 5,000 m (16,400 ft), back at M0.8 at 11,000 m (36,080 ft)	324 n miles (600 km; 372 miles)
air-to-ground attack, out and back at M0.8 at 10,000 m (32,800 ft), incl 5 min combat	486 n miles (900 km; 559 miles)
g limits during sustained turn at M0.9:	
at 1,000 m (3,280 ft)	+6.9
at 5,000 m (16,400 ft)	+4.7

SAC (SUKHOI Su-27SK) J-11

TYPE: Air superiority fighter.

PROGRAMME: In February 1996, the Russian military sales organisation Rosvooruzheniye (now Rosoboronexport) announced a contract under which China would be licensed to manufacture the Sukhoi Su-27 'Flanker' (up to 50 per year; total of 200 in all) at Shenyang.

An initial batch of 26 Russian-built Su-27s, delivered from 1992, comprised 24 Su-27SKs ('Flanker-B') and two two-seat Su-27UBK combat trainers ('Flanker-C'). These equipped the AFPLA's 3rd Division, based at Wuhu, Anhui Province, in the Nanjing Military Region. They were followed in 1996 by a further 24 (14 and 10, respectively), mostly delivered to the 2nd Division in Shuixi, Guangdong Province, Guangzhou Military Region. In February 1997 Russian licence granted for Chinese manufacture at Shenyang, initially in the form of CKD kit assembly; in 1998 KnAAPO delivered the first two kits; both aircraft made their first flight in December 1998. However, it was reported in mid-2000 that substandard work had caused Russian technicians to rebuild first two aircraft, necessitating import, from 14 December 2000 onwards, of 28 additional Russian-built two-seat Su-27UBKs to offset shortfall in Chinese production and maintain pilot training schedule. Eight of these delivered by 31 December 2000, with 10 each following in 2001 and 2002. Additional units now include 1st, 2nd, 6th, 7th, 19th, 29th and 33rd Divisions.

As regards Chinese production, six or seven Su-27s were planned to be assembled annually during 1999–2001, increasing to 15 to 20 per year from 2002. Chinese-built Su-27s are designated **J-11** (single-seat) and **JJ-11** (two-seat), but none of the latter had been reported by early 2006. By late 2004 all 105 parts kits (of diminishing completeness) representing the first batch had been delivered from Russia, of which 60 had been assembled and delivered to AFPLA, but there was no sign of the follow-on order for 95, nor of a change of local manufacture to Su-30MKK variant, as once expected. Acquisition of MKK (for which local designation J-13 suggested) is now from Russian production. PLA Naval Aviation also received 24 Su-30MK2s in 2004, bringing total 'Flanker' family acquisition to 273.

SAC J-11s of AFPLA's 6th Regiment/2nd Division at Suixi 1128924

55th Regiment/19th Air Division SAC J-11s 1128925

According to a late 2002 report Shenyang is developing its own multirole version of the J-11, to incorporate an indigenous multimode radar and other avionics and be capable of deploying the domestic PL-12/SD-10 active radar-homing AAM and Chinese or Russian PGMs. One Su-27SK/J-11 was also said to have been used in 2002 to flight test the domestic Liming WS10A turbofan engine. However, little progress in this direction had apparently been made by early 2006.

Completion of first J-11 batch assembly was anticipated by the end of 2006. Meanwhile, China said to be considering offer for second batch to be of upgraded Su-27SMK variant. According to Jane's sources in late 2004, 'several 10s' of J-11s had been refitted under a Russian (Technocomplex group) led programme involving changes to their NIIP N-001 radar to enable them to fire the Vympel RVV-AE (AA-12 'Adder') AAM.

CHINESE J-11 OPERATORS

Service	Air Division	Air Regiment	Base
PLA AF	1st	1st	Anshan
	2nd	6th	Suixi
	6th	n/k	Yinchuan
	7th	n/k	Zhangjiakou
	14th	40th	Nanchang
	19th	55th	Jining

SAC (?) 'J-X'

The embryonic advanced combat aircraft to which the US Office of Naval Intelligence (ONI) originally allocated the provisional designation XXJ was last described in the late 1990s, at which time it was thought likely to be a Chengdu (CAC) design. Little was then heard of it for some years, but in the early months of 2001 further US-sourced information indicated that the design had been considerably modified, then revealing a configuration suggesting some Sukhoi influence. This appeared to make Shenyang the more likely developer, although both Chinese companies are thought to have (possibly competing) advanced combat aircraft projects in hand.

According to the 2001 information, the aircraft had a canard delta configuration, combined with clipped-delta horizontal tail surfaces and twin outward-canted fins and rudders. Conformal underfuselage intakes fed a pair of thrust-vectoring turbojets (possibly the new 116 kN (26,000 lb) class WP15) or turbofans. Empty weight was estimated at 20,000 kg (44,100 lb); stealth characteristics and FBW flight controls were assumed.

However, according to a senior AVIC I official in late 2002, this was one of a number of design concepts created by Shenyang in collaboration with No. 601 Research Institute, wind tunnel testing of which was then under way. Possible power plant is the domestically developed Liming WS10A turbofan, with thrust-vectoring nozzles. Multifunction fire-control radars under consideration are said to include the Chinese Type 1473, reported to have a search range of 81 n miles (150 km; 93 miles) and be able to track up to 15 targets of which up to eight could be attacked simultaneously. Russia's Phazotron Zhemchug radar is also thought to be under consideration. The designs appear to cater for internal weapons stowage.

SAIC (SHANGHAI)

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The Shanghai Aviation Industries Group (SAIC) has more than 20 subordinate enterprises, of which the principal ones are Shanghai Aircraft Manufacturing Factory (SAMF); Shanghai Aircraft Research Institute (SARI); Shanghai Aero-Engine Manufacturing Factory; and Shanghai International Aero Technology. SAIC and SARI are taking part in the development programme for the ACAC ARJ21 regional jet. Subcontract work includes components for the ATR 72 and Boeing 737.

SAIC (SHIJIAZHUANG)

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GENERAL MANAGER: Cheng Bingyou
CHIEF ENGINEER: Zheng Shuwei

SAIC (formerly SAMC) has produced Chinese Y-5 versions of the An-2 general purpose biplane since its establishment in 1970. In 1989 it developed the Y-5B series to meet the demands of various domestic civil and military customers and markets; other products have included the LE-500 light multipurpose aircraft and LE-800 business aircraft, apparently inspired by the Socata TB 20 Trinidad and TBM 700 respectively; and W-5A-200 ultralight series. SAIC is the only major company now regularly building general aviation light aircraft in China. It became part of Xian Aircraft Industrial Group July 1992, but relocated within AVIC II in 1999 reorganisation.

Occupies 54 ha (133.4 acre) site, including over 100,000 m² (1,076,400 sq ft) of covered space. Workforce of 2,309 in December 2003 included 430 engineers and technicians.

SAIC Y-5

Chinese name: Yunshuji-5 (Transport aircraft 5)

TYPE: Utility biplane.

PROGRAMME: Antonov An-2 has been built under licence in China since 1957, chiefly at Nanchang (727 produced up to 1968) and latterly by SAIC (now only source of continuing production of this aircraft). Production of original Y-5 civil transport and general purpose version ended in 1986, at which time 221 had been completed. Y-5B dedicated agricultural and forestry version made first flight 2 June 1989; first nine produced in 1990; batch production continuing in 2004 (latest information received).

SAIC Y-5B in civilian use *(Robert Hewson)* 1044664

CURRENT VERSIONS: **Y-5B:** Dedicated agricultural and forestry version; certified to CCAR 23 Chinese equivalent of FAR Pt 23. A major annual task is locust plague pest control.

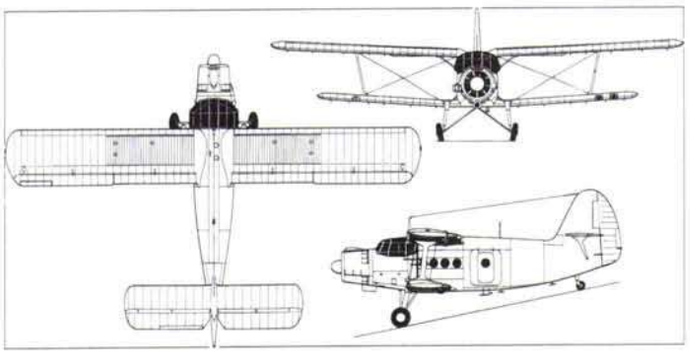
Following description applies to Y-5B, except where indicated.

Y5B-100: Designation of version displayed at Zhuhai in November 1998, fitted with wing 'tipsails' of the Y-5C and registered B-8448. Feature available as option.

Y-5B(K): Tourist version, first flown 1993; certified to CCAR 23.

Y-5B(D): Multipurpose (agri-forest or tourist) version, first flown 1995; certified to CCAR 23.

Y-5B(T): Parachutist version, with wingtip vanes ('tipsails'); first flown 1996 and 48 built for PLA Air Force (AFPLA).



SAIC Y-5 (Antonov An-2) transport biplane *(Paul Jackson)* 1047720

CUSTOMERS: Total of 142 Y-5Bs built by end of 2003.

DESIGN FEATURES: Unequal span, single-bay biplane; strut-braced wings (single I strut each side) and tail; fuselage circular section forward, rectangular in cabin section, oval in tail section; fin integral with rear fuselage. RPS wing section, thickness/chord ratio 14 per cent (constant).

FLYING CONTROLS: Conventional and manual. Differential ailerons, plus elevators and rudder, actuated by cables and push/pull rods; electric trim tab in port aileron, rudder and port elevator; full-span automatic leading-edge slots on upper wings; electrically actuated slotted trailing-edge flaps on both wings. Wingtip vanes on some variants (see Current Versions) for additional control at low speeds.

STRUCTURE: All-metal, with fabric covering on wings and tailplane. Y-5B specially treated to resist corrosion; cabin doors sealed against chemical ingress; empty weight reduced compared with original Y-5.

LANDING GEAR: Non-retractable split axle type, with long-stroke oleo-pneumatic shock-absorbers. Mainwheel tyres size 800×260, pressure 2.25 bar (33 lb/sq in). Pneumatic shoe brakes on main units. Fully castoring and self-centring tailwheel, size 470×210. Interchangeable ski landing gear optional.

POWER PLANT: One 735 kW (985 hp) Polish-built ASz-62IR-16 nine-cylinder radial engine, driving a Baoding J12B-G15 four-blade variable-pitch propeller. Fuel capacity 1,240 litres (328 US gallons; 273 Imp gallons). Oil capacity 115 litres (30.4 US gallons; 25.3 Imp gallons).

ACCOMMODATION: Flight crew of one or two; dual controls; seats for 12 tourist class passengers (Y-5B(K)) or 10 parachutists (Y-5B(T)). Emergency exit on starboard side at rear. Cabin heating and ventilation improved by new ECS.

AVIONICS: *Comms:* Honeywell KHF 950 HF and KY 196 VHF radios, KMA 24 MBR/audio control panel and KR 87 ADF; some electrical and other instrument installations also improved.

Flight: GPS 155.

EQUIPMENT: Large hopper/tank with emergency jettison of contents; high flow rate, wind-driven pump; sprayers with various nozzle sizes, depending upon spray volume required.

DIMENSIONS, EXTERNAL:

Wing span: upper	18.18 m (59 ft 7¾ in)
lower	14.24 m (46 ft 8½ in)
Wing aspect ratio: upper	7.6
lower	7.3
Length overall, parked	12.69 m (41 ft 7½ in)
Height overall, parked	6.10 m (20 ft 0¼ in)
Wheel track	3.36 m (11 ft 0¼ in)
Wheelbase	8.06 m (26 ft 5¼ in)
Propeller diameter	3.60 m (11 ft 9¾ in)
Cargo door (port): Mean height	1.55 m (5 ft 1 in)
Mean width	1.39 m (4 ft 6¾ in)

DIMENSIONS, INTERNAL:

Cargo compartment: Length	4.10 m (13 ft 5½ in)
Max width	1.60 m (5 ft 3 in)
Max height	1.80 m (5 ft 10¾ in)

AREAS:

Wings, gross: upper	43.54 m² (468.7 sq ft)
lower	27.98 m² (301.2 sq ft)

WEIGHTS AND LOADINGS (A: Y-5B with dry chemical spreader, B: Y-5B with liquid spray system, C: Y-5B(T)):

Max payload: A, B, C	1,500 kg (3,307 lb)
Max T-O weight: A, B, C	5,250 kg (11,574 lb)
Max wing loading: A, B, C	73.4 kg/m² (15.03 lb/sq ft)
Max power loading: A, B, C	7.15 kg/kW (11.75 lb/hp)

PERFORMANCE (A, B and C as for Weights):

Max level speed at S/L:	
A	110 kt (205 km/h; 127 mph)
B	108 kt (200 km/h; 124 mph)
C	129 kt (239 km/h; 148 mph)
Max level speed at FL56:	
A	119 kt (220 km/h; 137 mph)
B	116 kt (215 km/h; 133 mph)
C	138 kt (256 km/h; 159 mph)
Operating speed: A, B	86 kt (160 km/h; 99 mph)
Stalling speed: A, B, C	46 kt (85 km/h; 53 mph)
Max rate of climb at S/L: A	120 m (394 ft)/min
B	114 m (374 ft)/min
C	213 m (699 ft)/min
Rate of climb at FL52:	
A	133 m (436 ft)/min
B	123 m (404 ft)/min
C	225 m (738 ft)/min
Service ceiling: A, B	4,500 m (14,760 ft)
C	5,000 m (16,400 ft)
Air turning radius: A, B, C	350 m (1,150 ft)
T-O run: A	170 m (560 ft)
B	180 m (595 ft)
C	150 m (495 ft)
Landing run: A	160 m (525 ft)
B	157 m (515 ft)
C	170 m (560 ft)
Max range with 670 litres (177 US gallons; 147 Imp gallons) fuel:	
A, B	581 n miles (1,077 km; 669 miles)
C	874 n miles (1,620 km; 1,006 miles)
Max endurance, conditions as above: A, B	7 h 12 min
C	10 h 10 min
Agri-forest operating swath width (A, B): HV, LV	40–50 m (130–165 ft)
ULV	60 m (200 ft)

SAIC LE-500 LITTLE EAGLE

Western marketing name: Kitty Hawk

TYPE: Four/five-seat lightplane.

PROGRAMME: Begun in 2000. Mockup displayed at November 2002 Airshow China in Zhuhai; prototype (B-649L) rolled out and made first flight 26 October 2003. Completion of flight testing (339 flights) announced 21 April 2005; CCAR Type Certificate awarded October 2005. In production by early 2007.

CUSTOMERS: As of March 2006, firm orders reported (each for 15 aircraft) from Civil Aviation Flight University of China (CAFUC) and Qingdas Jiutian Spartan Flight Academy. First 10 for CAFUC due to be delivered by end of June 2006. Letters of intent said to have been received from other Chinese flying schools and general aviation companies for more than 150.

DESIGN FEATURES: Joint development by SAIC, Xian Aircraft Development and Research Institute (XADRI) and CAFUC; conforms to CCAR 23-R2 standards. Design life 10,000 hours or 20,000 take-offs and landings. Designed primarily for training, but adaptable for such roles as business transport, tourer, agricultural and forest work, environmental patrol, aerial survey and photography, club flying, police and military operations.

Dihedral 6° 30'; incidence 3°.

FLYING CONTROLS: Conventional and manual. All-moving slab tailplane.

STRUCTURE: All-metal semi-monocoque.

LANDING GEAR: Tricycle type; retractable.

POWER PLANT: One 194 kW (260 hp) Textron Lycoming IO-540-V4A5 flat-six engine, driving a Hartzell HC-C2YK-1BF/F8477-4-80 two-blade, constant-speed, non-feathering propeller.

ACCOMMODATION: Side-by-side seats, in two rows, for pilot and three (optionally four) passengers.

AVIONICS: To customer's choice.

DIMENSIONS, EXTERNAL:

Wing span	9.88 m (32 ft 5 in)
Length overall	7.745 m (25 ft 5 in)
Height overall	3.045 m (10 ft 0 in)
Wheel track	2.20 m (7 ft 2½ in)
Wheelbase	1.905 m (6 ft 3 in)
Propeller diameter	2.03 m (6 ft 8 in)

WEIGHTS AND LOADINGS:

Max fuel weight	235 kg (518 lb)
Useful load	560 kg (1,235 lb)
Max T-O weight	1,400 kg (3,086 lb)
Max power loading	7.23 kg/kW (11.87 lb/hp)

SAIC LE-500 Little Eagle four/five-seat light aircraft *(Robert Hewson)* 1040451

PERFORMANCE:
Max level speed ..... 151 kt (280 km/h; 174 mph)
Max cruising speed ..... 135 kt (250 km/h; 155 mph)
Max rate of climb at S/L ..... 345 m (1,132 ft)/min
Service ceiling ..... 4,200 m (13,780 ft)
T-O run ..... 383 m (1,260 ft)
Landing run ..... 270 m (885 ft)
Range with max fuel ..... 966 n miles (1,790 km; 1,112 miles)
Max endurance ..... 8 h

SAIC LE-800

TYPE: Business turboprop.
PROGRAMME: Joint development by SAIC and No. 1 Aircraft Institute; revealed in model form at Airshow China, Zhuhai, November 2004.
POWER PLANT: One Pratt & Whitney Canada PT6A turboprop, driving a four-blade propeller.
ACCOMMODATION: Seats for eight to 10 persons including pilot(s).
DIMENSIONS, EXTERNAL:
Wing span ..... 14.70 m (48 ft 2¾ in)
Length overall ..... 11.00 m (36 ft 1in)
WEIGHTS AND LOADINGS:
Weight empty ..... 2,000 kg (4,409 lb)

Model of Shijiazhuang LE-800, revealed at Zhuhai in November 2004
(Robert Hewson) 1044630

Fuel weight ..... 800 kg (1,764 lb)
Max T-O weight ..... 3,500 kg (7,716 lb)
PERFORMANCE (estimated):
Cruising speed ..... 221 kt (410 km/h; 255 mph)
Range at cruising speed above ..... 863 n miles (1,600 km; 994 miles)

SAMF

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Shanghai Aircraft Manufacturing Factory (SAMF) created 1950; now part of Shanghai Aviation Industries Group (SAIC, which see); occupies site area of 135.5 ha (334.8 acres). Developed Y-10, China's first indigenous jet airliner. Built small batch of McDonnell Douglas MD-82/83 airliners in mid-1990s, and produced main and landing gear doors for MD-80 series from 1979; produced cargo and service doors, avionics access doors and tailplanes for these aircraft. Current subcontract work includes tailplanes for Boeing 737 NG. Also built Q-2 ultralight.

SSAC

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GENERAL MANAGER: Chris Jaran
SALES MANAGER: Cai Yan

Agreement to form this private joint venture company announced in February 2002 by Sikorsky Aircraft of USA and Shanghai Little Eagle Science and Technology Company (SLEC). Objective is Chinese kit assembly and/or local manufacture of Schweizer 300C, 300CB and 333 (which see), with certification and marketing assistance from Sikorsky; shareholding SLEC 51 per cent, Sikorsky 49 per cent. Government business licence awarded April 2003. Exclusive sales rights for Cambodia, China, Hong Kong, Laos, Macau and Vietnam. Reported capacity to produce up to 24 aircraft per year from 2004. New 3,000 m² (32,292 sq ft) assembly plant opened in late 2004.

SSAC (SCHWEIZER) SHEN SERIES

PROGRAMME: First three (of five) kits delivered 26 August 2002; assembly in China by Schweizer personnel under way by November 2002. Target of 24 for completion in first full year of programme (not achieved); plan to reach eventual peak of 48 per year. Chinese government approval to begin business operations received April 2003. Name 'Shen' derived from Shanghai's river.
CURRENT VERSIONS: **Shen2B:** Schweizer 300CBi (two seats, 134 kW; (180 hp) Lycoming HO-360-G1A engine); optimised for training and police patrol.
Shen3A: Schweizer 300C (three seats, 142 kW; 190 hp Lycoming HIO-360-D1A engine); utility missions include agriculture and police or powerline patrol.
Shen4T: Schweizer 333 (four seats, 186 kW; 250 shp R-R 250-C20W turboshaft); law enforcement, observation, powerline patrol and turbine training. CAAC type certificate March 2005.
CUSTOMERS: First two Shen2Bs leased to Panyu Police by Guangdong Baiyun General Aviation Company 2002; two Shen2Bs and one Shen3A to Xinjin branch of China Civil Aviation Flying College in September 2002; one Shen3A to Sichuan Forestry Bureau in 2003; two Shen3A for April 2004 delivery to Pianjin Aviation University; one Shen4T for unnamed customer. No further sales or completions reported by mid-2006.
COSTS: Shen2B USD260,000, Shen3A USD280,000, Shen4T USD600,000 (approximate, 2003).

SVAM

SHANGHAI VANTAGE AIRSHIP MANUFACTURING COMPANY (SHANGHAI VANTAGE FEITING ZHIZAO GONGSI)

1258 Shitai Road, Baoshan District, Shanghai 200942
Tel: (+86 21) 66 03 65 88
Fax: (+86 21) 66 03 67 88
e-mail: svam@sh163.net
Web: www.vantageship.com
PRESIDENT: Xu Shunli

Company formed 1991 and registered in May 2000 with capital of CNY10 million; workforce of 28 are mainly former military personnel, many (including three qualified airship pilots) wth helium airship experience; has CAAC approval. Completed its first airship (single-place CA-50) in September 1999; second was medium-sized, twin-engined CA-80 for advertising, aerial photography and surveillance; combined flying hours more than 220 by late 2002. CA-120M (004) exported to Japan July 2002; prototype CA-160M completed July 2004 and was scheduled to fly during 2005. Engineering design and envelope manufacture for new model CA-120 completed in 2005. Long-term plans include 60 tonne payload CA-800.

SVAM CA-80 VANTAGESHIP

TYPE: Helium non-rigid airship.
PROGRAMME: Completed September 2001. In service as advertising and aerial survey or surveillance platform. Certified to equivalent of FAA airworthiness standard. A CA-80B has also been reported, built in 2002.

The twin-engined SVAM CA-80 helium semi-rigid 1042714

CUSTOMERS: Two built (001 and 002) for Dalian General Aviation Company; commercial operation due to begin June 2006.
DESIGN FEATURES: Conventional envelope shape with ventral gondola. Four tailfins, with rudders/elevators, in cruciform configuration. Internal illumination of full-colour graphics on translucent envelope; or easily interchangeable full-colour banner.
FLYING CONTROLS: Electro-mechanical. Front and rear ballonets for trim control (25 per cent of volume).
STRUCTURE: Envelope of US-developed material (lamination of woven fabric and plastics film), white and translucent; butt-welded, splice-welded and splice-bonded; all seams tape-sealed externally. Batten-reinforced nosecone.
POWER PLANT: Twin, Teledyne Continental IO-240-B vectored-thrust piston engines, each 93 kW (125 hp), driving MT-Propeller MTV-7(D) variable-pitch, pusher propellers. Fuel capacity 405 litres (107 US gallons; 89.1 Imp gallons).
ACCOMMODATION: Pilot and one passenger at front; seats for three more passengers to rear.

AVIONICS: *Comms:* Bendix/King Silver Crown, including dual KX 96A VHF and KT 76A transponder.
Flight: Garmin 168C GPS.
DIMENSIONS, EXTERNAL:
Envelope: Length ..... 42.00 m (137 ft 9½ in)
Max diameter ..... 11.00 m (36 ft 1 in)
Fineness ratio 3.8
Height overall ..... 14.40 m (47 ft 3 in)
Banner area (each side):
Length ..... 30.60 m (100 ft 4¾ in)
Depth ..... 10.08 m (33 ft 0¾ in)
Gondola: Length ..... 3.90 m (12 ft 9½ in)
Max width ..... 1.60 m (5 ft 3 in)
Max height ..... 1.85 m (6 ft 0¾ in)
DIMENSIONS, INTERNAL:
Envelope volume ..... 2,533.0 m³ (89,450 cu ft)
Ballonet volume (25%) ..... 633.25 m³ (22,363 cu ft)
Cabin length ..... approx 2.80 m (9 ft 2¼ in)
AREAS:
Advertising banner area (total) ..... 616.9 m² (6,640.25 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 1,850 kg (4,079 lb)
Max fuel weight ..... 300 kg (661 lb)
Max payload ..... 692 kg (1,526 lb)
Max buoyancy ..... 2,570 kg (5,666 lb)
Max T-O weight ..... 2,542 kg (5,604 lb)
PERFORMANCE:
Max level speed ..... 49 kt (91 km/h; 56 mph)
Max cruising speed ..... 37 kt (69 km/h; 43 mph)
Max rate of climb at S/L ..... 480 m (1,575 ft)/min
Max rate of descent ..... 300 m (985 ft)/min
Pressure ceiling ..... 2,745 m (9,000 ft)
Range ..... 301 n miles (557 km; 346 miles)
Endurance ..... up to 10 h

SVAM CA-120 VANTAGESHIP

TYPE: Helium non-rigid airship.
PROGRAMME: One CA-120M (004) completed and exported to Japan July 2002. Envelope for a second CA-120 completed in 2005.
Description generally as for CA-80 except as follows:
DIMENSIONS, EXTERNAL:
Envelope: Length ..... 48.00 m (157 ft 5¾ in)
Max diameter ..... 11.80 m (38 ft 8½ in)
Fineness ratio 4.1
Height overall ..... 15.20 m (49 ft 10½ in)
Banner area (each side):
Length ..... 36.00 m (188 ft 1¼ in)
Depth ..... 9.27 m (30 ft 5 in)
Gondola: Length ..... 5.90 m (19 ft 4¼ in)
Max width ..... 1.60 m (5 ft 3 in)
Max height ..... 1.75 m (5 ft 9 in)
DIMENSIONS, INTERNAL:
Envelope volume ..... 3,406 m³ (120,282 cu ft)
Ballonet volume (25%) ..... 851.5 m³ (30,070 cu ft)
Cabin length ..... approx 4.80 m (15 ft 9 in)
AREAS:
Advertising banner area (total) ..... 667.4 m² (7,183.8 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 2,180 kg (4,806 lb)
Max fuel load ..... 300 kg (661 lb)
Max payload ..... 1,203 kg (2,652 lb)
Max buoyancy ..... 3,456 kg (7,619 lb)
Max T-O weight ..... 3,383 kg (7,458 lb)
PERFORMANCE:
Max level speed ..... 46 kt (85 km/h; 53 mph)
Max cruising speed ..... 35 kt (65 km/h; 40 mph)
Max rate of climb at S/L ..... 480 m (1,575 ft)/min

WHIC

WUHAN HELICOPTER INDUSTRY COMPANY (WUHAN ZHISHENGJI GONGYE GONGSI)

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Fax: (+86 27) 85 49 63 78
e-mail: zsj@whzsj.com
Web: www.whzsj.com
PRESIDENT: Dinghe Zhang

Established August 1993, under auspices of Wuhan local government, and with CNY64.5 million capital, to co-produce Enstrom F28F, 280FX, TH-28 and 480 helicopters (which see); assembled first two (280FX and TH-28) from CKD kits October 1993; delivered to Wuhan Public Security Bureau and PLA respectively; at least one more US-built TH-28 supplied to China in May 1997. Two Enstrom 480s delivered for reassembly in June 1998. WHIC also operates an Enstrom 480 as demonstrator and for charter work. New factory completed on a 150 ha (370.7 acre) site and reportedly became operational in 1998.

Agreement revived by March 2003, when Enstrom announced that component manufacture by WHIC expected to begin in third quarter of that year. Manufacture duly launched on 3 September 2003, coupled with news that plant had received CNY202 million investment from Wuhan Helicopter General Aviation Company (www.whgac.com). However, only four sales reported by end of 2003 and full production had apparently not begun by end of 2005, despite mid-2004 letter of intent by Wuhan minicipal government for two 480Bs. Factory is expected to have eventual capability for completing up to 100 helicopters per year. Most are expected to be used for forest fire patrol work.

XAC

XIAN AIRCRAFT INDUSTRY COMPANY (XIAN FEIJI GONGYE GONGSI) (SUBSIDIARY OF AVIC I)

PO Box 140-84, Xian, Shaanxi 710089
Tel: (+86 29) 684 56 65
Fax: (+86 29) 620 37 07
e-mail: qhb@xac.com.cn
Web: www.xac.com.cn
CHAIRMAN AND PRESIDENT: Gao Dacheng
VICE-CHAIRMAN: Meng Xiangkai
VICE-PRESIDENT: Chen Fusheng
AIRCRAFT MARKETING MANAGER: Wang Zhigang

Aircraft factory established at Xian 1958; currently (2006) has 1.3 million m² (14 million sq ft) of factory accommodation on a 300 ha (741.5 acre) site and a workforce of more than 20,000. Aviation activities embrace 20 aircraft design departments and five aircraft design laboratories, and have produced more than 20 different types of aircraft. Non-aero subsidiaries of the Group include those devoted to electronic products (XAC Qinghua Electronics Company), automobiles and architectural materials. Group companies have ISO 9000 status.

Major current programmes concern JH-7 attack aircraft and MA60 transport (Y-7/An-24 derivative). Xian Aircraft Design and Research Institute (XADRI) is a participant in the ACAC ARJ21 regional jet programme.

Subcontract work includes glass fibre header tanks, water float pylons, ailerons and various doors for Bombardier 415 amphibian; fins and tailplanes for Boeing 737/747; wing trailing-edge ribs for Boeing 747 and floor beams for 747-400 Special Freighter; and A320 wing components and doors for Airbus; some 3,700 shipsets of various components had been delivered to Airbus and Boeing by the end of 2000. Since 1997, subcontracting for ATR (which began with ATR 42 wingtips in 1986) has been extended to include ATR 42 wing boxes and ATR 72 rear fuselage sections.

XAC H-6

Chinese name: Hongzhaji-6 (Bomber aircraft 6)
TYPE: Strategic bomber.
PROGRAMME: Reports from several Chinese sources imply that China's copy of the venerable Tu-16 'Badger' remains in production or, more precisely, was returned to production in the late 1990s as a launch platform for YJ-63 (KD-63) cruise missiles — one of which is carried beneath each wing — with the designation **H-6H**. The first H-6H is reported to have flown in December 1998 and made the first successful air launch of a YJ-63 in November 2002. Examples have also been seen with four underwing pylons, possibly for different weapons. H-6Hs carry search radar beneath the forward fuselage, but their distinguishing feature is a semi-globular radome scabbed to the lower rear fuselage. Defensive guns have been removed. Earlier, about 10 were converted as **H-6J** aerial refuelling tankers.

H-6 bomber production line at XAC 1037982

XAC JH-7

Chinese name: Jianjiji Hongzhaji-7 (Fighter-Bomber aircraft 7)
Westernised designation: FBC-1 (formerly B-7)
Export name: Flying Leopard
TYPE: Attack fighter.
PROGRAMME: Revealed publicly September 1988 as model at Farnborough International Air Show; first of at least four flying prototypes (081, 083, 084 and 085) said to have been rolled out during previous month; first flight 14 December 1988 and first supersonic flight 17 November 1989; service entry originally scheduled for 1992–93, but delayed; first seen openly in TV broadcast of October 1995 naval exercise.

First public appearance (by third prototype '083', wearing Flight Test Establishment colours) was made in November 1998 flypast at Airshow China in Zhuhai. This coincided with announcement of new export designation and name, and statement that aircraft was "being redesigned" for export market.
CURRENT VERSIONS: **JH-7**: Domestic version.
Following description applies to JH-7 except where indicated.

JH-7A: No. 603 Institute reportedly undertook improvements to JH-7 that include No. 613 Institute FLIR/laser targeting pod and No. 607 Institute Blue Sky low-altitude

XAC H-6 fitted with four underwing pylons and still in factory finish 1037987

XAC JH-7A of 28th Division, identified by single-piece windscreen and twin ventral fins, of which starboard unit is visible in this view 1128926

navigation pod; modified LETRI JL-10A Shen Ying J-band radar; digital (and possibly quadruple) fly-by-wire controls; a health monitoring system; INS/GPS; new databus; and integration of additional Russian weapons such as Kh-31P (AS-7 'Krypton') standoff missiles and KAB-500 laser-guided bombs.

Development completed in 2001 and first flight of aircraft '811' achieved 1 July 2002. External features include twin ventral fins; use of composites in wing and tailplane; removal of wing fences; two additional hardpoints each side; and one-piece windscreen. At least one other prototype ('8812'). Entered service in 2003. According to Jane's sources, a new (JH-7B) upgrade standard was in prospect in 2005.

FBC-1 Flying Leopard: Designation (from 1998) of proposed export version; would have customer-defined radar, avionics and armament. No orders yet announced.

FBC-1M Flying Leopard II: Upgraded export version, revealed in model form at Aviation Expo/China exhibition in Beijing, September 2003. Improvements generally parallel those described for JH-7A, plus possible further increase of external hardpoints to 11, enabling maximum stores load of up to 9,000 kg (19,842 lb).

CUSTOMERS: Earlier (1997) Chinese reports, of up to 24 in service with PLA Naval Air Force in operational evaluation role in mid-1997, were apparently exaggerated (stated at 1998 Airshow China that only seven prototype/preproduction aircraft then completed). By early 2001 20 aircraft, excluding prototypes, confirmed by code numbers (69 to 88); this is compatible with known number (50) of Spey engines initially purchased, but it has been reported that a further 80 to 90 surplus or second-hand Speys were delivered in mid-2001; these possibly for further JH-7s as well as JH-7A.

First identified JH-7 unit was PLA Naval Air Force 16th Bomber Regiment, 6th Naval Air Division, at Dachang, Shanghai. Aircraft of 1st Squadron numbered 81760 to '769; 2nd Squadron 81860 to '868; while 81669 also seen. By 2003, first of some 20 further JH-7s (at least codes 04 to 19) noted at Yiwu, with 17th Regiment; ranges appear to be 82061 to '069 and 82160 to'169. First JH-7As assigned to 9th Division, People's Navy, at Ledong, where 83096 and 83097 of 27th Regiment noted by 2004.

PLA Air Force had received initial aircraft by 2004, with 28th Air Division (formerly with Q-5s) equipping at Hangzhou with aircraft including 21092 and 21094, probably of 83rd Regiment.

DESIGN FEATURES: In same role and configuration class as Russian Sukhoi Su-24 'Fencer'. High-mounted wings with compound sweepback, dog-tooth leading-edges and 7° anhedral; twin turbofans, with lateral air intakes; all-swept tail surfaces, comprising large main fin, single small ventral fin and low-set all-moving tailplane with anti-flutter weights at tips; small overwing fence at approximately two-thirds span. Wings have 47° 30' sweepback on leading-edges. Quarter-chord sweep angles approximately 45° on fin, 55° on tailplane.

STRUCTURE: Conventional all-metal, except for dielectric panels. Plans to fit SF18 radar-absorbent material revealed in early 1999.

LANDING GEAR: Retractable tricycle type, with twin wheels on each unit. Trailing-link main units retract inward, nose unit rearward.

POWER PLANT: All aircraft so far built are powered by two licence-built (Xian WS9 Qinling) or UK-supplied Rolls-Royce Spey Mk 202 turbofans: each 91.2 kN; 20,515 lb st with afterburning). Centreline and outboard underwing stations plumbed for auxiliary fuel tanks.

Original intention to power production JH-7 with LM (Liming) WS6 turbofans of 71.1 kN (15,990 lb st) dry rating (122.1 kN; 27,445 lb st with afterburning) abandoned, as was licensed production of Russian alternative such as Saturn/Lyulka AL-31F or SNECMA M53-P2.

ACCOMMODATION: Crew of two in tandem (rear seat elevated). HTY-4 ejection seats, operable at speeds from zero to 540 kt (1,000 km/h; 621 mph) and altitudes from S/L to 20,000 m (65,600 ft). Individual canopies, hinged at rear and opening upward. One-piece wraparound windscreen on JH-7A.

AVIONICS (FBC-1): *Comms:* Short wave and ultra short wave transceivers of Italian origin.

Radar: LETRI JL-10A Shen Ying J-band pulse Doppler fire-control radar (search range 43 n miles; 80 km; 50 miles and tracking range 22 n miles; 40 km; 25 miles in look-up mode, or 29 n miles; 54 km; 34 miles and 17 n miles; 32 km; 20 miles, respectively, in look-down mode). Scans ±60° in azimuth and can track four targets simultaneously.

Flight: Automatic flight control system; GPS/INS navigation.

Instrumentation: Includes No. 603 Institute HUD and two other MFDs.

Mission: AFCS linked to fire-control system; No. 613 Institute helmet-mounted sight.

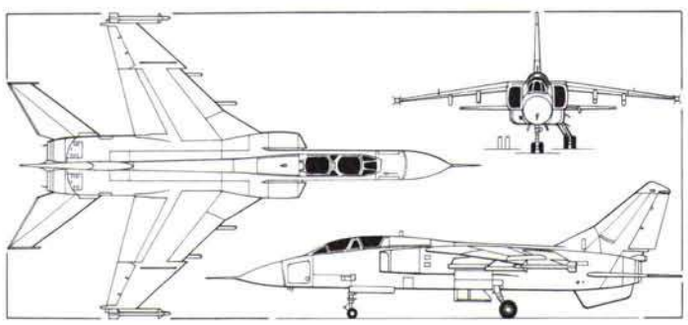
Self-defence: Chaff/flare dispenser at base of vertical tail; omnidirectional RWR; active and passive ECM.

ARMAMENT: Twin-barrel 23 mm gun, with 200 rounds, in starboard side of lower fuselage, just forward of mainwheel bay. JH-7 has fuselage centreline stores station, plus two under each wing and rail for PL-5B, PL-7 or similar close-range air-to-air missile at each wingtip; JH-7A has additional mid-point station under each wing, plus one on lower side of each engine intake trunk. Typical underwing load for maritime attack, two C-801K or C-802K sea-skimming anti-ship missiles (inboard) and two drop tanks (outboard); C-803 (YJ-83) test-launched in 2002. Other potential weapons may include C-701 TV-guided anti-ship missiles and 500 kg LGBs.

DIMENSIONS, EXTERNAL:

Wing span	12.705 m (41 ft 8¼ in)
Wing aspect ratio	3.1
Length overall: excl probe	21.025 m (68 ft 11¾ in)
incl probe	22.325 m (73 ft 3 in)
Fuselage length (excl probe)	19.105 m (62 ft 8¼ in)
Height overall	6.575 m (21 ft 6¾ in)

JH-7 of 17th Regiment, PLA Navy 1128927



XAC JH-7 interdictor *(James Goulding)* 0105034

Tailplane span	7.39 m (24 ft 3 in)
Wheel track	3.06 m (10 ft 0½ in)
Wheelbase	7.805 m (25 ft 7¼ in)
AREAS:	
Wings, gross	52.30 m² (563.0 sq ft)
WEIGHTS AND LOADINGS:	
Max fuel weight	10,050 kg (22,156 lb)
Max external stores load	6,500 kg (14,330 lb)
Max T-O weight	28,475 kg (62,776 lb)
Max landing weight	21,130 kg (46,583 lb)
Max wing loading	544.5 kg/m² (111.51 lb/sq ft)
Max power loading (WS9 engines)	156 kg/kN (1.53 lb/lb st)
PERFORMANCE:	
Max level speed at 11,000 m (36,080 ft) (clean)	M1.7 (975 kt; 808 km/h; 1,122 mph)
Max operating speed	653 kt (1,210 km/h; 751 mph) IAS
Cruising speed	M0.80-0.85 (459–487 kt; 850–903 km/h; 528–561 mph)
Service ceiling (clean)	15,600 m (51,180 ft)
T-O run	920 m (3,020 ft)
Landing run	1,050 m (3,445 ft)
Combat radius	891 n miles (1,650 km; 1,025 miles)
Ferry range	1,970 n miles (3,650 km; 2,268 miles)
g limit	+7

XAC MA60

Chinese name: Xinzhou-60

TYPE: Twin-turboprop airliner.

PROGRAMME: Model of MA60 as proposed Y7-200A (PW127 turboprop) variant first shown at Asian Aerospace, Singapore, February 2000. First flight (prototype B-995L) reportedly 12 March 2000; CAAC type certificate (to CCAR Pt 25) issued 22 June 2000; revenue service began August 2000; public debut (Airshow China) November 2000; production certificate issued 12 December 2000.

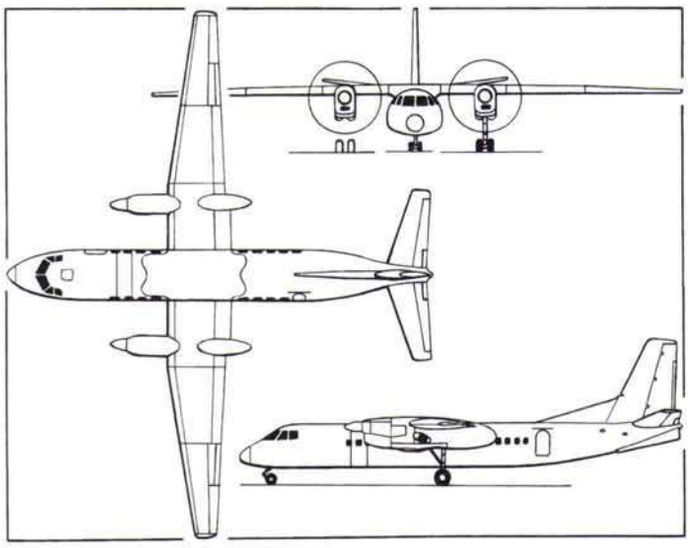
Designation indicates Modern Ark, 60 (high density) seats. To replace earlier Y-7 variants, which since 2001 have no longer met amended Chinese airworthiness requirements. XAC production capacity 12 to 15 a year; domestic operators lease from central leasing agency SFLC, which is responsible for sole-source marketing (first arrangement of this kind in China). According to a late 2004 report, the 11 reportedly delivered at that time had been grounded due to "reliability problems and two runway overruns".

CURRENT VERSIONS: **MA60**: Initial production passenger version; *as described*. Current life-cycle of 25,000 landings and 30,000 flight hours.

XAC MA60 twin-turboprop airliner 1128928

MA60 (two P&WC PW127G turboprops) 1128929

MA60 in the livery of Air Zimbabwe 1128930



XAC MA60 twin-turboprop airliner *(James Goulding)* 1158974

MA60-100: Improvements planned include reduction in empty weight by about 400 kg (882 lb); increase in 'hot-and-high' MTOW of about 900 kg (1,984 lb); increase in OEI ceiling; 162 n mile (300 km; 186 mile) increase in range; airframe drag reduction; Rockwell Collins Pro Line 21 avionics upgrade.

MA60-500: Updated MA60 equivalent of former Y7H, with rear-loading ramp/door inherited from An-26. Fully pressurised cargo compartment, with electric winch and hydraulic conveyor; cargo door can be retracted under belly to permit direct loading from truck or ground. Not known to have flown by early 2006, but programme then still active. Demonstrator bears CFTE serial number 073.

MA60M: Military transport version.

MA60-MPA (Fearless Albatross): Projected maritime patrol version (previously Y7-200BF); nose-mounted search radar; raked wingtips; auxiliary fuel tanks scabbed to fuselage sides to extend range to estimated 1,350 n miles (2,500 km; 1,553 miles); four underwing stations for air-to-air and anti-ship missiles. Shown as model at Airshow China, November 2000. Also seen in model form with dorsal 'balance beam' radar antenna similar to that on some Y-8 testbeds.

MA40: Shortened (40-passenger) version; under consideration.

CUSTOMERS: Sole-source domestic marketing by newly formed Shenzhen Finance Leasing Corporation which, on 7 November 2000, signed contract for delivery of 60 MA60s over five-year period. Launch operator Sichuan Airlines (five ordered, plus five on option) introduced first leased example (B-3426) into revenue service August 2000. Other reported domestic orders by March 2003 from Changan Airlines (two), China Northern (five), Wuhan Airlines (three) and Lao Aviation (three). Of these 18, six said to be in airline operation at that time. Order book reached 20 on 20 December 2004; China Eastern operating three by mid-2005. However, an April 2006 report claimed that only 11 of initial version completed, all of which withdrawn from service by that time. Most of first 60 expected to be of improved MA60-100 standard.

Export orders and commitments for 32 by November 2006, from Air Fiji (one), Air Zimbabwe (three), Congo Democratic Republic (three), Cuba (four), Lao Aviation (two), Merpati Nusantara (15), Royal Nepal Air Force (two VIP), and Zambian Air Force (two). Two delivered to Lao Aviation on 31 July and 20 September 2006 were 17th and 18th production aircraft.

COSTS: Approximately USD12.5 million (2006).

DESIGN FEATURES: Further upgrade of Y-7 series, mainly through Western engines and avionics and improved passenger comfort; incorporates best features of earlier Y7-200A and B programmes. Airframe life 40,000 hours, 25,000 cycles or 25 years. Operable from semi-prepared runways.

Non-swept high-mounted wings, with 2° 12′ 12″ anhedral on tapered outer panels; basically circular-section fuselage; sweptback fin and rudder; 9° dihedral on tailplane; twin ventral strakes under tailcone. Wing sweepback 6° 50′ at quarter-chord of outer panels; incidence 3°.

Xian MA60 of the Zambian Air Force ***(Robert Hewson)*** 1040447

FLYING CONTROLS: Conventional mechanical. Mass-balanced, servo-compensated ailerons with electrically actuated trim tabs; tab in each elevator; electric trim/servo tab in rudder. Hydraulically actuated single-slotted (inboard) and double-slotted (outboard) trailing-edge flaps; landing deflection 30°.

STRUCTURE: Conventional light alloy; two-spar wing, with spot-welded skins; bonded/welded semi-monocoque fuselage.

LANDING GEAR: Retractable tricycle type with twin wheels on all units. Hydraulic actuation, with emergency gravity extension. Multidisc, anti-skid carbon brakes on mainwheels; hydraulically steerable (±45°) and castoring nosewheel unit. Min ground turning radius 12.47 m (41 ft).

POWER PLANT: Two 2,051 kW (2,750 shp) Pratt & Whitney Canada PW127J (PW127G in cargo version) turboprops, each driving a Hamilton Sundstrand 247F-3 four-blade, composites, constant-speed, fully-reversible 'scimitar' propeller. Fuel in integral wing tanks immediately outboard of nacelles, and bag-type tanks in centre-section, total usable capacity 7,200 litres (1,902 US gallons; 1,584 Imp gallons). Provision for additional tanks in centre-section. Optional pressure refuelling point in starboard engine nacelle; gravity fuelling point above each tank.

ACCOMMODATION: Crew of two on flight deck, plus one or two cabin attendants. Standard layout has four-abreast seating, with centre aisle, for 52, 56 or 60 (with forward wardrobe removed) passengers at 76 cm (30 in) pitch in air conditioned, soundproofed and pressurised cabin. Galley and lavatory at rear on starboard side. Wardrobes forward and aft of passenger cabin, plus overhead stowage bins in cabin. Passenger airstair door on port side at rear of cabin; emergency exit opposite. Freight door forward, starboard. All doors open inward. MA60M can accommodate 40 armed troops or 24 stretchers.

SYSTEMS: Honeywell GTCP36-150 (CY) APU. Hydraulic system, pressure 157 bar (2,280 lb/sq in), for actuation of flaps, landing gear extension/retraction, nosewheel steering and anti-skid braking system; emergency system for trim, flaps and wheel brakes. Electrical power supplied by 12 kW, 28 V APU-driven AC generator and two 115/200 V, 400 Hz static inverters; two 24 V, 43 Ah Ni/Cd batteries for emergency power and engine starting. Pneumatic de-icing of wing and tail leading-edges and engine intakes; windscreen, propeller blades and sensors anti/de-iced electrically. Oxygen system for passengers and crew. Fire detection and extinguishing system.

AVIONICS: *Comms:* Bendix/King dual KTR 908 VHF, single KHF 950 HF and KXP 756 ATC transponder; Hamilton Sundstrand AV 557C CVR; Becker 3100 audio system; Chinese FJ-30A FDR.

Radar: Rockwell Collins WXR-350 weather radar; Honeywell ACAS II collision avoidance system.

Flight: Dual VIR-32 VOR/ILS/marker, dual ADF-60A, dual DME-42 and ALT-55B low-altitude radio altimeter (all Rockwell Collins); Universal UNS-1M nav system; Sfena H321AKM1 standby horizon.

Instrumentation: Four-tube EFIS-85 (B14), ADS-85 air data system, APS-85 autopilot and dual AHS-85 attitude and heading systems (all Rockwell Collins); Honeywell MkVII GPWS.

Avionics upgrading continuing in 2006, assisted by Honeywell and Rockwell Collins.

ARMAMENT (MA60-MPA): Six external stores stations: two on fuselage sides, each for 1,000 kg (2,205 lb) load; two inboard (each 1,500 kg; 3,307 lb) and two outboard (each 500 kg; 1,102 lb) under wings. Fuselage stations can each support two torpedoes, a 1,000 kg bomb, sonobuoy container or gun pod. Inboard wing stations suitable for drop fuel tank, anti-shipping missile or AAM. Outer wing stations able to carry single torpedo, 500 kg bomb, searchlight, gun pod or additional AAM.

DIMENSIONS, EXTERNAL:

Wing span	29.20 m (95 ft 9½ in)
Wing chord: at root	3.50 m (11 ft 5¾ in)
at tip	1.095 m (3 ft 7 in)
Wing aspect ratio	11.4
Length overall	24.71 m (81 ft 0¾ in)
Fuselage max width	2.90 m (9 ft 6¼ in)
Height overall	8.855 m (29 ft 0½ in)
Wheel track (c/l of shock-struts)	7.90 m (25 ft 11 in)
Wheelbase	9.565 m (31 ft 4½ in)
Propeller diameter	3.96 m (13 ft 0 in)
Passenger door: Height	1.405 m (4 ft 7¼ in)
Width	0.75 m (2 ft 5½ in)
Forward freight door: Height	1.22 m (4 ft 0 in)
Width	1.19 m (3 ft 10¾ in)
Rear baggage door: Height	1.41 m (4 ft 7½ in)
Width	0.75 m (2 ft 5½ in)
Emergency exits (two, each):	
Height	0.93 m (3 ft 0½ in)
Width	0.51 m (1 ft 8 in)

DIMENSIONS, INTERNAL:

Passenger cabin: Length	10.795 m (35 ft 5 in)
Max width	2.685 m (8 ft 9¾ in)
Max height	1.905 m (6 ft 3 in)
Aisle width	0.435 m (1 ft 5¼ in)
Width at floor	2.395 m (7 ft 10¼ in)
Baggage compartment volume: front	5.0 m³ (177 cu ft)
rear	4.5 m³ (159 cu ft)

AREAS:

Wings, gross	74.98 m² (807.1 sq ft)

WEIGHTS AND LOADINGS (A: passenger, B: cargo, C: MPA):

Operating weight empty: A	13,700 kg (30,203 lb)
Max usable fuel: A, B	4,030 kg (8,885 lb)
C	7,500 kg (16,535 lb)
Baggage capacity: front	540 kg (1,190 lb)
rear	300 kg (661 lb)
Max payload: A, B	5,500 kg (12,125 lb)
Max T-O weight: A, B	21,800 kg (48,060 lb)
C	24,000 kg (52,910 lb)
Max ramp weight: A, B	21,900 kg (48,281 lb)
Max landing weight: A, B	21,600 kg (47,620 lb)
Max zero-fuel weight: A, B	19,200 kg (42,329 lb)
Max wing loading: A, B	290.7 kg/m² (59.55 lb/sq ft)
C	320.1 kg/m² (65.56 lb/sq ft)
Max power loading: A, B	5.32 kg/kW (8.74 lb/shp)
C	5.86 kg/kW (9.62 lb/shp)

PERFORMANCE (A, B and C as above):

Max cruising speed: A	278 kt (514 km/h; 319 mph)
Econ cruising speed: A	232 kt (430 km/h; 267 mph)
Max operating altitude: A	7,620 m (25,000 ft)
C	8,500 m (27,880 ft)
Service ceiling, OEI: A	3,920 m (12,860 ft)
B	4,000 m (13,120 ft)
T-O run: A	810 m (2,660 ft)
T-O to 10.7 m (35 ft): A	1,100 m (3,610 ft)
C	969 m (3,180 ft)
T-O field length: A	1,425 m (4,675 ft)
B	1,400 m (4,595 ft)
C	650 m (2,135 ft)
Landing from 15 m (50 ft): A	1,060 m (3,480 ft)
Landing field length: A	1,460 m (4,790 ft)
Landing run at MLW: A	760 m (2,495 ft)
Range:	
with 56 passengers, 100 n miles + 45 min reserves	
A	772 n miles (1,430 km; 888 miles)
B	567 n miles (1,050 km; 652 miles)
with max fuel:	
A	1,322 n miles (2,450 km; 1,522 miles)
B	1,187 n miles (2,200 km; 1,367 miles)
C	2,591 n miles (4,800 km; 2,982 miles)
Max endurance: C	12 h

XAC WJ

Chinese name: Whoshan Jiaolian

TYPE: Twin-jet freighter.

PROGRAMME: Revealed (as model) at Airshow China, Zhuhai, November 2004, though few details provided. Reportedly in 50-passenger/20-tonne gross weight size class and

Model of XAC WJ twin-turbofan unveiled at Airshow China in November 2004 ***(Robert Hewson)*** 1044646

prospective short/medium-range successor to abortive Y-7H; but described in one account as "destined for training of crews and for experimentations".

DESIGN FEATURES: High-mounted, sweptback (supercritical ?) wings with underwing podded engines; circular-section fuselage; T tail.

LANDING GEAR: Tricycle type; retractable (main gear into fuselage-side bulges). Twin wheels on each unit.

POWER PLANT: Twin turbofans.

Colombia

AEROANDINA

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Web: www.airandina.com
PRESIDENT Maximo Tedesco

Former Agrocopteros Ltda established by Sen Tedesco in 1971, initially producing own autogyro and biplane agricultural sprayers and, from 1982, acting as local agent for RotorWay 162 two-seat helicopter. In 1980 built first of 12 Goldwing glass fibre canards and began manufacture of low-wing versions of metal Zenair designs, these leading to MXP-640 Amigo and MXP-650 Amigo-S. MXP-740 Savannah and MXP-740-F aerial sprayer based on Zenair CH-701 formula: both Amigo and Savannah later manufactured independently in Europe by ICP. MXP-100 Aventura open ultralight.

Became Technologias Aeronauticas (Aerot) in 1988 and began marketing MXP-800 Fantasy in 2002. Further change to current company name was followed by launch of MXP-1000 Tayrona in 2005. By that time had produced some 450 aircraft, of which 80 per cent exported.

Factory area 835 m² (9,000 sq ft).

AEROANDINA MXP-1000 TAYRONA

TYPE: Side-by-side ultralight.
PROGRAMME: MXP-740/750 series evolved into MXP-800 Fantasy, which further developed as Tayrona.
CUSTOMERS: Initial European sales in France and Italy, beginning 2005.
DESIGN FEATURES: High, constant-chord wing braced by streamlined V struts and auxiliary struts each side. Sweptback fin and low-set, sweptback tailplane. Cockpit cut away at rear. Leading-edge slats omitted to increase cruising speed.
FLYING CONTROLS: Conventional and manual. Flaps. Flaperons on prototype and first three production aircraft only.
STRUCTURE: Generally of 6061T6 aluminium alloy, with 4130 steel cage protecting cockpit.
LANDING GEAR: Tricycle type; fixed. Fuselage-mounted, cantilever spring mainwheel legs and steerable nosewheel.
POWER PLANT: One Rotax liquid-cooled flat-four; 58.8 kW (78.9 hp) 912 UL; 73.5 kW (98.6 hp) 912 ULS; or 84.6 kW (113.4 hp) 912 ULS Turbo. Total fuel capacity 92 litres (24.3 US gallons; 20.2 Imp gallons).
DIMENSIONS, EXTERNAL:
Wing span ..... 10.00 m (32 ft 9¾ in)
Length overall ..... 6.30 m (20 ft 8 in)
Height overall ..... 2.40 m (7 ft 10½ in)
DIMENSIONS, INTERNAL:
Cabin max width ..... 1.16 m (3 ft 9¾ in)
AREAS:
Wings, gross ..... 12.30 m² (132.4 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 290 kg (639 lb)
Max T-O weight ..... 450 kg (992 lb)
PERFORMANCE (Rotax 912 ULS Turbo):
Max level speed ..... 113 kt (210 km/h; 130 mph)
Cruising speed at 75% power ..... 108 kt (200 km/h; 124 mph)
Stalling speed, flaps down ..... 31 kt (56 km/h; 35 mph)
Max rate of climb at S/L ..... 372 m (1,220 ft)/min
T-O run ..... 40 m (135 ft)
Landing run ..... 80 m (265 ft)
Range at 75% power ..... 523 n miles (970 km; 602 miles)
g limits ..... +6/–3

Aeroandina MXP-1000 Tayrona 1158678

AERODYNOS

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In addition to producing its own JA-177 Evolution, Aerodynos is a local agent for the RotorWay 162 Exec two-seat helicopter kit manufactured in the US.

AERODYNOS JA-177 EVOLUTION

TYPE: Side-by-side ultralight/kitbuilt.
PROGRAMME: European debut at Blois RSA rally, 2005.
CUSTOMERS: At least seven produced by 2005.
COSTS: USD45,000 complete, as described; USD26,500 engineless standard kit; USD21,000 basic kit (plus tax; 2006).
DESIGN FEATURES: High, constant-chord wing with single streamlined bracing strut each side. Sweptback fin with low tailplane.
FLYING CONTROLS: Conventional and manual. Flaps.
STRUCTURE: Generally of aluminium alloy.
LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring cantilever mainwheel legs; steerable nosewheel. Wheel fairings. Hydraulic brakes. All wheels 5.00 aluminium.
POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS liquid-cooled flat-four driving an Ivo-Prop Helix variable-pitch (electric) propeller. Fuel capacity 125 litres (33.0 US gallons; 27.5 Imp gallons).
SYSTEMS: Electrical system with 12 V 18 Ah battery.
DIMENSIONS, EXTERNAL:
Wing span ..... 9.12 m (29 ft 11 in)
Length overall ..... 6.75 m (22 ft 1¾ in)
Height overall ..... 2.00 m (6 ft 6¾ in)
DIMENSIONS, INTERNAL:
Cockpit max width ..... 1.05 m (3 ft 5¼ in)
AREAS:
Wings, gross ..... 13.50 m² (145.3 sq ft)

Aerodynos JA-177 Evolution ultralight *(R W Simpson)* 1037962

WEIGHTS AND LOADINGS:
Weight empty ..... 265 kg (584 lb)
Max T-O weight ..... 495 kg (1,091 lb)
PERFORMANCE:
Max level speed ..... 110 kt (203 km/h; 126 mph)
Normal cruising speed ..... 105 kt (195 km/h; 121 mph)
Stalling speed ..... 31 kt (57 km/h; 36 mph)
Max rate of climb at S/L ..... 510 m (1,673 ft)/min
T-O run ..... 60 m (200 ft)
Landing run: ..... 120 m (395 ft)

GLASS

GLASS AIRCRAFT DE COLOMBIA

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Three types of light aircraft are currently under development by this company which was formed in January 1999. One of these is a light utility twin with Rotax engines, to be known as the TwinGlass. No development timetable has been announced for this aircraft.

The company had a workforce numbering 72 and in November 2001 reported production at around four aircraft per year. In September 2004 control of Glass Aircraft was seized by Colombian Police. No evidence of recent sales or promotion of company's products.

GLASS STOLGLASS SG70

TYPE: Two-seat lightplane.
PROGRAMME: North American marketing launched at AirVenture, Oshkosh, in July 2003 with a US-registered demonstrator; returned following year.
CUSTOMERS: Venezuelan Yaracuy state government reported to have ordered 12 aircraft of which three delivered by November 2001. By May 2002, 27 aircraft had been built. Orders for 2002 numbered 45. One in US only.
DESIGN FEATURES: Short-field performance. Constant-chord, high-lift, high-mounted mainplanes with V-strut bracing resemble those of Zenith CH 701. Sweptback fin and root-mounted tailplane.
FLYING CONTROLS: Conventional and manual. Junkers ailerons and flaps. No aerodynamic balances on tail surfaces.
STRUCTURE: Generally of glass fibre.
LANDING GEAR: Tricycle type; fixed. Fuselage-mounted cantilever main legs with hydraulic brakes. Speed fairings on all wheels.
POWER PLANT: One flat-four piston engine; option of 73.5 kW (98.6 hp) Rotax 912 S or 84.5 kW (123.3 hp) Rotax 914, each driving a three-blade propeller. Fuel capacity 76 litres (20.0 US gallons; 16.7 Imp gallons).
ACCOMMODATION: Two persons, side by side. Baggage area behind seats. Door each side.
DIMENSIONS, EXTERNAL (Rotax 912 or 914 engine):
Wing span ..... 9.15 m (30 ft 0 in)
Length overall ..... 6.50 m (21 ft 4 in)
Height overall ..... 2.57 m (8 ft 5¼ in)
WEIGHTS AND LOADINGS:
Weight empty ..... 330 kg (727 lb)
Max T-O weight ..... 600 kg (1,322 lb)
Max power loading: 912 ..... 8.16 kg/kW (13.41 lb/hp)
PERFORMANCE (Rotax 912 or 914 engine):
Never-exceed speed (VNE) ..... 121 kt (225 km/h; 140 mph)
Cruising speed at 75% power:
912 ..... 100 kt (185 km/h; 115 mph)
914 ..... 109 kt (201 km/h; 125 mph)
Stalling speed, power off:
flaps up ..... 31 kt (57 km/h; 35 mph)
flaps down ..... 26 kt (49 km/h; 30 mph)
Max rate of climb at S/L: 912 ..... 335 m (1,100 ft)/min
914 ..... 366 m (1,200 ft)/min
Service ceiling: 912 ..... 4,265 m (14,000 ft)
T-O run: at S/L, ISA: 912 ..... 50 m (165 ft)
914 ..... 45 m (150 ft)
at 1,220 m (4,000 ft), ISA: 912 ..... 125 m (410 ft)
914 ..... 120 m (395 ft)
Landing run ..... 130 m (430 ft)
Range: 912 ..... 365 n miles (675 km; 420 miles)
914 ..... 347 n miles (643 km; 400 miles)

GLASS SPEEDGLASS

TYPE: Two-seat lightplane.
PROGRAMME: First flown June 2003. Unknown number supplied to Venezuelan police for highway patrol and border control in 2003.

STOLGlass SG70 two-seat lightplane *(Paul Jackson)* 1042791

Prototype Glass SpeedGlass 0561678

COSTS: Company estimated unit cost at USD45,000 in 2002.
DESIGN FEATURES: Low wing with winglets; sweptback fin with root-mounted tailplane.
FLYING CONTROLS: Conventional and manual. No aerodynamic balances on tail surfaces.
STRUCTURE: Generally of glass fibre, with carbon fibre and duralumin.
LANDING GEAR: Tricycle type. Mainwheels retract inwards; nosewheel rearwards.
POWER PLANT: Not specified. Three-blade propeller. Fuel capacity 114 litres (30.0 US gallons; 25.0 Imp gallons).
DIMENSIONS, EXTERNAL:
Wing span ..... 8.75 m (28 ft 4½ in)
Length overall ..... 7.50 m (24 ft 7¼ in)
Height overall ..... 3.20 m (10 ft 6 in)
WEIGHTS AND LOADINGS:
Weight empty ..... 450 kg (992 lb)
Max T-O weight ..... 800 kg (1,763 lb)
PERFORMANCE (estimated):
Never-exceed speed (VNE) ..... 156 kt (290 km/h; 180 mph)
Cruising speed at 75% power ..... 130 kt (241 km/h; 150 mph)
Stalling speed, power off:
flaps up ..... 53 kt (97 km/h; 60 mph)
flaps down ..... 44 kt (81 km/h; 50 mph)
Max rate of climb at S/L ..... 304 m (1,000 ft)/min
Service ceiling ..... 4,570 m (15,000 ft)
T-O run, ISA: at S/L ..... 200 m (660 ft)
at 1,220 m (4,000 ft) ..... 350 m (1,150 ft)
Landing run ..... 400 m (1,315 ft)
Range ..... 955 n miles (1,770 km; 1,100 miles)

Czech Republic

AERO

AERO VODOCHODY A.S

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CHIEF DESIGNERS:
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Josef Jironč (Civil Programmes)
PRESS OFFICER: Vitezslav Kulich

Established on 1 July 1953, Aero Vodochody is the successor to the Aero Aircraft factory founded in Prague in 1919. Over the years it has produced more than 11,000 aircraft, most notably the L-29 Delfin (3,665 built) and more than 2,800 L-39 Albatros jet trainers. Most recent programme concerned the L159, last of which for the Czech Air Force was delivered in February 2004.

The company underwent a change of ownership as part of a restructuring programme approved on 31 July 1996, when it had yet to recover fully from debts occurring in 1990–91. It became a joint-stock company in which the majority shareholder was the Czech government, through shares held by Letka a.s. (35.66 per cent) and the Konsolidační Banka (29.00 per cent). From 17 August 1998, a further 35.29 per cent was acquired by Boeing Česká s.r.o., a joint venture comprising Boeing and Czech Airlines (CSA), owned 90 per cent by Boeing and 10 per cent by CSA. The remaining 0.05 per cent of Aero was owned by other shareholders. However, Boeing decided to withdraw its participation in early 2004; terms agreed on 11 October 2004, whereby Boeing's Česká holding repurchased by Czech government for nominal CZK2, 53 per cent being allocated to Letka and 47 per cent to the Konsolidačni Banka, making the company 99.96 per cent state-owned. Workforce at end of 2003 was about 2,000, but reduced to 1,600 in 2004, ending that year with CZK300 million profit largely due to work on S-76C+ programme.

Company is currently organised into four main business units: Military Aircraft, Civil Aircraft, Aero Structures and Sikorsky. Aircraft programmes are the L159, the S-76C+ and the Ae 270 Ibis civil transport, the last-named (certified by EASA 12 December 2005 and FAA 24 February 2006) in a 50/50 venture with AIDC of Taiwan. Delivery of the first L159As to the Czech Air Force enabled the company to return to an operating profit. By early 2003, it had 67 firm orders and six options for the Ae 270, but no export orders had been obtained for the L159, a situation which led the Czech government in late 2003 to call for an audit of the company's affairs. It had agreed in July 2003 to cover existing bank loan repayments until 2008, but subsequently indicated that this support could be withdrawn if no sales of the L159 were obtained by the end of 2004, which they were not. Meanwhile, Aero required to repay Czech government CZK5.5 billion (USD236 million) in respect of debts cancelled in 2004. Czech government announced in May 2005 intention to offer company for public sale, but to file for bankruptcy in early 2006 if no buyer found by then. BAE Systems and Elbit were among bidders in late 2005; selection then expected by April 2006 and purchase to be finalised by mid-year, but in March 2006 privatisation progress was extended "at least until 19 July" due to intervention of a general election and re-examination of some bidders' plans for future use of company's runway. Meanwhile, agreement with Czech MoD to support L159 until 2029 was signed 8 December 2005. Revealed in late October 2006 that Czech government had authorised sale of Aero to investment company Oakfield, a subsidiary of Czech/Slovak Penta Group, for a sum of CZK2.91 billion (USD130 million). Workforce 1,644 as of 30 January 2007, but planned to reduce to about 1,200 by end of August 2007. Investment in 2006 was CZK58 million; investment of further CZK150 million planned for 2007 in effort to achieve profitability by beginning of 2008.

Under a June 2000 agreement with Sikorsky, the Aero Structures business unit is undertaking fabrication and subassembly of S-76C+ helicopter airframes (but not their dynamic systems). The agreement originally called for delivery of 15 airframes per year over a seven-year period; first set, assembled from US-built kits, was redelivered to Sikorsky at Stratford, Connecticut, in January 2001. In-country manufacture by Aero had begun by the end of that year, with the number of airframes rising annually since then; 21 completed in 2003 (bringing total to 44) and 100th on 13 March 2006. This unit also supplies gun bay doors and detail parts to Boeing for the F/A-18E/F Super Hornet and Boeing 757; detail parts and subassemblies to BAE Systems for the Boeing 767; plus detail parts to Vought Industries for the Boeing 747, and to Airbus for the A320/A340. In 2006, Alenia Aeronautica signed an agreement with Aero Vodochody for the latter to manufacture centre wing boxes for the C-27J Spartan. Production of aluminium parts for Ariane 5 spacecraft launcher began in late 2005, under subcontract to MT Aerospace of Germany.

AERO L159

TYPE: Light fighter/advanced jet trainer.
PROGRAMME: Design started late 1992; F124 turbofan selected as power plant mid-1994; Rockwell North American (now Boeing) awarded avionics contract late 1994. Development

Aero L159B tandem-seat advanced jet trainer, equipped with in-flight refuelling probe 0593109

approved by Czech government 7 April 1995, followed by production commitment later the same month and 72-aircraft production contract 4 July 1997. Two prototypes (plus two airframes for static and dynamic test) built. First (two-seat) prototype/engine demonstrator (5831) rolled out 12 June and made first flight 2 August 1997.

Second (single-seat) prototype (5832), in Czech Air Force configuration (first flight 18 August 1998) named ALCA (Advanced Light Combat Aircraft); is first with full avionics and is avionics/weapons trials aircraft. Official first flight of 5832 was 20 August; public debut during Czech International Air Fest at Hradec Králové 29 August 1998. Gun firing tests in Czech Republic followed by air-launched weapon trials in Norway in April and May 1999; nav/attack system trials August/September 1999. Weapons qualification tests at Cazaux, France, from May to July 2000.

First flight of production L159A (6001) 20 October 1999. Deliveries to CzAF due to have begun late 1999 (five aircraft, followed by 16 in 2000, 26 in 2001 and final 25 in 2002); however, first two (6006 and 6007) not delivered (to 4 Tactical Fighter Base at Caslav) until 29 December 2000, with first pilot conversion training beginning in mid-March 2001. Deliveries then rescheduled as 37 by end of 2001, 21 during 2002 and final 14 during first half of 2003. However, in May 2001, during which month aircraft evaluated by US Navy Test Pilots' School, Czech defence minister stated that CzAF will operate only 37 aircraft.

The L159A fleet (then 25 aircraft) was grounded on 14 November 2001 following incidents to two aircraft apparently due to suspected avionics malfunctions. No other significant problems had been registered by the end of 2002, but in mid-2003 Czech government stated intention to reduce CzAF inventory further. This confirmed in July 2004, when government approved reduction of operational aircraft to only 18, plus six to be held in reserve. Remaining 47 to be sold. Final L159A was delivered to Coslav AB on 3 February 2004. In-service support guaranteed until 2029 under 8 December 2005 agreement with Czech MoD. Two further (three-year) contracts signed 27 February 2006, relating to storage of 47 surplus aircraft and spare parts delivery of remaining 24. Further contract expected by mid-2006 covering conversion of four L159As to two-seat L159Bs for the Czech Air Force.

First production L159B (6073) achieved maiden flight on 1 June 2002 and made international debut at Farnborough Air Show in following month. This aircraft, and L159A prototype, leased by Hungarian Air Force in mid-2004 as conversion trainers for MiG-29 pilots due to transfer to Saab Gripen in 2005. Four L159As being modified to L159T under contract of 26 June 2006, for re-delivery to Czech Air Force in 2007.

CURRENT VERSIONS: **L159A ALCA:** Single-seater.

Detailed description applies to L159A except where indicated.

L159B Albatros II: Tandem-seat trainer version, designed primarily for advanced and operational training; can also be configured to customer requirements from basic to lead-in fighter training, reconnaissance or ground attack. Further USD15 million invested by Boeing in July 2001 to develop software for this version.

L159T: Two-seat trainer; conversion of four CzAF L159As in 2006-07, under 26 June 2006 contract, for re-delivery by end 2007. For example (6069) due to fly in March 2007. Also to be promoted for export under designation L159BAT.

CUSTOMERS: Production lots 1 and 2 comprised five and 10 aircraft respectively, of which 12 delivered by 31 March 2001. Total 58 delivered by May 2003, but only 14 of these were then operations-capable, reportedly due to avionics and hydraulic systems problems. Deliveries completed in February 2004. Primary roles intended to be close air support, counter-insurgency, anti-ship missions, tactical reconnaissance, point air defence, air defence against slow/low-flying targets and border patrol. Prospect of exports to other countries, including Poland, to whom a Maverick-armed version was offered in late 2000, but no orders for either version by mid-2006.

AEROS

AEROS S.R.O.

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MANAGING DIRECTOR: Miroslav Staněk
INFORMATION OFFICER: Miss Ilona Černá

Known until 2002 as Lusus s.r.o., Aeros has 10 employees at its 700 m² (7,535 sq ft) plant. No recent evidence of activity.

AEROS UL-2000 FLAMINGO

TYPE: Side-by-side ultralight.
PROGRAMME: Entered production in 2000 and international debut at Friedrichshafen Air Show, April 2001. No recent reports of production.

UL-2000 Flamingo side-by-side ultralight *(Paul Jackson)* 0131725

AIRLONY

PETR LONSKý

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Tel: (+420 608) 02 98 16
e-mail: airlony@tiscali.cz

Company's two products are available complete, or in kit form.

AIRLONY HIGHLANDER

TYPE: Tandem-seat ultralight biplane kitbuilt.
PROGRAMME: Prototype (OK-AUO 23) flying by 2005.
DESIGN FEATURES: Single-bay biplane of classic appearance; stressed for aerobatic manoeuvres where national regulations allow.

Constant-chord wings with rounded tips; rounded fin and elevator tips. Open cockpits. Wings braced by streamlined, N-type interplane struts and wires; upper wing on central cabane. Empennage braced by steel struts and wires.

Wing sections NACA 63A415 (upper) and NACA 2412 (lower).

Airlony Highlander kitbuilt biplane 1037960

FLYING CONTROLS: Conventional and manual. Interconnected ailerons on upper and lower wings. Aileron and elevator actuation by pushrods; rudder by cables.
STRUCTURE: Glass fibre fuselage; wings of conventional ribs and spars with fabric covering.
LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted, spring cantilever mainwheel legs and steerable tailwheel. Hydraulic mainwheel brakes.
POWER PLANT: One 59.7 to 89.5 kW (80 to 120 hp) piston engine driving a two-blade propeller. Fuel capacity 50 litres (13.2 US gallons; 11.0 Imp gallons).
DIMENSIONS, EXTERNAL:
Wing span ..... 7.30 m (23 ft 11½ in)
Length overall ..... 6.00 m (19 ft 8¼ in)
Height overall ..... 2.15 m (7 ft 0¾ in)
AREAS:
Wings, gross ..... 14.50 m² (156.1 sq ft)
WEIGHTS AND LOADINGS:
Weight empty (average) ..... 220 kg (485 lb)
Max T-O weight ..... 450 kg (992 lb)
PERFORMANCE (89.5 kW; 120 hp engine):
Max cruising speed ..... 86 kt (160 km/h; 99 mph)
Stalling speed ..... 36 kt (65 km/h; 41 mph)
Max rate of climb at S/L ..... 360 m (1,180 ft)/min
Range ..... 297 n miles (550 km; 341 miles)

AIRLONY SKYLANE

TYPE: Side-by-side ultralight kitbuilt.
PROGRAMME: Prototype (OK-IUO 11) flying by 2005.
DESIGN FEATURES: Approximately two-thirds scale replica of Cessna 182 Skylane intended for touring and glider towing. High wing braced by single streamlined strut each side; constant chord inboard; trapezoidal outboard. Sweptback fin and low-mounted tailplane.
Wing section MS(1)-313, semi-laminar. Tailplane section NACA 0012.
FLYING CONTROLS: Conventional and manual. Mass-balanced ailerons and horn-balanced fin and elevator. Slotted flaps, electrically actuated, with fixed 13, 29 and 37° settings. Ailerons and elevator actuated by pushrods; rudder by cables.
STRUCTURE: Glass fibre fuselage with integral fin; acrylic windows. Wooden wing; main spar at 37 per cent chord, with torsion box ahead containing fuel tanks in constant-chord section and with plywood covering in trapezoidal section. Wooden ribs and short auxiliary spar, fabric-covered, behind main spar. Ailerons and flaps with plywood and fabric covering; tailplane similar.
LANDING GEAR: Tricycle type; fixed. Fuselage-mounted cantilever spring mainwheel legs; trailing-link nosewheel damped by helical steel spring and oleo.
POWER PLANT: One piston engine of between 37.3 and 74.6 kW (50 and 100 hp) driving fixed- or variable-pitch propeller up to 1.70 m (5 ft 7 in) diameter. Prototype with 58.8 kW (78.9 hp) Rotax 912. Fuel tanks in wings, combined capacity 70 litres (18.5 US gallons; 15.4 Imp gallons).
DIMENSIONS, EXTERNAL:
Wing span ..... 8.95 m (29 ft 4¼ in)
Length overall ..... 6.65 m (21 ft 9¾ in)
Height overall ..... 1.99 m (6 ft 6¼ in)
AREAS:
Wings, gross ..... 10.57 m² (113.8 sq ft)
WEIGHTS AND LOADINGS:
Weight empty (average) ..... 245 kg (540 lb)
Max T-O weight ..... 450 kg (992 lb)
PERFORMANCE (74.6 kW; 100 hp engine):
Max cruising speed ..... 97 kt (180 km/h; 112 mph)
Stalling speed ..... 36 kt (65 km/h; 41 mph)
Max rate of climb at S/L ..... 360 m (1,180 ft)/min
Range ..... 540 n miles (1,000 km; 621 miles)
g limits ..... +4/-2

Prototype Airlony Skylane *(R W Simpson)* 1037963

AIROX

AIROX S.R.O.

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DIRECTOR: Ing. Miroslav Hajek
INFORMATION: Tomáše Valouška

Airox was formed in 1998 to build aircraft from composites materials, as well as parts for ships. In mid-2003 the company's workforce numbered 24. There has been no evidence of recent promotion or production.

AIROX F-31

TYPE: Side-by-side ultralight twin.
PROGRAMME: Public debut (F-31A) at aviation exhibition in Prague, September 2000. Engines installed and ground running underway by late 2003. No further information received.

AIRSPORT

AIRSPORT S.R.O.

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Web: www.sweb.cz/airsport

Airsport showed its current products, the Sonet and Sonáta, at Aero '05, Friedrichshafen. The company also offers a Hirth 3701-engined version of the Aviasud Petrel and another design identified as the Victori. Is also promoting DOVA Skylark, described separately.

Airsport Victori (OK-JUI 10) 1127694

AIRSPORT SONET

TYPE: Side-by-side ultralight.
PROGRAMME: Prototype (OK-IUL 03) first flew 2003.
DESIGN FEATURES: Low-mounted, high aspect ratio wing with dihedral and sweepback on outboard panels; sweptback, T tail; and option of nose- or tailwheel.
Wing section UAG 88-143/20.
FLYING CONTROLS: Conventional and manual. Ailerons on dihedral section of wing. Single-piece, horn-balanced elevator with flight-adjustable trim tab. All control gaps sealed. Flap settings –10, 0, 10 and 40°. Door-type airbrakes.
STRUCTURE: Composites.

Airsport Sonet side-by-side ultralight *(Paul Jackson)* 1159059

LANDING GEAR: Fixed. Fuselage-mounted spring cantilever mainwheel legs. Tricycle or nosewheel; main and optional nosewheel sizes all 12×4. Cable-operated brakes.

POWER PLANT: One 47.8 kW (64.1 hp) Hirth 2706 two-cylinder piston engine driving a Jirasek two-blade, fixed-pitch propeller. Two fuel tanks in wings; total capacity 50 litres (13.2 US gallons; 11.0 Imp gallons).

DIMENSIONS, EXTERNAL:

Wing span	11.40 m (37 ft 4¾ in)
Length overall	6.80 m (22 ft 3¾ in)
Height overall	1.80 m (5 ft 10¾ in)

AREAS:

Wings, gross	9.50 m² (102.3 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	253 kg (558 lb)
Max T-O weight	450 kg (992 lb)

PERFORMANCE:

Normal cruising speed (–10° flap)	76 kt (140 km/h; 87 mph)
Stalling speed flaps down	35 kt (64 km/h; 40 mph)
Endurance	3 h

AIRSPORT SONÁTA

TYPE: Tandem-seat ultralight motor glider.

PROGRAMME: Derivative of Aerosport Sonet with increased wing span; narrow track, retractable mainwheels; Z-type, retractable propeller; and tandem seating. Prototype first flew September 2004.

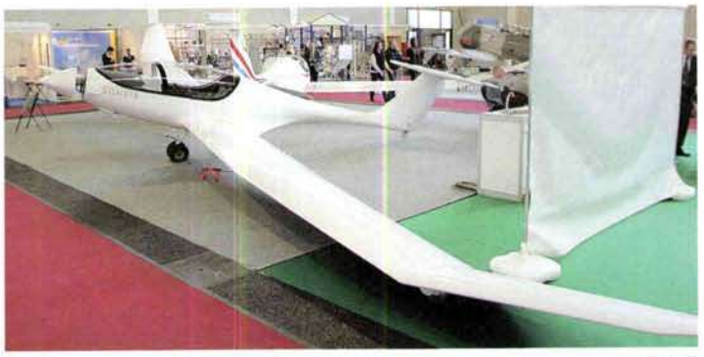
Description generally as of Sonet, except the following.

DESIGN FEATURES: Constant-chord wing centre-section; two-stage sweepback with progressively increased dihedral; rounded wingtips.

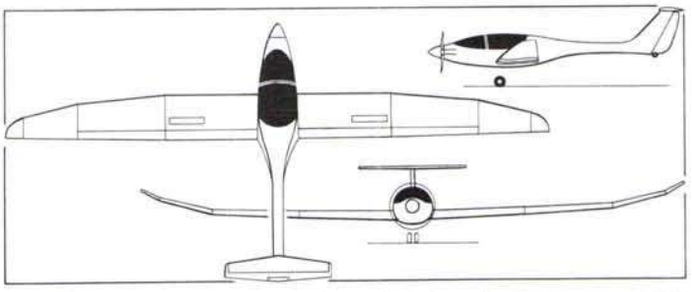
FLYING CONTROLS: Large ailerons mid-wing. Flap settings –10, 0, 10°.

LANDING GEAR: Tailwheel type. Fixed, solid tailwheel; narrow track mainwheels retract rearwards on cantilever legs with compressed rubber shock-absorbers. Fixed outrigger wheels.

POWER PLANT: One 36.8 kW (49.3 hp) Hirth F23 two-cylinder piston engine driving a Jirasek two-blade, fixed-pitch propeller. Two fuel tanks in wings; total capacity 52 litres (13.7 US gallons; 11.4 Imp gallons).



Airsport Sonáta motor glider *(Paul Jackson)* 1127786



Airsport Sonáta (Hirth F23 two-cylinder engine) *(James Goulding)* 1127533

DIMENSIONS, EXTERNAL:

Wing span	15.05 m (49 ft 4½ in)
Length overall	6.80 m (22 ft 3¾ in)
Height overall	1.45 m (4 ft 9 in)

AREAS:

Wings, gross	14.30 m² (153.9 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	278 kg (613 lb)
Max T-O weight	450 kg (992 lb)

PERFORMANCE (powered):

Never-exceed speed (VNE)	106 kt (198 km/h; 123 mph)
Stalling speed	30 kt (55 km/h; 35 mph)
Max rate of climb at S/L	120 m (394 ft)/min

PERFORMANCE (unpowered):

Stalling speed, flaps down	36 kt (65 km/h; 41 mph)
Best glide ratio	35
Min rate of sink	0.80 m (2.62 ft)/s

ATEC

ATEC V.O.S

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PRODUCTION DIRECTOR: Petr Volejník
SALES DIRECTOR: Jan Franěk

ATEC was formed in 1992 to develop, manufacture and sell ultralight aircraft. Its most recent product, the single-seat Solo, was launched in 2005. In late 2005, the company employed 20 in its 800 m² (8,610 sq ft) factory.

ATEC ZEPHYR and FAETA

TYPE: Side-by-side ultralight/kitbuilt.

PROGRAMME: Prototype Zephyr (OK-CUA 01). First flown 1996; production started the following year.

CURRENT VERSIONS: **Zephyr:** Original version, no longer available; 10.60 m (34 ft 9¼ in) wing span and 59.6 kW (79.9 hp) Rotax 912 UL engine.

Zephyr 2000: Introduced April 2001; C suffix indicates change to new shape all-carbon composites fuselage construction; shorter wing and tail spans.

Description below applies to Zephyr 2000C.

ATEC 212 Solo: Single-seat version. Prototype (OK-FUH 01) made initial flight 29 October 2000. Not proceeded with.

ATEC 321 Faeta: Maiden (OK-IUG 15) flight in February 2003; introduced at Aero '03, Friedrichshafen, April 2003. As Zephyr, but wholly of carbon fibre, including new, tapered wing with constant sweepback, differently proportioned ailerons and slotted flaps. Two-blade ground adjustable Fiti propeller and ballistic parachute. Generally as Zephyr unless otherwise indicated.

ATEC Zephyr 2000 being promoted for US LSA category *(Paul Jackson)* 1159060

ATEC 321 Faeta carbon fibre ultralight *(Paul Jackson)* 1121665

CUSTOMERS: Over 160 all versions (including some 50 kits) built and sold by April 2006. Exported to Australia, Belgium, Canada, China, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Lithuania, Netherlands, New Zealand, Norway, Portugal, South Africa, Spain, Sweden, Ukraine and the US.

COSTS: Zephyr 2000: EUR44,900 with Rotax 912 UL; EUR46,900 with Rotax 912 ULS (2005); Faeta: EUR52,500 with Rotax 912 UL; EUR54,500 with Rotax 912 ULS (2005) all flyaway, excluding tax. Zephyr kit (excluding engine) EUR27,790; fast-build kit EUR22,990 extra (2006).

DESIGN FEATURES: Low-wing monoplane with T tail. Wing section UA-2 laminar flow on Zephyr 2000 and SM 701 on Faeta. Meets LSA requirements where 550 kg (1,212 lb) MTOW acceptable.

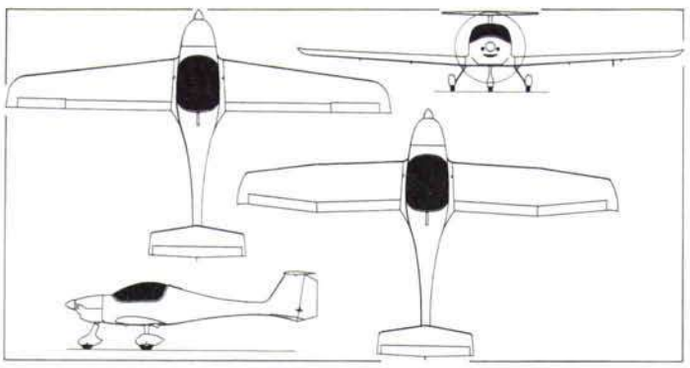
FLYING CONTROLS: Conventional and manual; spring trim. Electric flaps and elevator trim optional. Dual controls.

STRUCTURE: *Zephyr 2000:* Fuselage of carbon reinforced by wooden and hardened foam bulkheads; wing leading-edge of glass fibre sandwich; horizontal tail, wingtips, elevator, rudder, mainwheel legs and engine cowlings of glass fibre composites. Laminated hardwood wing main spar. Chromoly steel wing fittings; welded chromoly wing centre-section. Wing and horizontal tail trailing-edge of fabric-covered wood.

Faeta: Fuselage as Zephyr, with carbon, hardened foam and honeycomb sandwich reinforcements. Carbon sandwich wing with laminated hardwood spar; fittings and centre-section as Zephyr. Honeycomb sandwich control surfaces.

LANDING GEAR: Tricycle type, fixed. Fuselage-mounted cantilever mainwheel legs. Aerodynamic composites nosewheel leg and integral wheel fairing. Castoring nosewheel. Tyres sizes 380×100 (main), 300×100 (nose); Faeta has 350×120 main tyres. Hydraulic disc brakes. Speed fairings on all three wheels.

POWER PLANT: *Zephyr 2000:* One 59.6 kW (79.9 hp) Rotax 912 UL or 73.5 kW (98.6 hp) Rotax 912 ULS flat-four engine; Fiti two- or three-blade ground-adjustable pitch propeller;



ATEC Faeta general arrangement, with extra plan view (lower) of Zephyr
0547522

optional Fiti two- or three-blade in-flight-adjustable propeller with choice of mechanical or electric control. Rotax 582 UL engine optional. Fuel capacity 60 litres (15.9 US gallons; 13.2 Imp gallons) standard, 80 litres (21.1 US gallons; 17.6 Imp gallons) optional.

Faeta: Rotax 912 UL or 912 ULS. Fuel capacity 70 litres (18.4 US gallons; 15.4 Imp gallons).

ACCOMMODATION: Pilot and passenger side by side under one-piece canopy.

EQUIPMENT: Optional ballistic parachute system.

DIMENSIONS, EXTERNAL:

Wing span	9.60 m (31 ft 6 in)
Length overall	6.20 m (20 ft 4 in)
Height overall	2.00 m (6 ft 6¾ in)

AREAS:

Wings, gross	10.10 m² (108.7 sq ft)

WEIGHTS AND LOADINGS (912 ULS engine; A: Zephyr, B: Faeta):

Weight empty: A	275 kg (606 lb)
B	280 kg (617 lb)
Max T-O weight: standard	450 kg (992 lb)
with ballistic parachute	472.5 kg (1,041 lb)
where allowed	550 kg (1,212 lb)

PERFORMANCE:

Max level speed: A	132 kt (245 km/h; 152 mph)
B	138 kt (255 km/h; 158 mph)
Max cruising speed: A	116 kt (215 km/h; 133 mph)
B	124 kt (230 km/h; 143 mph)
Stalling speed, flaps down: A	36 kt (65 km/h; 41 mph)
B	33 kt (60 km/h; 38 mph)
Max rate of climb at S/L: A	390 m (1,280 ft)/min
B	420 m (1,378 ft)/min
T-O run	120 m (395 ft)
Landing run	200 m (660 ft)
Range: standard fuel	432 n miles (800 km; 497 miles)
optional fuel	594 n miles (1,100 km; 683 miles)
g limits: A	+4/–2
B	+5/–2

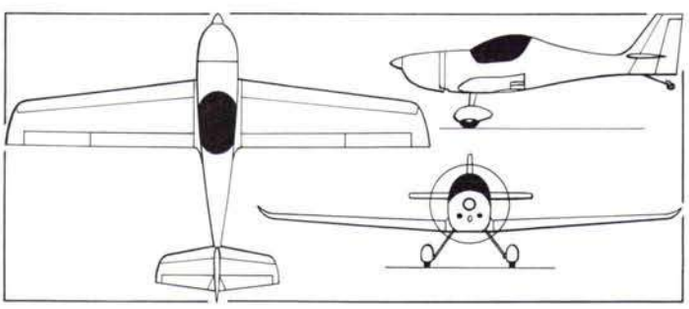
ATEC 212 SOLO

TYPE: Single-seat ultralight.

PROGRAMME: Prototype (OK-KUG 32) first flew 3 April 2005; public debut at Aero '05, Friedrichshafen, 21 to 24 April 2005.

DESIGN FEATURES: Single-seat derivative of ATEC 321 Faeta, incorporating wing of company's Faeta. Wing section SM 701.

ATEC 212 Solo at its public debut *(Paul Jackson)* 1159061



ATEC 212 Solo single-seat ultralight *(James Goulding)* 1151425

FLYING CONTROLS: Conventional and manual. Elevator and aileron actuation by pushrods; rudder by cables. Electric trim tab in elevator. Three-position, electrically-actuated, slotted flaps.

STRUCTURE: Tubular steel cockpit cage; carbon composites fuselage, reinforced with carbon bars and sandwich bulkheads. Integral empennage of carbon fibre with Nomex honeycomb. Wings constructed around laminated beech spar and carbon sandwich covering; carbon fibre ailerons.

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted, spring composites cantilever mainwheel legs with wheel fairings, 350×120 wheels and hydraulic disc brakes. Solid tailwheel.

POWER PLANT: One 48.0 kW (64.4 hp) Rotax 582 DCDI two-cylinder, liquid-cooled two-stroke. Fiti ground-adjustable pitch, two-blade propeller. Fuel tank beneath pilot, capacity 50 litres (13.2 US gallons; 11.0 Imp gallons).

DIMENSIONS, EXTERNAL:

Wing span	7.48 m (24 ft 6½ in)
Length overall	5.26 m (17 ft 3 in)
Height overall	1.53 m (5 ft 0¼ in)

AREAS:

Wings, gross	7.27 m² (78.3 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	200 kg (441 lb)
Max T-O weight	300 kg (661 lb)

PERFORMANCE:

Never-exceed speed (VNE)	157 kt (291 km/h; 180 mph)
Max level speed	146 kt (270 km/h; 168 mph)
Stalling speed: flaps up	42 kt (77 km/h; 48 mph)
flaps down	35 kt (64 km/h; 40 mph)
Max rate of climb at S/L	420 m (1,378 ft)/min
Range with max fuel	351 n miles (650 km; 403 miles)
g limits	+6/–3

CZAW

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In 1997 Zenair Ltd of Canada formed a joint venture with CZAW, established earlier that year, for manufacture in the Czech Republic of its STOL CH 701 and Zodiac CH 601 series of light aircraft. First Czech components were manufactured in 1998; by September 2003, over 500 aircraft had been produced. The STOL CH 801 and CH 2000 are now also available from CZAW. Workforce in 2005 was 130.

CZAW offers the CH 601, 701 and 801 in three different stages of completion: as a standard kit; as a factory-jigged, fast-build kit; and in full flyaway form with Rotax 912 engine, avionics, instruments and two-tone paint finish. A total of 85 CH 701s, with options for 48 more, was ordered by the Indian National Cadet Corps in late 2000 for the training of Indian Air Force pilots. Development was completed in late 1998 of a modified CH 701 for ULV agricultural applications. A Zodiac floatplane, flown by CZAW's CEO, won the 1999, 2001 and 2003 Schneider Cup seaplane races. Additionally, CZAW is European agent for the AMD CH 2000 and also offers upgraded and refurbished Lake Buccaneer and Renegade 2 amphibians.

A new design, the Mermaid, was unveiled at Sun 'n' Fun in April 2004; it was followed in 2005 by the Parrot and in 2006 by the Sport Cruiser, giving CZAW three aircraft optimised for the US LSA category.

CZAW produces a complete line of wheeled and non-wheeled aircraft floats, with displacements ranging from 250 to 1,000 kg (551 to 2,205 lb), suitable for such aircraft as the GlaStar, Kitfox, Zenair and Van's types. 'Jump-start' wings, ailerons, flaps and tail surfaces for the GlaStar kitplane are also manufactured.

CZAW MERMAID

TYPE: Two-seat amphibian ultralight/kitbuilt.

PROGRAMME: First flight (OK-JUR 99) 11 March 2004; initially known as CZAW Lake Sport Mermaid. Following preliminary testing, shipped to Lakeland, Florida, for public debut at Sun 'n' Fun, 13–19 April 2004. Flight testing (reregistered N599MM) was due for completion by end of 2004 and revealed need for several modifications, some of which applied to prototype, including cruciform empennage.

These embodied in first production aircraft, flown at Borsice on 3 May 2005 and transferred to US for exhibition at AirVenture, Oshkosh, July 2005. Changes included new wing aerofoil section; increased wing span, with upturned tips; wing incidence increased from 1 to 3°; 40 per cent larger ailerons; 5 cm (2 in) deeper hull; step moved 20 cm (8 in) to rear; rear fuselage angle raised 3°; vortex generators around rear of canopy; fin extension above tailplane; and four- (replacing three-) blade propeller.

LSA approval received February 2006; LSA exemption for retractable landing gear granted 4 April 2006.

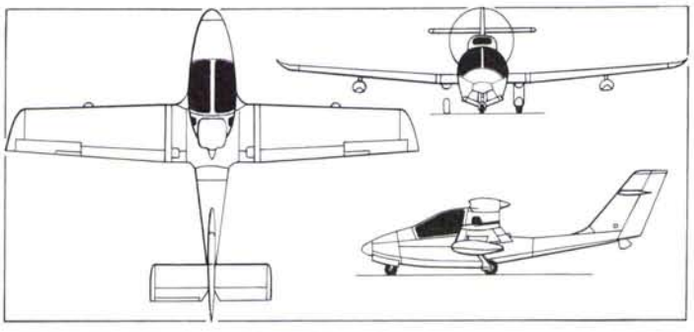
CUSTOMERS: More than 30 sold by April 2004 and over 100 by late 2005. Deliveries were scheduled to begin in first quarter of 2005, but were delayed by need for extensive modifications to design.

COSTS: USD85,000 E-LSA or USD87,500 S-LSA Rotax engine; USD88,500 E-LSA or USD91,000 S-LSA Jabiru engine; all flyaway. Kit minus engine USD45,500 (Experimental). (All 2006.)

DESIGN FEATURES: Intended as roomy, low-cost amphibian designed specifically to meet US LSA criteria and with useful range and dual controls.

Water trials of first production CZAW Mermaid

1158015



CZAW Lake Sport Mermaid *(James Goulding)*

1158034

Mid-wing configuration; constant-chord wings with stabilising floats at half span; cruciform empennage. Wings removable to reduce width of airframe for storage or transport; folding wing option to be added. Pusher propeller above and behind cockpit; retractable water rudder at rear of single-step hull. Five hull compartments, each watertight and with bilge pump socket in port wing, adjacent to cockpit. Quoted build time 400 hours.

Dihedral 5° (except centre-section); incidence 3°.

FLYING CONTROLS: Conventional and manual. Flight-adjustable trim tabs in elevator and starboard aileron. Fowler flaps; deflections 20 and 40°. Aileron trim optional. Control surface deflections: ailerons +28/–18°; elevator ±25°; rudder ±30°.

STRUCTURE: Aluminium alloy throughout, except for rubber nosecone. Full zinc chromate coating.

LANDING GEAR: Tricycle type; retractable. Mainwheels retract hydraulically (manual; electro-hydraulic option) rearward into wing, tread protruding through port in upper wing surface and visible from cockpit rear quarterlights. Nosewheel retracts forward and is steerable. Mainwheels size 14×4 with hydraulic brakes; nosewheel 4.00×4. Rubber-in-compression shock-absorbers throughout, with twin units on each mainwheel leg. Tail bumper. Retractable water rudder.

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS flat-four driving a Warp Drive three-blade, ground-adjustable pitch, carbon fibre propeller. Optionally, one 84.5 kW (113.3 hp) Rotax 914. Trial 89 kW (120 hp) Jabiru 3300 installation completed for trials in early 2006.

Fuel tanks in wing leading-edge, total capacity 100 litres (26.4 US gallons; 22.0 Imp gallons).

ACCOMMODATION: Two persons, side by side, beneath forward-hinged, single-piece canopy; dual controls. Baggage space to rear, above and below main spar.

AVIONICS: VFR instrumentation standard.

EQUIPMENT: Portable, hand-operated bilge pump. Optional BRS ballistic recovery parachute and landing light in starboard wing leading-edge.

DIMENSIONS, EXTERNAL:

Wing span	10.16 m (33 ft 4 in)
Wing aspect ratio	7.8
Length overall	7.635 m (25 ft 0½ in)
Height overall	2.61 m (8 ft 6¾ in)
Tailplane span	3.02 m (9 ft 11 in)
Wheel track	1.83 m (6 ft 0 in)
Propeller diameter	1.50 m (4 ft 11 in)

DIMENSIONS, INTERNAL:

Cabin max width	1.17 m (3 ft 10 in)
Baggage volume	0.23 m³ (8.1 cu ft)

AREAS:

Wings, gross	12.50 m² (134.5 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	377 kg (832 lb)
Max T-O weight	639 kg (1,410 lb)
Max wing loading	51.1 kg/m² (10.47 lb/sq ft)
Max power loading	8.70 kg/kW (14.30 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	135 kt (250 km/h; 155 mph)
Cruising speed (design)	107 kt (198 km/h; 123 mph)
Stalling speed: flaps up	44 kt (80 km/h; 50 mph)
flaps down	38 kt (71 km/h; 44 mph)
Max rate of climb at S/L	300 m (984 ft)/min
T-O run: on land	137 m (450 ft)
on water	229 m (755 ft)
Landing run: on land, water	152 m (500 ft)
Range	432 n miles (800 km; 497 miles)
Endurance	4 h 30 min
g limits	+4/–2

CZAW PARROT

TYPE: Two-seat lightplane; side-by-side kitbuilt.

PROGRAMME: Prototype first flew (OK-KUR 20) 15 June 2005, then immediately shipped to US (N599PP assigned) for further trials and debut at AirVenture, Oshkosh, 25 to 31 July 2005. Initial deliveries (beginning N595PP) then scheduled for second quarter of 2006. LSA approval granted January 2006.

CURRENT VERSIONS: **LSA:** *As described.*

Experimental: Proposed version for higher weight category; 93 kW (125 hp) or similar engine; cruising speed 130 kt (241 km/h; 150 mph); range unaltered.

COSTS: USD75,500 flyaway with Rotax engine or USD78,500 with Jabiru; USD39,500 fast-build kit, plus USD20,890 for full Rotax engine kit. (All 2006.)

DESIGN FEATURES: Optimised for US LSA category, but also suitable for Experimental category. Crew envisaged as each weighing 113 kg (250 lb) and 1.88 m (6 ft 2 in) tall.

High wing immediately behind cockpit; conical section rear fuselage with sweptback fin and low tailplane with sweptback leading-edge.

Wing sweepforward 7° at main spar; 5° at leading-edge.

FLYING CONTROLS: Conventional and manual. Horn-balanced rudder; single-piece elevator; flight-adjustable trim tabs in elevator and port aileron. Electrically actuated flaps.

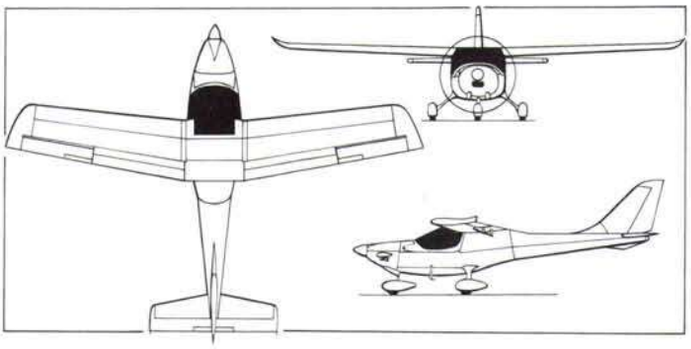
STRUCTURE: Generally of riveted aluminium.

LANDING GEAR: Tricycle type; fixed. All tyres 5.00-5. Steerable nosewheel. Optional wheel fairings. Optional floats.

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS flat-four driving a three-blade, carbon fibre, ground-adjustable pitch propeller. Optionally, one 89 kW (120 hp) Jabiru 3300

CZAW Parrot first production aircraft

1158017



CZAW Parrot, optimised for US LSA category *(James Goulding)* 1151448

flat-six; and choice of two-blade manual or electric in-flight adjustable pitch propellers. Two wing fuel tanks, standard combined capacity 100 litres (26.4 US gallons; 22.0 Imp gallons). Optional long range wing tanks.

ACCOMMODATION: Two persons side-by-side beneath forward-hinged, single-piece canopy/windscreen. Large baggage area behind seats.

EQUIPMENT: Optional BRS ballistic recovery parachute.

DIMENSIONS, EXTERNAL:

Wing span	9.495 m (31 ft 1¾ in)
Length overall	7.10 m (23 ft 3½ in)
Height overall	2.58 m (8 ft 5½ in)
Tailplane span	2.90 m (9 ft 6¼ in)
Wheel track	2.04 m (6 ft 8¼ in)
Wheelbase	1.65 m (5 ft 5 in)
Propeller diameter	1.77 m (5 ft 9¾ in)

DIMENSIONS, INTERNAL:

Cabin max width	1.15 m (3 ft 9¼ in)
Baggage volume	0.62 m³ (22.0 cu ft)

AREAS:

Wings, gross	11.40 m² (122.7 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	360 kg (794 lb)
Max T-O weight	598 kg (1,320 lb)

PERFORMANCE:

Never-exceed speed (VNE)	135 kt (250 km/h; 155 mph)
Cruising speed at 75% power	99 kt (185 km/h; 115 mph)
Stalling speed: flaps up	34 kt (63 km/h; 40 mph)
flaps down	31 kt (56 km/h; 35 mph)
Max rate of climb at S/L	480 m (1,575 ft)/min
T-O run	120 m (394 ft)
T-O to 15 m (50 ft)	225 m (740 ft)
Landing run	120 m (394 ft)
Range at cruising speed	479 n miles (888 km; 551 miles)
Endurance	4 h 30 min
g limits	+6/-4

CZAW SPORT CRUISER

TYPE: Side-by-side lightplane/kitbuilt.

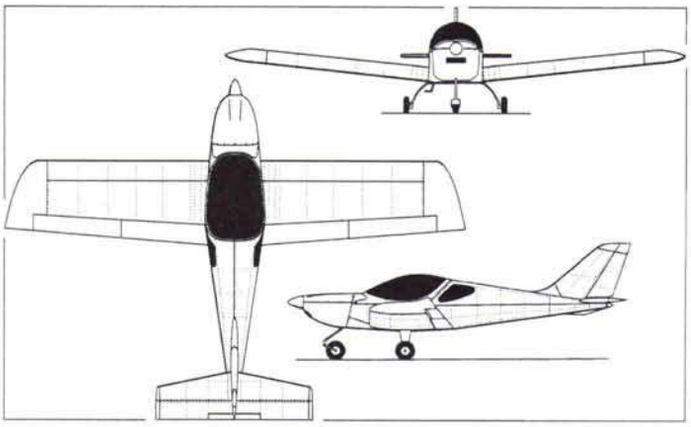
PROGRAMME: Announced January 2006 when prototype believed already flying; LSA approval granted March 2006; public debut at Sun 'n' Fun, Lakeland, Florida, 4 to 10 April 2006 when US demonstrator (N595SC c/n 002) displayed flying and sixth aircraft statically.

COSTS: USD65,000 flyaway; kit USD32,000, excluding engine (2006).

DESIGN FEATURES: Optimised for US S-LSA criteria and as Experimental homebuilt. Low wing with unswept leading edge and sweptforward trailing edge; sweptback fin with small fillet; and low tailplane.

FLYING CONTROLS: Conventional and manual. Balanced ailerons with tab in starboard unit; single-piece elevator with large trim/anti-balance tab; full-height, balanced rudder. Plain flaps.

STRUCTURE: Generally of metal, with composites wingtips.



CZAW Sport Cruiser general arrangement 1158033

LANDING GEAR: Nosewheel type; fixed. Fuselage-mounted, cantilever spring mainwheel legs with hydraulic brakes; trailing link, castoring nosewheel on metal tube cantilever leg; all tyres 4.00-6.

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS flat-four driving a three-blade, carbon fibre, ground-adjustable pitch propeller as standard. Options include 89 kW (120 hp) Jabiru 3300 flat-six; and Woodcomp three-blade fixed-pitch wooden propeller, ground-adjustable, composites Sensenich two-blade and Sport Prop three-blade propellers and in-flight adjustable equivalents. Fuel in two wing tanks, combined capacity 114 litres (30.1 US gallons; 25.1 Imp gallons).

ACCOMMODATION: Two persons side by side beneath single-piece, forward-hinged canopy/windscreen; small side windows.

SYSTEMS: Electrical system; 12 V.

AVIONICS: Basic flight instruments standard. Communications and navigation options to customer's requirements.

DIMENSIONS, EXTERNAL:

Wing span	8.50 m (27 ft 10¾ in)
Wing aspect ratio	6.1
Length overall	7.00 m (22 ft 11½ in)

DIMENSIONS, INTERNAL:

Cabin max width	1.14 m (3 ft 8¾ in)

AREAS:

Wings, gross	11.80 m² (127.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty (Rotax 912 ULS)	307 kg (677 lb)
Max T-O weight	598 kg (1,320 lb)
Max wing loading	50.7 kg/m² (10.39 lb/sq ft)
Max power loading	8.15 kg/kW (13.39 lb/hp)

PERFORMANCE (Rotax 912 ULS engine):

Never-exceed speed (VNE)	139 kt (258 km/h; 160 mph)
Cruising speed at 75% power	108 kt (201 km/h; 125 mph)
Stalling speed: flaps up	33 kt (61 km/h; 38 mph)
flaps down	30 kt (55 km/h; 35 mph)
Max rate of climb at S/L	360 m (1,181 ft)/min
T-O run	105 m (345 ft)
T-O to 15 m (50 ft)	210 m (690 ft)
Landing run	120 m (395 ft)
Range at cruising speed	478 n miles (886 km; 550 miles)
Endurance	5 h

CZAW (ZENAIR) CH 701-AG STOL

TYPE: Agricultural sprayer.

PROGRAMME: Developed by CZAW following cessation of Zenith production of a dedicated agricultural version. The CH 701-SP with 500 kg (1,100 lb) maximum take-off weight has been added to the range, while the standard CH 701 is also available.

COSTS: CH 701 kit USD12,980, ready to fly USD40,500; CH 701-AG USD50,000 ready-to-fly (all 2004).

Demonstration flight by CZAW Sport Cruiser at its public debut in April 2006 *(Paul Jackson)* 1158018

DESIGN FEATURES: STOL performance, plus ULV crop treatment system optimised for low cost and precise application.

Differences from basic, US-fabricated CH 701 as follows:

EQUIPMENT: Spray Miser ULV crop treatment system, comprising 113.6 litre (30.0 US gallon; 25.0 Imp gallon) belly tank and 12 wind-driven rotary atomisers with controlled droplet application. Hydraulic nozzles produce droplet sizes varying from 1 to 500 microns in size. Electrically powered pump (12 V DC), with remotely controllable on/off switch, can deliver liquid at up to 30.3 litres (8.0 US gallons; 6.7 Imp gallons)/min. Tank has emergency dump facility.

WEIGHTS AND LOADINGS:

Weight empty, equipped	270 kg (595 lb)
Max T-O weight	450 kg (992 lb)

PERFORMANCE:

Application speed range	39–65 kt (72–121 km/h; 45–75 mph)
Max rate of climb at S/L	305 m (1,000 ft)/min
Swath width	9.1–30.5 m (30–100 ft)
Range	217 n miles (402 km; 250 miles)

DF

DIRECT FLY

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Web: www.ultralights.cz

Direct Fly is marketing several versions of its Alto in Italy via local Aviomarche company.

DF ALTO

TYPE: Two-seat lightplane; side-by-side ultralight/kitbuilt.

PROGRAMME: Prototype, with tailwheel and Jabiru engine, registered I-8039; nosewheel prototype first flew 2 September 2006.

CURRENT VERSIONS: **Alto 912 UL TW:** Rotax 912 UL engine and tailwheel landing gear.
Alto 912 UL TG: Rotax 912 UL engine and tricycle landing gear.
Alto 912 ULS TW/TG: Rotax 912 ULS and landing gear options.
Alto 2200 TW/TG: Jabiru 2200 and landing gear options.
Alto 3300 TW/TG: Jabiru 3300 and landing gear options.

DESIGN FEATURES: Low-mounted, constant-chord wing and tailplane; sweptback fin. Quoted kit build time 160 hours.

FLYING CONTROLS: Conventional and manual. Flaps.

DF Alto nosewheel version 1158841

STRUCTURE: Metal throughout. Rectangular fuselage cross-section, rounded above and connected with reinforcing struts. Glass fibre engine cowling.

LANDING GEAR: Fixed. Nosewheel or tailwheel type. Fuselage-mounted, spring composites cantilever mainwheel legs. Mainwheels and optional nosewheel size 400×120.

POWER PLANT: Engine options comprise 58.8 kW (78.9 hp) Rotax 912 UL; 73.5 kW (98.6 hp) Rotax 912 ULS; 74.6 kW (100 hp) Jabiru 2200; and 89.5 kW (120 hp) Jabiru 3300. Three-blade propeller on geared Rotax 912 ULS version; two-blade propeller on Jabiru 3300 version. Fuel capacity 105 litres (27.7 US gallons; 23.1 Imp gallons) in all versions.

ACCOMMODATION: Two persons, side by side beneath single-piece canopy/windscreen.

EQUIPMENT: Optional ballistic recovery parachute.

DIMENSIONS, EXTERNAL:

Wing span	7.77 m (25 ft 6 in)
Wing aspect ratio	6.0
Length overall	6.50 m (21 ft 4 in)
Height overall	2.20 m (7 ft 2½ in)

DIMENSIONS, INTERNAL:

Cockpit max width	1.06 m (3 ft 5¾ in)

AREAS:

Wings, gross	10.14 m² (109.1 sq ft)

WEIGHTS AND LOADINGS:

Weight empty (912 ULS)	295 kg (650 lb)
Max T-O weight: Ultralight	450 kg (992 lb)
Ultralight with BRS	472.5 kg (1,041 lb)
LSA	598 kg (1,320 lb)
Max wing loading, LSA	59.1 kg/m² (12.10 lb/sq ft)
Max power loading, LSA, J 3300	6.70 kg/kW (11.00 lb/hp)

PERFORMANCE (Rotax 912 ULS):

Never-exceed speed (VNE)	145 kt (270 km/h; 167 mph)
Max level speed	132 kt (245 km/h; 152 mph)
Cruising speed at 75% power	97 kt (180 km/h; 112 mph)
Stalling speed, flaps down:	
with BRS	36 kt (65 km/h; 41 mph)
LSA	41 kt (76 km/h; 48 mph)
Max rate of climb at S/L: with BRS	312 m (1,024 ft)/min
LSA	282 m (925 ft)/min
T-O run	85 m (280 ft)
Landing run, without braking	150 m (495 ft)
g limits: with BRS	+5.2/–2.6
LSA	+4.0/–2.0

Prototype DF Alto, with tailwheel and Jabiru engine 1158840

For details of the latest updates to *Jane's All the World's Aircraft* online and to discover the additional information available exclusively to online subscribers please visit
jawa.janes.com

DOVA

DOVA AIRCRAFT CZ

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DOVA DV-1 SKYLARK

TYPE: Two-seat lightplane; side-by-side ultralight.

PROGRAMME: Designed and built in Canada as private project by Dr David Marsden, professor emeritus of Alberta University, whose previous aircraft have included Bushmaster, ARV Griffin, Westwind (ultralight), Gold Finch, and Gemini and Sigma sailplanes. Design began January 1999; prototype Skylark CL3 (C-GFMZ) first flew 10 March 2000; shortly after, tested with single, then double winglets on each tip; exhibited at AirVenture, Oshkosh, July 2001; reverted to single winglet, as shown one year later.

Dova obtained production rights in 2002. Czech ultralight type certificate awarded 19 October 2005. North American marketing by Sportsplanes of Draper, Utah, began at Sun 'n' Fun, Lakeland, Florida, April 2006.

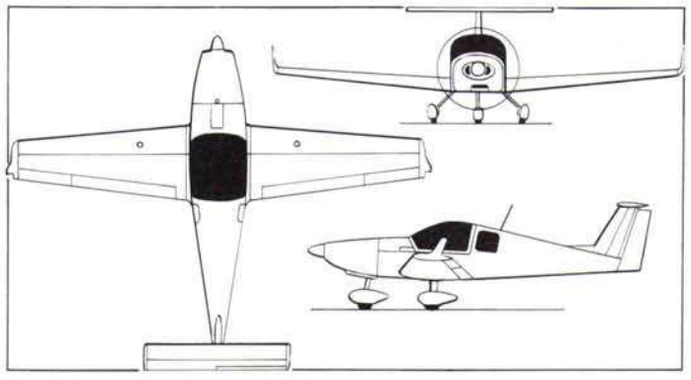
CURRENT VERSIONS: **Ultralight:** Available to various nationalities' ultralight max T-O weights.
LSA: Light Sport Aircraft to US specification and weight.

CUSTOMERS: Several produced in Czech Republic prior to North American launch.

DESIGN FEATURES: Low, tapered wing with winglets; sweptback fin and T tail. Prototype had Frise flaperons deflecting 20° for landing and up 10° for cruising.

Laminar flow wing of IARV 419 section designed by Dr Marsden for docile stall characteristics and continued good performance despite insect or rain contamination; dihedral 5°.

FLYING CONTROLS: Conventional and manual. Balanced control surfaces; trim tab in starboard side of elevator. Actuation by cables (rudder) and pushrods; electric trim tab. Plain flaps deflect 0, 10 and 40°.



DOVA DV-1 Skylark *(James Goulding)* 1158781

STRUCTURE: Generally 6061-T6 aluminium structure with 2024-T3 control surfaces, plus composites winglets, engine cowling and mainwheel legs. Wing has channel-type spar at 38 per cent chord and six stamped ribs; bolted to fuselage carry-through spar. Fuselage of semi-monocoque, with three formers aft of cockpit.

LANDING GEAR: Tricycle type; fixed. Hydraulic mainwheel brakes. Wheel fairings.

POWER PLANT: Typically one 73.5 kW (98.6 hp) Rotax 912S liquid-cooled flat-four driving a Kaspar, three-blade, ground-adjustable pitch propeller. Alternatively, 59.6 kW (79.9 hp) Rotax 912, 84.5 kW (113.3 hp) Rotax 914, or 72.3 kW (96.6 hp) BMW R1100. Fuel in two wing tanks, combined capacity 90 litres (23.8 US gallons; 19.8 Imp gallons).

ACCOMMODATION: Two persons, side by side, beneath single-piece, forward-hinged canopy/windscreen; rear window each side. Sliding canopy for LSA version.

EQUIPMENT: Galaxy GRS 450 B-2 ballistic recovery parachute.

DIMENSIONS, EXTERNAL:

Wing span over winglets	8.165 m (26 ft 9½ in)
Wing chord: at root	1.485 m (4 ft 10½ in)
at tip	0.775 m (2 ft 6½ in)
Wing aspect ratio	7.1
Length overall	6.625 m (21 ft 8¾ in)
Height overall	2.29 m (7 ft 6¼ in)
Tailplane span	2.865 m (9 ft 4¾ in)
Wheel track	1.755 m (5 ft 9 in)
Wheelbase	1.365 m (4 ft 5¾ in)
Propeller diameter	1.62 m (5 ft 3¾ in)
Propeller ground clearance	0.28 m (11 in)

DIMENSIONS, INTERNAL:

Cabin max width	1.09 m (3 ft 7 in)

AREAS:

Wings, gross	9.44 m² (101.6 sq ft)
Vertical tail surface	1.47 m² (15.82 sq ft)
Horizontal tail surface	1.02 m² (10.98 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	280 kg (617 lb)
Max baggage weight	25 kg (55 lb)
Max T-O weight: UL	450 kg (992 lb)
UL with parachute	472.5 kg (1,041 lb)
AULA	550 kg (1,212 lb)
LSA	598 kg (1,320 lb)
Max wing loading, LSA	63.3 kg/m² (12.99 lb/sq ft)
Max power loading, LSA, Rotax 912S	8.15 kg/kW (13.39 lb/hp)

PERFORMANCE (Rotax 912S engine):

Never-exceed speed (VNE)	151 kt (280 km/h; 174 mph)
Max level speed	130 kt (240 km/h; 149 mph)
Cruising speed at 75 % power	113 kt (210 km/h; 130 mph)
Stalling speed: flaps up	43 kt (79 km/h; 50 mph)
flaps down	35 kt (64 km/h; 40 mph)
Max rate of climb at S/L	480 m (1,574 ft)/min
Service ceiling	3,650 m (11,980 ft)
T-O run	152 m (500 ft)
Landing run	162 m (530 ft)
Range at 60% power, with 45 min reserves	540 n miles (1,000 km; 621 miles)
g limits: UL	+4/–2
LSA	+6/–3

DOVA DV-1 Skylark operating as a Czech ultralight 1128994

EVEKTOR

EVEKTOR-AEROTECHNIK AS

(a division of Evektor spol s.r.o.)

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The Evektor Group aircraft design office (workforce 150 in 1999) was formed in 1991, a major part of its initial work consisting of contribution to the designs of the L 159 and Ae 270 Ibis under contract to Aero Vodochody. On 2 February 1996 it acquired a 100 per cent

shareholding in Aerotechnik CZ, and in 1996–97 the two companies (now a single joint-stock company) developed and delivered preseries and test front fuselage components of the L 159 to Aero.

Aerotechnik was formed on 1 January 1970, originally as an enterprise of the former Czechoslovak defence organisation Svazarm. Its first aircraft programmes involved single- and two-seat rotorcraft such as the A-70, later diversifying into overhaul and maintenance of a range of Czech general aviation aircraft, including the Zlin family, L-13 Vivat and L-60 Brigadyr. Two facilities, at Kunovice and Moravská Třebová, had a combined floor space of 7,340 m² (79,000 sq ft). The combined Evektor-Aerotechnik workforce totalled 400 in mid-2003.

In 1996, Aerotechnik produced kits for the P 220 UL Koala development of the Pottier P 220 S Koala, powered by its own Mikron III engine of which 35 aircraft and seven kits were produced by 1999, at which time the design was further developed into the EV-97 Eurostar with a Rotax 912 UL engine, and became the first aeroplane to bear the Evektor name. A VLA version of the Eurostar, the Harmony, followed in 2001, and an LSA version, the SportStar, in 2003.

During 1999-2000, Evektor-Aerotechnik assisted in early stages of the Wolfsberg Raven 257 programme, including assembly of the prototype; this aircraft was subsequently transferred to Wolfsberg Letov. A separate joint venture was formed in October 1999 with GAIC of China, leading to establishment in June 2000 of Guizhou Evektor Aircraft Corporation for local production, sales and support of Evektor-Aerotechnik aircraft in that country. The first EV-97 CKD kit for Chinese assembly was delivered in August 2000. This arrangement superseded that previously agreed for Guizhou to become a licensed production centre for the Raven 257. Chinese EV-97 programme has been directed towards a UAV version, as revealed in early 2006.

In 2001, Evektor-Aerotechnik, in collaboration with the Aerospace Research Centre and Institute of Aerospace Engineering of Brno Technical University, began development of the VUT 100 Cobra which first flew on 11 November 2004. This was followed in 2003 by the EV-55 project, for which a first flight in mid-2007 is projected.

As well as aircraft design, Evektor also produces styling and stress analysis to the automotive and light engineering industries, including Stihl chainsaws.

EVEKTOR EV-97 TEAMEUROSTAR

TYPE: Side-by-side ultralight/kitbuilt.

PROGRAMME: Developed as P 220 UL from Pottier P 220 S Koala; extensive redesign started in September 1996; prototype (OK-CUR 97), then known as Eurostar, made first flight May 1997; first customer delivery October 1997. Certified as ultralight in Belgium, Czech Republic, Finland, France, Germany, Italy, Slovak Republic, Spain, Switzerland and United Kingdom. First UK-built example (G-NIDG, by distributor Cosmik Aviation) flown in April 2000. Local assembly in China by Guizhou Evektor Aircraft Corporation (GEAC); first flight by Chinese-assembled EV-97, 24 October 2000; this agreement ended 2005 and aircraft now sold direct, although a Chinese UAV has been developed.

CURRENT VERSIONS: **Eurostar 2000:** Introduced late 1999, replacing Eurostar Model 99. Increased fuselage width (4 cm; 1 in); modified wingtips and increased span; larger ailerons; steerable nosewheel; flush, oval nose air intake. Available factory-built or as kit.

teamEurostar 2001: Further-improved version, introduced in early 2001; choice of Rotax 912 UL or more powerful 912 ULS engine. Name changed to avoid conflict with Eurostar France-UK rail link.

teamEurostar 2002: Further improved version meeting Sport Pilot NRPM in USA.

teamEurostar 2005: Further improvements incorporated, including optional electric flaps and new cockpit layout; *as described.*

CUSTOMERS: More than 500 (all versions) ordered, including 36 Model 2000, of which 470 were flying by August 2005. Customers in Belgium, Czech Republic, Estonia, Finland, France, Germany, Ireland, Italy, Netherlands, Poland, Portugal, Russia, Slovak Republic, Spain, Sweden, UK, Ukraine and USA.

COSTS: EUR52,000 excluding taxes (2006).

DESIGN FEATURES: Low-wing monoplane; modified NACA 4415 aerofoil section; dihedral 3°. Wing folding optional.

FLYING CONTROLS: Conventional and manual. Dual controls, rod-operated ailerons and elevator. Four-position (0/15/30/50°) mechanically operated split flaps; electrical operation optional. Elevators, starboard aileron and rudder have trim tabs.

STRUCTURE: Fuselage, wings and empennage of anodised, corrosion-proofed aluminium, riveted and bonded; wingtips, cowling and mainwheel legs in GFRP.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted cantilever mainwheel legs. Hydraulic mainwheel disc brakes and (in current version) steerable nosewheel. Wheel sizes 350×140 (main), 300×100 (nose). Optional wheel fairings or mudguards. Optional floats and skis.

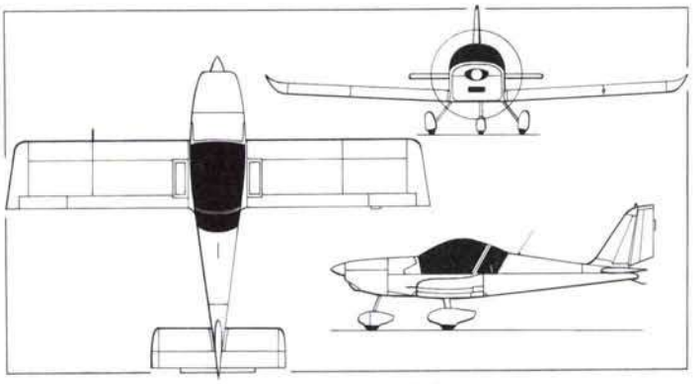
POWER PLANT: One 59.6 kW (79.9 hp) Rotax 912 UL flat-four engine standard, with VZLU V230C two-blade, fixed-pitch wooden propeller; 73.5 kW (98.6 hp) Rotax 912 ULS and V534BD-UL three-blade, constant-speed (hydraulic), wooden propeller optional. Jabiru 2200 also optional. Fuel capacity 70 litres (18.5 US gallons; 15.4 Imp gallons) of which 65 litres (17.2 US gallons; 14.3 Imp gallons) are usable.

ACCOMMODATION: Front-hinged, upward-opening canopy, with additional transparency aft of rear frame. Space for 15 kg (33 lb) of baggage aft of seats. Early versions had canopy/rear transparency break line further forward. Optional replacement of rear transparency by metal fairing and bulged cabin sides.

SYSTEMS: 12 V (battery) electrical system.

AVIONICS: To customer's specification.

EQUIPMENT: Optional ballistic parachute, wing-folding mechanism and aero-tow hook.



EV-AT EV-97 teamEurostar 2001 two-seat ultralight *(James Goulding)* 0059970

Evektor EV-97 teamEurostar *(Paul Jackson)* 1159062

DIMENSIONS, EXTERNAL:

Wing span	8.10 m (26 ft 7 in)
Length overall	5.98 m (19 ft 7½ in)
Fuselage max width	1.04 m (3 ft 5 in)
Height overall	2.34 m (7 ft 8¼ in)
Wheel track	1.60 m (5 ft 3 in)
Wheelbase	1.40 m (4 ft 7 in)

DIMENSIONS, INTERNAL:

Cabin max width: standard	1.04 m (3 ft 5 in)
optional	1.18 m (3 ft 10½ in)

AREAS:

Wings, gross	9.84 m² (105.9 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	262 kg (578 lb)
Max T-O weight	450 kg (992 lb)[1]

[1] *480 kg (1,058 lb) permitted in Slovak Republic and United Kingdom*

PERFORMANCE (at 450 kg; 992 lb MTOW. A: Rotax 912 UL engine, B: Rotax 912 ULS):

Never-exceed speed (VNE):	
A, B	145 kt (270 km/h; 167 mph) IAS
Max level speed: A	121 kt (225 km/h; 139 mph) IAS
B	132 kt (245 km/h; 152 mph) IAS
Max cruising speed: A	97 kt (180 km/h; 112 mph) IAS
B	108 kt (200 km/h; 124 mph) IAS
Stalling speed, flaps down:	
A, B	36 kt (65 km/h; 41 mph) CAS
Max rate of climb at S/L: A	330 m (1,083 ft)/min
B	480 m (1,574 ft)/min
Service ceiling: A, B	5,000 m (16,400 ft)
T-O run: A	145 m (475 ft)
B	100 m (330 ft)
Landing run: A, B	200 m (660 ft)
Max range, standard fuel:	
A, B	432 n miles (800 km; 497 miles)
g limits: A, B	+6/−3

OPERATIONAL NOISE LEVELS:

To German LSL Chapter 6	60 dBA

EVEKTOR HARMONY

TYPE: Two-seat lightplane.

PROGRAMME: Revealed (then called EV-97 VLA) 1999; renamed Harmony and made first flight (OK-VLA) 6 April 2001; certification to JAR-VLA standard achieved 13 January 2003, but no known production up to mid-2006, despite continuing promotion.

COSTS: EUR79,900 to EUR95,490 (excluding VAT), depending upon avionics fit (2003).

DESIGN FEATURES: Heavier/more powerful version of teamEurostar, conforming to JAR-VLA and BCAR Section S. Reinforced fuselage aft of cockpit; slightly wider wheel track. Split flaps deflect 0/15/40° and extend over two-thirds of wing length.

Description as for teamEurostar 2002 except as follows:

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS flat-four engine; VZLU V230E two-blade, fixed-pitch, wooden propeller. Standard fuel capacity 67 litres (17.7 US gallons; 14.7 Imp gallons).

ACCOMMODATION: Two seats side by side; dual controls. Front-hinged canopy, with larger size of rear transparency (refer EV-97). Baggage space aft of seats.

AVIONICS: VFR instrumentation only in basic aircraft. 'Effect' version adds VSI, turn co-ordinator, VHF com antenna, PM 1000 intercom, Bendix/King KT 76A transponder, ACK encoder, KY 97A VHF and DME/transponder antenna. Top-of-range 'Harmony Excellent'suite omits KY 97A and ACK encoder, but adds KLN 35A GPS with KA 92 antenna, KX 125 nav/com, KT 76A transponder, DME/transponder and VHF antennae, VOR/glideslope antenna, artificial horizon and directional gyro. Further options available.

DIMENSIONS: As for teamEurostar

AREAS:

Wings, gross	10.13 m² (109.0 sq ft)

Evektor Harmony prototype/demonstrator 1128996

WEIGHTS AND LOADINGS:
- Weight empty ... 330 kg (728 lb)
- Max baggage weight ... 15 kg (33 lb)
- Max T-O weight ... 575 kg (1,267 lb)
- Max wing loading ... 56.8 kg/m² (11.63 lb/sq ft)
- Max power loading ... 7.82 kg/kW (12.85 lb/hp)

PERFORMANCE (preliminary):
- Never-exceed speed (VNE) ... 145 kt (270 km/h; 167 mph) IAS
- Max level speed ... 129 kt (240 km/h; 149 mph) IAS
- Max cruising speed ... 111 kt (205 km/h; 127 mph) IAS
- Stalling speed, flaps down ... 44 kt (80 km/h; 50 mph) CAS
- Max rate of climb at S/L ... 300 m (984 ft)/min
- Service ceiling ... 5,000 m (16,400 ft)
- T-O run ... 130 m (425 ft)
- T-O to 15 m (50 ft) ... 260 m (855 ft)
- Landing from 15 m (50 ft) ... 480 m (1,575 ft)
- Landing run ... 240 m (790 ft)
- Range ... 388 n miles (720 km; 447 miles)
- *g* limits ... +5.7/–2.25

EVEKTOR SPORTSTAR

TYPE: Side-by-side lightplane/kitbuilt.

PROGRAMME: Announced in 2004, developed for the Light Sport Aircraft (LSA) category as a derivative of the earlier teamEurostar and Harmony. First flight mid-2003; certification achieved December 2003. Became first type to receive FAA Special Airworthiness Certificate for LSA category.

CURRENT VERSIONS: **SportStar:** Initial version, available as kit or ready to fly.

SportStar II: Improved version for LSA category; has tail skid with integral tie-down point; increased fuel capacity; and canopy with steel frame. Launched at Sun 'n' Fun, April 2006 under name of **SportStar SE (Special Edition)**.

CUSTOMERS: By October 2004, sales to Argentina, Australia, Canada, the Czech Republic, Romania and the United States has been achieved.

COSTS: Kit USD67,000; ready-to-fly USD98,500 (2006).

DESIGN FEATURES: Airframe based on the Harmony, with higher maximum take-off weight, increased wing span, wider cabin and redesigned landing gear.

Quoted quick-build kit time 200 hours.

FLYING CONTROLS: As teamEurostar; electric flaps.

STRUCTURE: As teamEurostar.

LANDING GEAR: As teamEurostar. Optional skis and floats.

POWER PLANT: One 73.4 kW (98.4 hp) Rotax 912 ULS driving a VZLU V230C three-blade on-ground adjustable-pitch propeller; 59.6 kW (79.9 hp) Rotax 912 UL can also be fitted. Usable fuel capacity 118 litres (31.2 US gallons; 26.0 Imp gallons) are usable.

AVIONICS: As teamEurostar; optional autopilot.

ACCOMMODATION: As teamEurostar.

Evektor SportStar cockpit 1128995

EQUIPMENT: Optional ballistic parachute and aerotow hook.

DIMENSIONS, EXTERNAL:
- Wing span ... 8.65 m (28 ft 4½ in)
- Length overall ... 5.98 m (19 ft 7½ in)
- Height overall ... 2.33 m (7 ft 7¾ in)

DIMENSIONS, INTERNAL:
- Cabin max width ... 1.18 m (3 ft 10½ in)
- Baggage hold volume ... 0.18 m³ (6.2 cu ft)

WEIGHTS AND LOADINGS:
- Weight empty ... 303 kg (668 lb)
- Max baggage weight ... 25 kg (55 lb)
- Max T-O weight ... 550 kg (1,212 lb)
- Max power loading ... 7.50 kg/kW (12.32 lb/hp)

PERFORMANCE:
- Never-exceed speed (VNE) ... 146 kt (270 km/h; 168 mph)
- Max operating speed ... 115 kt (213 km/h; 132 mph)
- Normal cruising speed at 75% power ... 110 kt (204 km/h; 127 mph)
- Stalling speed, power off: flaps up ... 44 kt (81 km/h; 51 mph)
- flaps down ... 39 kt (72 km/h; 45 mph)
- Max rate of climb at S/L ... 258 m (846 ft)/min
- Service ceiling ... 4,000 m (13,120 ft)
- T-O run ... 170 m (558 ft)
- Landing run ... 165 m (541 ft)
- Range with max fuel ... 700 n miles (1,296 km; 805 miles)
- Endurance ... 8 h 0 min
- *g* limits ... +6/–3

EVEKTOR VUT 100 COBRA

TYPE: Four-seat lightplane.

PROGRAMME: Project started in 2000 at Brno University; intended to be first of a family of four- to seven-seat aircraft. Development began in August 2001, with construction of first VUT 100-120i prototype (OK-EVE) beginning in February 2003; first flight 11 November 2004 (official first flight 16 November 2004) and by January 2005 had completed 14 flights. Exhibited at Aero '05, Friedrichshafen, April 2005 and AirVenture '05, August 2005. Certification intended by end 2006.

CURRENT VERSIONS: **VUT 100-120i Cobra:** Baseline version, *as described*.

VUT 100-120TDi: Powered by 169 kW (227 hp) SMA SR 305 diesel engine driving an MT Propeller MTV-9 three-blade, constant-speed propeller, diameter 1.96 m (6 ft 5 in). Not yet introduced.

VUT 100-131i Super Cobra: Second version introduced; will have 235 kW (315 hp) Textron Lycoming IO-580-B1A driving MT-Propeller MTV-9 three-blade, constant-speed propeller, diameter 1.98 m (6 ft 6 in). Fuel capacity as VUT 100-120i. Prototype (OK-RAF) made first flight on 24 October 2006.

DESIGN FEATURES: Multipurpose, all-metal aircraft designed to meet FAR/JAR 23 and a range of tasks including sport flying, basic and advanced training and aero-towing.

FLYING CONTROLS: Conventional and manual. Electrically operated flaps.

STRUCTURE: All-metal airframe with composites non-structural parts, such as cowlings.

LANDING GEAR: Tricycle type; retractable.

POWER PLANT: One 149 kW (200 hp) Textron Lycoming IO-360-A1B6 flat-four, driving an MT-Propeller MTV-12 three-blade, constant-speed propeller. Fuel capacity 340 litres (89.8 US gallons; 74.8 Imp gallons) in all versions.

ACCOMMODATION: Pilot and up to four passengers.

All data are provisional.

AVIONICS: *Comms:* Garmin GMA 430 nav/com/GPS, GNC 250XL com/GPS, GTX 327 transponder and GMA 340 audio panel.

Flight: S-TEC S55X autopilot.

Instrumentation: SAGEM ICDS 10 primary flight display and multifunction display. Optional avionics include Bendix/King KN 62A DME, KR 87 ADF, Ryan 9900BX TAS and L-3 WX-500 stormscope.

DIMENSIONS, EXTERNAL:
- Wing span ... 10.20 m (33 ft 5½ in)
- Length overall ... 8.00 m (26 ft 3 in)
- Propeller diameter ... 1.83 m (6 ft 0 in)

DIMENSIONS, INTERNAL:
- Cabin: Length ... 3.10 m (10 ft 2 in)
- Max width ... 1.31 m (4 ft 3½ in)
- Max height ... 1.22 m (4 ft 0 in)

Evektor SportStar (II) SE at its launch in April 2006 *(Paul Jackson)* 1159063

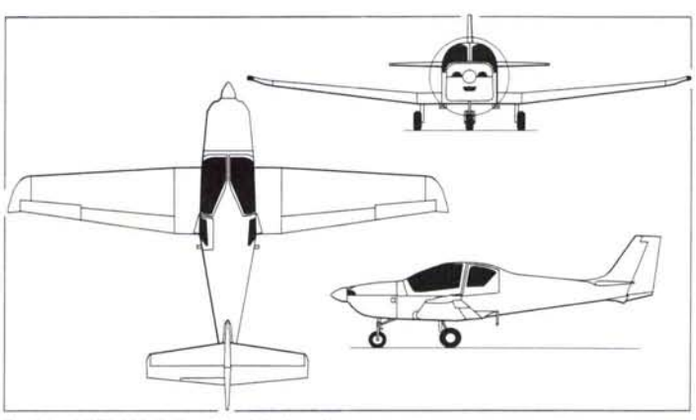
Prototype VUT 100-131i version of Evektor Cobra during its maiden flight on 24 October 2006 1040481

Prototype VUT 100 Cobra, designed and built by Evektor *(Jan Fridrich)* 1128997

WEIGHTS AND LOADINGS (A: 100-120i; B: 100-131i):
- Weight empty: A ..... 830 kg (1,830 lb)
- B ..... 880 kg (1,940 lb)
- Max T-O weight: A ..... 1,330 kg (2,932 lb)
- B ..... 1,451 kg (3,200 lb)

PERFORMANCE (A, B as above, estimated):
- Max level speed: A ..... 155 kt (287 km/h; 178 mph)
- B ..... 180 kt (333 km/h; 207 mph)
- Stalling speed, flaps down:
- A ..... 50 kt (93 km/h; 58 mph)
- B ..... 55 kt (102 km/h; 64 mph)
- Max rate of climb at S/L: A, B ..... 305 m (1,000 ft)/min
- Range with max fuel:
- A ..... 1,080 n miles (2,000 km; 1,242 miles)
- B ..... 1,000 n miles (1,852 km; 1,150 miles)
- Endurance: A ..... 8 h
- B ..... 6 h
- *g* limits: Normal ..... +3.8/–1.52
- Utility ..... +4.4/–1.76

Current Evektor VUT 100 Cobra instrument panel 1128998



Evektor VUT 100 Cobra *(Paul Jackson)* 1128976

EVEKTOR EV-55 OUTBACK

TYPE: Utility turboprop twin.

PROGRAMME: Announced in December 2003. Development being undertaken by Evektor as leader in a multi-company consortium; around 80 per cent of aircraft is sourced in the Czech Republic. Prototype expected to be flying by mid-2007, followed by EASA and FAA certification. First deliveries scheduled for 2009.

CUSTOMERS: Production expected to be 60 per year.

COSTS: Estimated USD1,700,000 (2006).

DESIGN FEATURES: High-wing utility aircraft with T-tail and modern aerodynamic design. Tapered, high-aspect ratio wing. Three models to be available: passenger, cargo and combi; medical evacuation model under consideration.

FLYING CONTROLS: Conventional and manual. Horn-balanced rudder and elevators. Trim tab in each aileron and elevator. Fowler flaps.

STRUCTURE: All-metal.

LANDING GEAR: Retractable tricycle type; mainwheels retract into nacelles on lower fuselage sides. Steerable nosewheel. Anti-skid system.

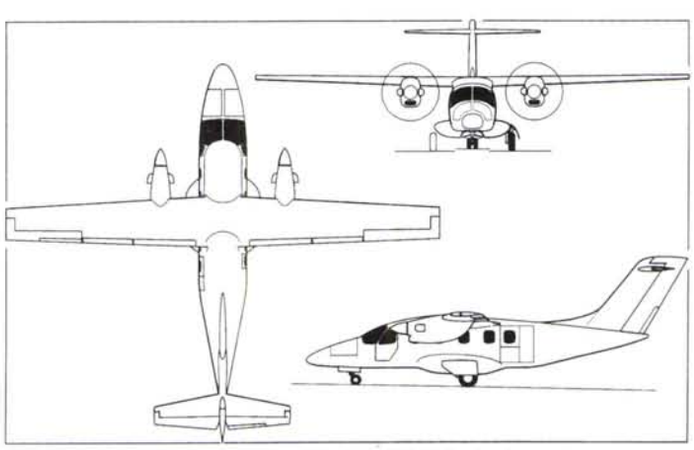
POWER PLANT: Two 400 kW (536 shp) Pratt and Whitney PT6A-21 turboprop engines, driving four-blade constant-speed, fully-feathering propellers.

ACCOMMODATION: Pilot and up to nine passengers standard; high-density option for 14 passengers; alternatively, cabin can be configured for cargo and combi use. Single pilot operation. Passenger door on port side of rear fuselage incorporates forward extension for cargo loading; cockpit door on each side forward of wing. Baggage compartments in nose (accessed by upward-hinged door) and in tailcone.

All data are provisional.

DIMENSIONS, EXTERNAL:
- Wing span ..... 16.10 m (52 ft 9¾ in)
- Length overall ..... 14.35 m (47 ft 1 in)
- Height overall ..... 4.66 m (15 ft 3½ in)
- Tailplane span ..... 4.80 m (15 ft 9 in)
- Wheel track ..... 2.92 m (9 ft 7 in)
- Wheelbase ..... 4.17 m (13 ft 8¼ in)
- Cargo door: Width ..... 1.25 m (4 ft 1¼ in)
- Height ..... 1.13 m (3 ft 8½ in)

DIMENSIONS, INTERNAL:
- Cabin: Length ..... 4.48 m (14 ft 8¼ in)
- Max width ..... 1.61 m (5 ft 3¾ in)
- Min height ..... 1.37 m (4 ft 6 in)
- Volume ..... 9.47 m³ (334.4 cu ft)
- Baggage compartments volume (total) ..... 3.20 m³ (113.0 cu ft)



Provisional general arrangement of Evektor EV-55 Outback *(Paul Jackson)* 1128977

Artist's impression of Evektor EV-55 Outback 1042817

WEIGHTS AND LOADINGS:

Weight empty	2,549 kg (5,620 lb)
Max payload	1,824 kg (4,021 lb)
Max T-O and landing weight	4,600 kg (10,141 lb)
Max power loading	5.76 kg/kW (9.46 lb/shp)

PERFORMANCE:

Max level speed at FL100	220 kt (408 km/h; 254 mph)
T-O to 15 m (50 ft)	420 m (1,378 ft)
Range: with 30 min reserves	1,240 n miles (2,298 km; 1,427 miles)

FANTASY AIR

FANTASY AIR GROUP

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Web: www.fantasyair.com
MANAGING DIRECTOR: Josef Jestřáb

Fantasy Air established at Písek 1995; initial product launched as Cora, in Legato and Allegro versions. By mid-2000 was standardising on variants of Allegro. Fantasy Air employs 23 workers at its 750 m² (8,073 sq ft) factory.

FANTASY AIR ALLEGRO

TYPE: Side-by-side ultralight/kitbuilt.

PROGRAMME: Certified in Australia, Belgium, Czech Republic, Finland, France and Germany; public debut at Friedrichshafen Air Show, May 1997. All are subvariants of Fantasy **Cora**. Legato subvariant no longer marketed; Arrius renamed as Allegro. Production rate three per month from 2001 onwards.

A new wing profile was first tested in May 2002. Revealed in the same month were plans to fit a Diesel Air D280 twin-piston engine, derated to 60.0 kW (80 hp); these were in abeyance by October 2002.

CURRENT VERSIONS: **Allegro ST:** Baseline version; 47.8 kW (64.1 hp) Rotax 582 UL. Remains available.

Allegro 200: As ST, but with 55.0 kW (73.8 hp) Rotax 618 UL. Remains available.

Allegro 2000: Introduced from 1 March 2000 (kit version introduced September 2000); United States S-LSA approval gained 19 May 2005; 59.6 kW (79.9 hp) Rotax 912 UL or (Allegro S) 73.5 kW (98.6 hp) 912 ULS. SportProp glass fibre or VZLU V331-3NC wooden three-blade propeller. Quoted build time 510 hours for standard kit and 190 hours for quick-build kit. Certified in Belgium, Czech Republic, Denmark, Finland, Germany and Spain.

Allegro SW: Short-span (Speed Wing) version, without taper on outer panels. New SM 701 aerofoil section wing and 47.8 kW (64.1 hp) Rotax 582 UL or 59.6 kW (79.9 hp) Rotax 912 UL. German marketing only with Rotax 912 UL and propeller options as for Allegro 2000. Four to France in September 1999, where certification subsequently awarded; also certified in Czech Republic and Spain. Kit version available from 1 March 2000.

Fantasy Air Allegro 2000 'Light Sport' being promoted for US LSA market
(Paul Jackson) 1159064

Aspects of Fantasy Air Allegro 2007 prototype 1040477

Allegro 2000 F: (formerly Arrius F) Float-equipped, standard-span wing (SM 701 section) and Rotax 912 UL or 912 ULS. Two to Finland in August 1999. First flight (converted Allegro, OK-DUU 03) 5 November 1999.

Allegro 2007: Improved version introduced October 2006, incorporating feedback from existing customers. Fuselage width increased by 10 cm (4 in); wing position raised 9 cm (3½ in) to give improved cabin height, and rear fuselage and tail redesigned and raised (vertical surfaces shortened in height and increased in chord) for improved ground clearance. Prototype OK-LUU 19.

CUSTOMERS: Total 70 (51 kits and 19 factory-built, including a few Cora Legatos) registered in Czech Republic by November 2000. Exports to Finland and Hungary began in 2000; followed by Luxembourg, Italy and Netherlands in 2001; Portugal and Belgium in 2002; USA in 2003; and Canada in 2004. Total sales by October 2002 exceeded 140, including 75 in Czech Republic, 27 in France and 17 in Germany; 32 built in 2000, 35 in 2001 and 34 in 2002. At least 40 in US by mid-2006, at which time company estimated over 450 flying worldwide.

COSTS: Allegro 2000 USD57,225; Allegro 2000 quick-build kit USD23,625 (both 2006).

DESIGN FEATURES: Braced high-wing monoplane; T tail; tapered outer panels on 2000, constant chord throughout on SW. UA-2 aerofoil section on ST and 200, improved SM 701 on 2000 and SW; dihedral 1° 10' on Allegro 2000; 1° 30' on Allegro SW. Quoted build time for kit version 190 hours.

FLYING CONTROLS: Conventional and manual. Electrically actuated flaperons (settings 0/15/48°). In-flight-adjustable tab in port half of elevator; ground-adjustable rudder tab.

STRUCTURE: Fabric- and metal-covered metal wings with welded steel tube centre-section and full-span metal flaperons; laminated glass fibre fuselage and integral fin; all-metal rudder, tailplane and one-piece elevator.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring Kevlar cantilever mainwheel legs and 350 mm wheels, rubber-block shock-absorbers, hydraulic mainwheel brakes and steerable nosewheel; wheel spats. Full Lotus twin-float gear to be certified for Allegro 2000 F; testing undertaken (with OK-DUU 03) in August 2001.

POWER PLANT: One Rotax engine (details under Current Versions); SportProp three-blade, glass fibre or Junkers Profly two-blade, ground-adjustable pitch, carbon fibre propeller. Fuel capacity in Allegro 2000 55 litres (14.5 US gallons; 12.1 Imp gallons); increased in Allegro 2007 to 63 litres (16.6 US gallons; 13.9 Imp gallons); optional 23 litre (6.0 US gallon; 5.0 Imp gallon) tanks (in either version) can be fitted in each wing.

EQUIPMENT: Junkers recovery parachute optional.

DIMENSIONS, EXTERNAL (A: 2000, B: 2000 F, C: SW):

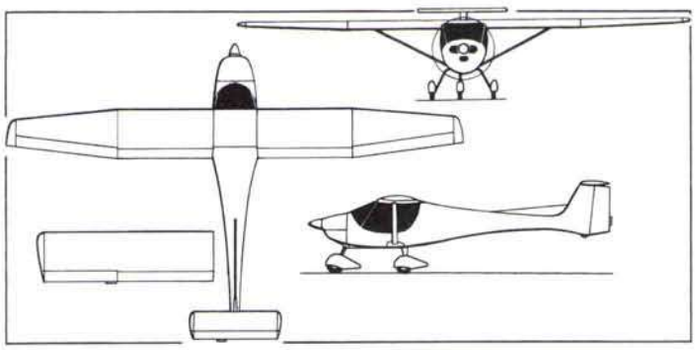
Wing span: A, B	10.81 m (35 ft 5½ in)
C	9.63 m (31 ft 7 in)
Length overall: A	6.36 m (20 ft 10½ in)
B, C	6.10 m (20 ft 0¼ in)
Height overall: all	2.05 m (6 ft 8¾ in)

DIMENSIONS, INTERNAL:

Cabin max width: A, B, C	1.08 m (3 ft 6½ in)

AREAS:

Wings, gross: A, B	11.37 m² (122.4 sq ft)
C	11.55 m² (124.3 sq ft)



Fantasy Air Cora Allegro 2000, with scrap view of short-span SW wing *(James Goulding)* 1128978

Comparison of Fantasy Air Allegro 2007 (right) with 2000 version 1040476

WEIGHTS AND LOADINGS:

Weight empty: A, B, C	285–295 kg (628–650 lb)
Max T-O weight: A, C[1]	450 kg (992 lb)
B	520 kg (1,146 lb)

[1] *559 kg (1,232 lb) where regulations permit.*

PERFORMANCE, POWERED (Rotax 912 UL):

Never-exceed speed (VNE):	
A	118 kt (220 km/h; 136 mph)
B, C	108 kt (200 km/h; 124 mph)
Max cruising speed at 75% power:	
A	89 kt (165 km/h; 103 mph)
B	97 kt (180 km/h; 112 mph)
Stalling speed: A, B, C	36 kt (65 km/h; 41 mph)
Max rate of climb at S/L: A	360 m (1,181 ft)/min
B	240 m (787 ft)/min
C	300 m (984 ft)/min
T-O run: A, C	150 m (495 ft)
B	220 m (722 ft)
Landing run: A, C	100 m (330 ft)
B	120 m (395 ft)
Max range: A, C	270 n miles (500 km; 310 miles)
B	297 n miles (550 km; 341 miles)

PERFORMANCE, UNPOWERED:

Best glide ratio: A, B	12
C	10

FLYING MACHINES

FLYING MACHINES

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Web: www.flyingmachines.cz

Company has expanded its aviation interests from flex-wings to three-axis ultralights.

FLYING MACHINES B612

TYPE: Single-seat ultralight/kitbuilt.

PROGRAMME: Prototype B-612 (OK-GUZ 02), designed and built by Ing Marek Ivanov; first flight in or by October 2001. Established FAI subclass RAL1 speed record of 104.9 kt (194.2 km/h; 120.7 mph) on 11 October 2003, then powered by a 29.5 kW (39.6 hp) Rotax 447 two-cylinder, in-line piston engine. Production version has wider (0.70 m; 2 ft 3½ in) cockpit.

COSTS: EUR25,845 with HKS engine, EUR22,100 with Rotax engine; kit, less engine and instruments EUR16,300; all plus tax (2006).

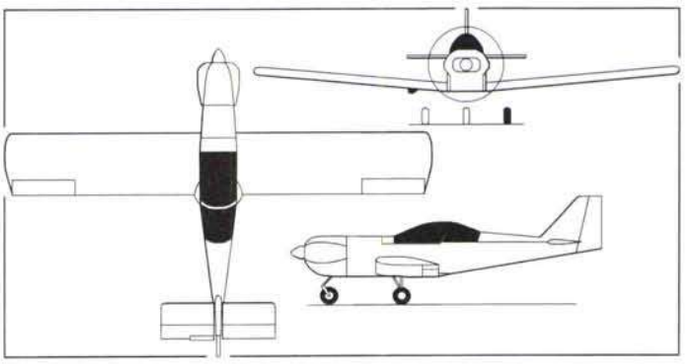
DESIGN FEATURES: Low-mounted, constant-chord wing; low-mounted, cantilever tailplane; sweptback fin. Wings removable for storage.

FLYING CONTROLS: Conventional and manual. No aerodynamic balances. Split flaps.

STRUCTURE: Welded 4130 chromoly steel fuselage with Ceconite fabric covering; composites empennage in current versions. Epoxy composites wing with carbon fibre main spar.

LANDING GEAR: Tricycle type; retractable. Mainwheels on welded steel legs, with hydraulic shock absorbers, retract outwards by manual hydraulic pump; wheel extremities protrude below wing lower surface when retracted. Steerable nosewheel. Mainwheel brakes.

POWER PLANT: One piston engine: 44.7 kW (60 hp) HKS 700E or 36.8 kW (49.3 hp) Rotax 503 driving a two-blade Sportprop propeller. Fuel capacity 30 litres (7.9 US gallons; 6.6 Imp gallons) in composites tank at rear of engine firewall or, optionally, in two wing tanks with combined capacity of 50 litres (13.2 US gallons; 11.0 Imp gallons).



Flying Machines B612 ultralight *(Paul Jackson)* 1159581

EQUIPMENT: Optional ballistic recovery parachute.

DIMENSIONS, EXTERNAL:

Wing span	6.85 m (22 ft 5¾ in)
Length overall	4.80 m (15 ft 9 in)
Height overall	1.76 m (5 ft 9¼ in)

DIMENSIONS, INTERNAL:

Cockpit max width	0.60 m (1 ft 11¾ in)

AREAS:

Wings, gross	6.85 m² (73.7 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	175 kg (386 lb)
Max T-O weight	300 kg (661 lb)

Flying Machines B612 single-seat ultralight 1158656

PERFORMANCE (HKS engine and wing tanks):
- Never-exceed speed (VNE) ..... 145 kt (270 km/h; 167 mph)
- Normal cruising speed ..... 108 kt (200 km/h; 124 mph)
- Stalling speed ..... 36 kt (65 km/h; 41 mph)
- T-O run ..... 50 m (165 ft)
- T-O to 15 m (50 ft) ..... 130 m (430 ft)
- Landing from 15 m (50 ft) ..... 120 m (395 ft)
- Max rate of climb at S/L ..... 360 m (1,181 ft)/min
- Max range ..... 486 n miles (900 km; 559 miles)
- g limits ..... +4/–2

FLYING MACHINES FM 250 VAMPIRE

TYPE: Side-by-side ultralight.

DESIGN FEATURES: Low-mounted wing and tailplane; sweptback fin. Fuselage waisted aft of cockpit for weight saving.

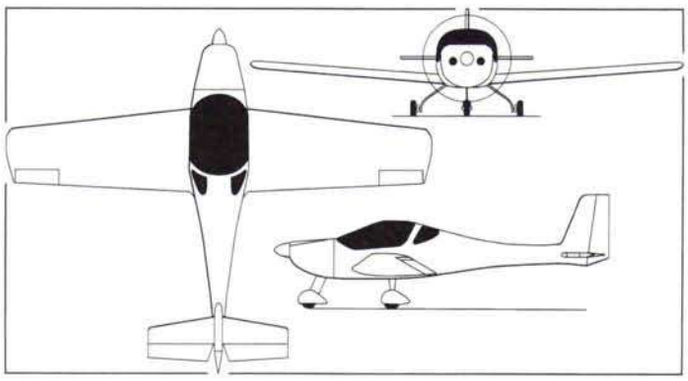
FLYING CONTROLS: Conventional and manual. No aerodynamic balances. Trim tab in starboard elevator. Flaps.

STRUCTURE: Composites, except aluminium alloy control surfaces. Sandwich fuselage construction.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted, spring composites cantilever mainwheel legs; steerable nosewheel on welded steel leg. Mainwheel hydraulic brakes. Optional wheel fairings.

POWER PLANT: One Rotax flat-four; option of 58.8 kW (78.9 hp) 912 UL, 73.5 kW (98.6 hp) 912 ULS or 76.9 kW (103.1 hp) 914. Integral, composites tank in starboard wing; capacity 68 litres (17.9 US gallons; 15.0 Imp gallons); mechanical pump for Rotax 912/912ULS; electric pump for 914. Fixed-, ground adjustable-, flight adjustable-pitch and constant-speed propeller options.

DIMENSIONS, EXTERNAL:
- Wing span ..... 7.66 m (25 ft 1½ in)
- Length overall ..... 6.065 m (19 ft 10¾ in)
- Height overall ..... 2.16 m (7 ft 1 in)



Flying Machines FM 250 two-seat ultralight *(Paul Jackson)* 1159583

AREAS:
- Wings, gross ..... 10.05 m² (108.2 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty ..... 255 kg (562 lb)
- Max T-O weight ..... 472.5 kg (1,041 lb)

PERFORMANCE:
- Never-exceed speed (VNE) ..... 145 kt (270 km/h; 167 mph)
- Manoeuvring speed ..... 84 kt (156 km/h; 97 mph)
- Stalling speed, flaps and gear down ..... 36 kt (65 km/h; 41 mph)
- Max rate of climb at S/L ..... 420 m (1,378 ft)/min
- g limits ..... +4.43/-2.43

Flying Machines FM 250 two-seat ultralight 1158667

FMP

FMP S.R.O.

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WORKS:
5.kvìtna 813, CZ-51251 Lomnice nad Popelkou

Formed in 1991, FMP produces a range of light engineering items including valves and connectors and has a workforce of 200. In 2004, it took over production of the Qualt 200 ultralight from Interplane.

FMP QUALT

TYPE: Side-by-side ultralight kitbuilt.

PROGRAMME: Original design by Aerosport. Certified in ULA category. Improved Qualt 201 series introduced in 2005, with enlarged cabin, reprofiled aerofoil, epoxy resin fuselage, tail and undercarriage, and composites wing.

CURRENT VERSIONS: **Qualt 200J:** Baseline model, powered by Jabiru 2200; replaced by Qualt 201J in 2005.

Qualt 200R: As 200J but with Rotax 912 engine; replaced by Qualt 201R in 2005.

Qualt 200RS: As 200J, but with Rotax 912S engine; replaced by Qualt 201RS in 2005.

Qualt 201J: Baseline version, powered by Jabiru 2200.

Qualt 201R582: As 201J, but with Rotax 582 engine.

Qualt 201R: As 201J, but with Rotax 912 engine.

Qualt 201RS: As 201J, but with Rotax 912S engine.

Qualt 201RS Super: As 201J, but with choice of 73.5 kW (98.6 hp) Rotax 912S3 or 89.5 kW (120 hp) Jabiru 3300 engine; max T-O weight of 558 kg (1,230 lb) where regulations permit, including US LSA category.

Interplane Skyboy 2000L and Interplane Falcon 2000L: Aircraft marketed by Interplane.

COSTS: Kit, firewall back EUR25,752 (2006).

DESIGN FEATURES: Typical low-wing, T-tail ultralight with large bubble canopy for good outward view. Tapered wing with upturned tips; large trailing-edge root glove.

FLYING CONTROLS: Conventional and manual. Horn-balanced elevators. Split flaps.

STRUCTURE: Fuselage and empennage of epoxy resin; wing of composites.

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted spring epoxy resin cantilever mainwheel legs. Steerable tailwheel.

POWER PLANT: *Qualt 201J:* One 59.7 kW (80 hp) Jabiru 2200 driving a VZLU V237 DF propeller.

Qualt 201R582: One 47.8 kW (64.1 hp) Rotax 582 driving a VZLU V230C propeller.

Qualt 201R: One 59.6 kW (79.9 hp) Rotax 912 driving a VZLU V230D propeller; other propellers from VZLU and KA can be fitted optionally.

Qualt 201RS: One 73.5 kW (98.6 hp) Rotax 912S driving a VZLU V230E propeller; other propellers from VZLU and KA optional.

Fuel capacity for all versions 47 litres (12.4 US gallons; 10.3 Imp gallons).

DIMENSIONS, EXTERNAL:
- Wing span ..... 9.20 m (30 ft 2¼ in)
- Length overall: Q201J ..... 6.10 m (20 ft 0¼ in)
- Q201582 ..... 6.05 m (19 ft 10¼ in)
- Q201R, Q201RS ..... 6.00 m (19 ft 8¼ in)
- Height overall ..... 1.72 m (5 ft 7¾ in)

AREAS:
- Wings, gross ..... 10.50 m² (113.0 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty: Q201J, Q201R582 ..... 265 kg (584 lb)
- Q201R ..... 282 kg (622 lb)
- Q201RS ..... 286 kg (631 lb)
- Max T-O weight ..... 450 kg (992 lb)

FMP Qualt 201J, launched in 2005 *(Paul Jackson)* 1159065

PERFORMANCE:

Never-exceed speed (VNE)	137 kt (254 km/h; 157 mph)
Max operating speed: 200J	124 kt (230 km/h; 142 mph)
Q201R582	97 kt (180 km/h; 111 mph)
Q201R	118 kt (220 km/h; 136 mph)
Q201RS	128 kt (237 km/h; 147 mph)
Normal cruising speed range: all except Q201R582	76-103 kt (140-190 km/h; 87-118 mph)
Q201R582	65-81 kt (120-150 km/h; 75-93 mph)
Stalling speed, flaps down: all	33 kt (60 km/h; 38 mph)
Max rate of climb at S/L: 201R582	192 m (630 ft)/min
201J, 201R	300 m (984 ft)/min
201RS	396 m (1,299 ft)/min
T-O and landing run	200 m (656 ft)
Range with max fuel	405 n miles (750 km; 466 miles)

INTERPLANE

INTERPLANE SPOL S.R.O.

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Tel: (+1 313) 882 34 00
e-mail: interplane@hotmail.com
PRESIDENT: Ben Dawson

Interplane was created as an ultralight manufacturer in 1992; design and product development is by Gryf Development company at Hodonin. Its first product, the Griffon, is no longer being promoted.

Interplane also markets the Dewald **Sunny** and the FMP Qualt 200L low-wing two-seater as the **Skyboy 2000L** (or **Falcon 2000L**), price USD39,900. Latter due to be relaunched as Interplane **S2 Falcon**. New FM 250 Vampir launched in 2006.

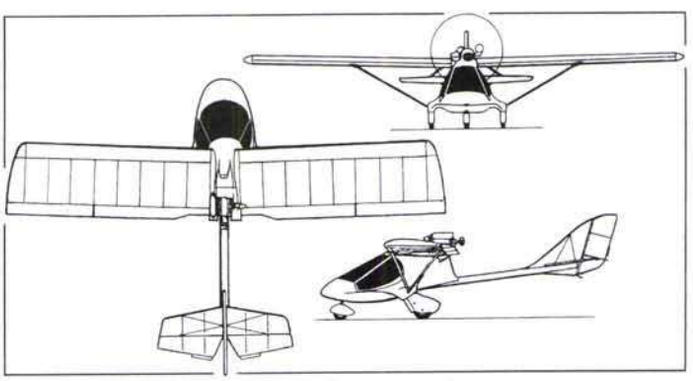
INTERPLANE SKYBOY

TYPE: Side-by-side ultralight/kitbuilt.

PROGRAMME: Prototype designed by team led by Jaroslav Dostal; first flown 1993; entered production 1994; conforms to Czech UL-2 and German BFU-DULV standards. Certified in Czech Republic (1994), France (1996), Slovak Republic and Germany (excluding noise tests, 1999). Current EX and UL versions introduced in 1999. New canopy design permits operation without doors for hot-weather flying.

CURRENT VERSIONS: **Skyboy:** Initial version, with Rotax 503 or 582 engine as standard and cockpit width of 1.20 m (3 ft 11¼ in); no longer produced.

Skyboy S: Reinforced version for higher MTOW and speeds; Rotax 582 engine and choice of wing spans; no longer produced.



Interplane Skyboy, showing optional flaps *(Paul Jackson)* 1128979

Skyboy EX: Standard version from 1999; for European customers; also for customers in Australia and US, where it is classified in the FAA Experimental category.

Skyboy UL: Specially lightened (empty weight 225 kg; 496 lb) to meet US FAR Pt 103 ultralight trainer regulations.

Skyboy ZK-F: Version with wing flaps; MTOW 475 kg (1,047 lb), where local regulations allow.

Skyboy LSA-F: MTOW 560 kg (1,234 lb) to meet Sport Pilot regulations. Was to be marketed as **S1 Cobra**, but discontinued.

S1A Cobra: Amphibian version offered in US with choice of aluminium or composites floats; no longer offered.

Skyboy XJ: Tractor propeller version with WarpDrive three-blade, ground-adjustable pitch propeller. Composites fuselage with fabric-covered wings and ailerons. Fuel capacity 56 litres (14.8 US gallons; 12.3 Imp gallons); prototype OK-IUR 21. By early 2005, this was reported to have been abandoned, despite display of the prototype at Sun 'n' Fun in April 2004 and simultaneous US registry as N69877. Also reported are plans for relaunch as Interplane **S3 Eagle**. Other features include fuselage-mounted spring cantilever

Interplane Skyboy two-seat ultralight *(Paul Jackson)* 1159066

composites mainwheel legs; built-up rear decking to pod; BRS parachute; hydraulic brakes and V-strut ZK-F wings. External mass balance on elevators; Flight-adjustable trim tabs attached to each elevator; ground-adjustable rudder tab. Length 6.86 m (22 ft 6 in); height 2.34 m (7 ft 8 in).

CUSTOMERS: Total of 115 registered by August 2005, including 34 on the FAA register. Sales to Australia, Austria, Belgium, Bulgaria, Canada, Czech Republic, Denmark, France, Germany, Luxembourg, Mexico, Netherlands, Poland, Portugal, Slovak Republic, South Korea, Thailand and US.

COSTS: *UL:* Flyaway USD33,025 (2006).

Description applies to Skyboy UL.

DESIGN FEATURES: High, constant-chord wing, boom-mounted empennage and pusher propeller. Available factory-built or (with or without power plant and instruments) as kit. Wing struts and tail surfaces can be folded for transportation and storage.

Wing aerofoil section NACA 4412; dihedral 1° 30'; incidence 4° 30'. Leading-edges swept forward 2°.

FLYING CONTROLS: Conventional and manual. Tabs on rudder and each elevator; flaps optional.

STRUCTURE: Aluminium tube primary structure with glass fibre and fabric covering.

LANDING GEAR: Tricycle type; fixed. Coil spring/hydraulic (motorcar-type) shock-absorbers on trailing-link mainwheels and castoring nosewheel; tyre sizes 14.4 (mainwheels) and 12.4 (nosewheel); mechanical or hydraulic brakes on nosewheel only. Ski and float gear optional.

POWER PLANT: One 47.8 kW (64.1 hp) Rotax 582 UL two-cylinder in-line two-stroke engine standard; 59.6 kW (79.9 hp) Rotax 912 UL or 73.5 kW (98.6 hp) Rotax 912 ULS flat-four; Rotax 462, 503 or 618; Hirth 2706; or Verner SVS 1400 optional. Wide choice of two- to six-blade wooden or laminate pusher propellers (three-blade, carbon fibre Junkers Profly standard). Standard fuel capacity 38 litres (10.0 US gallons; 8.4 Imp gallons); optional fuel capacity 57 litres (15.0 US gallons; 12.5 Imp gallons).

ACCOMMODATION: Optional cabin doors.

EQUIPMENT: Optional Magnum 450 or 560 ballistic recovery parachute.

DIMENSIONS, EXTERNAL:

Wing span	9.12 m (29 ft 11 in)
Length overall	6.37 m (20 ft 10¾ in)
Height overall	2.13 m (6 ft 11¾ in)

DIMENSIONS, INTERNAL:

Cockpit max width	1.24 m (4 ft 1 in)

AREAS:

Wings, gross: without flaps	12.87 m² (138.5 sq ft)
with flaps	13.38 m² (144.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, equipped	225 kg (496 lb)
Max T-O weight	450 kg (992 lb) or 558 kg (1,232 lb)

PERFORMANCE (Rotax 912, 558 kg; 1,232 lb MTOW):

Max level speed	75 kt (138 km/h; 86 mph)
Econ cruising speed	56 kt (105 km/h; 65 mph)
Stalling speed	34 kt (63 km/h; 40 mph)
Max rate of climb at S/L	306 m (1,004 ft)/min
T-O run	122 m (400 ft)
Landing run	152 m (500 ft)
Range with standard fuel	160 n miles (296 km; 184 miles)

JIHLAVAN

JIHLAVAB AIRPLANES S.R.O.

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Fax: (+420 567) 31 01 87
e-mail: ultralight@jihlavan.cz
Web: www.ultralight.cz

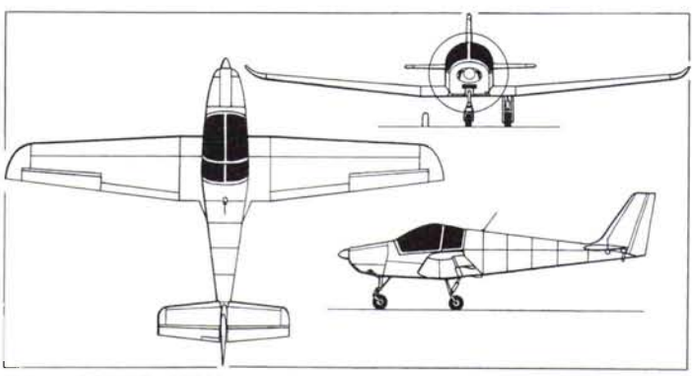
CHIEF DESIGNER: Antonín Píštěk

EXPORT SALES MANAGER: Miroslav Boubela

Founded in 1952, Jihlavan a.s. has produced components for most of the major aircraft manufacturing programmes undertaken since then in the former Czechoslovakia. Other branches of the company produce agricultural vehicles and fork-lift trucks.

Between 1998 and 2000, Jihlavan built the Sova lightplane for Kappa 77, manufacturing responsibility then passing to the designer. However, Jihlavan obtained manufacturing rights to the Sova in 2003, shortly before Kappa entered bankruptcy. The aircraft was re-launched as the Jihlavan Rapid following establishment of Jihlavan Airplanes s.r.o. on 2 March 2005.

In late 2005, the aviation workforce numbered 90.



Jihlavan KP 2U Rapid 200 *(James Goulding)* 1128980

JIHLAVAN KP 2U RAPID

TYPE: Side-by-side ultralight.

PROGRAMME: Designed by Kappa 77 company and Institute of Aerospace Engineering at Brno Technical University and developed over a 22-month period. Initially named Kappa Sova (Owl). First of two flying prototypes (OK-BUU 23) first flown 26 May 1996; first public demonstration the following month at Jihlava Aero '96. Czech certification 23 September 1997; German certification, and of kit by FAA, in June 1999, followed by Polish certification in April 2001, Portuguese in June 2002, Australian at end 2003, Spanish certification planned for 2006. Approved for use in Brazil, Canada, Ecuador, Finland, France, Italy, Netherlands, South Africa and Spain.

Following Kappa's bankruptcy in 2004, production continued by Jihlavan Airplanes under new name of Rapid and with modifications including new shape of engine cowling; revised canopy locking and cockpit seating arrangements, and electrically operated Fowler flaps.

CURRENT VERSIONS: **KP-2U Rapid 200**: *As described.* Available as **Master** baseline version, or as **Major**, with additional avionics and features.

KP-5 ASA Rapid 500: See separate entry.

CUSTOMERS: Over 140 sold by end 2005; customers in Belgium, Brazil, Czech Republic, Ecuador, Finland, France, Germany (known as KPD-2U), Italy, Netherlands, Poland, Portugal, Spain, South Africa and USA.

COSTS: Master EUR59,800; Major EUR65,000; both excluding tax, flyaway (2006).

DESIGN FEATURES: Low-wing monoplane conforming to BFU 95 regulations. Tapered wing with swept tips; sweptback fin with low tailplane.

Wing sections NACA GA(W)-1 at root and GA(W)-2 at tip; dihedral 6°. Fin and tailplane sections NACA 0012.

FLYING CONTROLS: Conventional and manual. Aileron actuation by pushrods. Electrically operated trim tab in port elevator; manually or electrically operated Fowler flaps (deflection 10 and 35°).

STRUCTURE: All-metal, except for CFRP cockpit frame. Two-spar wings detachable for storage. Fuselage constructed from Dural L-shape stringers, riveted bulkheads and Dural skin.

LANDING GEAR: Electrically retractable tricycle type (all units rearward) with manual override; rubber shock-absorption; mainwheels semi-exposed when retracted. Steerable nosewheel; hydraulic brakes. Fixed gear optional.

POWER PLANT: One 59.6 kW (79.9 hp) Rotax 912 UL engine, with 4:1 reduction drive to a three-blade ground-adjustable pitch propeller; can alternatively accommodate 73.5 kW (98.6 hp) Rotax 912 ULS or 84.5 kW (113.3 hp) Rotax 914 and be fitted with Kaspar or Wcomp Vária two-blade flight adjustable propellers; from 2006, 59.7 kW (80 hp) Jabiru

Jihlavan KP 2U Rapid 200 making the type's relaunch at Aero '05, Friedrichshafen, one month after formation of Jihlavan Airplanes *(Paul Jackson)* 1121649

2200 added to options. Fuel capacity (two wing centre-section tanks) 64 litres (16.9 US gallons; 14.1 Imp gallons). Optional two additional tanks each 15 litres (4.0 US gallons; 3.3 Imp gallons). Max fuel capacity 94 litres (24.8 US gallons; 20.7 Imp gallons).

ACCOMMODATION: Forward-hinged canopy. Dual controls. Starboard seat staggered rearwards 20 cm (8 in). Space behind seats for 30 kg (66 lb) of baggage.

EQUIPMENT: Optional emergency system under consideration.

DIMENSIONS, EXTERNAL:

Wing span	9.90 m (32 ft 5¾ in)
Length overall	7.165 m (23 ft 6 in)
Height overall	2.60 m (8 ft 6¼ in)
Propeller diameter	1.73 m (5 ft 8 in)

AREAS:

Wings, gross	11.85 m² (127.6 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	282 kg (622 lb)
Max T-O weight	472.5 kg (1,041 lb)

PERFORMANCE (Rotax 912 UL engine):

Max level speed	129 kt (240 km/h; 149 mph)
Max cruising speed at 75% power	108 kt (200 km/h; 124 mph)
Stalling speed: flaps up	39 kt (71 km/h; 45 mph)
flaps down	26 kt (48 km/h; 30 mph)
Max rate of climb at S/L	390 m (1,279 ft)/min
T-O run	100 m (330 ft)
Landing run	140 m (460 ft)
Range with max fuel	518 n miles (960 km; 596 miles)
g limits	+4/−2

JIHLAVAN KP 5 ASA RAPID 500

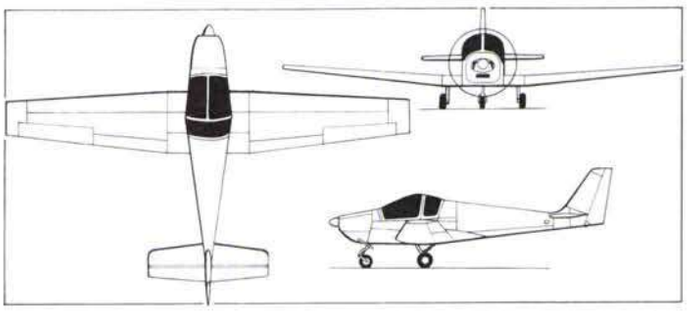
US marketing name: KP-5 Kappa

TYPE: Side-by-side ultralight/kitbuilt; two-seat lightplane.

PROGRAMME: Developed from Kappa's earlier KP 2U Sova, with financial backing from Czech Ministry of Industry and Trade. Prototype first flew December 2003; first public display at Narrowmine, Australia, in 2004. Czech certification received 29 March 2004. Australian certification during early 2004. FAA LSA approval gained 19 July 2005.

CURRENT VERSIONS: **KP 5 ASA Rapid 500**: Available as **Master** baseline version and **Major**, with additional avionics and features; *as described*.

Jihlavan KP 5 ASA Rapid 500 *(Paul Jackson)* 1159067



Jihlavan KP 5 Rapid 500 general arrangement *(James Goulding)* 1121597

KP-5 Kappa: Marketed in US by Kappa Aircraft of Pocono Pines, Pennsylvania (www.kappaaircraft.com) as factory-built LSA with 59.6 kW (79.9 hp) Rotax 912 or 73.5 kW (98.6 hp) Rotax 912S or 59.7 kW (80 hp) Jabiru 2200 or 89 kW (120 hp) Jabiru 3300 flat-four and 64 litre (17.0 US gallon; 14.2 Imp gallon) fuel capacity.

CUSTOMERS: Total of 16 aircraft sold to customers in Australia, South Africa and USA by end-2005.

COSTS: Master EUR62,800; Major EUR68,000; both flyaway, excluding taxes (2006).

DESIGN FEATURES: As KP 2U Rapid; conforms to Czech UL2 ultralight and most European equivalents at reduced MTOW, but optimised for Australian and US (LSA) markets.

FLYING CONTROLS: As KP 2U Rapid.

STRUCTURE: All-metal, two-spar wing and fuselage with CFRP cockpit frame.

LANDING GEAR: Tricycle-type; fixed. Optional spats. Rubber shock-absorption; steerable nosewheel; hydraulic brakes.

POWER PLANT: As KP 2U Rapid, but options cover 912 ULS and 914 only, plus Jabiru 2200. Fuel capacity as KP 2U Rapid, with option to increase to 94 litres (24.8 US gallons; 20.7 Imp gallons).

ACCOMMODATION: As KP 2U Rapid.

DIMENSIONS, EXTERNAL (As KP 2U Rapid, except):

Height overall: fixed gear	2.46 m (8 ft 0¾ in)
retractable gear	2.60 m (8 ft 6¼ in)
Propeller diameter	1.73 m (5 ft 8 in)

WEIGHTS AND LOADINGS:

Weight empty	320 kg (705 lb)
Baggage capacity	30 kg (66 lb)
Max T-O weight: Czech Republic	472.5 kg (1,041 lb)
Australia, USA	544 kg (1,199 lb)

PERFORMANCE (Rotax 912S engine):

Never-exceed speed (VNE)	141 kt (260 km/h; 162 mph)
Max level speed	120 kt (222 km/h; 138 mph)
Cruising speed	99 kt (183 km/h; 114 mph)
Stalling speed	33 kt (62 km/h; 38 mph)
Max rate of climb at S/L	335 m (1,100 ft)/min
T-O run	139 m (455 ft)
Range	338 n miles (627 km; 390 miles)
g limits	+4/-2

KLN

KLN

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DESIGNER AND MANUFACTURER: Karel Klenor

KLN's VL-3 originated in design offices of Vanessa Air sro at Litomysl, a company managed by Ing Miroslav Kábrt and Petr Kábrt which has produced some 12 previous light aircraft concepts. KLN was established in 1990 by Karel and Nadia Klenor as a manufacturer of composites aerostructures and components for motor vehicles, sanitary ware and other applications. Occupied current premises in 1997. Workforce in 2005 was 200.

KLN VL-3

TYPE: Two-seat lightplane; side-by-side ultralight.

PROGRAMME: Prototype (OK-JUU 21) flew 6 June 2004 and made debut at CIAF air show, Brno, 4 September 2004; also exhibited at Aero '05, Friedrichshafen, in April 2005. Tests on a static airframe were undertaken in February and March 2005, prior to launch of series manufacture. On 19 October 2005 the prototype set a new FAI world speed record in class RAL2 (three-axis control microlights) of 143.0 kt (265 km/h; 164.7 mph). First fused landing gear example (OK-LUU 05) first flown April 2006.

DESIGN FEATURES: Aerodynamically efficient configuration in composites, with low, tapered wing and sweptback fin. Conforms to Czech UL-2 regulations for ultralights, or as lightplane to JAR-VLA, LSA, or equivalent.

Prototype (retractable landing gear) KLN VL-3 1159002

FLYING CONTROLS: Conventional and manual. Split flaps. Flight-adjustable trim tab in starboard elevator. Aileron, flap and elevator activation by carbon-reinforced pushrods; rudder by cables; trim tabs by Bowden cable.

KLN VL-3 cockpit 1159003

KLN VL-3 fixed gear prototype 1159004

STRUCTURE: Fuselage of sandwich shell with transverse bulkheads; engine bolted to sandwich firewall. Carbon fibre engine cowlings; cockpit of hybrid carbon-Kevlar for additional strength; acrylic canopy; carbon sandwich rear fuselage. Hollow wing spars of carbon fibre; ribless wings with integral wingroot fuel tanks; individual wings connected by spar extensions pinned together, the whole attached to fuselage by two pins; ailerons and flaps attached to secondary spars. Empennage comprises tailplane and integral fin; tailplane construction and attachment as for wings.

LANDING GEAR: Tricycle type; retractable or fixed. Hydraulic retraction; all units retract rearwards; emergency hand-pump. Mainwheels 14×4 (4.00-6); nosewheel 12×4. Fuselage-mounted, spring GRP cantilever mainwheel legs; compressed rubber nosewheel shock-absorber. Hydraulic brakes. Wheel fairings on fixed gear version.

POWER PLANT: One Rotax flat-four piston engine; 59.6 kW (79.9 hp) 912 UL or 73.5 kW (98.6 hp) 912 ULS. Two-blade, fixed- or Woodcomp Kremen SR3000 variable-pitch (electric) propeller. Fuel in wingroot tanks; total capacity 90 litres (23.8 US gallons; 19.8 Imp gallons).

ACCOMMODATION: Two persons, side-by-side; baggage stowage to rear. Forward-hinged, single-piece canopy/windscreen; rear window each side.

SYSTEMS: Electrical system 12 V, with 14 Ah battery.

DIMENSIONS, EXTERNAL:

Wing span	8.44 m (27 ft 8¼ in)
Length overall	6.24 m (20 ft 5¾ in)
Height overall	2.05 m (6 ft 8¾ in)

AREAS:

Wings, gross	9.77 m² (105.2 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, retractable gear	301 kg (664 lb)
Max T-O weight: Ultralight	450 kg (992 lb)
VLA	560 kg (1,234 lb)

PERFORMANCE (Ultralight; Rotax 912 ULS engine)::

Never-exceed speed (VNE)	162 kt (300 km/h; 186 mph)
Max level speed	151 kt (280 km/h; 174 mph)
Normal cruising speed	113 kt (210 km/h; 130 mph)
Stalling speed	36 kt (65 km/h; 41 mph)
Max rate of climb at S/L	365 m (1,200 ft)/min

KUBICEK

BALONY KUBICEK SPOL S.R.O. (KUBICEK BALLOONS LTD)

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Fax: (+420 5) 45 42 26 21
e-mail: sales@kubicekballoons.cz
Web: www.kubicekballoons.cz
OWNER: Dipl Ing Aleš Kubíček
MANAGING DIRECTOR: Dipl Ing Radím Poláček
SALES MANAGER: Michael Suchý

First Kubíček hot-air balloon was manufactured in 1983 and was followed by about 50 more of Kubíček design by various state-owned companies such as Aviatik and Aerotechnik. Present company was formed as private enterprise in 1991 and began new range of hot-air balloons under BB series designations (total of 420 produced by December 2005). Currently markets standard, ready-to-fly balloon systems (including baskets, banners and other equipment) in 13 envelope sizes or types from 1,200 m³ (42,380 cu ft) to 8,500 m³ (300,175 cu ft); also special-shape balloons to order. Own polyester fabric for these is produced by sister company, Kubíček Textil. Workforce of 27 in early 2006, in factory area of 1,400 m² (15,069 sq ft).

Kubíček's first hot-air airship design was the AV-1. A new design, the AV-2, made its maiden flight in 1999. AV-1 continues to be operated in Russia by Avgur and RosAeroSystems, still with its original Kubíček polyester envelope, having now exceeded 950 hours and 1,000 flights. Registered as RF-000032R *Eagle Owl* and piloted by Nikola Galkin, it established a new FAI BX-04 class duration record of 6 hours 1 minute at Dmitrov, Russia, on 20 February 2004. The same aircraft, crewed by Natalia Volodicheva and Ekaterina Kochetkova, set two women's BX-04 records during February 2005: for speed over a 1 km course (9.1 kt; 16.9 km/h; 10.5 mph) on 7 February, and duration (3 hours 22 minutes 44 seconds) on 24 February, both at Zhukovsky.

Development and marketing of airships suspended in 2005 due to increased demand for balloons (67 sold in that year, a company record), but AV-2 being developed and marketed again in 2006.

KUBICEK AV-2

TYPE: Hot-air non-rigid/airship.
PROGRAMME: First flight 26 May 1999; public debut (c/n 106/OK-8036) June 1999; then sold to Reprox Kosice in Slovak Republic as OM-ADS, though returned to factory in 2003 for resale. In September 2004, was owned by Dirigible Atlantic Airship SL, operating on advertising activities in Spain.
COSTS: USD35,000 (2003).
STRUCTURE: Envelope of PES proprietary fabric, with rip panel and safety valves; unbraced, air-filled tail surfaces. All-metal (welded chromoly steel tube) frame, laminated plastics skin gondola.

Kubicek AV-2 flying for a Spanish sponsor 1044870

LANDING GEAR: Tricycle type, with twin nosewheels; fixed.
POWER PLANT: One 34.0 kW (45.6 hp) Rotax 503 UL-2V engine and Avia V-230C two-blade wooden pusher propeller. Fuel tank beneath centre seat, capacity 30 litres (7.9 US gallons; 6.6 Imp gallons).
ACCOMMODATION: Pilot and two passengers.
AVIONICS: *Comms:* Icom A3E 760-channel VHF radio.
Flight: Garmin 12XL nav receiver.
Instrumentation: Flytec 3040 instrument pack.

DIMENSIONS, EXTERNAL:

Envelope: Length	38.00 m (124 ft 8 in)
Max diameter	14.20 m (46 ft 7 in)
Gondola: Length	3.00 m (9 ft 10 in)
Max width	1.70 m (5 ft 7 in)
Max height	1.85 m (6 ft 0¾ in)

DIMENSIONS, INTERNAL:

Envelope volume	3,500 m³ (123,601 cu ft)

AREAS:

Display area (each side)	100.0 m² (1,076.4 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	440 kg (970 lb)
Fuel weight	20 kg (44 lb)
Max T-O weight	870 kg (1,918 lb)

PERFORMANCE (Rotax 503):

Max level speed	10.5 kt (20 km/h; 12 mph)
Pressure ceiling (estimated)	2,440 m (8,000 ft)
Endurance	1 h 30 min to 2 h

LARUS

LARUS

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Web: www.larus-czech.cz
CHIEF DESIGNER: Ludovit Packo

The Larus is the company's first product.

LARUS LARUS

English name: Gull
TYPE: Side-by-side ultralight.
PROGRAMME: Design work started 1991; prototype (OK-EUC 01) made first flight 22 October 1997. A second prototype has also flown. Will be certified in both ultralight and VLA categories.
DESIGN FEATURES: Typical small lightplane low-wing configuration. Wing sections NACA 2305 at root, NACA 2312 at tip.
FLYING CONTROLS: Conventional and manual. Horn-balanced rudder and one-piece elevator; central trim tab in elevator. Flaps fitted.
STRUCTURE: Mainly composites fuselage and wooden wings with single spar.
LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring cantilever main units; castoring nosewheel.
POWER PLANT: One 70.8 kW (95 hp) Aero Max 2400 piston engine; two-blade propeller. Fuel capacity 40 litres (10.6 US gallons; 8.8 Imp gallons).
ACCOMMODATION: Pilot and passenger seated side by side. Doors open forwards. Baggage compartment behind seats.

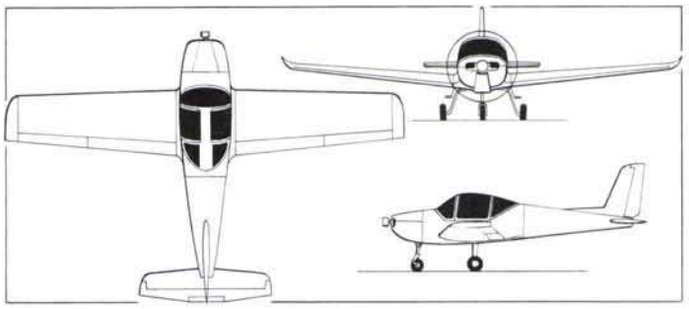
Prototype Larus OK-EUC 01 0576232

DIMENSIONS, EXTERNAL:

Wing span	9.80 m (32 ft 1¾ in)
Length overall	6.30 m (20 ft 8 in)
Height overall	2.80 m (9 ft 2¼ in)

AREAS:

Wings, gross	12.86 m² (138.4 sq ft)



Larus two-seat ultralight *(James Goulding)* 0121274

WEIGHTS AND LOADINGS:
Weight empty ..... 305 kg (672 lb)
Max T-O weight ..... 450 kg (992 lb)
PERFORMANCE:
Max level speed ..... 124 kt (230 km/h; 143 mph)
Cruising speed ..... 94 kt (175 km/h; 109 mph)
Stalling speed, flaps down ..... 38 kt (70 km/h; 44 mph)
Max rate of climb at S/L ..... 330 m (1,083 ft)/min
Service ceiling ..... 3,000 m (9,840 ft)
T-O to 15 m (50 ft) ..... 250 m (820 ft)
Landing from 15 m (50 ft) ..... 280 m (919 ft)

LD AVIATION

LD AVIATION PRAGUE S.R.O.

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Web: www.ldap.cz
MANAGING DIRECTOR: Jaroslav Najman

LD Aviation was created in 1994 as a joint venture by Letecké Opravany Kbely, Prague Aviation and US-based Duncan Aviation, being known as LOK-Duncan Aviation until US shareholder bought out in October 2000. Current company is owned 34 per cent by Letecké Opravny Kbely and 66 per cent by Czech Aviation Sales.

Company expanded its diversified aviation sales and support business by acquiring the rights to produce uncertified versions of Björn Andreasson's MFI-9 lightplane (Saab retaining rights to certified aircraft).

LD AVIATION MFI 9UL1

TYPE: Side-by-side ultralight
PROGRAMME: Andreasson BA-7 first flew 10 October 1958; developed by Malmö Flygindustri in slightly modified form as MFI-9 Junior (first flight 17 May 1961); MFI-9B Trainer; and combat-capable Mil Trainer — nine of last-mentioned being used operationally in Biafran war of independence, 1969. Bölkow (MBB) of Germany acquired licence in July 1961, building MFI-9 as Bö 208 Junior (first flight April 1962) until 1971. All had 74.6 kW (100 hp) Continental O-200-A engine. Saab acquired NFI in 1968 and built enlarged MFI-15 and MFI-17, latter remaining in production in Pakistan as PAC Mushshak. For some years, amateur builders' plans continued to be sold by Mr Andreasson, with kits available from Cana Aircraft Company of Singapore.

LD Aviation transferred original drawings to CATIA programme and introduced modified nose shape (some 12 cm; 4¾ in) longer than original to maintain C of G with lighter Rotax engine. Lightened structure, saving 45 kg (99 lb). Prototype (OK-JUU 55) first flew 24 November 2004; second aircraft was under construction in 2005 with longer (8.02 m; 26 ft 3¾ in) Bö 208C-style wings and enlarged ailerons. However, by 2006 there was no indication of continuing development or promotion.

LET-MONT

LET-MONT S.R.O.

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DIRECTORS:
Petr Podešva
Jaroslav Podešva
BUSINESS MANAGER: Tomáš Podešva

Aircraft formerly detailed under this heading are now produced by Podešva.

MARA WING

PETR BRZÁK

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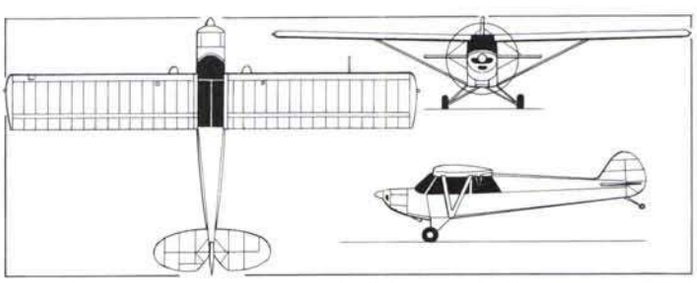
Web: www.sweb.cz/marawing

Mára Wing L-1 Malamut (also known as 1-L) is distributed by Urban Air s.r.o.

MARA WING L-1 MALAMUT

TYPE: Tandem-seat ultralight.
PROGRAMME: Prototype (OK-IUG 10) flying by 2003. Name derived from a breed of sturdy, Alaskan dog.
COSTS: EUR90,000, plus tax, excluding instruments (2005).
DESIGN FEATURES: Constant-chord, high-mounted wings braced to lower longerons by streamlined V struts; rounded fin. Deep fuselage. Tailplane braced to lower longerons by V struts and to fin by wires.
FLYING CONTROLS: Conventional and manual. Horn-balanced elevators and plain rudder with flight-adjustable tab to port. Cable-actuated, three-stage Fowler flaps. Ailerons and elevators actuated by pushrods; rudder by cables.

Mára Wing Malamut ultralight *(Paul Jackson)* 1159174



Mára Wing L1 Malamut tandem-seat ultralight *(James Goulding)* 1129167

STRUCTURE: Welded steel tube cockpit cage and riveted rear fuselage with fabric skin. Wing fabric-covered.
LANDING GEAR: Tailwheel type; fixed; two faired-in side Vs hinged to lower longerons, plus half-axles sprung on centreline with bungee cord. Hydraulic brakes. Mainwheels 9.00-6 (4 ply); solid, steerable tailwheel.
POWER PLANT: One 59.6 kW (79.9 hp) Rotax 912 UL flat-four driving a Woodcomp two-blade wooden propeller. Optionally 73.5 kW (98.6 hp) Rotax 912 ULS or 59.7 kW (80 hp) Jabiru 2200. Fuel in two wing tanks, combined capacity 80 litres (21.1 US gallons; 17.6 Imp gallons).
EQUIPMENT: Optional GRS 450 ballistic recovery parachute.
DIMENSIONS, EXTERNAL:
Wing span ..... 10.10 m (33 ft 1¾ in)
Length overall ..... 6.80 m (22 ft 3¾ in)
Height overall ..... 2.15 m (7 ft 0¾ in)
AREAS:
Wings, gross ..... 15.10 m² (162.5 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 280 kg (617 lb)
Max T-O weight: Ultralight ..... 450 kg (992 lb)
Option ..... 472 kg (1,040 lb)
PERFORMANCE:
Cruising speed at 80% power ..... 97 kt (180 km/h; 112 mph)
Econ cruising speed at 50% power ..... 81 kt (150 km/h; 93 mph)
Stalling speed ..... 29 kt (52 km/h; 33 mph)
Max rate of climb at S/L ..... 300 m (985 ft)/min
Range ..... 432 n miles (800 km; 497 miles)

NA DESIGN

NA DESIGN COMPANY INC

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CHAIRMAN AND CHIEF DESIGNER: Jan Námisňák
CUSTOMER SERVICE DIRECTOR: Jaroslav Najman
GENERAL MANAGER: Jan Oplatek

NA Design was created in third quarter of 1999, in co-operation with Moravan Aeroplanes Inc. Development of the (formerly UNIS) Bongo continued into early 2002, at which time NA Design was seeking a Western partner to assist with certification, production and marketing; the project was put on hold in late 2002 while finance was sought but, despite this, a new version, the four-seat NA50, was announced in late 2002. Some USD2.5 million said to be required to bring aircraft to production readiness; by 2006, no evidence that this had been raised. Designer Jan Námisňák previously built the Caprice 21 tandem-seat, high-wing pusher lightplane.

NA DESIGN NA 40 BONGO

TYPE: Two-seat ultralight helicopter.

PROGRAMME: Design work 1992 followed by model tests 1993; construction of Bongo technology demonstrator started 1996; public debut at Brno International Machinery Fair 1997 (then called UNIS NA40, and with two-blade main rotor) by first prototype OK-CIU. Began 70 hours of tethered hover flights March 1998. Two further prototypes completed by mid-1998. NA Design plans Normal category certification to FAR Pts 27, 33, 34 and 36 by late 2003, subject to finding joint venture Western partner to share certification, manufacturing and marketing costs. However, by 2002, financial support of USD2.5 million was still being solicited; by March 2003 the company stated that development was continuing and commercial launch was due for 2005; had not occurred by mid-2006.

PODEŠVA

TOMÁŠ PODEŠVA

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PRESIDENT: Tomáš Podešva

Tomáš Podešva is responsible for the design of the UL Tulák and UL Piper ultralights, previously detailed under Let-Mont.

The company builds and distributes a wide range of ultralight aircraft including the Trener, Dandy (Tulák), Cubby (Piper), Amigo and Chico as well as scale replicas of the Messerschmitt Bf 109 and Bücker C 104. Overseas distribution is handled by a range of companies including HB Flugtechnik of Austria, Aero-Impex of France and Fläming-Air of Germany. The Bf 109 is marketed exclusively by Roland of Germany.

PODEŠVA TRENER BABY

TYPE: Tandem-seat ultralight/kitbuilt.

PROGRAMME: Designed and built as ultralight prototype by Peter Podešva; 80 per cent scale replica of Czechoslovak Zlin 126 Trener (member of Zlin 26 family, which was produced between late 1940s and mid-1970s). Production version built by son, Tomáš Podešva at Hranice; certified and distributed by Fläming Air; second aircraft (OK-FUD 01) exhibited at ILA, Berlin, June 2000. Type certificate awarded 18 February 2003 in Czech Republic, 18 February 2004 in Germany and 4 February 2005 in France.

CURRENT VERSIONS: **Ultralight:** Wooden wings; MTOW limited to 450 kg (992 lb). Also available as kit, meeting '51 per cent rule'.

Experimental: Metal wings; 520 kg (1,146 lb) MTOW; kitbuilt.

Podešva Trener Baby in 'house colours' 1159203

Akro: Version with all-metal wing and tailplane. Fluted aileron skins and split flaps; fabric-covered elevator. Three-piece canopy, plus windscreen, public debut (D-EETB) at Berlin, May 2004.

COSTS: Ultralight: kit EUR41,667; complete example with engine EUR59,524. Experimental: EUR52,530; with retractable landing gear EUR53,372. Akro kit EUR46,578 (all 2006).

DESIGN FEATURES: Low wing with sweptback leading-edge and unswept trailing-edge; mid-mounted, braced tailplane. Replica of Zlin 126 aerobatic trainer to 80 per cent scale, except full-scale cockpit.

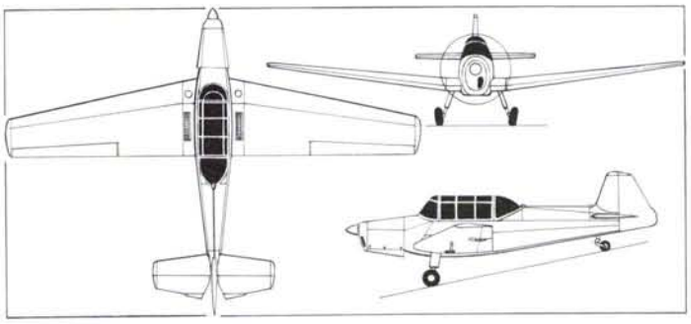
FLYING CONTROLS: Conventional and manual. Split flaps. Flight-adjustable tabs on both elevators; ground-adjustable tab on rudder and port aileron.

STRUCTURE: Steel tube fuselage with fabric covering, except for sheet metal upper surface and engine cowling; fabric-covered empennage. Wings wood or metal, according to version, with aluminium leading-edge and fabric covering. Composites nose fairing.

LANDING GEAR: Tailwheel type; fixed. Wing-mounted, trousered, cantilever sprung main legs. Mainwheels 5.00-5; tailwheel 200×50. Hydraulic brakes.

POWER PLANT: One 55.1 kW (73.9 hp) Walter Mikron III four-cylinder, in-line piston engine driving a Kremen two-blade, variable-pitch (electric), wooden propeller or Woodcomp

Akro version of Podešva Trener Baby 1159204



Podešva Trener Baby (Walter Mikron III engine) *(James Goulding)* 0558570

Podešva Cubby (Piper) two-seat ultralight 1159177

fixed-pitch propeller. (VZLÚ two-blade wooden propeller on prototype.) Option to fit LOM engines in Experimental version. Fuel capacity 35 litres (9.2 US gallons; 7.7 Imp gallons).

AVIONICS: To customer's specification.

EQUIPMENT: Optional rescue system.

DIMENSIONS, EXTERNAL:

Wing span	8.68 m (28 ft 5¾ in)
Length overall	6.52 m (21 ft 4¾ in)
Height overall	1.80 m (5 ft 10¾ in)

AREAS:

Wings, gross	10.80 m² (116.3 sq ft)

WEIGHTS AND LOADINGS (UL: Ultralight, E: Experimental):

Weight empty: UL	296 kg (653 lb)
E	380 kg (837 lb)
Max T-O weight: UL	450 kg (992 lb)
where regulations permit	472.5 kg (1,041 lb)
E	600 kg (1,322 lb)

PERFORMANCE (UL, E, as above):

Never-exceed speed (VNE):	
UL	121 kt (225 km/h; 139 mph)
E	178 kt (330 km/h; 205 mph)
Cruising speed at 75% power:	
UL	94 kt (175 km/h; 109 mph)
E	124 kt (230 km/h; 143 mph)
Stalling speed: UL	36 kt (65 km/h; 41 mph)
E	45 kt (83 km/h; 52 mph)
Max rate of climb at S/L	270 m (886 ft)/min
Max range	432 n miles (800 km; 497 miles)
g limits: UL	+4/−2
E	+6/−3

PODEŠVA UL DANDY (TULÁK) and UL CUBBY (PIPER)

TYPE: Side-by-side ultralight/kitbuilt; tandem-seat ultralight.

PROGRAMME: Tulák certified 21 February 1996 and Piper 24 March 1998. Variations of the design are marketed by HB Flugtechnik of Austria as the Amigo and Cubby. First factory-built aircraft (OZ-ZUD 11) produced in 1998.

CURRENT VERSIONS: **UL Tulák:** Side-by-side seats; factory-built or kit. Marketed by HB as Dandy. English name: Rambler.

UL Piper: Tandem seats; otherwise as Tulák. No kit version. German name **Tandem Tulák**. Span 9.82 m (32 ft 2½ in); length 5.96 m (19 ft 6½ in); maximum cruising speed 70 kt (130 km/h; 81 mph). Engine options include 58.8 kW (78.9 hp) or 73.5 kW (98.6 hp) BMW; 58.8 kW (78.9 hp) Verner; 62.5 kW (83.8 hp) Tatra; and 51.5 kW (69.0 hp) Limbach. Marketed by HB as Cubby.

CUSTOMERS: Total 55 kits and complete aircraft built by end of 2002; ninth factory-built machine was registered in Poland in 2002 and completed in 2003. Known sales in Czech Republic, France, Germany and Poland.

Data apply to both Tulák and Piper, except where indicated.

DESIGN FEATURES: High, constant-chord wing braced by V struts; optional tapered or downturned wingtips. Wings fold back for storage and transportation. Resemble Piper designs of 1940s/1950s.

Clark Y wing section, thickness/chord ratio 12.5 per cent.

FLYING CONTROLS: Conventional and manual. Flight-adjustable trim tab in each elevator. Plain flaps.

STRUCTURE: Fabric-covered metal tube fuselage; two-spar wooden wing; engine cowling metal; some composites.

LANDING GEAR: Tailwheel type; fixed. Two faired side Vs hinged to lower longerons, plus half-axles sprung under centreline with bungee cord. Steerable tailwheel; 420×150 mainwheels with bungee suspension and cable-operated brakes. Mainwheel spats optional.

POWER PLANT: One 37.0 kW (49.6 hp) Rotax 503 UL-2V engine; SportProp three-blade, ground-adjustable pitch, glass fibre propeller. Fuel capacity 50 litres (13.2 US gallons; 11.0 Imp gallons).

DIMENSIONS, EXTERNAL:

Wing span: tapered tips	9.60 m (31 ft 6 in)
downturned tips	9.40 m (30 ft 10 in)
Width, wings folded	3.10 m (10 ft 2 in)
Length overall	5.60 m (8 ft 4½ in)
Height overall	2.00 m (6 ft 6¾ in)

DIMENSIONS, INTERNAL:

Cabin max width: Tulák	1.14 m (3 ft 9 in)
Piper	0.70 m (2 ft 3½ in)

AREAS:

Wings, gross	13.00 m² (139.9 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: Tulák	255 kg (562 lb)
Piper	265 kg (584 lb)
Max T-O weight: both	450 kg (992 lb)

PERFORMANCE (both):

Never-exceed speed (VNE)	89 kt (165 km/h; 102 mph)
Econ cruising speed	59 kt (110 km/h; 68 mph)
Stalling speed, flaps down	33 kt (60 km/h; 38 mph)
Max rate of climb at S/L	300 m (984 ft)/min
T-O run	65 m (215 ft)
Landing run	60 m (200 ft)
g limits	+6/−4

PODEŠVA C 104

TYPE: Tandem-seat ultralight biplane kitbuilt.

CUSTOMERS: Prototype (OK-IUD 04) constructed in 2004.

DESIGN FEATURES: Scale replica of Aero C 104 biplane, itself a licence-built Bücker Bü 131 Jungmann. Equal-span upper and lower wings, lower plane attached to bottom longerons; upper mounted on twin N-type strut cabane and twin interplane struts; wire bracing. Wire-braced tailplane.

FLYING CONTROLS: Conventional and manual. Interconnected ailerons on upper and lower wings. Unbalanced elevators and rudder; trim tab on each elevator.

STRUCTURE: Fuselage of welded steel tube and wooden wing, both covered with Ceconite fabric.

LANDING GEAR: Tailwheel type; fixed. Two faired-in side Vs attached to lower longerons, plus half-axles attached to tripod compression frame. Fully castoring tail wheel.

POWER PLANT: One 55.1 kW (73.9 hp) Parma Mikron III four-cylinder, in-line piston engine driving a two-blade propeller.

ACCOMMODATION: Pilot and passenger in separate, open cockpits. Aircraft is flown solo from rear cockpit.

DIMENSIONS, EXTERNAL:

Wing span	6.60 m (21 ft 7¾ in)
Length overall	6.25 m (20 ft 6 in)
Height overall	2.06 m (6 ft 9 in)

AREAS:

Wings, gross	12.00 m² (129.2 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	285 kg (628 lb)

Podešva C 104 ultralight kitbuilt biplane 1159200

PROAIR

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DIRECTOR: Libor Veverka

The Skywalk GL 165 is Proair's first autogyro.

PROAIR SKYWALK

TYPE: Two-seat autogyro ultralight.
PROGRAMME: Prototype (OK-KWA 01) first flew in January 2005 and made public debut at Aero '05, Friedrichshafen, in April 2005.
CURRENT VERSIONS: **Skywalk GL 165:** Prototype.
Skywalk GL 180: Production version with uprated engine; was due to be manufactured from late 2005.
DESIGN FEATURES: Enclosed autogyro with large, twin fins and tailplane mounted on cantilever boom. Hydraulic prerotation mechanism; hydraulic rotor disc brake.
FLYING CONTROLS: Twin, horn-balanced rudders.
STRUCTURE: Metal keel supporting composites pod containing cockpit and power plant; keel bifurcated at rear to support composites tailplane with fin and rudder at each tip.
LANDING GEAR: Tricycle type; fixed. Keel-mounted spring carbon fibre cantilever mainwheel legs. Tyre size (all) 10×4.50-5; solid tail bumper wheel. Hydraulic disc brakes.
POWER PLANT: One 122 kW (164 hp) piston engine driving a Warp Drive four-blade, ground-adjustable pitch propeller. Fuel capacity 60 litres (15.9 US gallons; 13.2 Imp gallons).
AVIONICS: Single-screen 'glass cockpit'.
ARMAMENT: Optional ballistic parachute recovery system.
DIMENSIONS, EXTERNAL:
Rotor diameter ..... 9.00 m (29 ft 6¼ in)
Propeller diameter ..... 1.70 m (5 ft 7 in)
WEIGHTS AND LOADINGS:
Max T-O weight ..... 450 kg (992 lb)
PERFORMANCE:
Never-exceed speed (VNE) ..... 116 kt (216 km/h; 134 mph)
Max level speed ..... 97 kt (180 km/h; 112 mph)
Max cruising speed ..... 81 kt (150 km/h; 93 mph)
Econ cruising speed ..... 54 kt (100 km/h; 62 mph)
Max rate of climb at S/L ..... 180 m (590 ft)/min
Service ceiling ..... 3,000 m (9,840 ft)
T-O run ..... up to 60 m (200 ft)
Landing run ..... up to 20 m (65 ft)

Prototype Proair GL 165 Skywalk *(Paul Jackson)* 1159173

TEST

TEST S.R.O.

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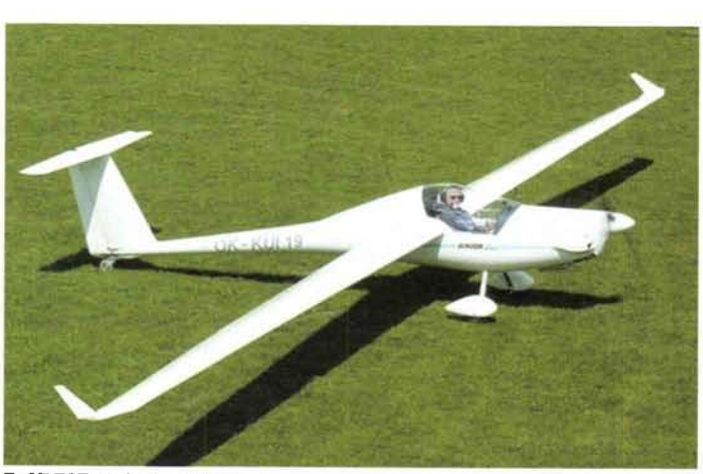
Web: www.test.infoline.cz
PRODUCTION DIRECTOR: Zdeněk Teply
MARKETING DIRECTOR: Zbynek Jaros

Company was established 1992 to design, develop and produce ultralight sailplanes, powered sailplanes and aircraft; first product was TST-1 Alpin sailplane. Capacity increased to 10 aircraft per year in 1995 and to 40 per year from September 1998. Developed versions of Alpin (TST-3 and TST-8), available in both sailplane and motor glider variants, still form core of production; the TST-5, TST-6 and TST-9 have now been discontinued. Workforce was 17 in 2004.

In October 2002, a further sailplane - the TST-10 Atlas M — was added to the product line, and the company announced that it had started development of the TST-12, a two-seat, low-wing, tailwheel ultralight. In 2004, the TST-14 Bonus M two-seat derivative of the TST-10 was added to the range as the company concentrated on its composites sailplane products.

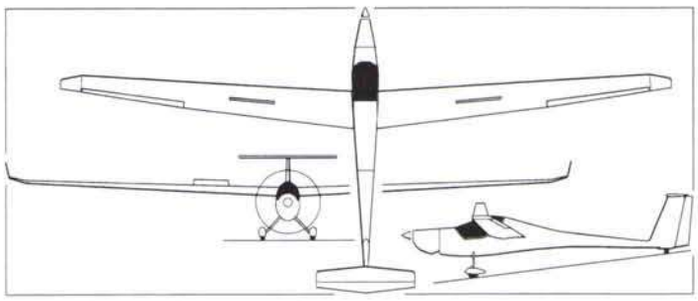
In 2005, the TST-13 Junior 2005 all-composites successor to the TST-9 was introduced.



TeST TST-13 Junior 2005 prototype 1159216

TEST TST-13 JUNIOR 2005

TYPE: Single-seat ultralight motor glider.
PROGRAMME: Developed in late 1990s, is a derivative of the earlier TST-9 Junior 2000, itself derived from the TST-7 Junior.
DESIGN FEATURES: Forward-swept, high-wing monoplane with T tail. Tailplane removable for storage and transportation. Tailplane aerofoil NACA 0011.
FLYING CONTROLS: Conventional and manual. Ailerons and elevators rod-actuated, rudder by cables. Two position flaps; uper-surface spoilers.



TeST TST-13 general arrangement 1159219

STRUCTURE: Composites wing with I-shaped spar identical to that used on TST-10 glider. Fuselage of sandwich structure with integral empennage. Wing, with plywood and fabric covering; glass fibre wingtips. All-wood fuselage except for glass fibre panel behind cockpit.

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted spring cantilever mainwheel legs with wheel fairings and 300×100 wheels; 120×30 steerable tailwheel.

POWER PLANT: One 31.0 kW (41.6 hp) Rotax 447 engine and two-blade SportProp 1600 propeller standard; or suitable equivalent; 37.0 kW (49.6 hp) Rotax 503 can also be fitted. Standard fuel capacity 20 litres (5.3 US gallons; 4.4 Imp gallons); this can be optionally increased to 40 litres (10.6 US gallons; 8.8 Imp gallons) by use of interchangeable wing tank.

EQUIPMENT: Optional BRS parachute.

DIMENSIONS, EXTERNAL:

Wing span	15.00 m (49 ft 2½ in)
Length overall	7.05 m (23 ft 1½ in)

DIMENSIONS, INTERNAL:

Cabin max width	0.59 m (1 ft 11¼ in)

AREAS:

Wings, gross	10.03 m² (108.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	195 kg (430 lb)
Max T-O weight	300 kg (661 lb)
with BRS parachute system	322 kg (709 lb)

PERFORMANCE, POWERED:

Never-exceed speed (VNE), and max speed with spoilers extended	108 kt (200 km/h; 124 mph)
Max cruising speed	86 kt (160 km/h; 99 mph)
Normal cruising speed	65 kt (120 km/h; 75 mph)
Stalling speed	36 kt (65 km/h; 41 mph)
g limits	+4.8/–2.8

PERFORMANCE, UNPOWERED:

Best glide ratio at 50 kt (93 km/h; 58 mph)	32

TL

TL ULTRALIGHT

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Formed in 1990, TL previously produced the TL-1, TL-2 and TL-32 ultralights, progressing then to the TL-132, predecessor of the current TL-232. The TL-22 Duo/Eso Rogallo-wing trike is also available. In February 2006 the company opened a new 4,087 m² (44,000 sq ft) factory, at which time it had a workforce of 70 and had delivered over 400 aircraft.

TL-96 STAR and TL-2000 STING CARBON

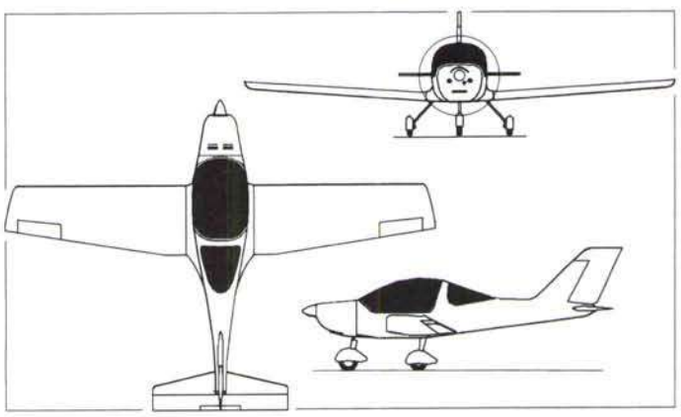
TYPE: Side-by-side ultralight.

PROGRAMME: Prototype Star first flew November 1997.

CURRENT VERSIONS: **TL-96 Star:** Baseline version; *as described*. Marketed in USA as StarSport, but only demonstrator (N551WA) produced. Low rate production only.

TL-2000 Sting Carbon: All-CFRP version; prototype OK-GUU 10; announced 2000; Czech type certificate issued, 19 December 2002. Marketed in USA as StingSport and received S-LSA approval on 24 May 2005. Retractable gear version shown (prior to first flight) at Aero '03, Friedrichshafen, April 2003. Estimated 15 kt (28 km/h; 17 mph) speed advantage for 3 kg (7 lb) weight penalty. US version has increased weight of 386 kg (851 lb) empty and 648 kg (1,430 lb) max T-O, with Rotax 914 engine.

TL-2000 Sting RG: Retractable landing gear version introduced in 2005, based on TL-2000 Sting Carbon. Mainwheels retract outwards.



TL-2000 Sting two-seat ultralight 1159140

CUSTOMERS: Sales in Australia, Belgium, Canada, Czech Republic, Finland, France, Germany, Hungary, Italy, Japan, Netherlands, New Zealand, Poland, Portugal, South Africa, South Korea, Spain and USA. Production rate set at four per month in 2006. By mid-2006, at least 141 TL-96s and 121 TL-2000s (including RG versions) produced in Europe, while further 50 registered in US. Last-mentioned mostly StingSports, but include two Sting Carbons, two Sting RGs and one each of Sting, Sting XS, Sting Trainer and StarSport.

EQUIPMENT: Optional AmSafe Aviation inflatable restraints available on US aircraft.

COSTS: TL-96 EUR51,000; TL-2000 EUR55,000 (2005).

DESIGN FEATURES: Conventional, low-wing monoplane with constant-chord wings and tailplane, plus sweptback fin.

MS 313 wing aerofoil section. Optional tailcone extension for towing hook.

FLYING CONTROLS: Manual. All-moving tailplane with anti-balance tab. Three-position (0, 15, 35°) split flaps.

STRUCTURE: All-composites (GFRP and CFRP).

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring GFRP cantilever legs and wheel fairings. Steerable nosewheel. Tyre sizes 4.00-8/400×100 (main), 4.00-4 (nose). Hydraulic mainwheel brakes.

POWER PLANT: One 59.6 kW (79.9 hp) Rotax 912 UL-DCDI or 84.6 kW (113.4 hp) Rotax 914 flat-four engine; three-blade Albastar propeller. Optional 67.1 kW (90 hp) Aero Prag AP-45 flat-four and two-blade wooden propeller. Fuel capacity (RON 95) 67 litres (17.7 US gallons; 14.7 Imp gallons) in TL-96 and TL-2000, optionally 100 litres (26.4 US gallons; 22.0 Imp gallons) in fuselage tank and two 30 litre (7.9 US gallon; 6.6 Imp gallon) wing tanks.

TL-2000 StingSport LSA version for US market *(Paul Jackson)* 1159144

ACCOMMODATION: Heated as standard.
DIMENSIONS, EXTERNAL (A: TL-96, B: TL-2000):
Wing span: A ..... 9.20 m (30 ft 2¼ in)
B ..... 8.44 m (27 ft 8¼ in)
Length overall: A ..... 6.50 m (21 ft 4 in)
B ..... 5.93 m (19 ft 5½ in)
Height overall: A, B ..... 2.30 m (7 ft 6½ in)
DIMENSIONS, INTERNAL:
Cabin max width: A, B ..... 1.02 m (3 ft 4¼ in)
AREAS:
Wings, gross: A ..... 12.20 m² (131.3 sq ft)
B ..... 9.08 m² (97.7 sq ft)
WEIGHTS AND LOADINGS:
Weight empty: A ..... 285 kg (628 lb)
B ..... 275 kg (606 lb)
Max T-O weight: A, B ..... 450 kg (992 lb)
B, where permitted ..... 598 kg (1,320 lb)
PERFORMANCE, POWERED (Rotax 912):
Never-exceed speed (VNE):
A ..... 148 kt (275 km/h; 170 mph)
B ..... 164 kt (305 km/h; 189 mph)
Max level speed: A ..... 138 kt (255 km/h; 158 mph)
B ..... 145 kt (270 km/h; 167 mph)
Max cruising speed: A ..... 119 kt (220 km/h; 137 mph)
B ..... 140 kt (260 km/h; 162 mph)
Stalling speed: A ..... 34 kt (63 km/h; 40 mph)
B ..... 36 kt (65 km/h; 41 mph)
Max rate of climb at S/L: A ..... 300 m (984 ft)/min
B ..... 480 m (1,575 ft)/min
Range: A ..... 540 n miles (1,000 km; 621 miles)
B ..... 810 n miles (1,500 km; 932 miles)
PERFORMANCE, UNPOWERED:
Best glide ratio: A 16

TL-232 CONDOR

TYPE: Tandem-seat ultralight/kitbuilt.
PROGRAMME: Side-by-side seat TL-132 (Rotax 503 engine) first flown 1993; entered production, and TL-232 introduced, in 1994. TL-132 subsequently discontinued.
CURRENT VERSIONS: **TL-232 Condor Plus**: Compared to TL-132, has modified wing profile; option of more powerful engine; cut-down rear fuselage and additional glazing for rear cockpit.

Power Condor: Version with 73.5 kW (98.6 hp) Rotax 912 ULS and glider-towing equipment; able to aero-tow sailplanes of up to 400 kg (882 lb) AUW.

Condor S: Aerotowing version, certified 23 October 2001. Prototype (D-MPAK) fitted with Hirth fuel-injected engine.
CUSTOMERS: Operators in Czech Republic, Germany, Netherlands, Poland and Sweden. Total of 320 sold by November 2004. Promotion was continuing in 2006.
COSTS: Kit only EUR21,010; with Rotax 582 UL-DCDI EUR38,000; Rotax 912 UL EUR47,700; Rotax 912S UL EUR58,800 (all 2003).
DESIGN FEATURES: Constant-chord, high wing with V-strut bracing; mid-mounted tailplane; sweptback fin with long fillet. Wings and horizontal tail surfaces foldable for transportation and storage.
FLYING CONTROLS: Conventional and manual. In-flight-adjustable tab in starboard elevator. Two-position flaps. Dual controls.
STRUCTURE: Fabric-covered metal. Composites rear top-decking.
LANDING GEAR: Tricycle type; fixed (tailwheel version discontinued). Fuselage-mounted spring cantilever mainwheel legs with wheel fairings. Tyre sizes 16×4 (main), 400×100 (nose). Hydraulic brakes. Leg and wheel speed fairings optional.
POWER PLANT: One 47.8 kW (64.1 hp) Rotax 582 UL-DCDI two-cylinder two-stroke in-line engine in basic TL-232, driving a three-blade Albastar ground-adjustable pitch propeller. Optional alternatives include 59.6 kW (79.9 hp) Rotax 912 UL-DCDI or 73.5 kW (98.6 hp) Rotax 912 ULS flat-four with Ivoprop three-blade composites propeller. Fuel capacity 50 litres (13.2 US gallons; 11.0 Imp gallons) standard, 62 litres (16.4 US gallons; 13.6 Imp gallons) optional.
DIMENSIONS, EXTERNAL:
Wing span ..... 10.60 m (34 ft 9¼ in)
Length overall ..... 5.90 m (19 ft 4¼ in)
Height overall ..... 2.30 m (7 ft 6½ in)
AREAS:
Wings, gross ..... 14.84 m² (159.7 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 265–280 kg (584–617 lb)
Max T-O weight ..... 450 kg (992 lb)
PERFORMANCE (Rotax 912 UL-DCDI engine):
Max level speed ..... 97 kt (180 km/h; 111 mph)
Cruising speed ..... 81 kt (150 km/h; 93 mph)
Stalling speed ..... 33 kt (60 km/h; 38 mph)
Max rate of climb at S/L ..... 276 m (906 ft)/min

TL Ultralight TL-232 Condor Plus 1042745

URBAN

URBAN AIR S.R.O.

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SALES MANAGER: Ing Milos Mladek

This company produces the UFM-10 Samba and UFM-13 Lambáda ultralight at its three factories in the area of Usti nad Orlici.

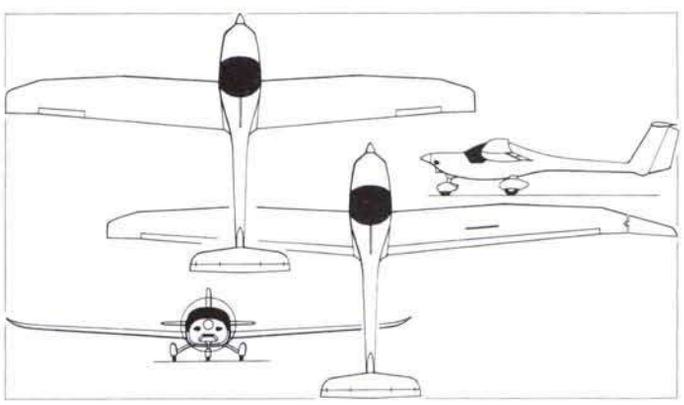
URBAN UFM-13 LAMBÁDA

TYPE: Side-by-side ultralight/kitbuilt.
PROGRAMME: Design started June 1994; first flight (UFM-11 prototype) 23 May 1996; production began October 1996; first customer delivery October 1997.
CURRENT VERSIONS: **UFM-11 UK:** Short-span (11.80 m; 38 ft 8½ in) version. Production discontinued in 2000, but restarted in 2003, featuring two-position slotted flaps as fitted to UFM-10.

UFM-13: Standard version, *as described*. Optional wingtips to extend span from 13 to 15 m (UFM-13/15). Also available as sailplane (**UFM-13W**) with single mainwheel.

A UFM-13/15 (D-MZGG) shown at Berlin in May 2002 featured a Hirth fuel-injected engine and Hoffmann HO-V62R two-blade, variable pitch, metal propeller.
CUSTOMERS: Total 17 factory-built UFM-11s and 68 UFM-13s built by late 2005, exported to Brazil, Estonia, France, Germany, Ireland, Netherlands, South Africa, Spain, Switzerland and USA.
COSTS: Flyaway, excluding VAT, EUR47,300 (2004).
DESIGN FEATURES: Conforms to JAR-VLA. Forward-swept wings with cranked leading-edge and laminar profile (aerofoil section SM 701); incidence 3°. T tail. Wings and horizontal tail detach for storage and transportation.
FLYING CONTROLS: Conventional (manual) three-position (5, 9, 16°) flaperons, rudder and one-piece elevator; upper surface Schempp-Hirth spoilers. Ailerons and slotted flaps on UFM-11.
STRUCTURE: Laminated glass fibre and carbon fibre, with CFRP wing spar.
LANDING GEAR: Fixed; tricycle or tailwheel type. Fuselage-mounted spring cantilever mainwheel legs with wheel fairings and hydraulic brakes. Mainwheel tyres 4.00–8.
POWER PLANT: One 59.6 kW (79.9 hp) Rotax 912 UL, 73.5 kW (98.6 hp) Rotax 912 ULS or 59.7 kW (80.0 hp) Jabiru 2000 four-stroke engine; driving SportProp two-blade, glass fibre (Rotax) or Kremen three-blade, wooden (Jabiru) propeller. Fuel tank in port wing, capacity 50 litres (13.2 US gallons; 11.0 Imp gallons); second identical tank can be fitted into starboard wing.

Urban UFM-11 Lambáda *(Paul Jackson)* 1159145



Urban UFM-11 Lambáda, with additional plan view of UFM-13 showing UFM-15 wingtip to starboard *(Paul Jackson)* 1159139

DIMENSIONS, EXTERNAL:
- Wing span: standard ..... 13.00 m (42 ft 7¾ in)
- extended ..... 15.00 m (49 ft 2½ in)
- Length overall ..... 6.60 m (21 ft 7¾ in)
- Height overall ..... 1.95 m (6 ft 4¾ in)

DIMENSIONS, INTERNAL:
- Cabin max width ..... 1.06 m (3 ft 5¾ in)

AREAS:
- Wings, gross: standard span ..... 12.16 m² (130.9 sq ft)
- extended span ..... 12.85 m² (138.3 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty: standard span ..... 265 kg (562 lb)
- extended span ..... 280 kg (617 lb)
- Max T-O weight: both ..... 472.5 kg (1,041 lb)

PERFORMANCE, POWERED (Rotax 912 UL):
- Never-exceed speed (VNE) ..... 108 kt (200 km/h; 124 mph)
- Max cruising speed ..... 81 kt (150 km/h; 93 mph)
- Stalling speed ..... 35 kt (63 km/h; 40 mph)
- Max rate of climb at S/L ..... 300 m (984 ft)/min
- Range ..... 432 n miles (800 km, 497 miles)

PERFORMANCE, UNPOWERED:
- Best glide ratio: standard wing 26
- extended wing 30
- Min rate of sink ..... 1.10 m (3.61 ft)/s

URBAN UFM-10 SAMBA

TYPE: Side-by-side ultralight/kitbuilt.

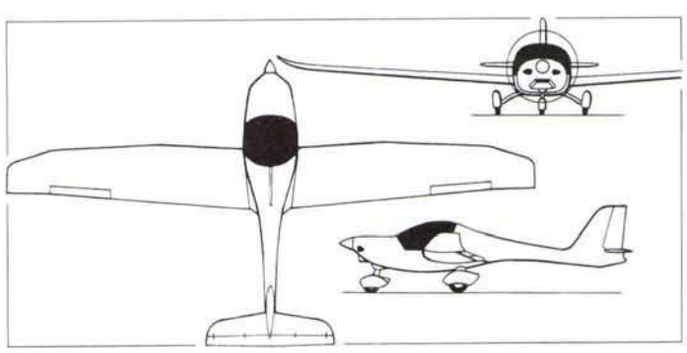
PROGRAMME: Previously known as Speed Lambáda. Prototype OK-EUU 38 rolled out July 1999; first production aircraft (OK-EUU 39) flew 21 July 1999.

CURRENT VERSIONS: **UFM-10 Samba:** *As described.*

UFM-10 Samba XXL: Introduced in 2003. Superficially similar to standard Samba, but has redesigned carbon fibre fuselage and empennage. Cockpit section is from ATEC Zephyr, and Samba XXL is thus broadly in parallel to FSU Saphir, marketed by Fläming Air of Germany. Wing maintains 10.00 m (32 ft 9¾ in) span. Fuselage length increased by 10 cm (4 in); height 2.20 m (7 ft 2½ in), due to redesigned, longer landing gear legs. MTOW 472.5 kg (1,041 lb) as parachute-equipped Ultralight, or 520 kg (1,146 lb) in Experimental category. Weight 260 kg (573 lb); cruising speed 119 kt (220 km/h; 137 mph); max speed 146 kt (270 km/h; 168 mph). Other differences from standard Samba include front-hinged canopy, winglets and fin fillet. Third prototype (OK-IUA 54) was first to fly – on 15 April 2003.

CUSTOMERS: Total of at least 41 Sambas produced by late 2004, including examples to Germany, Ireland, Netherlands, South Africa, Swaziland and USA; none known in 2005 or early 2006. At least 31 Samba XXLs sold by early 2006 to customers in South Africa, Norway and Czech Republic.

Urban Samba XXL with optional winglets *(Paul Jackson)* 1159146



Urban UFM-10 Samba *(Paul Jackson)* 1159138

COSTS: EUR47,300 excluding VAT (2004).

DESIGN FEATURES: Short-span version of UFM-13; low-mounted wing and tailplane; shorter wheelbase. Suitable as tug for sailplanes of up to 380 kg (837 lb) MTOW.

FLYING CONTROLS: Conventional and manual. Balanced ailerons. Two-position (20 and 45°) slotted flaps.

POWER PLANT: One 59.6 kW (79.9 hp) Rotax 912 UL or 73.5 kW (98.6 hp) Rotax 912 ULS flat-four, driving two- or three-blade, ground-adjustable pitch propeller as per UFM-13. Motor Design 63.0 kW (84.5 hp) MD 90 Diesel engine as option from 2005. Fuel capacity 50 litres (13.2 US gallons; 11.0 Imp gallons) in port wing tank; second tank can be fitted to starboard wing.

EQUIPMENT: BRS recovery parachute and glider-towing equipment optional.

DIMENSIONS, EXTERNAL:
- Wing span: normal ..... 10.00 m (32 ft 9¾ in)
- option ..... 13.00 m (42 ft 7¾ in)
- Length overall ..... 5.90 m (19 ft 4¼ in)
- Height overall ..... 1.95 m (6 ft 4¾ in)

AREAS:
- Wings, gross ..... 8.90 m² (95.8 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty: standard ..... 250 kg (551 lb)
- with parachute and hook ..... 286 kg (630 lb)
- Max T-O weight: standard ..... 472.5 kg (1,041 lb)
- with parachute and hook ..... 520 kg (1,146 lb)

PERFORMANCE, POWERED (Rotax 912 UL):
- Never-exceed speed (VNE) ..... 140 kt (260 km/h; 161 mph)
- Normal cruising speed ..... 108 kt (200 km/h; 124 mph)
- Stalling speed: flaps down ..... 36 kt (65 km/h; 41 mph)
- Max rate of climb at S/L ..... 300 m (984 ft)/min

PERFORMANCE, UNPOWERED:
- Best glide ratio 19
- Min rate of sink ..... 1.50 m (4.92 ft)/s

WOLFSBERG LETOV

WOLFSBERG LETECKÁ TOVARNA S.R.O.
(SUBSIDIARY OF WOLFSBERG AIRCRAFT CORPORATION NV)

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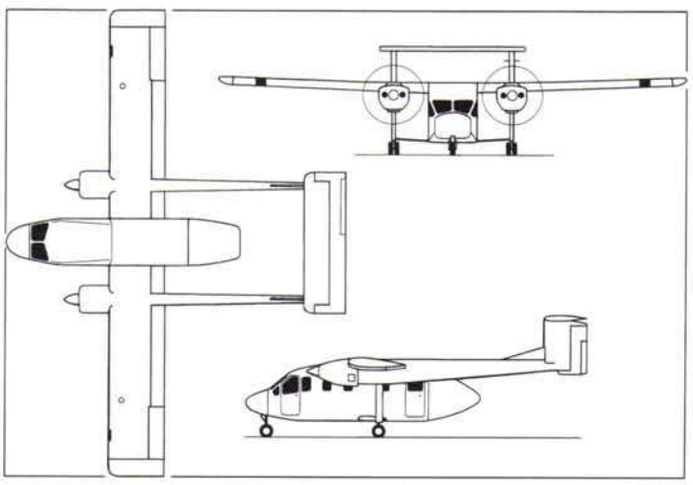
CHIEF ENGINEER: Sergei Orlov
CHIEF DESIGNER: Alec Clark

Company formed from part of former Letov, established in 1918 and privatised in mid-1990s as separate divisions, including Letov Letecká Výroba, Letov Simulator, Letov Nastrojana and Letov Air. Following 1998 bankruptcy of Letov group, Letov Letecká Výroba (Letov Aircraft Production) was sold by administrator on 1 June 2000 to Latécoère of France and continued with manufacture of aerostructures, while Letov Air became a wholly owned subsidiary of Wolfsberg Aircraft Corporation of Belgium as (initially) Letecká Tovarna ('Aircraft Factory', abbreviated to Letov), having discontinued production of ultralight aircraft (LK-2, LK-3 and ST-4).

On 21 November 2000, it was announced that Letecká Tovarna had been assigned design and production responsibility for the Wolfsberg Raven 257 (now Corvus 1) cargo aircraft, taking over from Evektor-Aerotechnik, another Czech firm. Marketing and financing is the responsibility of the Belgian company. Following a major reorganisation of management in 2003, the company began restructuring under the name of Wolfsberg. Current activities include production of sheet metal parts and sub-assemblies for Aero Vodochody, Ibis Ae 270, Evektor EV-96, Pilatus PC-6 Porter and parts for emergency doors of Airbus aircraft.

Prototype Wolfsberg Corvus 1F rear aspect 1159082



Wolfsberg Corvus 1 utility aircraft *(Paul Jackson)* 1154395

WOLFSBERG CORVUS 1

TYPE: Light utility twin-prop transport.

PROGRAMME: Definitive design began in June 1997; then known as Raven 257. Wings and tail surfaces of prototype made by Letov Air in Prague; rest of aircraft and flight testing assigned to Evektor-Aerotechnik in Kunovice, Czech Republic. First flight (OK-RAV) 28 July 2000. Original date set for certification to FAR Pt 23 was April 2002, but this postponed when prototype found to be 400 kg (881 lb) overweight and collaboration with Evektor was terminated.

Design and manufacture transferred back to Letov Air in September 2000. Some major structural modifications were carried out to prototype, increases in wing span and MTOW; and forward port and starboard doors repositioned to provide direct access to flight deck. Letov was, meanwhile, acquired by Wolfsberg. Production of the conforming prototype and structural test aircraft was proceeding in late 2003/early 2004 after reorganisation and changing the name of the company to Wolfsberg Letecká Tovarna s.r.o.

Redesigned aircraft was relaunched as Corvus 1 in 2005. Prototype (OK-WLT) first flew at Praha-Kbely, 6 June 2006.

CURRENT VERSIONS: **Corvus 1F**: Freight version. May be converted to Corvus 1P with modification kit. *As described.*

Corvus 1P: Passenger version. May be converted to Corvus 1F with modification kit. Empty weight 2,020 kg (4,453 lb); pilot and nine passengers (one in cockpit), plus 80 kg (176 lb) baggage in tailcone. Range 800 n miles (1,481 km; 920 miles) with full load and full fuel.

COSTS: USD885,000 (2006).

DESIGN FEATURES: High-wing, twin-boom configuration with square section fuselage and high-set tailplane. Design goals include ability to operate from short unprepared strips, simple systems and easy field maintenance for operation in less-developed areas, combined with low acquisition and operating costs; seen as modern replacement for aircraft in the B-N Islander and Piper Aztec class, and as a 'step up' for operators of single-engined utility aircraft such as the Cessna 206, with applications in passenger, cargo, medevac and airdrop roles.

NACA 23018 section wings, with 2° 30′ dihedral; 3° incidence; NACA 0012 section horizontal and vertical tail surfaces.

FLYING CONTROLS: Conventional and manual, via push-pull rods. Control surfaces statically balanced. Two-section elevator with independent controls and trim tab on port side. Maximum elevator deflection +27/–22°, aileron deflection +25/–15°; rudder deflection ±25°. Trim tab on starboard rudder. Four-section electrically actuated flaps, T-O setting 20°, landing 48°.

STRUCTURE: Conventional, mostly riveted aluminium alloy, with glass fibre wingtips, nosecone, cargo hatch and engine cowlings.

LANDING GEAR: Tricycle type; fixed. Based on, and mostly interchangeable with, that of B-N Islander, with main legs mounted outboard, beneath tailboom/wing intersection and braced to lower fuselage by streamline section horizontal strut; twin wheels on each main unit and single nosewheel; oleo strut suspension. Mainwheel tyre size 7.00–6; nosewheel 6.00–6; Cleveland 40–90F brakes on mainwheels; 40–76D on nosewheel.

POWER PLANT: Two 231.2 kW (310 hp) Teledyne Continental IO-550-N8B flat-six engines, driving two-blade constant-speed propellers. Fuel contained in two integral tanks in outer wings, combined capacity 660 litres (174 US gallons; 145 Imp gallons), of which 640 litres (169 US gallons; 141 Imp gallons) usable; filler port in upper surface of each wing.

ACCOMMODATION: Two-crew on 26 *g* seats (although aircraft will be certified for single-pilot operation); up to eight passengers, or combi configuration with four passengers and 500 kg (1,102 lb) of cargo. Crew door on each side; sliding semi-bulkhead separates flight deck from cabin/cargo area, which has flat floor and quick-change features including four floor attachment rails, with passenger door at rear on port side and upward-hinged rear cargo door. In cargo configuration, fuselage can accommodate 304 × 139 cm pallets, 1.2 × 1.0 m Europallets and bulk cargo under netting. Baggage door on port side, emergency exit on starboard side. Max floor loading 730 kg/m² (150 lb/sq ft)

SYSTEMS: 24 V electrical system includes two engine-driven 100 A alternators and 24 V 19 Ah accumulator. Optional features include pneumatic leading-edge de-icing; electric propeller and windscreen anti-icing; air conditioning; and autopilot.

AVIONICS: Bendix/King equipment.

Comms: Twin KX 155 nav/com/glideslope; KT 70 Transponder. Optional ELT.

Nav: KN 62A DME; KR 87 ADF with KI 227 indicator. Optional GPS.

Data refer to production version.

DIMENSIONS, EXTERNAL:

Wing span	15.40 m (50 ft 6¼ in)
Wing chord, constant	1.85 m (6 ft 0¾ in)
Wing aspect ratio	8.3
Length overall	11.30 m (37 ft 1 in)
Height overall	3.95 m (12 ft 11½ in)
Tailplane span	4.80 m (15 ft 9 in)
Wheel track	4.00 m (13 ft 1½ in)
Wheelbase	3.86 m (12 ft 8 in)
Propeller diameter	1.98 m (6 ft 6 in)

DIMENSIONS, INTERNAL:

Cabin, excl flight deck: Length	3.99 m (13 ft 1 in)
Max width	1.48 m (4 ft 10¾ in)
Max height	1.48 m (4 ft 10¾ in)
Volume	8.74 m³ (309 cu ft)

AREAS:

Wings, gross	28.45 m² (306.2 sq ft)
Ailerons (total)	1.48 m² (15.93 sq ft)
Trailing-edge flaps (total): inner	1.06 m² (11.41 sq ft)
outer	1.60 m² (17.22 sq ft)

Wolfsberg Corvus 1F prototype on its maiden flight, 6 June 2006 1159081

Front view of Wolfsberg Corvus 1F prototype 1159083

Tailplane	4.54 m² (48.87 sq ft)
Elevators, incl tabs	3.36 m² (36.17 sq ft)
Fin (total)	3.84 m² (41.33 sq ft)
Rudders (total)	2.36 m² (25.40 sq ft)
WEIGHTS AND LOADINGS:	
Weight empty	1,950 kg (4,299 lb)
Max fuel weight	475 kg (1,047 lb)
Max T-O and landing weight	3,100 kg (6,834 lb)
Max zero-fuel weight	3,000 kg (6,613 lb)
Max wing loading	109.0 kg/m²(22.32 lb/sq ft)
Max power loading	6.71 kg/kW (11.02 lb/hp)
PERFORMANCE (estimated):	
Max level speed	148 kt (274 km/h; 170 mph)
Cruising speed at 75% power	133 kt (246 km/h; 153 mph)
Econ cruising speed	120 kt (222 km/h; 138 mph)
Stalling speed	61 kt (113 km/h; 71 mph)
Max rate of climb at S/L	335 m (1,100 ft)/min
Service ceiling	5,000 m (16,400 ft)
Service ceiling, OEI	1,860 m (6,100 ft)
T-O run	145 m (475 ft)
T-O to 15 m (50 ft)	330 m (1,085 ft)
Landing from 15 m (50 ft)	440 m (1,445 ft)
Landing run	170 m (560 ft)
Range: with max fuel and 560 kg (1,234 lb) payload	810 n miles (1,500 km; 932 miles)
with 950 kg (2,094 lb) payload	140 n miles (259 km; 161 miles)

ZLIN

MORAVAN AEROPLANES A.S. (A DIVISION OF MORAVAN INC)

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MARKETING: Eva Buresova

Formed 18 September 1934 as Zlinská Letecká Akciová Společnost (Zlin Aviation Company Ltd) in Zlin; manufacture of Zlin aircraft started 1933 by Masarykova Letecká Liga (Masaryk League of Aviation); total of approximately 650 aircraft, including gliders and military transports, manufactured by end of Second World War.

Company then renamed Moravan; post-war aircraft production included 1,495 of the Z 26 family (162 Z 26, 170 Z 126, 366 Z 226, 436 Z 326, 331 Z 526 and 30 Z 726) built between 1949 and 1975. Production began in 1970 of Z 42/142/242 and Z 43/143 families; Algerian Z 43s (five supplied in 1991) designated **Safir 43**; Algerian Z 142s (17 complete and 29 kits in 1987–91) designated **Firnas 142**. In July 1997, the factory suffered serious flood damage, causing production to be suspended until the following year.

In June 1999, Moravan announced the sale of 100 Z 242s to Egypt, equivalent to a two-year backlog of work at then-current production rates. This order then represented approximately half of Moravan's backlog value of USD40 million, but was later cancelled. Moravan sold 22 aircraft in 2000, compared with only 15 in 1999. Aerolease, a joint venture with Dutch financial support, was formed in 2000 to lease Zlin aircraft to European flying clubs and flying training schools. The Z 142 C, out of production since 1995, was resumed as the result of a 2001 order; these were to be manufactured by LZ. Licensed manufacture of the Russian Technoavia Finist, with an Orenda OE-600 piston diesel engine, was planned under the designation Z 400 Rhino. Under a contract with EADS Socata, signed on 22 June 2001, Moravan Aeroplanes was to produce complete fuselages for the TB series; deliveries were to begin in August 2002, at a rate of six to eight per month.

It was announced on 16 July 2001 that approval had been given for Moravan Aeroplanes to acquire Let Kunovice, with the exception of the L 610 G programme, for the sum of CZK200 million (USD5 million). Moravan intended to keep open the L 410/420 production line, as well as Let's L-13, L-23 and L-33 sailplanes, and planned to use the factory (renamed Letecké Závody; LZ) also for its work on the Z 400 Rhino programme, but latter did not materialise. L 610 G programme subsequently acquired by LZ in early 2002.

Shortly after its acquisition of Let, Moravan Aeroplanes announced plans to establish a final assembly centre for its aircraft at Beeville, Texas, USA, in a joint venture with Pereira Internacional Aérea of Houston. However, company was declared bankrupt on 18 June 2004, following the earlier bankruptcy of LZ on 30 March that year, and a receiver was called in to restructure and reduce the business in size. Trading resumed, and in 2005 EASA Type Certificates were awarded to the Z 242 L and Z 143 L, as well as a fuel-injection version of the latter designated Z 143 LSi, with 175 kW (235 hp) Lycoming engine. The company opened its own flying school in May 2005. In October 2006, the assets administrators announced a common tender for the sale of part of Moravan Aeroplanes as "movables, incorporeal rights and other material values designated for the operation [of the company]", with manufacturing buildings to be sold in a separate auction. Meanwhile, technical support, sale of spare parts and sale of new aircraft were authorised to continue unrestricted.

ZLIN Z 242 L

TYPE: Primary prop trainer/sportplane.
PROGRAMME: Lycoming-powered version of earlier Z 142. Design started December 1988; first flight (OK-076) 14 February 1990; second prototype (SE-KMS) followed, both converted on production line from Z 142; Czech certification to FAR Pt 23 (A, U and N categories) 22 March 1992; also now certified in Argentina, Australia, Austria, Belgium, Canada, Denmark, Hungary, Israel, Luxembourg, Macedonia, Poland, Slovenia, Sweden, UK and USA. EASA type certificate A.027 awarded 1 February 2005.
CURRENT VERSIONS: **Z 242 L:** Aerobatics-capable trainer.
Description applies to this version.

Z 242 LA: Lower-powered, non-aerobatic version for primary, day/night and IFR training and glider/banner towing; *g* limits +4.4/−1.76. Prototype (OK-ANA) test-flown in 1996. No known production.

For details of the latest updates to *Jane's All the World's Aircraft* online and to discover the additional information available exclusively to online subscribers please visit
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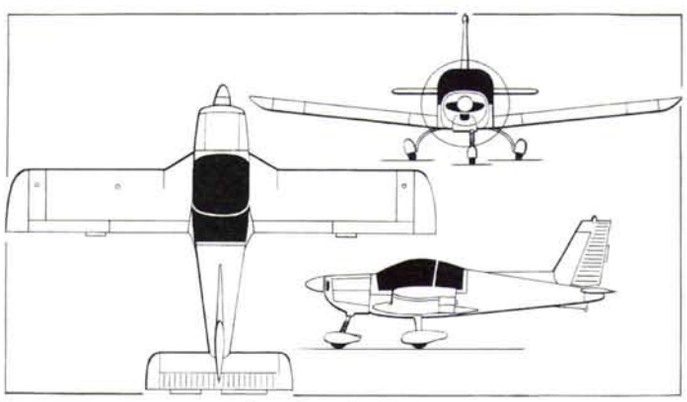
Zlin Z 242 L two-seat sportplane and trainer before delivery to Yemen Air Force 1128932

Indira Gandhi Rashtriya Uran Akademi (IGRUA) Zlin Z 242 primary trainer 1158601



Zlin Z 242 L primary prop trainer *(James Goulding)* 1158551

CUSTOMERS: Total of at least 133 delivered by mid-2006, for customers including Algeria (Air Force), Angola (Air Force), Argentina (one), Australia (one), Canada (15), Cuba (Border Guard), Czech Republic (Air Force, four), Egypt (Army), Germany, Hungary (Air Force), India, Israel (three), Macedonia (Air Force, four), Mexico (Navy, 10), Peru (Air Force, 18), Poland, Slovakia, Slovenia (Defence Force, seven), Sweden (two), UK (three), USA (38) and Yemen (Air Force, 12). Bid (unsuccessfully) for USAF T-3A Firefly replacement contract in 2001. Five to Yemen and one to Macedonian CAA in 2003; additional (unspecified) contracts in that year from unnamed Asian countries. Third Macedonian CAA aircraft delivered October 2004. Six ordered for Indian government flying school April 2005; first two handed over July, second and third pairs in January and March 2006. Four ordered by unidentified Asian customer in May 2006.

COSTS: Mexican Navy contract reported as approximately USD2.6 million (2002).

DESIGN FEATURES: Conventional low-wing monoplane. Constant-chord horizontal surfaces with wingroot glove. Sweptback fin with fillet. Changes from Z 142, apart from new engine, include redesigned (and shorter) engine cowling and front fuselage, wing incidence, 0° sweep, wingroot glove, redesigned wing- and tailplane tips, redesigned fuel system and updated instruments. Spin recovery strake each side of cowling.

Wing section NACA $63_2$416.5.

FLYING CONTROLS: Conventional and manual. Slotted, mass-balanced surfaces used for ailerons and flaps; horn-balanced elevator with trim tab; ground-adjustable tabs in ailerons and rudder; ailerons and elevator operated by rods, rudder by cables.

STRUCTURE: Mainly metal; wing has main and auxiliary spars; duralumin skins, fluted on control surfaces; metal engine cowlings; centre-fuselage is steel tube cage with composites skin panels.

LANDING GEAR: Non-retractable tricycle type, with nosewheel offset 13 cm (5.1 in) to port. Oleo-pneumatic nosewheel shock-absorber. Mainwheels carried on flat spring steel legs. Nosewheel steered (±38°) by rudder pedals. Mainwheels and Barum tyres size 420×150 or Goodyear 6.00–6.5, pressure 1.90 bar (28 lb/sq in); nosewheel and Barum tyre size 350×135 or Goodyear 5.00–5, pressure 2.50 bar (36 lb/sq in). Hydraulic disc brakes on mainwheels can be operated from either seat. Parking brake standard.

POWER PLANT: One Textron Lycoming AEIO-360-A1B6 flat-four engine (149 kW; 200 hp at 2,700 rpm) driving an MTV-9-B-C/C-188-18a three-blade constant-speed wood/composites propeller or Hartzell HC-C3YR-4BF/FC 6890 three-blade constant-speed metal propeller. Fuel capacity 120 litres (31.7 US gallons; 26.4 Imp gallons); Normal category version wingtip tanks 55 litres (14.5 US gallons; 12.1 Imp gallons) each, bringing usable capacity to 230 litres (60.7 US gallons; 50.6 Imp gallons). Inverted flight limited to 1 minute. Oil capacity 8 litres (2.1 US gallons; 1.8 Imp gallons).

ACCOMMODATION: Side-by-side seats for two persons, instructor's seat to port. Both seats adjustable and permit use of back-type parachutes. Baggage space (20 kg; 44 lb) aft of seats. Cabin and windscreen heating and ventilation standard. Forward-sliding cockpit canopy. Dual controls standard.

SYSTEMS: Electrical system includes 1.6 kW 28 V engine-driven generator and 24 V 19 Ah Gill battery. External power source can be used for engine starting.

AVIONICS: To customer's specification, usually from Bendix/King Silver Crown or Garmin range.

EQUIPMENT: Standard equipment includes EGT gauge, fuel flow indicator, g meter and anti-collision beacon. Optional items include cockpit/instrument/cabin lights, landing/taxying lights, anti-collision lights, and towing gear for gliders of up to 500 kg (1,102 lb) weight.

DIMENSIONS, EXTERNAL:

Wing span	9.34 m (30 ft 7¾ in)
Wing chord, constant portion	1.50 m (4 ft 11 in)
Wing aspect ratio	6.3
Length overall	6.94 m (22 ft 9¼ in)
Height overall	2.95 m (9 ft 8¼ in)
Elevator span	3.20 m (10 ft 6 in)
Wheel track	2.33 m (7 ft 7¾ in)
Wheelbase	1.76 m (5 ft 9¼ in)
Propeller diameter: MTV	1.88 m (6 ft 2 in)
Hartzell	1.78 m (5 ft 10 in)
Propeller ground clearance: MTV	0.33 m (1 ft 1 in)
Hartzell	0.38 m (1 ft 3 in)

DIMENSIONS, INTERNAL:

Cabin: Length	1.80 m (5 ft 10¾ in)
Max width	1.12 m (3 ft 8 in)
Max height	1.20 m (3 ft 11¼ in)
Baggage space	0.20 m^3 (7.1 cu ft)

AREAS:

Wings, gross	13.86 m^2 (149.2 sq ft)
Ailerons (total)	1.41 m^2 (15.18 sq ft)
Trailing-edge flaps (total)	1.41 m^2 (15.18 sq ft)
Fin	0.54 m^2 (5.81 sq ft)
Rudder, incl tab	0.81 m^2 (8.72 sq ft)
Tailplane	1.23 m^2 (13.24 sq ft)
Elevator, incl tabs	1.36 m^2 (14.64 sq ft)

WEIGHTS AND LOADINGS (A: Aerobatic, U: Utility, N: Normal category):

Basic weight empty: A, U, N	730 kg (1,609 lb)
Max T-O weight: A	970 kg (2,138 lb)
U	1,020 kg (2,248 lb)
N	1,090 kg (2,403 lb)
Max landing weight: A	970 kg (2,138 lb)
U	1,020 kg (2,248 lb)
N	1,050 kg (2,315 lb)
Max wing loading: A	70.3 kg/m^2 (14.40 lb/sq ft)
U	73.6 kg/m^2 (15.07 lb/sq ft)
N	78.6 kg/m^2 (16.11 lb/sq ft)
Max power loading: A	6.50 kg/kW (10.68 lb/hp)
U	6.84 kg/kW (11.24 lb/hp)
N	7.31 kg/kW (12.01 lb/hp)

PERFORMANCE:

Never-exceed speed (V_{NE}):	
all versions	170 kt (315 km/h; 195 mph)
Max level speed at S/L:	
A	127 kt (236 km/h; 146 mph)
U	125 kt (233 km/h; 144 mph)
N	124 kt (231 km/h; 143 mph)

Cruising speed at FL656 at 75% power:
A ..... 123 kt (227 km/h; 141 mph)
U ..... 125 kt (233 km/h; 144 mph)
N ..... 124 kt (231 km/h; 143 mph)
Max cruising speed at FL656 at 75% power:
A ..... 123 kt (227 km/h; 141 mph)
U ..... 121 kt (225 km/h; 140 mph)
N ..... 120 kt (223 km/h; 139 mph)
Stalling speed at S/L:
flaps up: A ..... 60 kt (111 km/h; 69 mph)
U ..... 62 kt (114 km/h; 71 mph)
N ..... 64 kt (118 km/h; 74 mph)
T-O flap setting: A ..... 57 kt (105 km/h; 66 mph)
U ..... 58 kt (107 km/h; 67 mph)
N ..... 60 kt (111 km/h; 69 mph)
flaps down: A ..... 51 kt (94 km/h; 59 mph)
U ..... 53 kt (97 km/h; 61 mph)
N ..... 54 kt (100 km/h; 63 mph)
Max rate of climb at S/L: A ..... 336 m (1,102 ft)/min
U ..... 300 m (984 ft)/min
N ..... 270 m (886 ft)/min
Service ceiling: A ..... 4,800 m (15,740 ft)
N ..... 4,500 m (14,760 ft)
T-O run: A ..... 242 m (795 ft)
U ..... 233 m (765 ft)
N ..... 306 m (1,005 ft)
T-O to 15 m (50 ft): A ..... 560 m (1,840 ft)
U ..... 495 m (1,625 ft)
N ..... 706 m (2,320 ft)
Landing from 15 m (50 ft): A ..... 516 m (1,695 ft)
U ..... 525 m (1,725 ft)
N ..... 560 m (1,840 ft)
Landing run: A ..... 265 m (870 ft)
N ..... 285 m (935 ft)
Range with max fuel:
A, U ..... 267 n miles (495 km; 308 miles)
N ..... 570 n miles (1,056 km; 656 miles)
Range at FL100, 65% power:
A ..... 228 n miles (424 km; 263 miles)
N ..... 504 n miles (935 km; 581 miles)
g limits: A ..... +6/−3.5
U ..... +5/−3
N ..... +3.8/−1.5

ZLIN Z 143

Czech Air Force designation: Z 143 MAF

TYPE: Four-seat lightplane.

PROGRAMME: Launched May 1991, with prototype construction beginning mid-year and first flight (Z 143 L prototype OK-074) 24 April 1992. Czech certification of this version 10 June 1994; now also certified in Austria, Bulgaria, Germany, Slovak Republic, Switzerland and USA. EASA type certificate A.028 awarded 1 February 2005.

CURRENT VERSIONS: **Z 143 L:** Standard version, with Textron Lycoming engine.

Detailed description applies to Z 143 L except where indicated.

Z 143 LSi: Version with Lycoming fuel-injection engine, enabling more advanced manoeuvres and unlimited spins. Prototype (OK-LSI); certified by Czech CAA May 2004. First production aircraft (OK-STA, c/n 55) delivered to Czech customer, Aeroklub Ostrava, August 2005.

CUSTOMERS: Total of 55 (including prototype and three testbeds/demonstrators) delivered by December 2005 to customers in Argentina (one), Austria (one), Bulgaria (two), Czech Republic (Air Force, four), Egypt (five), Germany (eight), Israel (two), Macedonia (one), Slovenia (two), Switzerland (four), Thailand (two), USA (seven) and elsewhere. Orders in May 2006 of three Z 143 L for Jharkand Civil Aviation Department, India, and one LSi for an unidentified Asian customer.

COSTS: Standard (VFR) aircraft EUR195,000; limited edition IFR-equipped Z 143 L also EUR195,000; Z 143 LSi: EUR198,900 (VFR) and EUR220,500 (IFR) (all 2005).

DESIGN FEATURES: Generally as for Z 242. For basic aerobatics (except inverted flight), glider towing and (with equipment) night and IFR training. Non-swept wings, of similar planform to Z 242 L but with NACA $63_2$416.5 wing section and 6° dihedral. Z 143 LSi: improvements include canopy jettison system and nitrogen-pressurised main spar.

FLYING CONTROLS: As for Z 242 L.

STRUCTURE: As for Z 242 L, nitrogen-pressurised wing main spar.

LANDING GEAR: As for Z 242 L.

POWER PLANT: *Z 143 L:* One Textron Lycoming O-540-J3A5 flat-six engine (175 kW; 235 hp at 2,400 rpm); MTV-9-B/195-45a three-blade variable-pitch propeller. Fuel capacity 122 litres (32.2 US gallons; 26.8 Imp gallons) in two wing tanks; provision for two 51 litre (13.5 US gallon; 11.2 Imp gallon) auxiliary tanks in Normal category version, raising total to 224 litres (59.2 US gallons; 49.3 Imp gallons). Oil capacity 12 litres (3.2 US gallons; 2.6 Imp gallons).

Z 143 LSi: One 175 kW (235 hp) Textron Lycoming IO-540-C4D5 flat-six with Bendix RSA-type fuel injection; propellers and fuel capacities as for Z 143 L. Oil capacity 11.4 litres (3.0 US gallons; 2.5 Imp gallons).

ACCOMMODATION: Four seats in 2 + 2 configuration, with pilot in front left-hand seat. All seats have four-point safety belts. Baggage compartment (capacity 60 kg; 132 lb) aft of rear seats, with external door on port side. One-piece forward-sliding canopy (jettisonable in L 143 LSi). Dual controls standard. Cabin and windscreen heating and ventilation standard.

SYSTEMS: As for Z 242 L.

AVIONICS: As for Z 242 L.

DIMENSIONS, EXTERNAL:
Wing span ..... 10.14 m (33 ft 3¼ in)
Wing chord, mean aerodynamic ..... 1.49 m (4 ft 10¾ in)
Wing aspect ratio 7.0
Length overall ..... 7.58 m (24 ft 10½ in)
Height overall ..... 2.91 m (9 ft 6½ in)
Elevator span ..... 3.01 m (9 ft 10½ in)
Wheel track ..... 2.44 m (8 ft 0 in)
Wheelbase ..... 1.75 m (5 ft 9 in)
Propeller diameter ..... 1.95 m (6 ft 4¾ in)
Propeller ground clearance ..... 0.28 m (11 in)

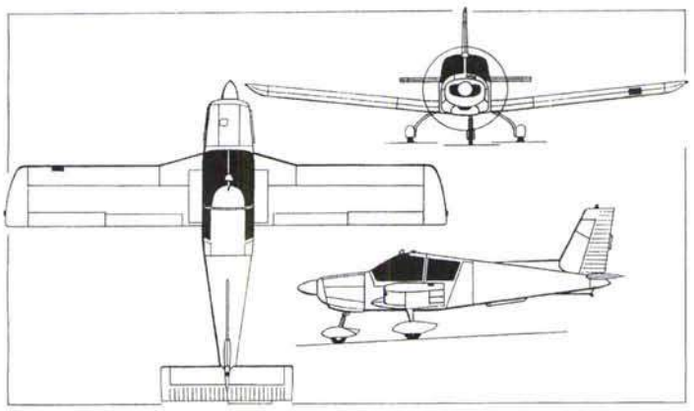
DIMENSIONS, INTERNAL:
Baggage compartment volume ..... 0.25 m³ (8.83 cu ft)

AREAS: As for Z 242 L except:
Wings, gross ..... 14.78 m² (159.1 sq ft)

WEIGHTS AND LOADINGS (A: Aerobatic, N: Normal category):
Weight empty, equipped: A, N (L) ..... 850 kg (1,874 lb)
N (LSi) ..... 855 kg (1,885 lb)
Max T-O weight: A ..... 1,080 kg (2,381 lb)
N ..... 1,350 kg (2,976 lb)
Max landing weight: A ..... 1,080 kg (2,381 lb)
N ..... 1,280 kg (2,822 lb)
Max wing loading: A ..... 73.1 kg/m² (14.97 lb/sq ft)
N ..... 91.4 kg/m² (18.72 lb/sq ft)
Max power loading: A ..... 6.16 kg/kW (10.13 lb/hp)
N ..... 7.70 kg/kW (12.66 lb/hp)

PERFORMANCE:
Never-exceed speed (VNE):
A, N ..... 170 kt (315 km/h; 195 mph)
Max level speed at S/L: A ..... 144 kt (267 km/h; 166 mph)
N (L) ..... 142 kt (264 km/h; 164 mph)
N (LSi) ..... 140 kt (260 km/h; 161 mph)
Max cruising speed at FL656 at 75% power:
A ..... 127 kt (235 km/h; 146 mph)
N ..... 125 kt (232 km/h; 144 mph)
Econ cruising speed at 60% power:
A ..... 116 kt (216 km/h; 134 mph)
N (L) ..... 111 kt (205 km/h; 127 mph)
N (LSi) ..... 113 kt (209 km/h; 130 mph)
Stalling speed:
flaps up: A ..... 58 kt (108 km/h; 67 mph)
N ..... 63 kt (117 km/h; 73 mph)
flaps down: A (L), N (LSi) ..... 54 kt (100 km/h; 63 mph)
N (L) ..... 60 kt (110 km/h; 69 mph)
Max rate of climb at S/L: A ..... 444 m (1,457 ft)/min
N ..... 294 m (964 ft)/min
Service ceiling: A ..... 5,700 m (18,700 ft)
N ..... 4,170 m (13,680 ft)
T-O run: A, N (LSi) ..... 295 m (970 ft)
N (L) ..... 170 m (560 ft)
T-O to 15 m (50 ft): A ..... 450 m (1,480 ft)
N ..... 640 m (2,100 ft)
Landing from 15 m (50 ft): A ..... 590 m (1,935 ft)
N ..... 765 m (2,510 ft)
Landing run: A ..... 305 m (1,000 ft)
N ..... 380 m (1,250 ft)
Range at FL100:
at 65% power: A (L) ..... 631 n miles (1,170 km; 727 miles)
N (L) ..... 259 n miles (480 km; 298 miles)
at 60% power: N (LSi) ..... 599 n miles (1,110 km; 689 miles)
g limits: A ..... +4.4/−1.76
N ..... +3.8/−1.52

Zlin Z 143 LSi prototype 1128934



General arrangement of the Zlin Z 143 L (Textron Lycoming O-540-J3A5 engine) ***(Mike Keep)*** 1158100

ZLIN AVIATION

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PRESIDENT: Paquale Russo

Morava Zlin Aero Service set up in 1999 to market the Russo Savage ultralight; renamed Zlin Aviation. Works are at Holešov Airport. US promotion began in 2005.

ZLIN AVIATION (RUSSO) SAVAGE

US marketing name: Savage Cub

TYPE: Tandem-seat ultralight/kitbuilt.

PROGRAMME: First flown 1997; public debut at CAP meeting, Capri, Italy, 1999. Initial development of Russo Savage was undertaken in Italy, with parts being manufactured in Czech Republic; entire operation now undertaken in Czech Republic; Czech type approval being sought in late 2003. Available in both ready to fly and kit form.

CURRENT VERSIONS: **Savage:** As described. Retrospectively designated Savage Classic.

Savage LSA: To US LSA rules as factory-built (Special LSA) or kit (Experimental LSA), latter with Rotax 912, 912S or 914 engine.

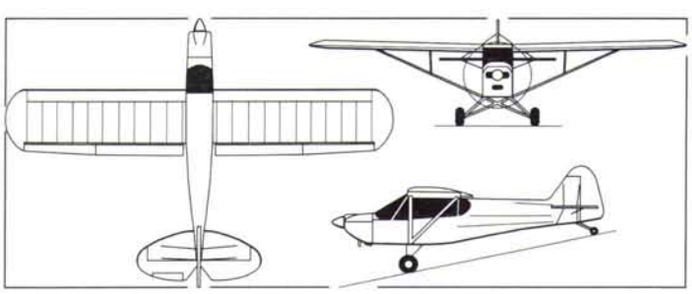
Savage Cruiser: Prototype completed mid-2005; modelled on Piper PA-12 Super Cruiser. As Savage, except 106 kt (197 km/h; 122 mph) max level speed; 97 kt (180 km/h; 119 mph) cruising speed; and 475 n mile (880 km; 546 mile) range.

Calao: Marketed in France by ALMS.

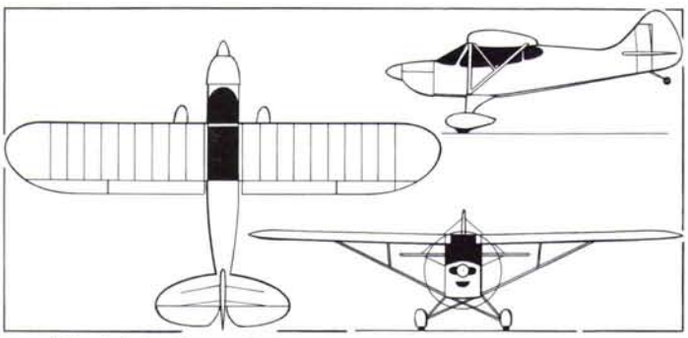
CUSTOMERS: Total of some 65 aircraft productd by mid-2005.

COSTS: Kit USD27,000, basic, or USD33,000, advanced, excluding engine; factory-built USD53,200 to 55,000 (Rotax 912 or 912S engine) from North American Sport Aviation (2005).

DESIGN FEATURES: Based on Piper J3 Cub; high, constant-chord wing with V lift struts and auxiliary struts each side; curved fin with dorsal strake; mutually wire-braced empennage; wings fold for storage and transportation. Quoted build time 350 hours. Wing section NACA 4412.



Zlin Aviation (Russo) Savage tandem-seat ultralight *(Paul Jackson)* 1047725



Russo/Zlin Aviation Savage Cruiser *(James Goulding)* 1151418

FLYING CONTROLS: Conventional and manual. Horn-balanced rudder, cable operated; simple-hinged elevator, pushrod operated. Cable-operated three-position simple flaps (maximum 35°). Manual trim in port elevator. Differential ailerons.

STRUCTURE: Fuselage of 4130 tubular welded steel; two-spar wings of 6061-T6 anodised aluminium; all fabric-covered. Composites engine cowl.

LANDING GEAR: Tailwheel type; fixed. Two faired-in side Vs hinged to lower longerons, plus half-axles, each with bungee cord shock-absorber, attached to compression frame. Mainwheels typically 8.00-6; tailwheel steerable, 2.50-4. Hydraulic brakes.

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS driving a two-blade GT wooden propeller; other Rotax, Limbach and Subaru engines can be fitted. Fuel capacity 68 litres (18.0 US gallons; 15.0 Imp gallons) in two welded aluminium tanks in wingroots.

ACCOMMODATION: Single door on starboard side. Lexan 5006 windscreen and windows.

DIMENSIONS, EXTERNAL:

Wing span	9.31 m (30 ft 6½ in)
Length overall	6.39 m (20 ft 11½ in)
Height overall	2.03 m (6 ft 8 in)

DIMENSIONS, INTERNAL:

Cabin max width	0.69 m (2 ft 3¼ in)

AREAS:

Wings, gross	14.20 m² (152.8 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	288 kg (635 lb)
Max T-O weight: Ultralight	450 kg (992 lb)
Experimental	540 kg (1,190 lb)

PERFORMANCE:

Never-exceed speed (VNE)	110 kt (205 km/h; 127 mph)
Max operating speed	104 kt (192 km/h; 119 mph)
Cruising speed at 75% power	92 kt (170 km/h; 106 mph)
Stalling speed, flaps down	32 kt (58 km/h; 36 mph)
Service ceiling	4,600 m (15,100 ft)
Max rate of climb at S/L	288 m (945 ft)/min
T-O run	85 m (280 ft)
Landing run	70 m (230 ft)
Range with max fuel	463 n miles (858 km; 533 miles)
g limits (ultimate)	+6/–3

Zlin Aviation Savage tandem-seat ultralight 1159194

Finland

PATRIA

PATRIA AVIATION OY (SUBSIDIARY OF PATRIA INDUSTRIES OY)

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Tel: (+358 20) 46 91
Fax: (+358 20) 469 33 85
e-mail: aviation@patria.fi
Web: www.patria.fi
EXECUTIVE VICE-PRESIDENT, AVIATION: Jukka Holkeri
VICE-PRESIDENT: Seppo Rytsy

Patria Aviation (formerly Patria Finavitec) and its Valmet predecessors have built 30 types of aircraft, including 19 of Finnish design, since 1922. Five business units (fixed-wing aircraft, helicopters, avionics, aero-engines and pilot training); current activities include production of aircraft and aero-engine parts; and maintenance, overhaul, repair and modification of aircraft, aero-engines and their accessories. Workforce approximately 1,300, including engines facility at Linnavuori and Patria Helicopters AB (formerly Patria Ostermans Aero AB), a Swedish helicopter maintenance company acquired in 1999. Helsinki-based Pilot Aircraft Oy became a wholly owned subsidiary of Patria Aviation on 24 March 2004, subsequently being renamed Patria Pilot Training Oy; activities include pilot and ATC training.

Patria Aviation currently manufactures rear and centre fuselage sections for the Embraer ERJ-135/145 under subcontract to Sonaca of Belgium, to which first shipsets were delivered in second half of 1998. MoUs signed in December 1999 by Patria Finavitec and Airbus Industrie for former to take part in conceptual definition of A380 and to explore other possible industrial co-operation, leading to manufacture of composites structures for A320 and A340 families. Selected in 2005 to design and deliver structures also for A400M, and in March 2006 to begin deliveries in 2007 of main landing gear fairings for A320 family. Agreed in September 2000 to support Sikorsky bid of S-92 for Nordic Standard Helicopter Programme (NSHP) requirement but, following selection of EHI and NHI as joint winners, Patria contracted on 19 October 2001 to assemble a minimum of 50 NH90s and associated RTM322 engines at Jämsä and Linnavuori, respectively; maiden flight of first aircraft (KH-202), 13 July 2005; deliveries taking place between 2005 and 2011. Work at new Jämsä factory began in September 2003. Contract for 150 NH90 rear fuselages received 16 September 2004; deliveries to begin in late 2005.

In June 2001, EADS acquired a 26.8 per cent interest in parent company Patria Industries Oy.

France

ABS

ABS AEROLIGHT

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e-mail: info@absaerolight.com
Web: www.absaerolight.com
GENERAL MANAGER: Raphaël Celier
XENON PRODUCTION DIRECTOR: Artur Trendak

Formed in July 1993, ABS (Aviation Business System) first exhibited the Xenon autogyro at Paris in June 2005. The company also produces a range of paragliders and the Pixy powered parachute UAV. A two-seat helicopter, the Xerus, is under development.

ABS XENON

TYPE: Two-seat autogyro ultralight kitbuilt.
PROGRAMME: Two prototype (including 83-SS) flying by time of first public showing at Paris, June 2005.
CUSTOMERS: Total of 10 sold by mid-2006.
COSTS: Hirth F30 powered, kit EUR34,000; with Rotax 912S EUR40,800; with Rotax 914 EUR48,800; all plus tax (2006).
DESIGN FEATURES: Enclosed cockpit (two doors optional); twin booms and unswept fins with high tailplane in centre of propeller thrust line. Mechanical prerotator and brake. Aircopter rotor; aerodynamic section 8H12.
STRUCTURE: Monocoque composites fuselage pod with aluminium rotor boom and twin tailbooms. Tailplane of two indentical composita (port and starboard) halves, each with endplate, inboard elements forming centreline fence. Rotor of 6005T6 aluminium.
FLYING CONTROLS: Manual. Twin rudders, each actuated by Bowden cable.
POWER PLANT: Prototype has one 77.2 kW (104 hp) Hirth F30A flat four driving an Ivoprop Patriot three-blade, fixed-pitch carbon composites propeller via 2.64 reduction gear; later versions have 73.5 kW (98.6 hp) Rotax 912S and 84.6 kW (113.4 hp) Rotax 914 engines. Fuel in two tanks, combined capacity 60 litres (15.9 US gallons; 13.2 Imp gallons).
LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring aluminium cantilever mainwheel legs with hydraulic brakes and 110/95-6 tyres. Steerable, undamped nosewheel leg with 4.00-4 tyre.
DIMENSIONS, EXTERNAL:

Rotor diameter	8.40 m (27 ft 6¾ in)
Fuselage length	4.90 m (16 ft 1 in)
Max width: at pod	1.25 m (4 ft 1¼ in)
at tailplane	2.20 m (7 ft 2½ in)
Height overall	2.80 m (9 ft 2¼ in)

ABS Xenon enclosed autogyro *(R W Simpson)* 1159197

AREAS:

Rotor disc	55.38 m² (596.1 sq ft)

WEIGHTS AND LOADINGS (A: F30; B: Rotax 912S; C: Rotax 914):

Weight empty: A	245 kg (540 lb)
B	265 kg (584 lb)
C	275 kg (606 lb)
Max T-O weight: all	450 kg (992 lb)

PERFORMANCE (A: F30; B: Rotax 912S; C: Rotax 914):

Max level speed: A	86 kt (160 km/h; 99 mph)
B	97 kt (180 km/h; 112 mph)
C	105 kt (195 km/h; 121 mph)
Max rate of climb at S/L: A	240 m (787 ft)/min
C	457 m (1,500 ft)/min
T-O run	10-100 m (33-330 ft)
Landing run	5 m (17 ft)
Endurance	4 h

AEROJAMES

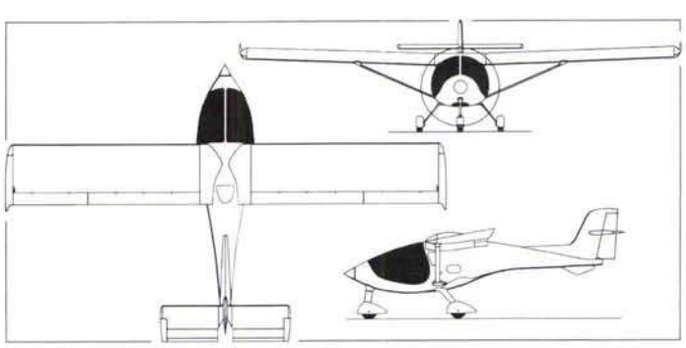
AEROJAMES SARL

2 rue Hyacinthe Campiglia, F-20090 Ajaccio
Tel/Fax: (+33 4) 92 62 20 74 or (+33 6) 84 48 99 27
Web: www.aerojames.com
DIRECTORS: Philippe Baffray
Paul Conil

AéroJames formed in 2004, having previously operated under the title of Isatis, the name of its first aircraft. Manufacture is in a 420 m² (4,525 sq ft) plant at Ajaccio and test-flying at Sisteron, south-east France.

AÉROJAMES ISATIS 01

TYPE: Side-by-side ultralight.
PROGRAMME: Design began 2001. Partly complete prototype first shown at Aero '03, Friedrichshafen, April 2003. By early 2005 static testing was complete, the prototype (F-WPDG) conducting its maiden flight on 24 February 2005. Assigned to EASA certification, although initial aircraft to be marketed as Ultralights. Firtst production aircraft was due for completion in June 2006.
COSTS: EUR62,000, excluding tax, flyaway (2006).



Aerojames Isatis 01 general arrangement *(Paul Jackson)* 1159137

DESIGN FEATURES: Optimised for low noise and emissions; economy and ease of stowage. Mid-engined configuration with high, strut-braced, foldable wings. T tail with small underfin.
FLYING CONTROLS: Conventional and manual. Balanced ailerons. Slotted flaps, electrically deflected +6° for high-speed cruise; −15° for T-O; and −30° for landing.

Prototype AéroJames Isatis 01 in April 2005 *(Paul Jackson)* 1121788

STRUCTURE: Composites skin throughout; carbon fibre driveshaft (passing through cockpit from engine to propeller) and cantilever mainwheel legs. Carbon fibre wing structure with glass fibre skin.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted, sweptback, steel tube mainwheel legs with composites fairings. Shock loads transmitted to horizontal torsion bars within fuselage, anchored on centreline. Steerable nosewheel damped by oleo and external helical spring. All tyres 4.00–6; speed fairings over each.

POWER PLANT: One mid-mounted BMW 1200 flat-four, rated at 73.5 kW (98.6 hp) with catalytic exhaust converter, driving a three-blade carbon fibre, ground-adjustable pitch propeller. Fuel capacity 64 litres (16.9 US gallons; 14.1 Imp gallons) in two wing tanks, of which 60 litres (15.8 US gallons; 13.2 Imp gallons) usable.

EQUIPMENT: Junkers Magnum ballistic parachute standard.

DIMENSIONS, EXTERNAL:

Wing span	9.80 m (32 ft 2 in)
Length overall	6.30 m (20 ft 8 in)
Height overall	2.50 m (8ft 2½ in)

DIMENSIONS, INTERNAL:

Cockpit max width	1.30 m (4 ft 3¼ in)

AREAS:

Wings, gross	11.40 m² (122.7 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	270 kg (595 lb)
Max T-O weight	472.5 kg (1,041 lb)

PERFORMANCE (estimated):

Never-exceed speed (VNE)	145 kt (270 km/h; 167 mph)
Normal cruising speed	124 kt (230 km/h; 143 mph)
Stalling speed, flaps down	30 kt (55 km/h; 35 mph)
T-O run	100 m (330 ft)
Landing from 15 m (50 ft)	188 m (617 ft)
Range	809 n miles (1,500 km; 932 miles)
g limits	+4.4/−2.2

AEROKUHLMANN

AEROKUHLMANN

Aérodrome de Cerny, F-91590 Cerny
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AeroKuhlmann's first product, built in the company's 600 m² (6,450 sq ft) factory on La Ferté-Alais airfield, near Cerny, is the SCUB. No recent communication has been received from the company.

AERONIX

AERONIX SARL

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DIRECTOR GENERAL: Lionel de Mauduit du Plessis
TECHNICAL DIRECTOR: Rémi Cuvelier
COMMERCIAL DIRECTOR: Gérard Mosali
TEST PILOT: Gary 'Cody' Purdom

Formed in 1999, Aéronix has launched production of its first aircraft, the Airelle. The aircraft was displayed statically at Paris in June 2005 and in flight at the RSA rally at Breuil in September 2005. The company also markets avionics and provides simulated training.

Fifth production Aéronix Airelle *(Paul Jackson)* 1151704

AERONIX AIRELLE

TYPE: Side-by-side ultralight/kitbuilt.

PROGRAMME: Development began in 1999; one-third scale model flew October 2000. Announced at Paris Air Show, June 2001; first flight February 2002 (unannounced); mockup shown at Paris, June 2003. Deliveries of kit version began in 2003; promotion concentrating on Ultralight version; VLA to be available later.

Company test pilot Gary Purdom is planning a pole-to-pole flight to promote the Airelle.

CURRENT VERSIONS: **Ultralight:** (*Ultra Léger*) Two 29.8 kW (40 hp) Zanzottera flat-twin engines replaced by Hirth F23ESs of same power in production version; Duc or Arplast or Ecoprop, ground-adjustable pitch three-blade propellers. *As described.*

Two-seat lightplane: (*Avion Biplace*) Projected version for VLA certification; two engines up to 74.6 kW (100 hp).

Four-seat lightplane: (*Avion Quadriplace*) Projected stretched version with two engines up to 74.6 kW (100 hp). Available from 2006.

CUSTOMERS: Total 36 orders and five built by June 2005.

COSTS: Ultralight, flyaway EUR95,000; kit EUR45,000 including engine and avionics; both plus tax (2005).

DESIGN FEATURES: Unconventional 'four-wing, push-pull' design, featuring tapered, 3° anhedral foreplane with downturned tips and sweptback (30°), 2° dihedral mainplane with vertical fins at tips; fins have inturned tips. Flight control system lacking pilot's rudder pedals and incorporating 'glass cockpit'.

FLYING CONTROLS: Manual. Plain ailerons (with external mass balances and upper surface piano hinges) and flaps on mainplane, plus rudder in each fin; full-span elevators, each with trim tab, on foreplane. Piano-hinged split rudders operable conventionally in unison; split one side only as spoilers; or both split as airbrakes.

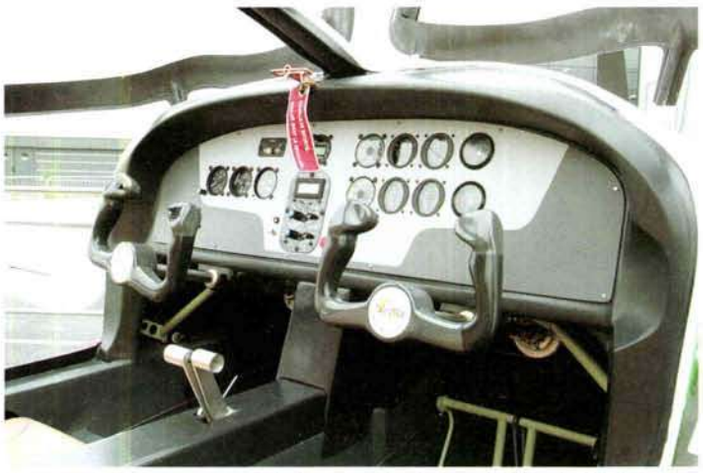
STRUCTURE: Generally of carbon fibre.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring composites cantilever mainwheel legs. Mainwheels 4.00–6 or 110/95-6; steerable nosewheel, 11×4.00–5.

POWER PLANT: Two piston engines, power according to variant, in tractor/pusher arrangement, each driving Arplast or Duc three-blade propeller via 2.5:1 reduction gear. Fuel in wing tanks, combined capacity 62 litres (16.4 US gallons; 13.6 Imp gallons) in ultralight; 160 litres (42.3 US gallons; 35.2 Imp gallons) in two- and four-seat versions.

ACCOMMODATION: Two or four persons, according to variant. Two centreline-hinged, foreward/upward-opening canopy/doors.

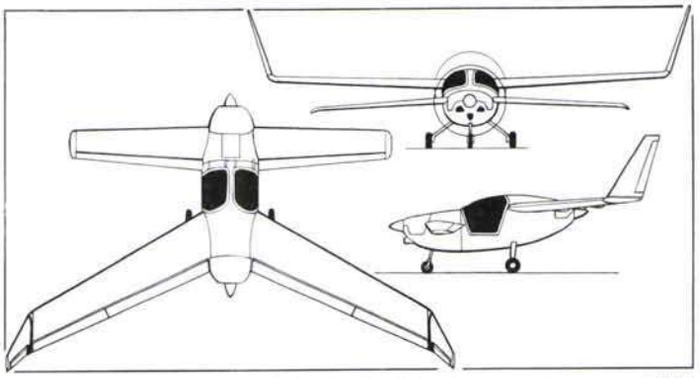
EQUIPMENT: Ballistic recovery parachute standard.



Non-standard instrument panel of proposed pole-to-pole Aéronix Airelle *(Paul Jackson)* 1127691

AVIONICS: *Comms:* Bendix/King KY 97 VHF.
Instrumentation: Single LCD.
EQUIPMENT: BRS-5 ballistic parachute.
DIMENSIONS, EXTERNAL:

Wing span	9.46 m (31 ft 0½ in)
Length: overall	5.88 m (19 ft 3½ in)
fuselage	4.225 m (13 ft 10¼ in)
Height overall	3.015 m (9 ft 10¾ in)
Wheel track (outer rims)	1.875 m (6 ft 1¾ in)
Wheelbase	1.87 m (6 ft 1½ in)
Propeller diameter	1.60 m (5 ft 3 in)



General arrangement of Aéronix Airelle Ultralight *(James Goulding)* 1154283

DIMENSIONS, INTERNAL:

Cabin max width	1.14 m (3 ft 9 in)

AREAS:

Wings, gross	15.00 m² (161.5 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, equipped	295 kg (650 lb)
Max T-O weight	472.5 kg (1,041 lb)

PERFORMANCE:

Never-exceed speed (VNE)	156 kt (290 km/h; 180 mph)
Max level speed	146 kt (270 km/h; 168 mph)
Cruising speed	127 kt (235 km/h; 146 mph)
Stalling speed	32 kt (58 kmh; 36 mph)
Max rate of climb at S/L	600 m (1,968 ft)/min
Rate of climb at S/L, OEI	180 m (591 ft)/min
Service ceiling	5,000 m (16,400 ft)
Range with max payload	378 n miles (700 km; 435 miles)

AERO SERVICES

AERO SERVICES GUEPARD

F-12200 Toulonjac
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DIRECTOR: Jean-Daniel Roman
HEAD OF ENGINEERING: Jean-Michel Razoux

Aéro Services Guépard produces the Guépard and Guépy ultralights; four versions are available.

AERO SERVICES GUÉPARD and GUEPY

TYPE: Side-by-side ultralight.
PROGRAMME: Certified by DGAC in ULM category, August 2000.
CURRENT VERSIONS: **Guépard:** Highest-powered version. *As described.* Flyaway or kit.
Guépy: Powered by 48.0 kW (64.4 hp) Rotax 582 or 59.7 kW (80 hp) Jabiru 2200. Metal wing with fabric covering and full-span flaperons; choice of constant-chord or tapered wing. Weight empty 240 kg (529 lb) or 286 kg (630 lb) with optional extras. Flyaway or kit.
Guépy Club: Lowest-powered version, with 34.0 kW (45.6 hp) Rotax 503 or 48.0 kW (64.4 hp) Rotax 582. Weight empty (fabric-covered wing only) 210 kg (463 lb) or 286 kg (630 lb) with optional extras.
Super Guépard: Announced 2004 with reprofiled fuselage and choice of metal or fabric-covered tubular steel wing.
CUSTOMERS: More than 80 sold in France by 2003.
COSTS: Guépard, flyaway: fabric-covered wing: Rotax 912 EUR42,745, Rotax 912S EUR44,290; all-aluminium wing: Rotax 912 EUR48,410, Rotax 912S EUR50,367. Guépard kit (less engine) with fabric wing EUR20,600, with aluminium wing EUR26,780. Guépy, flyaway: constant-chord wing: Rotax 582 EUR32,030, Jabiru EUR37,750; tapered wing: Rotax 582 EUR33,475, Jabiru EUR39,140; kit (less engine), constant-chord wing EUR20,085, tapered wing EUR21,115. Guépy Club Kit EUR16,160. (All 2006.)
DESIGN FEATURES: Constant-chord, high wing with V-strut bracing. Tailplane at base of sweptback fin, braced below by V-strut.
FLYING CONTROLS: Conventional and manual. Flaps.

Aéro Services Super Guépard *(R W Simpson)* 1159266

STRUCTURE: Airframe of 4130 aluminium tube, with Dacron covering; wings 2017 and 2024 aluminium with Dacron or aluminium covering.
LANDING GEAR: Fixed; option of nosewheel or tailwheel type. Brakes.
POWER PLANT: One piston engine: 48.0 kW (64.4 hp) Rotax 582, 73.5 kW (98.6 hp) Rotax 912 or 84.5 kW (113.3 hp) Rotax 912S. Two-blade (optional three-blade) propeller. Standard fuel 65 litres (17.2 US gallons; 14.3 Imp gallons).
DIMENSIONS, EXTERNAL:

Wing span	9.60 m (31 ft 6 in)

AREAS:

Wings, gross	14.60 m² (157.2 sq ft)

WEIGHTS AND LOADINGS (Rotax 912S):

Weight empty: basic	262 kg (578 lb)
with all options	286 kg (631 lb)
Max T-O weight	472.5 kg (1,041 lb)

PERFORMANCE (Rotax 912S):

Max level speed	103 kt (190 km/h; 118 mph)
Normal cruising speed	97 kt (180 km/h; 112 mph)
Stalling speed, flaps down	30 kt (55 km/h; 35 mph)
Max rate of climb	360 m (1,181 ft)/min
T-O run	50 m (165 ft)
Landing run	70 m (230 ft)

ALMS

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ALMS was formed in 2001 to build and market ultralight aircraft; the company's first design was the Calao, optimised for aerial work and based on the Zlin Savage, for which the company is the French agent; marketing began in 2005 and in June of that year ALMS launched its factory-built version of the Jodel D20; following its takeover of Sauper on 1 February 2006, it also markets the J300 and Papageno.

ALMS CALAO

TYPE: Multisensor surveillance lightplane.
PROGRAMME: Adaptation of Pasquale Russo's Zlin Savage for low-cost surveillance; also available for spraying and medical evaluation roles. Prototype (91-XZ, F-JPMO) exhibited at Aero '05, Friedrichshafen, April 2005 and demonstrator 91-XU at Paris Air Show, June 2005.
DESIGN FEATURES: Offered complete, with Rotax 912 engine. *Generally as for Zlin Savage except the following.*

ALMS Calao demonstrator *(Paul Jackson)* 1159337

ACCOMMODATION: Two, in tandem, including equipment operator in rear seat.

EQUIPMENT: Sony FCB-EX 780SP gyro-stabilised, 360° turret beneath centre fuselage mounting video camera with 56° to 8° zoom; datalink, infra-red camera. Medevac version has integral stretcher; spray version has Micronair 7000 system with 100 litre (26.4 US gallon; 22.0 Imp gallon) tank.

ALMS JODEL D 20

TYPE: Side-by-side ultralight/kitbuilt.

PROGRAMME: First Jodel light aircraft designed by Jean Delmontez and Edouard Joly in 1946; D 20 Jubilé designed by M Delmontez in 1996 and named to mark 50th anniversary.

Initially marketed as plans-built by Avions Jodel at Beaune, operable as lightplane or ultralight; early examples with JPX 4T 75/A engine; later Rotax 912 or Jabiru 2200. First aircraft (F-PSAB, c/n 01) built by Patrice Roux and flew 3 March 1997; first in Ultralight category was WAAA-01 (c/n 08), flown May 2000.

Production rights to ultralight acquired by Cedric Braquet of Aeroconsult; marketing began by ALMS in mid-2003, although prototype of this version (91-YC; F-JPGW) not flown until mid-2004; promotion began at end 2005.

CUSTOMERS: ALMS prototype built from 21st set of plans (c/n 22; No. 13 not assigned). Previous 20 aircraft included at least nine ultralights (of which three with tailwheel); not all completed, including sole **D 21**, begun by Aero Club de Bourgogne. Further three retractable gear versions identified as DelVion DVD-01 Diesel marketed by Jacques Vion.

COSTS: Completed, flyaway, EUR69,000 to EUR77,000, including tax, according to D20 version (2005). Kit prices on application.

DESIGN FEATURES: Classic Jodel configuration with dihedral on outer wing panels and all-moving tail surfaces. Low wing of constant chord inboard; tapered on dihedral panels; sweptback fin and constant-chord tailplane.

Optimised for sport flying and amateur construction. Wider fuselage version of Jodel D 19.

FLYING CONTROLS: Manual; cable actuation. All moving fin with horn balance; all-moving tailplane with anti-balance tab starboard side. Plain, three-position flaps. Plain ailerons with sealed upper gaps.

STRUCTURE: Generally of wood and plywood; some composites. Spruce frame fuselage covered with Okoume plywood above, with Dacron sides and belly, except composites engine cowling and plywood cockpit sides. Five bulkheads and seven formers, reinforced by vertical spruce members. One-piece wing of plywood box construction, with cantilever ribs reinforced with plywood; Dacron covering, except plywood flaps and leading-edge. One-piece, single-spar tailplane with six ribs; fin of plywood box structure; both Dacron-covered.

LANDING GEAR: Fixed. Wing-mounted cantilever mainwheel legs with integral oleo-pneumatic shock-absorbers; tyre size 4.00-6. Option of castoring nosewheel with 4.00-4 tyre and oleo-pneumatic shock-absorber; or steerable tailwheel. Hydraulic disc brakes.

POWER PLANT: One flat-four piston engine. Option of 59.6 kW (79.9 hp) Rotax 912 UL; 73.5 kW (98.6 hp) Rotax 912S; or 59.7 kW (80 hp) Jabiru 2200 driving two- (Rotax 912 UL, Jabiru 2200) or three-blade (Rotax 912S) wood or carbon fibre propeller. Fuel tank ahead of cockpit, capacity 55 litres (14.5 US gallons; 12.1 Imp gallons).

DIMENSIONS, EXTERNAL:

Wing span	7.50 m (24 ft 7¼ in)
Length overall	6.05 m (19 ft 10¼ in)
Height overall	1.93 m (6 ft 4 in)
Wheelbase	1.89 m (6 ft 2½ in)

DIMENSIONS, INTERNAL:

Cockpit max width	1.12 m (3 ft 8 in)

AREAS:

Wings, gross	10.50 m² (113.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	260 kg (573 lb)
Max T-O weight	450 kg (992 lb)

PERFORMANCE:

Max level speed	124 kt (230 km/h; 143 mph)
Cruising speed	111 kt (205 km/h; 127 mph)
Stalling speed	33 kt (60 km/h; 38 mph)
T-O run	60 m (200 ft)
Landing run	50 m (165 ft)
Range	324 n miles (600 km; 372 miles)
g limits	+6/–3

Prototype ALMS-built Jodel D 20 *(Paul Jackson)* 1159338

ALMS J.300 SERIES 4 JOKER

TYPE: Side-by-side ultralight.

PROGRAMME: Designed by Tony Minguet in 1987. Series 3, introduced in 2000, has modified empennage, and new instrument panel. Series 4, introduced in 2006, includes a tricycle option.

CURRENT VERSIONS: **Civilian version** is used for private flying, crop-spraying, aerial photography and in-flight survey work. **Military version** features larger tyres and a full instrument panel including artificial horizon, UHF radio, GPS and transponder.

CUSTOMERS: Total 102 of all versions built by 2004, including at least 18 in Africa; most recent sales to Senegal, Madagascar, Cameroon and the Arabian Peninsula. Two evaluated by the French Army in 1996.

COSTS: EUR39,000 (2004) excluding tax.

DESIGN FEATURES: Braced, high-wing monoplane with mid-mounted, braced tailplane; constant chord wing with tapered tips.

Wing section Clark Y; 2° 12' anhedral.

FLYING CONTROLS: Conventional and manual. Self-centring (by helical spring) elevator. Flight-adjustable tab in each elevator. No flaps.

STRUCTURE: Welded steel (25CD4S) tube airframe; Diatex 1500EV3 fabric covering; composites engine cowling.

LANDING GEAR: Tailwheel type; fixed. Two side Vs hinged to lower longerons, plus half-axles sprung under centreline with bungee cord. Mainwheels 6.00–6; speed fairings optional; hydraulic Grimeca brakes; tailwheel 2.60×85. Nosewheel version introduced 2006.

POWER PLANT: One 59.6 kW (79.9 hp) Rotax 912 or (optional) 73.5 kW (98.6 hp) Rotax 912 ULS flat-four driving a DUC Hélices three-blade propeller. Two fuel tanks beneath seats, each 48 litres (12.7 US gallons; 10.6 Imp gallons) capacity of which 47 litres (12.4 US gallons; 10.3 Imp gallons) are usable. Oil capacity 3.0 litres (0.8 US gallon; 0.7 Imp gallon).

SYSTEMS: 12 V 17 Ah battery.

AVIONICS: *Comms:* VHF radio.

Flight: Garmin III Pilot standard; GPS 295 optional.

EQUIPMENT: Optional ballistic parachute.

DIMENSIONS, EXTERNAL:

Wing span	9.04 m (29 ft 8 in)
Length overall	5.95 m (19 ft 6¼ in)
Height overall	2.00 m (6 ft 6¾ in)

AREAS:

Wings, gross	15.60 m² (167.9 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	282 kg (622 lb)
Max T-O weight	450 kg (992 lb)
with optional parachute	472.5 kg (1,042 lb)

PERFORMANCE (Rotax 912 ULS):

Max operating speed (VMO)	106 kt (198 km/h; 123 mph)
Max cruising speed	97 kt (180 km/h; 112 mph)
Econ cruising speed	76 kt (140 km/h; 87 mph)
Stalling speed	32 kt (58 km/h; 36 mph)
Max rate of climb at S/L	300 m (984 ft)/min
T-O run	80 m (262 ft)
Landing run	100 m (330 ft)
Range	432 n miles (800 km; 497 miles)
Endurance	6 h

First production tricycle J.300 Joker Series 4 and ALMS J.300 Jokers overflying the Chateau de Chenonceau 1159267

ALMS PAPANGO

English name: Black Kite

TYPE: Side-by-side ultralight; two-seat lightplane.

PROGRAMME: First flown (F-WWNO) as VLA, 30 November 2002; second prototype (41-ME/F-PJHE) built as ultralight. Marketing began end of 2004, when first deliveries of Ultralight due in July 2005. VLA certification scheduled for mid-2006.

CURRENT VERSIONS: **VLA**: Lightplane. Features include certified Rotax 912 S engine, Evra propeller, electric elevator trim, Cleveland hydraulic brakes and tyres, and standard fit of artificial horizon, GPS, transponder and navigation lights.

Second prototype ALMS Papango in Ultralight configuration *(Paul Jackson)*
1129182

ULM: Ultralight. Rotax 912 ULS engine, Duc propeller, 8.00×6 tyres with Grimeca hydraulic brakes and electric elevator trim. Empty weight 272 kg (600 lb). POC prototype (41-ME/F-PJHE) flown third quarter of 2004.

Kit: Experimental category; engines up to 89.5 kW (120 hp) and 650 kg (1,433 lb) MTOW.

COSTS: VLA EUR90,000, including tax, complete. ULM EUR60,000, including tax, complete. Kit approximately EUR30,000, excluding engine (2005).

DESIGN FEATURES: Rugged lightplane with extensive glazing. Braced, high-wing monoplane; mid-mounted tailplane and sharply tapered fin; long mainwheel legs.

Wing section NACA 23015; tailplane section NACA 0010.

FLYING CONTROLS: Conventional and manual. All-moving tailplane with electrically actuated, full-span anti-balance tab. (Initially flown with full-span flaperons which replaced by flaps). Actuation by pushrods (elevator) and cables.

STRUCTURE: Fuselage structure of welded 4130 steel tube in cockpit area, and aluminium 5086. Wings aluminium 5086 with Diatex 1500EV3 fabric covering. Polyester engine cowling.

LANDING GEAR: Tailwheel type; fixed. Two streamlined side Vs hinged to cockpit frame and attached to oleo shock-absorbers anchored to cockpit sides. Cleveland 6.00-6 mainwheels (8.00-6 optional) and Cleveland hydraulic disc brakes. Solid tailwheel; steerable.

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912S or 912 ULS flat-four driving an Evra two-blade, fixed pitch, wooden or Duc propeller. Fuel tank behind seats; capacity 70 litres (18.5 US gallons; 15.4 Imp gallons).

SYSTEMS: 17 Ah battery and 20 A generator.

AVIONICS: *Comms:* VHF radio and transmitter.

Flight: Garmin 295 GPS.

EQUIPMENT: BRS 1050 ballistic parachute optional.

DIMENSIONS, EXTERNAL:

Wing span	9.40 m (30 ft 10 in)
Wing chord, constant	1.63 m (5 ft 4¼ in)
Length overall	6.50 m (21 ft 4 in)
Height overall	2.50 m (8 ft 2½ in)
Tailplane span	2.40 m (7 ft 10½ in)
Tailplane chord, constant	0.80 m (2 ft 7½ in)
Wheel track	2.40 m (7 ft 10½ in)

DIMENSIONS, INTERNAL:

Cabin max width	1.23 m (4 ft 0½ in)

AREAS:

Wings, gross	15.35 m² (165.2 sq ft)

WEIGHTS AND LOADINGS:

Max T-O weight: VLA, kit	650 kg (1,433 lb)
ULM	472.5 kg (1,042 lb)

PERFORMANCE (VLA; provisional/demonstrated):

Never-exceed speed (VNE)	124 kt (230 km/h; 142 mph)
Max level speed	97 kt (180 km/h; 112 mph)
Econ cruising speed	81 kt (150 km/h; 93 mph)
Stalling speed, clean	37 kt (67 km/h; 42 mph)
flaps down	32 kt (58 km/h; 36 mph)
Max rate of climb	300 m (984 ft)/min
T-O run	70 m (230 ft)
Landing run	60 m (200 ft)

AMEUR

AMEUR AVIATION SA

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PRESIDENT AND CHIEF DESIGNER: Boussad Ameur

Ameur Aviation (known until 2001 as Ameur Aviation Technologie - AAT) originated on the island of Corsica, but moved to mainland France and was part of the Slicom Group.

The company was declared bankrupt on 3 February 2006 and a liquidator appointed.

APEX

APEX INTERNATIONAL

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CHAIRMAN AND CEO: Guy Pellissier
SALES MANAGER: Pierre Pelletier

Three French light aircraft manufacturers are included in the holding company Apex International (formerly known as Aéronautique Service); products of BUL, CAP and Robin are described where appropriate; related companies are detailed here. In total, the group had 200 employees in 2001, which declined to 160 in 2005.

In late 2001, the company announced that it was embarking on restructuring its component parts and building a new customer service centre at Darois, due to be operational in April 2002.

However, Apex entered voluntary receivership in September 2002 and underwent financial restructuring while aircraft production at its member companies was slowed or stopped; on 30 May 2003 a French court approved an extension of receivership until July, by which time Apex hoped to have completed restructuring, including downsizing of its workforce and focusing on FAA certification for CAP and Robin aircraft; work on the CAP 222 was discontinued; receivership lifted on 25 August 2003. In the year following imposition of receivership Apex delivered 23 aircraft of various types; in 2006 production was set at 50 to 70 per year.

In October 2004, production of the Robin Alpha range was transferred to New Zealand following the sale of manufacturing rights to Alpha Aviation.

Constructions Aéronautiques de Bourgogne (CAB): Construction of BUL Zùlù and CAP 10 at Darois, and Robin aircraft at Bernay. Zùlù prototype was not followed by any production aircraft. President: Patrice Serignac.

CAP Aviation: Construction of CAP 232 and after-sales service of all CAP aircraft (including former Mudry CAP designs) at Bernay. Director-General: Eric Willaert.

Aviation Service Center (ASCO): after-sales service and support. Director-General: Ludovic Paul.

Group administrative services are provided by **Aeronautique Financements & Services**.

AVIAKIT

AVIAKIT FLIGHT CONCEPT SARL

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Original Aviakit company formed by Roland Prevot to produce kits of his Hermes. Production rights were acquired by PJB Aerocomposite of St Leger sous Brienne on 1 September 2001, but financial aspects of the transfer were not completed and the proposed Véga 2000 programme lapsed.

Dormant Aviakit was revived under new management and took over new premises at Troyes on 15 June 2004, relaunching the aircraft as Vega 3000.

Future Aviakit projects will include the Parasol in the 1930s style; and 100 hp (74.6 kW) Résolution two-seat, retractable gear, high speed tourer; work on both was continuing during 2006.

AVIAKIT VEGA 3000

TYPE: Side-by-side ultralight.

DEVELOPMENT: Originally marketed as a kitbuilt by Aviakit as Hermes and around 35 built before project was due to be taken over by PJB Aerocomposite on 1 September 2001. Despite being shown at the 2001 Paris Salon in new guise as Véga 2000, the planned transfer failed to take place. Aviakit re-established in 2004 to build Véga 3000s, second of which was exhibited at Aero '05, Friedrichshafen, April 2005.

CURRENT VERSIONS: Three options of engine and two options of landing gear. **Vega 3000 TJ80, TR80** and **TR100** with tricycle gear and Jabiru, Rotax 912 UL and 912 ULS engines;

Aviakit Véga 3000 nosewheel version *(Paul Jackson)*
1159339

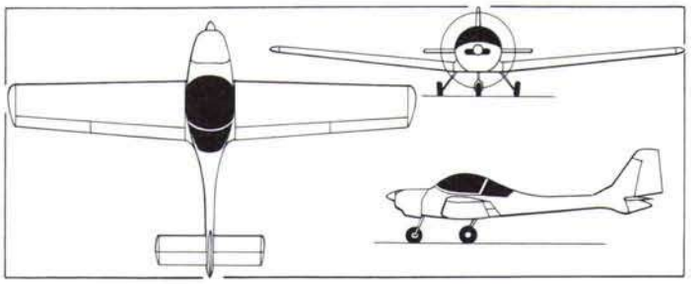
Vega 3000 CJ80, CR80 and CR100 with *Classique* (classic; tailwheel) gear and same engines.

COSTS: Kits, without engine, EUR24,500 (tailwheel or tricycle). Completed (tricycle only) aircraft: Jabiru 2200 EUR43,600, Rotax 912 UL EUR45,800, Rotax 912 ULS EUR47,950; all plus tax (2006).

DESIGN FEATURES: Low-wing tourer with high-mounted canopy and centre fuselage of sharply reduced cross-section aft of cockpit; low-mounted tailplane (replaces strut-braced, cruciform empennage of Hermes); small underfin. Other changes to design made by PJB include cutaway base of rudder and redesigned wing of shorter span.

NACA 23015 wing section with 5° dihedral. Quoted build time is 300 hours.

FLYING CONTROLS: Conventional and manual, with control sticks. Large ground-adjustable tab added to rudder by 1998. Electrically actuated flaps, maximum deflection 45°.



Aviakit Véga 3000 side-by-side ultralight *(James Goulding)* 1151424

STRUCTURE: Fuselage of glass fibre with optional carbon fibre cockpit. Wings are wood/composites with carbon spar; strut-supported mid-mounted tailplane.

LANDING GEAR: Choice of tricycle or tailwheel type; both fixed. Fuselage-mounted spring cantilever mainwheel legs with optional speed fairings. Hydraulic brakes.

POWER PLANT: Choice of 73.5 kW (98.6 hp) Rotax 912 ULS, 59.6 kW (79.9 hp) Rotax 912 UL or 59.7 kW (80 hp) Jabiru 2200 engines. Duc two-blade, fixed-pitch, carbon fibre propeller standard; Duc three-blade, Neuform two/three-blade and Filser and Neuform variable-pitch propellers optional. Fuel capacity 80 litres (21.1 US gallons; 17.6 Imp gallons) in two wing tanks.

AVIONICS:
To customer's requirements.

EQUIPMENT: Navigation lights, strobe light and Junkers high-speed ballistic parachute recovery system optional.

DIMENSIONS, EXTERNAL:
- Wing span ..... 9.35 m (30 ft 8 in)
- Length overall ..... 6.50 m (21 ft 4 in)
- Height overall ..... 1.80 m (5 ft 10¾ in)

DIMENSIONS, INTERNAL:
- Cabin max width ..... 1.10 m (3 ft 7¼ in)

AREAS:
- Wings, gross ..... 11.50 m² (123.8 sq ft)

WEIGHTS AND LOADINGS (Rotax 912 ULS and parachute):
- Weight empty ..... 264 kg (582 lb)
- Max T-O weight: Ultralight ..... 472.5 kg (1,041 lb)
- Experimental ..... 560 kg (1,234 lb)

PERFORMANCE (with Rotax 912 ULS engine):
- Never-exceed speed (VNE) ..... 135 kt (250 km/h; 155 mph)
- Max operating speed (VMO) ..... 119 kt (220 km/h; 137 mph)
- Cruising speed at 75% power ..... 113 kt (210 km/h; 130 mph)
- Stalling speed, flaps 10° ..... 34 kt (62 km/h; 39 mph)
- Max rate of climb at S/L ..... 510 m (1,673 ft)/min
- T-O run ..... 150 m (495 ft)
- Landing run ..... 100 m (330 ft)
- Range ..... 510 n miles (945 km; 587 miles)

AVYRON

AVYRON

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MANAGER: Jean-Luc Journo
SALES MANAGER: Georges Chemla

New Avyron company announced its intention of producing a development of Grinvalds Orion at Paris Air Show in June 2005.

Prototype Grinvalds G-801 above the Avyron stand at Paris in June 2005 *(Paul Jackson)* 1129260

AVYRON JG-803

TYPE: Four-seat kitbuilt.

PROGRAMME: Design initiated by Jean Grinvalds in 1975; G-801 Orion (F-PYKF) first flew 2 June 1981 as two-seater with 48.5 kW (65 hp) engine; developed G-802 (134 kW; 180 hp Textron Lycoming IO-360) followed 4 November 1983; marketed as kit or plans by Aérodis of France; further small number of kits sold by Aerodis America Inc. Programme transferred to Avyron and improved JG-803 launched at Paris Air Show in June 2005. Prototype then under construction. Kits to be manufactured in Switzerland.

CURRENT VERSIONS: **G-190:** Powered by 142 kW (190 hp) Mazda (Mistral Engines modified) rotary Diesel engine.

G-230: With 172 kW (230 shp) Innodyn turboprop.

COSTS: Prices not finalised by early 2006.

DESIGN FEATURES: Low-wing, mid-engined pusher with T tail. JG-803 is fly-by-wire version with increased carbon fibre content.

FLYING CONTROLS: Electronic. Flaps; max deflection 35°.

STRUCTURE: Glass fibre wing with Kevlar and carbon fibre reinforcement; landing gear attached to reat spar; aluminium fuel tanks in prototype; integral tanks in production version. Carbon fibre fuselage and propeller drive shaft.

Wing section NACA 43015 at root; NACA 43012 at tip. Dihedral 4° 30'; incidence 2° 30' at root. Tailplane NACA 09; no incidence.

LANDING GEAR: Tricycle type; retractable. Mainwheels retract inwards; nosewheel forward. Electric actuation standard; hydraulic optional; manual emergency handle.

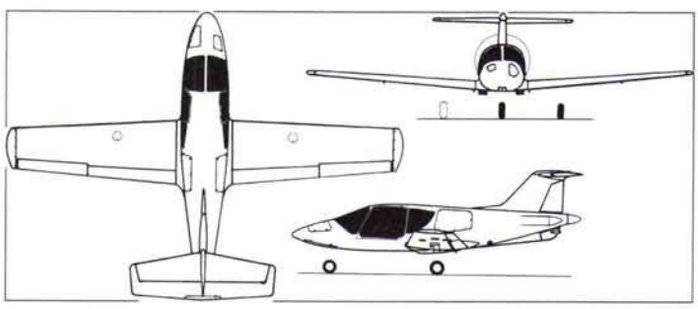
POWER PLANT: One Jet A-1-fuelled engine behind cabin, driving pusher propeller in extreme tail. Fuel tank in each wing; combined capacity 180 litres (47.5 US gallons; 39.6 Imp gallons).

ACCOMMODATION: Four persons in side-by-side tandem pairs. Upward-hinged door each side. Tinted Plexiglas windows.

AVIONICS: EFCS.

EQUIPMENT: Ballistic recovery parachute.

DIMENSIONS, EXTERNAL:
- Wing span ..... 8.90 m (29 ft 2½ in)
- Wing chord: at root ..... 1.50 m (4 ft 11 in)
- at tip ..... 1.00 m (3 ft 3¼ in)
- Wing aspect ratio 7.1
- Length: fuselage ..... 6.70 m (21 ft 11¾ in)
- overall ..... 6.85 m (22 ft 5¾ in)
- Height overall ..... 2.55 m (8 ft 4½ in)
- Tailplane span ..... 3.30 m (10 ft 10 in)
- Wheel track ..... 2.90 m (9 ft 6¼ in)
- Wheelbase ..... 2.55 m (8 ft 4½ in)
- Doors (each): Height ..... 0.75 m (2 ft 5½ in)
- Width: max ..... 0.90 m (29 ft 6¼ in)
- min ..... 0.65 m (2 ft 1½ in)



Avyron JG-803 four-seat kitbuilt 1129162

DIMENSIONS, INTERNAL:
- Cabin: Length ..... 2.30 m (7 ft 6½ in)
- Max width ..... 1.10 m (3 ft 7¼ in)
- Max height ..... 1.05 m (3 ft 3¼ in)

AREAS:
- Wings, gross ..... 11.12 m² (119.7 sq ft)
- Ailerons (total) ..... 0.86 m² (9.26 sq ft)
- Trailing-edge flaps (total) ..... 1.22 m² (13.13 sq ft)
- Fin ..... 1.10 m² (11.84 sq ft)
- Underfin ..... 0.18 m² (1.94 sq ft)
- Rudder, incl tab ..... 0.30 m² (3.23 sq ft)
- Tailplane ..... 3.13 m² (33.69 sq ft)

WEIGHTS AND LOADINGS (G-190):
- Weight empty ..... 610 kg (1,345 lb)
- Max T-O weight ..... 1,050 kg (2,314 lb)
- Max wing loading ..... 94.4 kg/m² (19.57 lb/sq ft)
- Max power loading: G-190 ..... 4.21 kg/kW (6.92 lb/hp)
- G-230 ..... 6.12 kg/kW (10.06 lb/shp)

PERFORMANCE (estimated):
- Max level speed: G-190 ..... 189 kt (350 km/h; 217 mph)
- G-230 ..... 194 kt (360 km/h; 224 mph)
- Cruising speed at 75% power: G-190 ..... 173 kt (320 km/h; 199 mph)
- G-230 ..... 178 kt (330 km/h; 205 mph)
- Stalling speed, flaps down ..... 49 kt (90 km/h; 55 mph)
- Max rate of climb at S/L ..... 270 m (886 ft)/min
- Service ceiling ..... 4,500 m (14,760 ft)
- Range ..... 1,619 n miles (3,000 km; 1,864 miles)

BEST OFF

BEST OFF

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This company holds rights to the Sky Ranger ultralight, which is built under licence in Ukraine by Aeros and distributed by several dealerships throughout the world.

BEST OFF SKY RANGER

TYPE: Side-by-side ultralight kitbuilt.

PROGRAMME: Designed in Toulouse, France, in 1990 by Philippe Prevot; winner of World FAI two-seat ultralight championships in 1996, 1999 and 2003, plus silver medal in European ultralight championship in 2002 and 2004. After production of 200 by Synairgie in France, between 1992 and 1997, manufacture was transferred to Aeros in 1998; current version is Sky Ranger 2, offered in two versions: standard **V.Fun** and BCAR section S-compliant **V.Max.** Tailwheel and short-wing options added to range in 2006; short wing **Swift** developed in UK by Flylight and announced at Popham Microlight Fair, 29 April 2006. Prototype (G-UPHI) first flew October 2006.

CUSTOMERS: Over 950 (including 200 of first series) delivered by early 2006.

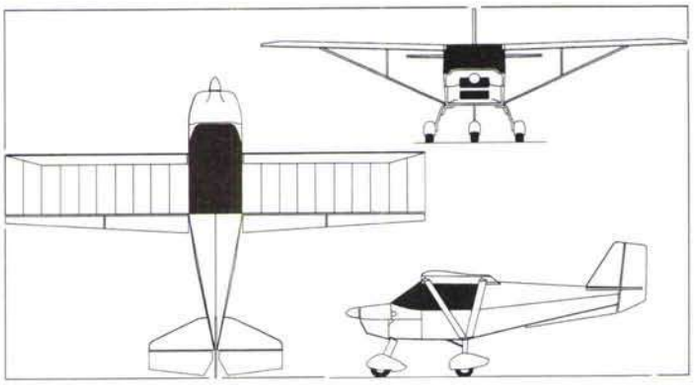
COSTS: V.Fun kit EUR11,800, engine EUR12,000 extra; V.Max kit EUR12,800, engine EUR12,000 extra, all excluding taxes (2006).

DESIGN FEATURES: Intended to combine high performance with simple construction. Delivered as fast-build kit, assembled by two persons in two weeks. Wings foldable for storage by two persons in 20 minutes.

High wing with V-strut bracing and auxiliary struts; wire-braced empennage. Purpose-designed wing section. Directional stability enhanced from 2003 onwards by addition of large underfin, although this quickly changed to revised design comprising smaller underfin and flush, downward extension of rudder. US aircraft also have downward extension to rudder.

Best Off Sky Ranger nosewheel version *(Paul Jackson)* 1159340

Best Off Sky Ranger Swift 912S developed in UK *(Paul Jackson)* 1040498



Best Off Sky Ranger side-by-side ultralight *(Paul Jackson)* 1159375

FLYING CONTROLS: Conventional and manual; cable operated. Three-position flaps; pushrod actuated.

STRUCTURE: Employs only straight 2024 and 2017 aluminium tubing; no bends or welds; fabric covering, except for composites engine cowling and forward fuselage. No composites in structural elements. Other parts of stainless steel and plated mild steel. Optional composites wingtips.

LANDING GEAR: Tricycle type; fixed. Spring steel cantilever mainwheel legs with drag bracing tubes attached to lower longerons. All tyres 4.00-6. Cantilever-sprung main legs. Hydraulic disc brakes. Optional wheel fairings and floats.

POWER PLANT: One 59.6 kW (79.9 hp) Rotax 912 UL with 1:2.27 gearing in highest-powered version, Rotax 503, 582, 912 UL-S (France only). BMW, Simoncini, HKS 700E and Jabiru 2200 are alternatives. Three-blade, ground-adjustable pitch propeller. Fuel capacity 50 litres (13.2 US gallons; 11.0 Imp gallons) in tank behind seats.

DIMENSIONS, EXTERNAL:

Wing span	9.50 m (31 ft 2 in)
Length overall	5.50 m (18 ft 0½ in)
Height overall	2.00 m (6 ft 6¾ in)

AREAS:

Wings, gross	14.10 m² (151.8 sq ft)

WEIGHTS AND LOADINGS (Rotax 912 engine):

Weight empty	250 kg (551 lb)
Max T-O weight (where allowed)	560 kg (1,234 lb)

PERFORMANCE (Rotax 912 engine):

Never-exceed speed (VNE)	107 kt (199 km/h; 124 mph)
Max cruising speed	87 kt (161 km/h; 100 mph)
Stalling speed, flaps down	33 kt (60 km/h; 37 mph)
Max rate of climb at S/L	274 m (900 ft)/min
T-O run	90 m (295 ft)
Landing run	120 m (394 ft)
g limits (ultimate)	+6/−4

PERFORMANCE, UNPOWERED:

Glide ratio	9:1

CAP

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PRESIDENT, CEO AND HEAD OF DESIGN: Dominique Roland

SALES MANAGER, EUROPE: Alain Ruelloux

CAP Aviation (renamed from Akrotech Europe in January 1999) is owned by holding company Apex International (formerly known as Aéronautique Service — AES) (which see), also responsible for the Robin and BUL concerns. It formed in 1997, initially to market the Giles G-202 two-seat aerobatic aircraft, subsequently marketed in factory-completed form as the CAP 222.

Apex took over production of the Mudry series of aerobatic aircraft on 12 May 1997 following that company's bankruptcy. All aerobatic aircraft produced by Apex are marketed by CAP Aviation: the CAP 232 built at Bernay until transferred to Darois in mid-2005; and CAP 10 at Darois. CAP 222 has been discontinued.

CAP Aviation's parent company, Apex Aircraft, emerged from voluntary receivership on 25 August 2003.

CAP 10

TYPE: Aerobatic two-seat sportplane.

PROGRAMME: Derived from Piel CP-30/CP-301 Emeraude, first flown 19 June 1954 and built by amateur constructors as well as by 11 commercial plants, under various names. Super Emeraude modified with taller fin and 119 kW (160 hp) engine as CP-100 prototype, flown 13 August 1966; with broader chord rudder and 134 kW (180 hp) engine, became prototype CAP 10 B, first flight (F-WOPX) 22 August 1968; further three pre-series aircraft; certified 4 September 1970; FAA certification for day and night VFR on 13 June 1974. Produced by Mudry until 1996.

Production transferred to Dijon, beginning with CAP 10 C in 2001. Total fleet time exceeded 500,000 flight hours by 2005.

CURRENT VERSIONS: **CAP 10 B:** Previous version; now out of production, but can be upgraded to CAP 10 C in one day's work.

CAP 10 C: Announced in early 1999; features carbon fibre-reinforced wing spar (Mod 000302) for reduced weight and increased speed and roll rate.

Improvements effected in CAP 10 C include substitution of pushrods for aileron control, replacing cables; larger (25 per cent) ailerons of increased chord with repositioned axis for faster roll rate, compensated by two spade-type servos per side; aileron max 'down' deflection increased from 15 to 25°; electric actuation of flaps; electric fuel gauges and flush filler caps; optional constant-speed propeller (in prospect); upgraded instrumentation with four standard options; redesigned landing gear to improve ground handling; local airframe reinforcement and landing gear attachments; and revised canopy design to reduce cockpit noise levels. Roll rate improved by 30 per cent. New wing available for retrofitting to existing CAP 10 Bs and is supplied complete with landing gear.

Static test of wing undertaken 27 April 2000; prototype first flight (CAP 10 B HB-SAX retrofitted with new wing) 5 March 2001; first 'true' CAP 10 C (F-WWNN, c/n 300) first flown 15 May 2001 and following initial flight testing was delivered to CEV during July. DGAC certification achieved in early 2002. Reregistered F-GYKA on completion of trials. CAP 10Cs are registered under CAP 10B type certificate. FAA certification achieved 16 June 2004.

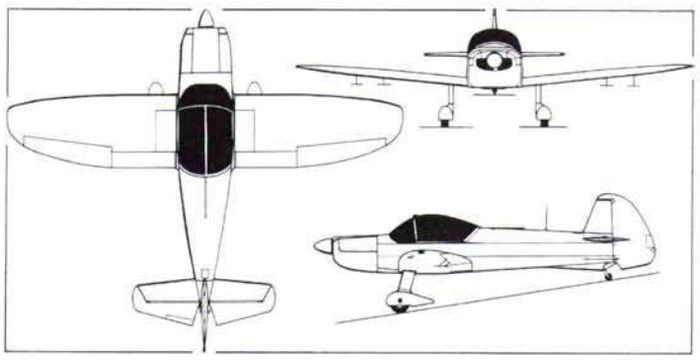
Description refers to CAP 10 C unless otherwise stated.

CUSTOMERS: Total 284 of earlier versions (including prototypes) built to mid-1999, of which 279 completed by Mudry before 1996 bankruptcy. Final five produced by Akrotech Europe in temporary factory at Bernay and include exports to UK (three) and USA (one); last, in 1999, was G-LORN (c/n 282) to UK. Production then paused, pending launch of CAP 10 C and transfer of production to Dijon. Previous major users, French Air Force (56) and Mexican Air Force (20) began disposals in 1994–95. Two more recent aircraft operated by 208 Squadron of South Korean Air Force; French Navy has eight.

First production CAP 10 C (c/n 301; G-CPXC) registered in December 2001 to Cole Aviation in UK; 14th registered in November 2004; 15th in 2005; customers include SEFA of France (five). By mid-2004 an additional 45 sets of CAP 10 C wings had been sold to existing CAP 10 B operators.

COSTS: EUR162,320 to EUR185,274 depending on equipment level (2004).

CAP 10 C owned by Mr I Valentine *(Paul Jackson)* 1042959



CAP 10 C, showing new ailerons *(Paul Jackson)* 0137207

DESIGN FEATURES: Simple, sporting lightplane with low, basically elliptical wing, mid-mounted tailplane and curved rudder.

Wing section NACA 23012; dihedral 5°; incidence 0°.

FLYING CONTROLS: Conventional and manual. Electric trim tabs on port elevator; balance tab on rudder; tailplane incidence adjustable on ground; electric three-position (0, 15, 40°) flaps. Control surface deflections: ailerons +25/−25°, elevators ±25°; rudder ±18°.

STRUCTURE: Main spar of carbon fibre caps and birch ply webs; wooden ribs; birch ply skin; carbon fibre wingtips; birch ply ailerons, flaps, fin/rudder and tailplane/elevator. Wooden fuselage, with okoumé ply upper decking and polyester fabric covering elsewhere.

LANDING GEAR: Tailwheel type; fixed. Wing-mounted, trousered, cantilever main legs of light alloy, with integral ERAM type 9 270 C oleo-pneumatic shock-absorbers. Single wheel on each main unit, tyre size 380×150/15×6.00–5. Solid tailwheel tyre, size 6×2.00. Tailwheel is steerable by rudder linkage but can be disengaged for ground manoeuvring. Hydraulically actuated mainwheel disc brakes (controllable from port seat) and parking brake. Dual toe brakes standard. Streamline fairings on mainwheels and legs.

POWER PLANT: One 134 kW (180 hp) Textron Lycoming AEIO-360-B2F flat-four engine, driving a Hoffmann HO29HM-189–170 two-blade, fixed-pitch wooden propeller; optional Evra 3,180-170-H5.F. Standard fuel tank aft of engine fireproof bulkhead, usable capacity 72 litres (19.0 US gallons; 15.8 Imp gallons); total 75 litres (19.8 US gallons; 16.5 Imp gallons). Auxiliary tank, usable capacity 78 litres (20.6 US gallons; 17.2 Imp gallons), total capacity 79 litres (20.8 US gallons; 17.3 Imp gallons), beneath baggage compartment, must be empty for aerobatics. Inverted fuel and oil (Aviat/Christen) systems permit continuous inverted flight.

ACCOMMODATION: Side-by-side adjustable seats for two persons, with provision for back parachutes, under rearward-sliding and jettisonable moulded transparent canopy. Five-point aerobatic shoulder harness standard. Leather upholstery optional. Space for 20 kg (44 lb) of baggage aft of seats in training and touring models.

SYSTEMS: Electrical system includes Delco-Rémy 40 A engine-driven alternator and STECO ET24 Ni/Cd battery.

AVIONICS: Bendix/King and Garmin suites optional.

Comms: Optional KY97A VHF com; GMA 340 audio panel and Sigtronics SPA400 intercom; GTX 320 or GTX 327 transponder; ACK 30 encoder; EBC 102A ELT.

Flight: Garmin GNC 250 XL, GNS 420 or GNS 430 GPS; GI 106A VOR/ILS; Sandel SN3308 EHSI.

Instrumentation: ASI (kt and mph); altimeter; VSI; recording g-meter; positive/negative slip indicator; compass; tachometer; fuel gauges; oil pressure/temperature, EGT and CHT gauges; and manifold pressure/fuel flow gauge, all standard. Artificial horizon, turn co-ordinator, and directional gyro optional or standard according to selected equipment fit level.

Equipment: Panel light, cockpit light, landing light, navigation and strobe lights, external power socket, aerobatic sighting device, and canopy cover, all optional.

DIMENSIONS, EXTERNAL:

Wing span	8.08 m (26 ft 6 in)
Wing aspect ratio	6.0
Length overall	7.16 m (23 ft 6 in)
Height overall	2.55 m (8 ft 4½ in)
Tailplane span	2.90 m (9 ft 6 in)
Wheelbase	4.30 m (14 ft 1¼ in)
Wheel track	2.06 m (6 ft 9 in)
Propeller diameter	1.90 m (6 ft 2¾ in)

DIMENSIONS, INTERNAL:

Cabin: Length	1.05 m (3 ft 5½ in)
Max width	1.05 m (3 ft 5½ in)
Max height	0.98 m (3 ft 2½ in)

AREAS:

Wings, gross	10.85 m² (116.8 sq ft)
Vertical tail surfaces (total)	1.32 m² (14.25 sq ft)
Horizontal tail surfaces (total)	1.86 m² (20.02 sq ft)

WEIGHTS AND LOADINGS (A: Aerobatic, U: Utility):

Weight empty, equipped	540 kg (1,190 lb)
Max baggage weight: A	nil
U	50 kg (110 lb)
Fuel weight: A	54 kg (119 lb)
U	108 kg (238 lb)
Max T-O weight: A	780 kg (1,719 lb)
U	830 kg (1,830 lb)
Max landing weight	800 kg (1,764 lb)
Max wing loading: A	71.9 kg/m² (14.72 lb/sq ft)
U	76.5 kg/m² (15.67 lb/sq ft)
Max power loading: A	5.82 kg/kW (9.56 lb/hp)
U	6.19 kg/kW (10.16 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	183 kt (340 km/h; 211 mph)
Max level speed at S/L and cruising speed at 75% power at FL80	148 kt (274 km/h; 170 mph)
Stalling speed: clean	53 kt (99 km/h; 61 mph)
flaps down	46 kt (85 km/h; 53 mph) IAS
Max rate of climb at S/L	488 m (1,600 ft)/min
Service ceiling	5,000 m (16,400 ft)
T-O run	350 m (1,150 ft)
T-O to 15 m (50 ft)	395 m (1,300 ft)
Landing from 15 m (50 ft)	600 m (1,970 ft)
Landing run	360 m (1,185 ft)
Range with max fuel	521 n miles (965 km; 600 miles)
g limits: A	+6/−4
U	+4.4/−1.8

CAP 232

TYPE: Aerobatic single-seat sportplane.

PROGRAMME: Prototype (F-WZCH) first flew 7 July 1994; French certification and first sales March 1995; initial production aircraft (No. 02/F-GPRC) first flew 9 April 1995. First place in 2000 World Aerobatic Championship in France was taken by Eric Vazeille in CAP 232 F-GKDX; Catherine Maunoury was fifth (women's first) in F-GXCM. Production transfer of CAP 232 from Bernay to Darois announced June 2005.

CUSTOMERS: Total 44 built by late 2004, including prototype, one destroyed before first flight and one crashed on test; no known production in 2005. Mainly to French civil register (19) and four to French Air Force, but others sold to Australia (one, 1996 and USA eight). Others employed in Switzerland and UK, but retaining French registry. Moroccan Air Force placed order for nine in mid-2000 to re-equip Marche Verte aerobatic team; deliveries were completed between early 2001 and 2004.

COSTS: US$250,000 (2001).

DESIGN FEATURES: Optimised for world-class aerobatic competition. Similar to, and improvement on, CAP 231 EX. Strong, carbon fibre wing of broad root chord, sharply tapered for high roll rates; tapered tail surfaces.

FLYING CONTROLS: Conventional and manual. Electrically actuated elevator tab; elevator servo tab to reduce stick forces. Almost full-span ailerons for high roll rates.

STRUCTURE: Two-spar carbon fibre wings; 10 ribs.

LANDING GEAR: Fixed tailwheel type; fuselage-mounted cantilever mainwheel legs with wheel fairings. Mainwheel tyres 5.00–5.

POWER PLANT: One 224 kW (300 hp) Textron Lycoming AEIO-540-L1B5D flat-six engine, driving a variable-pitch (hydraulic) MT-Propeller MTV-14-BC-C190-17 four-blade propeller. Total fuel capacity 189.3 litres (50.0 US gallons; 41.6 Imp gallons) in one fuselage tank and two wing tanks. Fuel and oil system designed for prolonged inverted flight.

ACCOMMODATION: Single seat under rear-hinged canopy. Baggage space behind pilot.

SYSTEMS: Electrical system includes engine-driven alternator and 12 V 60 Ah battery.

French Air Force CAP 232 aerobatic sportplane *(Paul Jackson)* 1153750

AVIONICS: Customer specified.
Comms: Radio and transponder optional.
Flight: GPS optional.
EQUIPMENT: Sighting frame can be attached to wingtip for judging exact verticals in competition aerobatics.
DIMENSIONS, EXTERNAL:

Wing span	7.39 m (24 ft 3 in)
Wing chord: at root	1.83 m (6 ft 0 in)
at tip	0.91 m (3 ft 0 in)
Wing aspect ratio	5.4
Length overall	6.76 m (22 ft 2 in)
Tailplane span	2.74 m (9 ft 0 in)
Wheel track	1.75 m (5 ft 9 in)
Propeller diameter	1.90 m (6 ft 2¾ in)
Propeller ground clearance	0.30 m (1 ft 0 in)

AREAS:

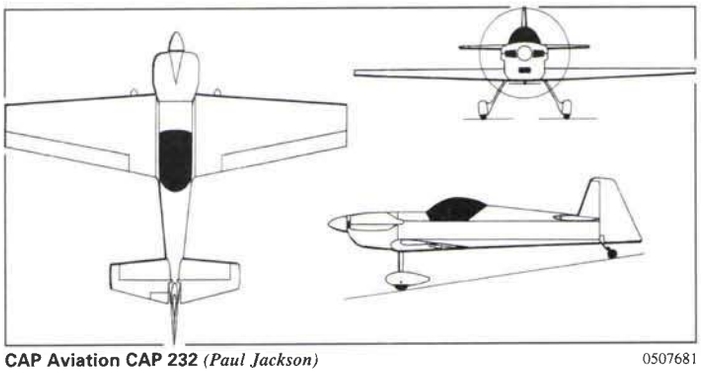
Wings, gross	10.15 m² (109.3 sq ft)
Ailerons (total)	1.00 m² (10.76 sq ft)
Fin	0.55 m² (5.92 sq ft)
Rudder	0.77 m² (8.29 sq ft)
Tailplane	1.02 m² (10.99 sq ft)
Elevators	1.11 m² (11.93 sq ft)

WEIGHTS AND LOADINGS (A: Aerobatic, N: Normal category):

Weight empty	585 kg (1,290 lb)
Max payload	227 kg (500 lb)
Fuel weight	123 kg (270 lb)
Max T-O and landing weight: N	730 kg (1,610 lb)[1]
A	821 kg (1,810 lb)[1]
Max wing loading	80.9 kg/m² (16.56 lb/sq ft)
Max power loading	3.67 kg/kW (6.03 lb/hp)

[1] *As quoted by manufacturer*
PERFORMANCE:

Never-exceed speed (VNE)	219 kt (405 km/h; 252 mph)
Max level speed	189 kt (349 km/h; 217 mph)
Max cruising speed at 75% power	174 kt (322 km/h; 200 mph)
Manoeuvre speed (VA)	170 kt (314 km/h; 195 mph)
Econ cruising speed	145 kt (269 km/h; 167 mph)
Stalling speed, power off	56 kt (104 km/h; 65 mph)
Max rate of climb at S/L	1,003 m (3,290 ft)/min
Rate of roll at manoeuvre speed	420°/s
Service ceiling	4,575 m (15,000 ft)
T-O run	150 m (495 ft)
T-O to 15 m (50 ft)	180 m (595 ft)
Landing from 15 m (50 ft)	450 m (1,480 ft)
Range with max fuel, 45% power	650 n miles (1,203 km; 748 miles)
g limits	±10



CAP Aviation CAP 232 *(Paul Jackson)* 0507681

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F-33260 La Teste (Cazaux), F-64205 Biarritz,
F-13804 Istres, F-74370 Argonay,
F-59472 Lille-Seclin, F-86580 Biard (Poitiers)
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CHAIRMAN AND CEO: Charles Edelstenne
VICE-CHAIRMAN: Bruno Revellin-Falcoz
SENIOR EXECUTIVE VICE-PRESIDENT, OPERATIONS: Christian Decaix
SENIOR EXECUTIVE VICE-PRESIDENT, INTERNATIONAL: Bruno Cotté
VICE-PRESIDENT, COMMUNICATIONS: Gérard David
INFORMATION OFFICER: Luc Berger

Former Avions Marcel Dassault-Breguet Aviation formed from merger of Dassault and Breguet aircraft companies in December 1971; French government acquired 20 per cent of stock in January 1979, raised to 45.76 per cent in November 1981; present company name adopted June 1990.

Dassault Aviation is owned 50.21 per cent by Dassault Group; 46.22 per cent by EADS France; and 3.57 per cent by others.

Global employees total some 12,040, mostly at 10 French industrial sites: St Cloud, Argenteuil, Argonay, Biarritz, Mérignac, Martignas, Istres, Cazaux, Poitiers and Seclin. Consolidated orders in 2004 amounted to EUR4.02 billion, with 66 per cent exports. Dassault sold 69 Falcon business jets in 2004.

Work began on 16 September 2002 on new manufacturing building at Bordeaux for Falcon 7X. Three Falcon 7X prototypes flew in 2005. Signed co-operation accord with Sukhoi of Russia in June 2003, collaborative opportunities including supersonic business jet, corporate shuttle aircraft and UAVs.

Dassault assembles and tests its civil and military aircraft in its own factories, but operates wide network of subcontractors. Other products include flight control system components, maintenance and support equipment. Related companies include Dassault Falcon Jet Corporation, Dassault Falcon Service and SOGITEC. All are subordinate to Groupe Industriel Marcel Dassault, previously including Dassault Electronique, which became part of Thomson-CSF Detexis (now Thales) on 1 January 1999. Falcon Jet Corporation has HQ and completion centre at Little Rock and service centres in North and South America; workforce 2,300 in 2005.

European Aerosystems Ltd established with BAE Systems as a joint venture military aircraft company. On 5 July 2002, Dassault, EADS CASA, EADS Military Aircraft and Saab signed industrial collaboration agreement for feasibility study of Advanced European Jet Pilot Training system.

Dassault has produced more than 1,650 executive jets for service in 65 countries and received orders for over 2,700 Mirages of all types. The company has delivered some 7,500 aircraft to 75 countries and these have accumulated 20 million flying hours.

DASSAULT CONSOLIDATED SALES TRENDS (EUR MILLION)

	DEFENCE				
Fiscal year	France	Export	Falcon	Total	% Export
1999	780	149	1,960	**2,889**	68%
2000	864	147	2,474	**3,485**	73%
2001	653	164	2,653	**3,470**	77%
2002	1,053	158	2,226	**3,437**	66%
2003	545	1,061	1,692	**3,298**	82%
2004	505	838	2,116	**3,459**	83%

Special 'Tiger' colour scheme on a Mirage 2000C of EC 1/12, French Air Force *(Jean-Louis Gaynecoetche)* 1153764

DASSAULT MIRAGE 2000

Indian Air Force name: Vajra (Divine Thunder)
TYPE: Multirole fighter.
PROGRAMME:

DEVELOPMENT MILESTONES

Mirage 2000C	
Official go-ahead	18 Dec 75
First flight	10 Mar 78
First flight, production	20 Nov 82
Entered service (EC 1/2)	2 Jul 84
Subsequent versions:	
Mirage 2000N	
First flight	3 Feb 83
First flight, production	3 Mar 83
First delivery	30 Mar 88
Entered service (EC 1/4)	1 Jul 88
Mirage 2000D	
First flight	19 Feb 91
First delivery (CEAM)	9 Apr 93
Entered service (EC 1/3)	29 Jul 93
Mirage 2000-5	
First flight	24 Oct 90
First flight, production	Oct 95
First delivery (Taiwan)	May 97
Mirage 2000-9	
First flight	14 Dec 00
First delivery (Abu Dhabi)	14 Apr 03

Selected as main French Air Force combat aircraft 18 December 1975; first of four single-seat prototypes flew 10 March 1978, followed by two-seat version on 11 October 1980; initially developed as interceptor with SNECMA M53 power plant and Thomson-CSF (now Thales) RDM multimode pulse Doppler radar; M53-5 in early production aircraft succeeded by M53-P2; fitted with RDI radar from 38th French Air Force 2000C onwards;

French Air Force Dassault Mirage 2000B *(Paul Jackson)* 1153766

first flight of production 2000C 20 November 1982; first flight of production two-seat 2000B, 7 October 1983; first unit, EC 1/2 'Cigognes', formed at Dijon 2 July 1984. Subsequently developed for strike/attack as 2000N/D.

Second-generation Mirage 2000-5 first flown as prototype 24 October 1990; initial production aircraft flown in October 1995 and type qualification granted (for SF1 French production standard) by DGA procurement agency on 13 June 1997; initial export delivery in May 1997, followed by first to French Air Force in December 1997. By end of 2004, Mirage 2000s of eight air forces had accumulated 1.2 million flying hours.

Third-generation Mirage 2000-5 Mk 2 launched in April 1999; first flew December 2000; deliveries began April 2003.

Potential engine upgrade revealed in early 2000; M53 PX3 under study to provide additional 8 to 10 per cent thrust. PX3 offered to Brazil for Mirage 2000BR in 2002.

CURRENT VERSIONS: **2000B:** (*Biplace*: two-seat). Trainer counterpart of 2000C; Nos. 501 to 514 (Series) S3 with RDM radar and M53-5 power plant; Nos. 515 to 520, S4 with RDI J1-1 radar and M53-5, but Nos. 516 and 517 retrofitted with RDM; No. 521 S4-2 with RDI J2-4 and M53-5; No. 522 also S4-2, but M53-P2; Nos. 523 to 530 S5 with RDI J3-13 and M53-P2. Final delivery in December 1994. See also Mirage 2000DA below. One or two Mirage 2000Bs distributed to each 2000C operating squadron, but most operated by OCU, EC 2/5 at Orange, which assumed task from EC 2/2 at Dijon on 1 July 1998. S3 aircraft have been upgraded with RDI radar. French holding in 2005 being nine S4-2A/M53-5, six S5-2C/M53-5 and three S5-2C/M53-P2.

2000BR: Version of 2000-5 Mk 2 proposed for Brazil, 2001, but new fighter competition was subsequently postponed. Development and promotion agreement signed by Dassault, Embraer, Snecma and Thales 27 March 2002. Total 48 had been required, of which 32 to be assembled locally by Embraer.

Alternative option adopted 16 July 2005 when Brazil ordered 12 ex-French Mirage 2000Cs (RDI radar) for EUR60 million; early delivery expected from surplus stocks held at Chateaudun maintenance depot.

2000C: (*Chasse*: fighter). Standard interceptor; Nos. 1 to 37 built as series S1, S2 and S3 with RDM radar and M53-5 power plants; since upgraded to S3 radar standard. Loosely called Mirage **2000RDM;** Mirage 2000B and C collectively known as Mirage **2000DA** (*Défense Aérienne*). Later aircraft (loosely **2000RDI**) have RDI radar and M53-P2 power plants: Nos. 38 to 48 Series S4, delivered from July 1987 and later upgraded to S4-1; Nos. 49 to 63 S4-1; Nos. 64 to 74 S4-2; Nos. 75 to 124 Series S5, delivered between late 1990 and June 1995. Equipment standards of Mirage 2000B/Cs are **S3**, incapable of launching Matra BAe 530D (530F only); **S4** RDI J1-1 radar; **S4-1** retrofit of all S4s with improved J1-2; **S4-2** further radar upgrade to J2-4; **S4-2A** retrofit of all S4-1 and S4-2 aircraft (Nos. 38 to 74, 515 and 518 to 522) with improved J2-5 radar; **S5** definitive standard with J3-13 radar and, from No. 93 onwards, Spirale chaff/flare dispenser; and **S5-2C** retrofit introduced 1995 (aircraft of EC 1/12) providing better anti-jamming protection for RDI radar. Conversion completed of 37 2000B/Cs to Mirage 2000-5F (which see). Withdrawal of S3 began in January 1998 for upgrading with RDI radar and final aircraft returned to service (at Orange) in March 1999; EC 2/2 gained late production (RDI) aircraft, with which it became operational in the air defence role on 1 August 1998. By 2005, Cambrai squadrons (EC 1/12 and 2/12) operating S5-2C aircraft and Orange squadrons (EC 1/5 and 2/5) S4-2A.

Detailed description applies to 2000C except where indicated.

2000D: Two-seat conventional attack version of 2000N, lacking ASMP missile interface and nose pitot but with HOTAS controls, additional display screens for both crew members, Antilope 5-3D terrain-following/terrain-reference radar, GPS and improved (ICMS Mk 2) ECM; functions of pilot and navigator more clearly demarcated. First flight (D01, ex-N01) 19 February 1991; second prototype, D02 (ex-N02), flown 24 February 1992 ; first 2000D (No. 601) delivered CEAM Mont-de-Marsan for trials 9 April 1993; first squadron, EC 1/3 'Navarre', achieved limited IOC (six aircraft only) 29 July 1993 at CEAM. Combat debut was 5 September 1995, launching AS 30L ASMs in Bosnia. Last of 86 delivered February 2002.

Initial six aircraft built to 'interim baseline' configuration known as **R1N1L**, with ability to launch AS-30 laser-guided ASM and Magic AAM only. Further 18 (Nos. 607 to 624), designated **R1N1**, had only 'classic' (free-fall, non-laser) options. Later **R1** aircraft (No. 625 onwards) have full range of current French Air Force armament (BAP 100, BAT 120, Belouga, 68 mm rockets, AS 30L, GBU-12 (Mk 82), BGL 1000, Magic 2 and PDLCT designator). Deliveries of new aircraft ended in December 2001. PDLCT-S (*Synergie*), first employed over Yugoslavia in March 1999, is modified version with improved imagery contrast. All interim 2000Ds were modified to full R1 standard by June 1995. **R2** standard, operational July 2001 (as R2.1), introduced improved navigation system, Eclair fully integrated self-defence suite and Atlis II laser designator pods (from Jaguar force) for use with Paveway II and III bombs; APACHE capability was added in late 2003. First two R2 conversions completed early 2000 at Nancy; further 18 followed, last in 2002. All aircraft to receive Thales RSA NG improved electronic warfare system. Planned **R3** version, with SCALP SOM and a reconnaissance pod, was abandoned in June 1996.

However, further enhancements implemented, including SCALP-EG (from October 2003) and MIDS/Link 16 datalink for NATO inter-operability (from early 2004). These enhancements form part of 'Post-R2' upgrade, which operational at Nancy from June 2004 on completion of 18th aircraft and due for completion in March 2006 with 80th machine. Related weapons, for NATO compatibility, include GBU-12/16/24 Paveway bombs. Self-protection includes Eclair IR/EM dispenser and DDM missile warning.

2000E: Multirole fighter for export; M53-P2 power plant throughout. Details in Customers subsection. Baseline version for India, Egypt and Peru, differences from 2000C including RDM radar with CW illumination for Super 530D AAM; two main computers, with expanded memory; ULISS 52 INS; improved ECM (integrated system with VCM-65 display or, alternatively, Remora and Caiman pods); VE-130 HUD; VMC-180 head-down; and expanded weapon options. Abu Dhabi and Greek 2000Es have extra computing power, further armament options and improved self-defence (SAMET system for Abu Dhabi; ICMS Mk 1 for Greece).

2000N: Two-seat low-altitude penetration version to deliver ASMP nuclear standoff missile; two prototypes; first flight 3 February 1983; one preseries aircraft (No. 301) built at Istres and first flown 3 March 1986; first 24 production aircraft (Nos. 302-325) were 2000N-K1 with ASMP capability only; from July 1988 remaining aircraft, designated 2000N-K2, have full conventional and ASMP capability; production ended 1993; all K1s (initially of squadrons 3/4 and part of 2/4) retrofitted to K2 for conventional attack, programme completed by late 1998. Equipment includes Antilope 5 terrain-following radar, two SAGEM inertial platforms, two improved AHV-12 radio altimeters, colour head-down CRT, two Magic self-defence missiles, and internal countermeasures system comprising Cameleon jamming system, Serval RWR and Spirale automatic chaff/flare dispenser system. Further improvement (K2-4C) in 2002 integrated self-defence systems with nav/attack system.

Follow-on upgrade, 2000N K3, launched in September 2003 for incorporation in 50 aircraft of EC 1/4, 2/4 and 3/4, gaining IOC in 2007. Thales Reco-NG reconnaissance pod; new self-protection avionics and upgraded ASMP-Ameliore (which authorised late 2000 for 2011 service entry).

2000N' (N Prime): Initial designation of 2000D.

2000R: Single-seat day/night reconnaissance export version of 2000E but with normal radar nose; various sensor pods possible (see Avionics paragraph).

2000–5: Multirole upgrade incorporating improvements from private venture Mirage 2000-3 project, plus Thales RDY radar and new central processing unit, Thales VEM 130F HUD and ICMS Mk 2 countermeasures; laser-guided bombs and ASMs in air-to-ground role; MICA AAM. First Mirage flight of RDY radar in BY1 (later numbered BY2) May 1988; first flight of full 2000–5 (two-seat) 24 October 1990 (same aircraft; initially no serial number; later reverted to B01); first single-seater, 01 (conversion of trials aircraft CY1) flown 27 April 1991.

Export orders from Taiwan and Qatar; air-to-air firing trials with MICA completed July 1996; air-to-ground trials completed May 1997; operational use (export; Taiwan) from June 1997.

FFr4,600 million (US$830 million) conversion programme announced November 1992 for upgrading 37 French Air Force 2000Cs (34 S4-2As, Nos. 38 to 49, 51 to 59, 61 to 63 and 65 to 74 and three S5s, Nos. 77 to 79) mainly from EC 2/5 and 3/5 at Orange to **2000-5F** for continued service; contract awarded 25 November 1993; funding included only one reworked aircraft in 1994 defence budget; 10 more in 1995 funding; and 23 in 1996. Delivery schedule (not achieved) was one in 1997; 11 in 1998; 22 in 1999; and three in 2000; one lost on 16 March 1999. Rework (at Argenteuil, with reassembly at Bordeaux) required six months per aircraft and involved complete dismantling and return of fuselages to Argenteuil. RDI radars from these upgraded aircraft retrofitted in early production (RDM) Mirage 2000Cs. Prototypes were conversions of Nos. 51 and 77 (latter an S5); both modified at Istres; initial aircraft reflown 26 February 1996; second followed two months later.

First 'production' conversion, No. 38 handed over 30 December 1997 at Istres test centre before delivery in April 1998 to CEAM, Mont-de-Marsan, to begin conversion of pilots of EC 1/2 from Dijon. IOC at Dijon (12 aircraft) 31 March 1999; FOC 4 February 2000; re-equipment of EC 2/2 began late 1999; deliveries complete by 2001.

Identification features are additional (LAM) 'bullet' antenna on fin leading-edge, absence of nose pitot and four horizontal antenna bands on radome. Normal external configuration is two MICA and two Magic AAMs, plus two 2,000 litre (528 US gallon; 440 Imp gallon) and one 1,300 litre (343 US gallon; 286 Imp gallon) external tanks. Optional configuration (Standard Kilo) is four MICAs and two Magics. MICA delivered (first 25 rounds) in radar mode from August 1999 followed by IR version in 2003. Early 2000-5F deliveries were to SF1 standard; SF1C upgrade then followed, improving radar range by 15 per cent and adding non-co-operative target mode which analyses returns from target's engines. Follow-on upgrades projected with MIDS terminal for Link 16 datalink capability, IR version of MICA (SF1-IR from 2006) and provision for helmet-mounted sight.

2000-5 Mk 2: Announced April 1999; purchased initially by Greece. Features in common with 2000-9 include modular avionics, larger LCDs, secure communications, tactical datalink, additional decoy dispenser, laser gyro INS, upgraded ECM, expanded aircraft-missile datalink, Damoclès laser-designation pod (known as Shehab on 2000-9), Nahar navigational FLIR in Damoclès pylon, upgraded version of RDY radar (RDY2, with multitarget air-to-sea search and track, high-resolution SAR mapping mode and search and track of mobile land targets), increased MTOW of 17,500 kg (38,580 lb), new multichannel

Greek Dassault Mirage 2000BG *(Jean-Louis Gaynecoetche)* 1153744

digital recording system, new rear cockpit colour display repeater and, possibly, helmet-mounted sight. Can carry six MICA AAMs (active radar or IR) in addition to air-to-surface weapons.

2000-8: Mirage 2000EAD/RAD/DAD supplied to Abu Dhabi/UAE from 1989. Standard AD8.

2000-9: Version of 2000-5 for United Arab Emirates incorporating long-range air-to-ground capability with weapons including Black Shaheen SOM and Hakim allied to Damoclès laser designator. Configuration includes M53-P2 engines, RDY-2 radar with synthetic aperture and beam-sharpening modes, Thales Totem 3000 laser INS and digital terrain system. First 2000-9s undertook flight testing and proving (three aircraft) at Istres from early 2001; first flight (DAD10; two-seat version) 14 December 2000; sole single-seat 2000-9RAD (RAD19) flew 25 January 2001. Further features, including retention of cannon, as for 2000-5 Mk 2. Upgrades of existing aircraft began in UAE in 2002. Second stage of 2000-9, AD92, integrates EMTI modular data processing unit (DGTD/RTP M2000-X), replacing CP and BGS-type computers in earlier versions; also incorporates Elettronica IMEWS (integrated modular electronic warfare system).

FRENCH MIRAGE 2000 SQUADRONS

Squadron	Base	Type	Commissioned	Remarks
EC 1/2 'Cigognes'	Dijon	2000C (RDM)	2 Jul 84	Temp stood down Jan 98[4]
		2000-5F	31 Mar 99	Operational 4 Feb 00
EC 2/2 'Cote d'Or'	Dijon	2000B/C (RDM)	27 Jul 86	OCU until Jan 98
		2000C	1 Aug 98	
		2000-5F	2000	
EC 3/2 'Alsace'	Dijon	2000C (RDM)	Mar 86	Disbanded 31 Jul 93
EC 1/3 'Navarre'	Nancy	2000D	1 Apr 94[1]	
EC 2/3 'Champagne'	Nancy	2000N	30 Aug 91	Conventional attack only
		2000D	24 Apr 97[2]	Converted 1996–98
EC 3/3 'Ardennes'	Nancy	2000D	21 Aug 95	
EC 1/4 'Dauphine'	Luxeuil	2000N	1 Jul 88	
EC 2/4 'La Fayette'	Luxeuil	2000N	1 Jul 89	
EC 3/4 'Limousin'	Istres	2000N	1 Jul 90	
EC 1/5 'Vendée'[6]	Orange	2000C	1 Apr 89	
EC 2/5 'Ile de France'	Orange	2000C	1 Apr 90	
		2000B/C	1 Jul 98	OCU
EC 3/5 'Comtat Venaissin'	Orange	2000C	3 Sep 90[3]	Disbanded 31 Aug 97
EC 1/12 'Cambrésis'	Cambrai	2000C	1 Jul 92	
EC 2/12 'Picardie'	Cambrai	2000C	1 Sep 93	
EC 4/33 'Vexin'	Djibouti	2000C/D[5]	5 Aug 2002	

[1] Limited IOC 29 Jul 93
[2] When only partly equipped with 2000D
[3] First delivery
[4] And equipped with Alpha Jets to maintain pilot currency
[5] Multirole unit with five Mirage 2000Cs and three 2000Ds
[6] To disband in 2008

CUSTOMERS: Refer to table for rapid reference. **France** required seven prototypes and 372 production aircraft; reduced in late 1991 to 318 by abandonment of final 24 2000Cs and 30 2000Ds and transfer of some single-seat aircraft to trainer contract; no Mirages funded in 1992 or 1993, but one 2000B and 14 2000Cs cancelled, then re-ordered in 1994 defence budget as 2000Ds. French orders subsequently amended to 30 2000Bs, 124 2000Cs, 75 2000Ns and 86 2000Ds (total 315); last in 2001. Mirage 2000C equipped three squadrons of EC 2 at Dijon (1984–86), three of EC 5 at Orange (1988–90) and two of EC 12 at Cambrai.

Mirage 2000N deliveries began at Luxeuil 30 March 1988; EC 1/4 'Dauphine' formed 1 July 1988, now with full dual-role K2 series aircraft, followed by two more squadrons. Pending 2000D, EC 2/3 'Champagne' operational at Nancy 1 September 1991 with 2000N in conventional role. EC 1/3 'Navarre' fully operational with 2000D from 31 March 1994; EC 3/3 'Ardennes' began re-equipment, July 1994; EC 2/3 began converting to 2000D (ex-2000N) in mid-1996, completing conversion in 1999. Mirage 2000N depot servicing required every 900 hours or 36 months, whichever sooner.

Abu Dhabi (United Arab Emirates) ordered 18 aircraft on 16 May 1983 and took up 18 options in 1985 for a total of 22 2000EADs, eight 2000RADs and six 2000DADs; these to Standard AD8; deliveries delayed from 1986 to 1989 by provision for US weapons such as Sidewinder; deliveries to Maqatra/Al Dhafra completed November 1990 for Nos. 1 and 2 Shaheen (Warrior) Squadrons. Abu Dhabi 2000RADs carry COR2 multicamera pod, but alternatives include Raphaël-type SLAR 2000 or Harold pods; second 18 have Elettronica ELT/158 threat warning receivers and ELT/558 self-protection jammers; all with Spirale chaff/flare system. Self-defence suite code-named SAMET. Deliveries 7 November 1989 to November 1990. Weapons include BAE Systems PGM Hakim ASM.

Follow-on batch authorised in late 1996; reported 16 December 1997 as 30 new 2000-9s and upgrade to this standard of 33 earlier aircraft; contract signed 15 November 1998, becoming effective on 8 May 1999; new element later confirmed as 32 aircraft, while upgrades reduced by attrition to 30; total value estimated as USD3.4 billion for aircraft, or USD5.5 billion, including weapons and support. Weapons include Black Shaheen version of Storm Shadow/SCALP SOM, IR and active radar MICA AAMs; IMEWS, incorporating Spirale and Eclair ECM systems; Shebab target designator pod (export version of Damoclès/PDLCT-S) and Nahar navigation FLIR mounted in starboard shoulder pylon. Retains HAROLD 1700 mm LOROP pod.

Prototypes flew December 2000 and February 2001; initial AD91 standard qualified 15 January 2003. Acceptances began at Bordeaux on 14 April 2003 with two new-build aircraft; first nine arrived in Abu Dhabi on 26 April 2003 and last 2004; first refurbished aircraft were received in June 2003; 12 accepted by 31 December 2004; last due late 2007. Early aircraft are Standard AD91 with MICA AAM capability; Standard AD92, with additional air-to-ground radar modes and weapons, plus reconnaissance capability, available from mid-2005 (testbeds: DAD11 and single-seat RAD19 retained by Dassault for AD92 trials, although these slowed by loss of DAD11 on 4 April 2005).

Egypt ordered 16 2000EMs and four BMs in December 1981; deliveries 30 June 1986 to January 1988; based at Beni Suef with 82 Squadron in interceptor role.

Greece ordered 36 2000EGs and four 2000BGs on 20 July 1985; handed over from 21 March 1988 and delivered from 27 April 1988 for 331 'Aegeas' and 332 'Geraki' Mire Pandos Kairou within 114 Pterix Mahis at Tanagra; deliveries suspended October 1989 at 28th aircraft; resumed 1992 and completed 18 November 1992. RDM3 radar; Spirale chaff/flare system installed, as part of ICMS self-defence suite; full ICMS system operational from August 1995. Some upgraded to 2000EG-SG3 standard with launch capability for AM 39 Exocet anti-ship missile.

Further 15 Mirage 2000-5 Mk 2s, including five two-seat, confirmed 30 April 1999 and formally ordered on 21 August 2000, together with upgrade to this standard of 10 earlier aircraft by HAI. Deliveries began to 332 Squadron on 12 July 2004, with equipment including RDY-2 radar, Thales Damoclès laser designation pods and ICMS Mk 3. New weapons include MICA AAM (Standard EG 51) and SCALP EG ASM (EG 52). Final deliveries were expected in 2006, but option held on further three new aircraft and five upgrades.

India first ordered 36 2000Hs and four THs in October 1982; 26 Hs and four THs temporarily powered by M53-5; final 10 by M53-P2 from outset; first flight of 2000H (KF101) 21 September 1984; first flight of 2000TH (KT201) early 1985; No. 7 IAF Squadron 'Battle Axe' formed at Gwalior AB 29 June 1985, coincident with first arrivals in India. Named *Vajra* (Divine Thunder); second Indian order for six Hs and three THs signed March 1986 and delivered April 1987 to October 1988 to complete No. 1 'Tigers' Squadron. Third order placed 19 September 2000 for four 2000Hs and six 2000THs to be delivered in 2004, but THs held in storage pending resolution of dispute over avionics fit.

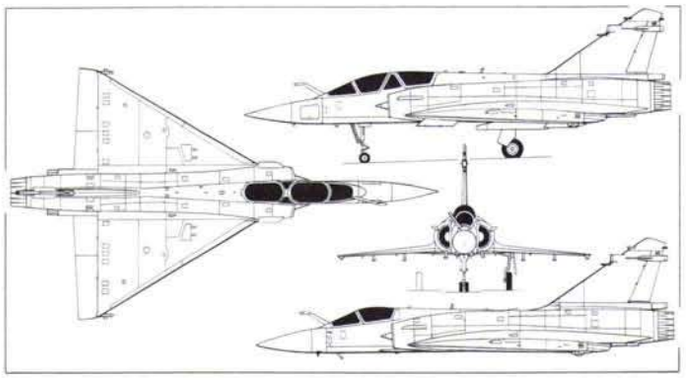
Despite grey-and-blue air defence camouflage, unconfirmed report claimed Indian Mirages optimised for attack, with Antilope 5 radar and twin INS. Role (at least) confirmed by 1996 selection (subject to operational trials) of the Rafael Litening laser-designator pod for IAF Mirage 2000s and Jaguars. By 1993 IAF aircraft appearing in experimental brown-and-green low-level colours, with Spirale chaff dispensers. By 1998, 38 remaining 2000Hs had been upgraded by HAL at Bangalore with local flare dispensers and were preparing for receipt of LGBs. In 2002, India planning acquisition of 126 Mirage 2000-5s to equip seven squadrons in strike role; final 108 would be assembled locally by HAL. Discussions continued into 2003, when India also announced intention of buying 12 aircraft from Qatar.

Peru ordered 24 2000Ps and two 2000DPs in December 1982, but reduced this to 10 2000Ps and two 2000DPs; first 2000DP handed over 7 June 1985; deliveries to Peru from December 1986; Escuadron de Caza-Bombardeo 412 of Grupo Aéreo de Caza 4 at La Joya inaugurated 14 August 1987.

Qatar ordered 12 Mirage 2000-5s under contract 'Falcon' on 31 July 1994, together with MICA and Magic 2 AAMs. Versions are 2000-5EDA (nine; single-seat) and 2000-5DDA (three; two-seat). Equipment includes GPS, ICMS Mk 2 and provision for Spirale. First flight late 1995; first three handed over at Bordeaux on 8 September 1997; four delivered to Qatar 18 December 1997; four more on 1 April 1998. All 12 offered for sale to India in mid-2003; nothing further reported by late 2004.

Taiwan ordered 60 Mirage 2000-5s with M53-P2 power plants on 18 November 1992. First export sale for -5; first flight late 1995; first handed over on 9 May 1996 for training in France; initial five arrived in Taiwan as sea freight on 5 May 1997; equips 41, 42 and 48

Dassault Mirage 2000C *(Paul Jackson)* 1153765



Dassault Mirage 2000-5DDA, with added side view (bottom) of Mirage 2000-5Ei *(Dennis Punnett)* 0062696

Squadrons of 2nd Tactical Fighter Wing at Hsinchu; IOC of initial squadron, November 1997. Final eight delivered late October 1998, at which time second squadron declared operational. Versions are 2000-5Ei (48 aircraft; single-seat) and 2000-5Di (12 aircraft; two-seat). Requirement revealed in 1997 for an additional 60. Armament includes MICA and Magic AAMs.

Additionally, Jordan ordered 10 2000EJs and two 2000DJs on 22 April 1988; all were cancelled in August 1991.

Total 601 firm orders (excluding seven prototypes and six company-owned trials and demonstrator aircraft) by 1 January 2001 (315 French; 286 exports); none further by 2006. France had received all 124 Cs, 30 Bs, and 75 Ns by 31 December 1995, only 2000Ds being delivered after that date (all 86 by December 2001). Provisional agreement signed with Pakistan in January 1992 for 44 Mirage 2000Es; under further discussion in 1994–95, quantity having been revised to 36, including nine two-seat aircraft, all to 2000-5 standard. No further progress made.

Demonstration and evaluation sorties by a Mirage 2000-5 two-seat version given to Czech, Hungarian and Polish air forces in August 1996. Possible Polish final assembly by PZL Mielec is covered by an MoU announced in June 1997. MoU for assembly by Embraer was agreed before postponement of Brazilian requirement, acquisition of ex-French aircraft having been adopted as 2005 second option.

MIRAGE 2000 ORDERS

Customer	Qty	Version	First aircraft
Abu Dhabi/UAE[1]	6	2000DAD	701
	8	2000RAD	711
	22	2000EAD	731
	20	2000-9RAD	719[4]
	12	2000-9DAD	707[5]
Egypt	16	2000EM	101
	4	2000BM	201
France	30	2000B	501
	124[2]	2000C	1
	86	2000D	601
	75	2000N	301
Greece	36[3]	2000EG	210
	4	2000BG	201
	10	2000-5 Mk 2	546
	5	'2000-5B Mk 2'	505
India	46	2000H	KF101
	13	2000TH	KF201
Peru	10	2000P	050
	2	2000DP	193
Qatar	9	2000-5EDA	QA90
	3	2000-5DDA	QA86
Taiwan	48	2000-5Ei	2001
	12	2000-5Di	2051
Subtotal	**601**		
Prototypes	7		
Development	6		
Total	**614**		

[1] Total 30 upgraded to 2000-9DAD/RAD. All rebuilt EADs have reconnaissance pod capability and thus become RADs
[2] 37 upgraded to 2000-5F
[3] 10 to be upgraded to 2000-5 Mk 2
[4] 719 to 731 and 753 to 760
[5] 707 to 710 and 761 to 768

COSTS: Programme unit cost: Taiwan FFr 333 million (1997).

DESIGN FEATURES: Multirole combat aircraft; low-set, thin delta wing for high internal volume and low wave drag, but with delta's disadvantages in manoeuvrability and landing/take-off requirements offset by relaxed stability and leading-edge slats. Area-ruled fuselage.

Wing has cambered section, 58° leading-edge sweep and moderately blended root employing Karman fairings. Cleared for 9 *g* and 270°/s (automatically limited by FBW system) roll at sub- and supersonic speed carrying six air-to-air missiles.

FLYING CONTROLS: Full fly-by-wire control with Thales four-channel autopilot; two-section elevons on wing move up 16° and down 25°; inner leading-edge slat sections droop up to 17° 30' and outer sections up to 30°; fixed strakes on intake ducts create vortices at high angles of attack that help to correct yaw excursions; small airbrakes above and below wings.

STRUCTURE: Multispar metal wing; elevons have carbon fibre skins with AG5 light alloy honeycomb cores; carbon fibre/light alloy honeycomb panel covers avionics bay; most of fin and all rudder skinned with boron/epoxy/carbon; rudder has light alloy honeycomb core.

LANDING GEAR: Retractable tricycle type by Messier-Bugatti, with twin nosewheels; single wheel on each main unit. Hydraulic retraction, nosewheels rearward, main units inward. Oleo-pneumatic shock-absorbers. Electro-hydraulic nosewheel steering (±45°). Manual disconnect permits nosewheel unit to castor through 360° for ground towing. Light alloy wheels and tubeless tyres, size 360×135-6 or 360×135R6, pressure 9.5 bar (138 lb/sq in) on nosewheels; size 750×230R15, pressure 15.00 bar (217 lb/sq in) on mainwheels. Messier-Bugatti hydraulically actuated polycrystalline graphite disc brakes on mainwheels, with anti-skid units. Compartment in lower rear fuselage for brake parachute, arrester hook or additional chaff/flare dispenser.

POWER PLANT: One SNECMA M53-P2 turbofan, rated at 64.3 kN (14,462 lb st) dry and 95.1 kN (21,385 lb st) with afterburning. Alternative M53-P20, rated at 98.1 kN (22,046 lb st), is no longer offered. Movable half-cone centrebody in each air intake.

Internal wing fuel tank capacity 1,325 litres (350 US gallons; 291 Imp gallons); fuselage tank capacity 2,675 litres (707 US gallons; 588 Imp gallons) in single-seat aircraft, 2,595 litres (686 US gallons; 571 Imp gallons) in two-seat aircraft. Total internal fuel capacity 4,000 litres (1,057 US gallons; 880 Imp gallons) in 2000C and E, 3,920 litres (1,036 US gallons; 862 Imp gallons) in 2000B, N, D and S. Provision for one jettisonable 1,300 litre (343 US gallon; 286 Imp gallon) RPL-522 96 kg (212 lb) fuel tank under centre of fuselage, and a 1,700 litre (449 US gallon; 374 Imp gallon) RPL-501/502 210 kg (463 lb) or 2,000 litre (528 US gallon; 440 Imp gallon) drop tank under each wing. Total internal/external fuel capacity 8,526 litres (2,252 US gallons; 1,876 Imp gallons) in 2000C and E, 8,450 litres (2,233 US gallons; 1,859 Imp gallons) in 2000B.

Detachable flight refuelling probe forward of cockpit on starboard side, including export aircraft. Dassault type 541/542 tanks of 2,000 litres (528 US gallons; 440 Imp gallons) are available for the 2000-5, 2000-9, 2000N, D and S wing attachments (and optional on 2000B/C), empty weight 240 kg (529 lb) each, and may be complemented by an RPL-522 on centreline.

ACCOMMODATION: One or two occupants (see Current Versions) on SEMMB licence-built Martin-Baker Mk 10Q zero/zero ejection seat(s), in air conditioned and pressurised cockpit. Pilot-initiated automatic ejection in two-seat aircraft; 500 milliseconds delay between departures. Canopy/ies hinged at rear to open upward and, on Mirage 2000D, covered in gold film to reduce radar signature.

SYSTEMS: ABG-Semca air conditioning and pressurisation system. Two independent hydraulic systems, pressure 280 bar (4,000 lb/sq in) each, to actuate flying control servo units, landing gear and brakes. Hydraulic flow rate 110 litres (29.1 US gallons; 24.2 Imp gallons)/min. Electrical system includes two Auxilec 20110 air-cooled 20 kVA 400 Hz constant frequency alternators (25 kVA in Mirage 2000D and 2000-5), two Bronzavia DC transformers, a SAFT 40 Ah battery and ATEI static inverter. Intertechnique oxygen system.

AVIONICS: *Comms:* Thales ERA-7000 V/UHF com transceiver, ERA-7200 UHF (with optional Have Quick II) or SCP 5000 secure voice com; Thales NRAI-7A/NRAI-11 IFF transponder/interrogator (SC10/IDEE 1 on 2000-5) for Taiwan; SC10/TSA2535 on 2000-9; TSC2031/TSA2531 on 2000-5 Mk 2).

Radar: Thales RDM multimode radar or RDI pulse Doppler radar, each with operating range of 54 n miles (100 km; 62 miles). (Mirage 2000N/D have Thales Antilope terrain-following radar for automatic flight down to 61 m (200 ft) at speeds not exceeding 600 kt (1,112 km/h; 691 mph); Antilope 5TC in 2000N includes altitude-contrast updating of navigation system; Antilope 5-3C in 2000D has full terrain-reference navigation facility.) Thales RDY multimode, multitarget radar in 2000-5 and 2000-9 have the ability to detect 24 targets while tracking eight.

Flight: SOCRAT 8900 solid-state VOR/ILS and IO-300-A marker beacon receiver, Thales radio altimeter (AHV-6 in 2000B and C, AHV-9 in 2000-5/5 Mk 2/-9 export aircraft, two AHV-12 in 2000N. Thales NC12 or Deltac Tacan. SAGEM Uliss 52 inertial platform (52D in 2000C and B; 52E for export; and two 52P in 2000N/D; plus integrated GPS in 2000D and 2000-5). Thales Totem 3000 RLG in 2000-9 and 2000-5 Mk 2, combined with GPS and modular data processing. Thales Type 2084 central digital computer and Digibus digital databus (2084-XR in 2000D; Xi in 2000-5. Thales AP 605 autopilot (606 in 2000N, 607 in 2000D, 608 in 2000-5), 609 in 2000-5 Mk 2 and 2000-9). New-generation modular data processing unit in 2000-5 Mk 2 and 2000-9 for mission computing and graphics generation. Thales TLS 2020 MMR (multimode receiver) in 2000-5 Mk 2 and 2000-9, combining ILS, microwave landing and differential GPS). Undisclosed operator ordered BASE (BAE Systems) Terprom GPWS in 1996 for retrofit by Orbital Sciences Corporation. Digital terrain system (DTS) on 2000-9.

Instrumentation: Thales TMV 980 data display system (VE 130 head-up and VMC 180 head-down) (two ICC 55 head-down in 2000N/D). Mirage 2000-5 has Thales integrated multidisplay system featuring combined HUD/head-level display with Thales recording camera. Provision optional in 2000-5 and -9 for Thales Topsight E helmet-mounted sight/display system.

Mission: Mirage 2000-5 has LAM (*liaison avion-missile*) 'bullet' antenna on fin leading-edge for mid-course guidance of MICA AAMs. Sensors of strike/attack and export versions include 570 kg (1,257 lb) Thales Raphaël SLAR 2000 pod, 400 kg (882 lb) Thales COR2 multicamera pod or 680 kg (1,499 lb) Dassault AA-3-38 Harold long-range oblique photographic (Lorop) pod; 110 kg (243 lb) Thales/Intertechnique Rubis FLIR pod; Thales Atlis laser designator and marked target seeker (in pod on forward starboard underfuselage station); 340 kg (750 lb) Thales PDLCT day/night (TV/thermal imaging) laser designator pod on Mirage 2000D (or CLDP/Atlis II on export aircraft)(2000D squadrons also being issued with Atlis II designation pods — being refurbished Atlis systems from Jaguar force), while PDLCT-S available from mid-1999; one 550 kg (1,213 lb) Thales TMV 004 (CT51J) Caiman offensive or intelligence ECM pod and one 400 kg (882 lb) Thales Astac elint (interferometer) pod. Export PDLCT-S known as Damoclès (and Shehab in UAE). Mirage 2000-5 Mk 2 and 2000-9 have Thales Thomrad 5000/6000 secure communications and datalink.

Self-defence: Systems in 2000C and 2000N include Thales Serval radar warning receiver (antennas at each wingtip and on trailing-edge of fin, near tip, plus VCM-65 cockpit display); Thales Caméléon (2000N), Caméléon C2 (2000D) or Sabre (2000C) jammer at base of fin (detector on fin leading-edge); and MBDA Spirale, comprising chaff dispensers in Karman fairings at wing trailing-edge/fuselage intersection and flares in lower rear fuselage. French Air Force DDM (*Détecteur Départ Missile*) missile plume detector requirement satisfied by 1994 purchase of SAGEM SAMIR system for 1995 fitment in rear of Magic launch rails (2000D/N first, but also to 2000Cs patrolling Bosnia). Spirale fitted to 2000N-K2; retrofitted to 2000N-K1 and installed on 2000Cs from No. 93; earlier 2000Cs have Eclair system (Alkan LL5062 chaff and flare launcher) in place of braking parachute, lacking automatic operation. Spirale on some export 2000Es.

Upgrade planned of 2000E with ICMS Mk 1 (integrated countermeasures system; as in 2000EG) comprising RWR and SHR, Thales high-band jammer (leading-edge of fin and bullet fairing at base of rudder) and Spirale; automated ICMS Mk 2 of Mirage 2000-5 adds receiver/processor in nose to detect missile command links; extra pair of antennas near top of fin and additional DF antennas scabbed to existing wingtip pods (fin and secondary wingtip antennas also on Greek Mirage 2000s); ABD2000 export version of Sabre in some Mirage 2000Es. Mirage 2000-5 Mk 2 has ICMS Mk 3. ICMS Mk 3/IMEWS eventually to comprise fully integrated suite of RWR, jammer, Spirale (chaff/flare), additional Eclair (chaff/flare), ESM, tactical situation awareness and targeting. External equipment can include two 182 kg (401 lb) Thales DB 3141/3163 Remora self-defence ECM pods.

EQUIPMENT: Optional 250 kg (551 lb) Intertechnique 231-300 buddy-type in-flight refuelling pod.

ARMAMENT: Two 30 mm DEFA 554 guns in 2000C, 2000E and single-seat 2000-5 (not fitted in B, D or N), with 125 rds/gun. Nine attachments for external stores, five under fuselage and two under each wing. On 2000-5, fuselage centreline stressed for 1,400 kg (3,086 lb) loads; other four fuselage points for 450 kg (992 lb) each; inner wing pylons for 1,830 kg (4,034 lb) each; and outboard wing points for 230 kg (507 lb) each.

Typical interception weapons comprise two 275 kg (606 lb) Super 530D or (if RDM radar not modified with target illuminator) 250 kg (551 lb) 530F missiles (inboard) and two 90 kg (198 lb) 550 Magic or Magic 2 missiles (outboard) under wings. Alternatively, each of four underwing hardpoints can carry a Magic. MICA (active radar or — qualified 31 July 2002 — IR versions) AAM (110 kg; 243 lb) on Mirage 2000-5 Mk 2 and 2000-9. Primary weapon for 2000N is 900 kg (1,984 lb) ASMP tactical nuclear missile mounted on LM-770 centreline pylon.

In air-to-surface role, the Mirage 2000 can carry up to 6,200 kg (13,669 lb) of external stores, including MBDA 250 kg retarded bombs or 32.5 kg (72 lb) TDA BAP 100 anti-runway bombs; 16 MBDA Durandal 219 kg (483 lb) penetration bombs; one or two 990 kg (2,183 lb) MBDA BGL 1000 laser-guided bombs; five or six 305 kg (672 lb) MBDA Belouga cluster bombs or 400 kg (882 lb) TDA BM 400 modular bombs; up to three Rafaut F2 practice bomb launchers; US Mk 20, Mk 82, GBU-24 and GBU-12 bombs; two 520 kg (1,146 lb) AS 30L, Armat anti-radar, or 655 kg (1,444 lb) AM 39 Exocet anti-ship, air-to-surface missiles; four 185 kg (408 lb) MBDA LR F4 rocket launchers, each with eighteen 68 mm rockets; two packs of 100 mm rockets; or a 765 kg (1,687 lb) Dassault CC 630 gun pod, containing two 30 mm guns and total 600 rounds of ammunition.

Mirage 2000D armed with APACHE-AP and SCALP-EG, plus GBU-12, GBU-16 and GBU-24 versions of Paveway LGB. Stealthy cruise missiles. For air defence weapon training, a Cubic Corporation AIS (airborne instrumentation subsystem) pod, externally resembling a Magic missile, can replace Magic on launch rail, enabling pilot to simulate a firing without carrying actual missile.

DIMENSIONS, EXTERNAL:

Wing span	9.13 m (29 ft 11½ in)
Wing aspect ratio	2.0
Length overall: 2000C, E	14.36 m (47 ft 1¼ in)
–5	14.33 m (47 ft 0⅝ in)[1]
2000B, N	14.55 m (47 ft 9 in)[1]
Height overall: 2000C, E, –5	5.14 m (16 ft 10¼ in)
2000B, N, D	5.10 m (16 ft 8¾ in)
Wheel track	3.50 m (11 ft 5¾ in)
Wheelbase	5.00 m (16 ft 4¾ in)

[1] *2000D, -5, -5 Mk 2 and -9 versions lack nose pitot*

AREAS:

Wings, gross	41.0 m² (441.3 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: 2000C, E, –5	7,500 kg (16,534 lb)
2000B, N, D	7,600 kg (16,755 lb)
2000-5 Mk 2; single-seat	7,920 kg (17,460 lb)
two-seat	7,990 kg (17,615 lb)
Max internal fuel: 2000C, –5	3,160 kg (6,967 lb)
2000B, N, D	3,100 kg (6,834 lb)
Max external fuel	4,140 kg (9,127 lb)
Max external stores load	6,200 kg (13,669 lb)
Combat weight: 2000-5	9,500 kg (20,944 lb)
T-O weight clean: 2000C, E, –5	10,860 kg (23,940 lb)
2000B, N, D	10,960 kg (24,165 lb)
Max T-O weight: except –5, –9:	
normal	14,000 kg (30,864 lb)
overload	17,000 kg (37,480 lb)
–5, –9	17,500 kg (38,580 lb)
Max landing weight	16,700 kg (36,817 lb)
Max wing loading	414.6 kg/m² (84.92 lb/sq ft)
Max power loading (M53-P2)	179 kg/kN (1.75 lb/lb st)

PERFORMANCE (M53-P2 power plant):

Max level speed: at height	M2.2
at S/L	M1.2
Max continuous speed: 2000C, E	M2.2
2000N, D	M1.6
Min speed in stable flight	100 kt (185 km/h; 115 mph)
Authorised min flight speed	zero
Approach speed	140 kt (259 km/h; 161 mph)
Landing speed	125 kt (232 km/h; 144 mph)
Max rate of climb at S/L:	
M53-P2	17,060 m (56,000 ft)/min
M53-P20	16,765 m (55,000 ft)/min
Time to 11,000 m (36,080 ft) and M1.8:	
2000-5	approx 5 min
Time from brake release to intercept target flying at M3.0 at 24,400 m (80,000 ft)	less than 5 min
Service ceiling: 2000C	16,460 m (54,000 ft)
2000-5	18,290 m (60,000 ft)
Range: hi-hi-hi	1,000 n miles (1,852 km; 1,151 miles)
interdiction, hi-lo-hi	800 n miles (1,480 km; 920 miles)
attack, hi-lo-hi	650 n miles (1,205 km; 748 miles)
attack, lo-lo-lo	500 n miles (925 km; 575 miles)
with one 1,300 litre and two 1,700 litre drop tanks	1,800 n miles (3,333 km; 2,071 miles)
Operational loiter (2000-5) at M0.8 at 7,620 m (25,000 ft) with three external tanks, four MICA and two Magic AAMs	2 h 30 min
Operational range (2000-5) for 5 min combat at M0.8 at 9,145 m (30,000 ft) with four MICA and two Magic AAMs, tanks jettisoned	780 n miles (1,445 km; 898 miles)
g limits:	+9.0/–3.2 normal
	+11.0/–4.5 ultimate

DASSAULT RAFALE

English name: Squall

TYPE: Multirole fighter.

PROGRAMME:

DEVELOPMENT MILESTONES

Design began	June 82
Official go-ahead	late 82
First order (demonstrator)	13 Apr 83
Rolled out	14 Dec 85
First flight	4 July 86
First flight, pre-production	19 May 91
Production go-ahead	23 Dec 92
First flight, production	24 Nov 98
First delivery (Landivisiau)	Dec 00
Entered service (12 F)	18 May 01

Ordered (as *Avion de Combat Tactique; ACT*) to replace French Air Force Jaguars and (as *Avion de Combat Marine; ACM*) Navy Crusaders and Super Etendards; first flight of Rafale A prototype (F-ZJRE) 4 July 1986; first flight with SNECMA M88 replacing one GE F404, 27 February 1990 (was 461st flight overall); 867th and final sortie, 24 January 1994. ACE International (*Avion de Combat Européen*) GIE set up in 1987 by Dassault Aviation, SNECMA, Thomson-CSF (now Thales) and Dassault Electronique, partly to attract international partners; none found. Four preproduction aircraft, as described under Current Versions (specific). Production launch officially authorised, 23 December 1992 (and 31 December 1992 for M88-2 power plant). First Rafale B and Rafale M ordered 26 March 1993; first production aircraft (Rafale B No. 301) flew 24 November 1998 and made 'inaugural' (official) first flight 4 December; to CEV at Istres, early 1999, for development of F2 production standard. First production Rafale M (No. 1) flew at Bordeaux 7 July 1999. Rafale had by then accumulated over 4,000 sorties.

Test airframe, in Rafale M configuration, delivered to CEAT at Toulouse for ground trials 10 December 1991. Between 17 December 1991 and 2 March 1993, completed 10,000 simulated flights, including 3,000 catapult take-offs and 3,000 deck landings. Rafale structural validation achieved 15 December 1993.

French Air Force preference switched to operational two-seat (pilot and WSO) derivative of Rafale C in 1991; announced 1992 that 60 per cent of procurement to be two-seat, although 16 aircraft deleted from requirements at this time. Procurement target further reduced, as detailed in Customers paragraph. Two-seat version of naval Rafale announced September 2000.

Funding constraints and French government demands for cost reductions resulted in suspension of Rafale programme in November 1995 and temporary blocking of most 1996 funds. Plans were simultaneously abandoned for three progressively more sophisticated service standards of Rafale (*Standard Utilisateur* 0, 1 and 2) and replaced by a common French military standard and an export parallel, although three basic software standards (F1 to F3) will phase-in operational capabilities, as described under Current Versions (general). Work on production Rafales temporarily halted in April 1996. On 22 January 1997, Dassault and French defence ministry agreed on 48-aircraft multiyear procurement (1997–2002) in return for a 10 per cent cost reduction, effectively relaunching the programme. This initiative lapsed with the change of government after June 1997, but reinstated in January 1999, with firm orders for 28, plus 20 options, covering deliveries between 2002 and 2007. Contract awarded January 2000 for development of F2 Standard Rafale, representing first capability upgrade. F3 standard authorised 18 February 2004.

First production aircraft completed late 1998; second and third (No. 302 and M1) delivered to CEV trials unit late 1999/early 2000; M2 and M3 to Landivisiau naval air station, December 2000; first naval squadron, 12 F, formed 18 May 2001 and achieved planned strength of 10 Rafales in September 2002; first operational carrier deployment by four aircraft (M2 to M5) aboard FS *Charles de Gaulle* for exercise Trident d'Or in Mediterranean, 21 to 29 May 2001. First three Rafales for French Air Force delivered to conversion squadron EC 5/330 *Côte d'Argent* within CEAM trials establishment at Mont-de-Marsan: No. 304 on 22 December 2004; No 305 on 28 December; and No. 303 on 29 December. Unit formed basis of EC 1/7 *Provence* at Dijon in mid-2006. First Air Force single-seat aircraft (C102) delivered 3 June 2005.

Associated programmes include Thales electronic scanning RBE2 (*Radar à Bayalage Electronique deux plans*) multimode radar, ordered November 1989; test flights begun in Falcon 20 No. 104, 10 July 1992; first RBE2 flight in Rafale 7 July 1993 (B01); first production RBE2 flew on 16 October 1997 in a Falcon 20 before being refitted in Rafale B01 from November 1997. Development authorised in early 1999 of upgraded RBE2 version (full air-to-ground weapons capability) for 2003 delivery and installation in F2 standard Rafales.

Thales/MBDA defensive aids package named Spectra (*Système pour la Protection Electronique Contre Tous les Rayonnements Adverses*); wholly internal IR detection, laser warning, electromagnetic detection, missile approach warning, jamming and chaff/flare launching; nine prototypes ordered; total weight 250 kg (551 lb); Spectra trials begun on Mirage 2000 in 1992, while full suite installed in Falcon 20 No. 252 by Dassault at Istres between December 1992 and September 1994 before flight trials; Spectra flown in Rafale M02 on 20 September 1996 at launch of integration programme at CEV Istres. Development contract awarded 1991 for Thales OSF (*Optronique Secteur Frontal*) with IRST, FLIR and laser range-finder in two modules ahead of windscreen; surveillance, tracking and lock-on by port module; target identification, analysis and optical identification by starboard module; combined output in pilot's head-level display; initially tested in Mirage 2000BOB. In December 2004, it was acknowledged that early Rafales would lack Spectra and OSF (48 sets of latter ordered by that time) pending definition of new-generation systems, revised OSF delivery target being 2011-12.

M88 engine, which has flown only on Rafales, achieved type certification on 22 March 1996. First of initial production batch of 42 M88-2 engines delivered by SNECMA

Initial Rafale B for French Air Force on its delivery flight, 22 December 2004 *(SIRPA Air)* 1153762

30 December 1996. Conformal fuel tanks flight-tested in April 2001. Integration of Matra BAe MICA AAM completed 5 July 2000, after 27 launches.

Rafale offered for export; Greek evaluation in January 2000; model displayed February 2000 carried two conformal fuel tanks, each of 1,250 litres (330 US gallons; 275 Imp gallons), increasing range with two SCALP missiles to 1,000 n miles (1,852 km; 1,150 miles), hi-lo-hi. Rafale B No. 302 equipped with supplementary software to enable demonstration of LGB capability; test separation of GBU-12 bombs in April 2000, followed by live drop in October 2000. Offered in South Korea's F-X competition (40 aircraft), but unsuccessful against Boeing F-15K, early 2002.

CURRENT VERSIONS (GENERAL): **Rafale B:** Originally planned two-seat, dual-control version for French Air Force; weight initially envisaged as 350 kg (772 lb) more than Rafale C; 3 to 5 per cent higher cost than Rafale C. Being developed into fully operational variant for either pilot/WSO or single-pilot combat capability. Serial numbers begin at 301. First two assigned to Dasault at Istres by 2004, both in F2 avionics configuration.

Rafale C: Single-seat combat version for French Air Force. Serial numbers begin at 101, first flown 16 April 2003. First aircraft to F2 standard with Dassault test fleet at Istres, 2004.

Rafale D: Original configuration from which production versions derived; now '*Rafale Discret*' (stealthy) generic name for French Air Force versions.

Rafale M: Single-seat carrierborne fighter; serial numbers begin at 1. Navalisation weight penalty, 610 kg (1,345 lb); has 80 per cent structural and equipment commonality with Rafale C, 95 per cent systems commonality. Navy's financial share of French programme cut in 1991 from 25 to 20 per cent.

Initial operational software standard for Rafale M, designated F1, permits air defence missions against multiple targets using Magic and radar-homing version of MICA; self-defence provided by Spectra system. F2 will apply to both naval and air force Rafales delivered from late 2004 (15 M/Ns, 22 Bs and 11 Cs) and combine F1 with air-to-ground radar modes and the ability to launch IR-guided MICA, SCALP and AASM weapons as well as OSF electro-optics suite and MIDS datalink; operational in 2006. Funding for F2 development granted 31 December 1998; first stage of F2, known as E12, is OSF, SCALP and standard air-to-surface ordnance. First production aircraft, M1, on loan to Dassault for F2 integration, including weapons carriage, and will be upgraded to F3. Last of 25 single-seat naval Rafales to be delivered in 2008. In same year (operational 2009), F3 standard (for which initial, risk mitigation phase launched January 2003 and full go-ahead given 18 February 2004) provides full capabilities to naval and air force Rafales, including air-to-sea attack, AM39 and ASMP-A weapons, refuelling and reconnaissance pods, and helmet-mounted display. Anticipated engine upgrade to 88.3 kN (19,840 lb st) was not included in F3. Unspecified and unfunded F4 envisaged for 2010, but early naval aircraft will all have been upgraded to F2 and F3 by 2008; Meteor AAM and associated electronically scanned radar antenna are key elements of F4.

Rafale N: Cancelled in September 2004. Was to have been two-seat, dual control, naval version; also known briefly as Rafale BM; announced September 2000; development and production contracts placed December 2002;prototype, No. 16, for trials in 2006; requirement for 35 aircraft within overall Navy purchase; first production aircraft in 2008; final delivery in 2012. Cost 5 per cent more than single-seat M; 250 kg (551 lb) heavier, but 215 kg (474 lb) less internal fuel; 85 per cent commonality with three previous versions; deletion of internal canon replaces 200 litres (52.8 US gallons; 44.0 Imp gallons) of fuel lost with addition of second seat.

'Rafale Mk 2': Export version, under active consideration by 2000, featuring active antenna radar, M88-3 engines of 88.3 kN (19,850 lb st) each. Available from 2006; conformal tanks and Damoclès laser target designator. Development cost estimated in 2001 as €1.3 billion; joint venture agreed in January 2001 by Dassault, Thales and SNECMA; offered to South Korea.

CURRENT VERSIONS (SPECIFIC): **C01:** Single-seat Rafale C prototype, C01/F-ZWVR, ordered 21 April 1988; flown 19 May 1991; officially flight tested at CEV in October 1991, two months ahead of schedule; 100th sortie 12 May 1992. First Rafale gun firing, 5 March 1993; first Magic 2 AAM launch, 26 March 1993. Continued high AoA trials in 2000, having exceeded 30°. M88-2 Stage 4 engine trials in late 2000; continued engine trials into 2004.

Second Rafale C order (C02) not placed; abandoned 1991.

M01: First navalised prototype, F-ZWVM, ordered 6 December 1988; flown 12 December 1991. Assigned to structural qualification, FCS and aerodynamic trials. Catapult trials ashore at US Naval Air Warfare Center, Patuxent River, and Lakehurst, 13 July/23 August 1992; second series of US trials 15 January/18 February 1993 followed by deck trials on *Foch*; first deck landing 19 April 1993; first deck launch 20 April 1993, although first take-offs with 'jump strut' nosewheel leg began in following month; third US trials series 18 November/16 December 1993, carrying external loads; fourth series, October/December 1995, including dummy deck launch at maximum weight of 22,300 kg (49,163 lb). On 8 June 1995, M01 made the first launch of a MICA AAM against an aerial target acquired by RBE2 radar fitted in a Rafale. Employed on development trials for F2 production standard. Total 438 hours in 723 sorties by October 1997. In storage 1999; F1 standard avionics trials in 2000. Retired by 2003 and in storage at Istres.

B01: Two-seat dual-control trainer Rafale B prototype, B01/F-ZWVS, ordered 19 July 1989 as first with RBE2 radar and Spectra defensive systems; first flight 30 April 1993; first flight with RBE2 7 July 1993. Longest Rafale sortie, Istres to Dubai, November 1995: approximately 3,020 n miles (5,600 km; 3,475 miles) in 6 hours 30 minutes with three aerial refuellings (including one precautionary). Heavy configuration trials (23,400 kg; 51,588 lb, including two APACHEs) completed in February 1997. Total 990 sorties by mid-1999. First Rafale to fly with conformal tanks, 18 April 2001. APACHE/SCALP trials continuing in 2004.

M02: Second naval prototype, ordered 4 July 1990; first flight 8 November 1993; assigned to operational and maintenance testing aboard ship and navigation/weapons trials. Joint carrier trials with M01 aboard *Foch* (second series) 27 January/4 February 1994. Third series of deck trials (M02 only) aboard *Foch* begun 17 October 1994 for three weeks (total 28 launches including two at night); included maintenance, electromagnetic compatibility, RBE2 radar and Spectra ECM tests. Fitted with model of OSF in late 1994, for vibration tests. Flew Singapore to Istres (6,300 n miles; 11,668 km; 7,250 miles) in under 15 hours, February 1996. First launch of Magic 2 AAM at moving target, 4 April 1996. Total 297 hours in 348 sorties by October 1997. With B01, employed by 1998 on development of F2 and F3 avionics standards. On 6 July 1999 became only second jet fighter (following Super Etendard) to land on new carrier FS *Charles de Gaulle*. Continued Spectra trials in 2000. Dassault trails fleet at Istres in F2 configuration, 2004.

CUSTOMERS: Anticipated worldwide market for 500 aircraft in addition to originally planned 250 for French Air Force (225 Cs and 25 Bs) and 86 for French Navy; former service announced revised requirement for 234, comprising 95 Rafale Cs and 139 two-seat (pilot and WSO) combat versions, in 1992. Defence economies in 1996 included reduction of requirements to 60 Ms and Ns.

Naval deliveries began with No. 2 to CEPA trials unit on 19 July 2000, followed by No.3 in September 2000; service familiarisation began 4 December 2000 when Nos. 2 and 3 delivered to Landivisiau naval air base; Landivisiau's 12 Flottille re-formed 18 May 2001 with four aircraft; first operational voyage began aboard *Charles de Gaulle* (commissioned 1999) on 1 December 2001, and Nos. 2 to 8 had embarked by 10 March 2002, when stationed in Arabian Gulf; Nos. 9 and 10 received mid-2002 and IOC then declared in October 2002. Full capability achieved 24 June 2004 with formal acceptance into naval service.

Balance of naval order replaces Super Etendards, 11 Flottille being first recipient, in 2006–07; third squadron to follow. Navy received 10 aircraft in F1 configuration (actually LF1, which upgraded to partial F1 in early 2002, incorporating some air-to-air capability, although full F1, with cannon and MICA AAM, not due until late 2002) 15 F2s and 35 F3s, last in 2015, all to be based at Landivisiau. Actual or planned deliveries (at mid-2004) were one, three, five and one in 1999-2002, followed by six, 10, three and four in 2006-2009, then 27 up to 2015.

Air Force deliveries originally planned for 1996–2009, including first 20 in interim configuration; two year postponement announced 1992; further slips in development funding delayed first receipts to 2002 and IOC to 2006. Only Air Force's first three aircraft 301, 302 and 101 (two Bs and one C) to F1 standard. Deliveries of F2.1 standard aircraft began to CEAM operational trials unit at Mont-de-Marsan in December 2004; first squadron, EC 1/7 'Provence', established within CEAM on 1 July 2005, prior to gaining autonomy at St Dizier with 15 Rafale Bs (upgraded to F2.2) one year later.

Official authorisation to launch production given 23 December 1992. Initial production contract in 1993 defence budget (formally awarded 26 March 1993), comprising one aircraft each for Air Force and Navy. Total 13 by 1996, while 1997–2002 plan envisaged 33 B/Cs and 15 naval versions (total 48) to be ordered (and two Bs and 12 Ms delivered), followed by orders for 15 B/Cs per year from 2003. In early 1997, French defence procurement agency, DGA, agreed with Dassault a multiyear procurement of the 48 aircraft in return for a 10 per cent cost reduction, but this later suspended. Authorisation to order the first 13 Rafales was only granted in May 1997, however. At the same time, separate plans were being formulated for acceleration into service of the first 10 air force Rafales to equip an export-promoting and operational trials (half) squadron, but those plans also soon abandoned. Eventually, go-ahead given on 14 January 1999 for 48 aircraft, including 20 options, these confirmed on 21 December 2001. In 2003, details finalised for further batch of 59 (46 Air Force and 13 Navy), making 120 (82 + 38) in all, this finally approved on 6 December 2004, with deliveries between June 2008 (B328) and January 2012.

Deliveries in 2003–08 five-year plan will be 47 to Air Force and 16 to Navy. Export

Dassault Rafale B No. 302, assigned to F3 standard upgrade development *(SIRPA Air)* 1153763

versions of naval variant were available to potential customers from 1999 onwards. China expressed interest in 1996–97. French expects 234th aircraft to be delivered in 2023.

RAFALE PLANNED ORDERS AND DELIVERIES

Date	Orders		Deliveries	
	AF	Navy	AF	Navy
up to 2002	36	25	2	10
2003–2008	94	31	47	16
post 2008	104	4	185	34
Totals	**234**	**60**	**234**	**60**

RAFALE PROCUREMENT

Year	Rafale C	Rafale B	Rafale M	Total
1993		1	1	2
1994		1	2	3
1995			5	5
1996		1	2	3
1997				
1998				
1999[1]	7	14	7	28
2001	5	7	8	20
2002				
2003				
2004	36	11	12	59
Totals	**48**	**35**	**37**	**120**

[1] start of F2 production version; earlier aircraft are F1; 62nd and subsequent will be F3

Notes: Orders as announced. Third Rafale B was subsequently exchanged with first production Rafale C.

COSTS: Estimated EUR26.4 billion for 234 aircraft (2005). Programme originally estimated at FFr155 billion (1991), including FFr40 billion for R&D; revised to FFr178 billion in 1993, FFr198.4 billion in 1995 and FFr202.37 billion in 1996. Last mentioned total comprises FFr48.62 billion (of which 25 per cent paid by industry) for development, FFr17.583 billion for industrialisation, FFr76.25 billion for 234 Rafale B/Cs, FFr20.89 billion for 60 Rafale Ms, FFr37.812 billion for spares and FFr1.215 billion for simulators. Early 1997 agreement on 10 per cent cost reduction resulted in flyaway price falling to FFr282 million for a Rafale C, FFr299 million for Rafale B and FFr315 million for Rafale M. Total of FFr30 billion spent by 1995. Second production order for eight aircraft (1994/1995 authorisations) estimated at FFr1.5 billion, excluding engines, radar and weapons system. In 1998, however, new cost estimate for 294 aircraft was FFr320 billion as a consequence of programme delays, this having become €33,274 million by 2004. Cost (1999) of 48 aircraft given as FFr17.2 billion. Introduction of Rafale N version increased programme cost by €274 million. F3 upgrade (2004) valued at €659 million.

DESIGN FEATURES: Multirole combat aircraft, rivalling Eurofighter Typhoon; designated "omnirole" to describe simultaneous air-to-air and air-to-ground capabilities. Minimum weight and volume structure to hold costs to minimum; thin, mid-mounted delta wing with moving canard; individual fixed, kidney-shaped intakes without shock cones. HOTAS controls, with sidestick controller on starboard console and small-travel throttle lever.

All components of modular design (including engine), replaceable at base engineering level; Rafale does not need ever to leave its operational station for maintenance.

Wing leading edge sweepback approximately 48°.

FLYING CONTROLS: Fully digital fly-by-wire controls with fully modulated two-section leading-edge slats and two elevons per wing; canard incidence automatically increased to 20° when landing gear lowered. Specification includes 30° AoA in stable flight.

STRUCTURE: Most of wing components made of carbon fibre including elevons; slats in titanium; wingroot and tip fairings Kevlar; canard made mainly by superplastic forming and diffusion bonding of titanium; fuselage 50 per cent carbon fibre; fuselage side skins of aluminium-lithium alloy; wheel and engine doors carbon fibre; fin made primarily of carbon fibre with aluminium honeycomb core in rudder. Composites account for 25 per cent by weight of structure and 20 per cent of surface area; weight saving directly attributable to composites is 300 kg (661 lb) — equivalent to a 1 tonne reduction in empty weight.

LANDING GEAR: Hydraulically retractable tricycle type supplied by Messier-Dowty, with single 790×275-15 (20 ply) or 790×275R15 mainwheels and twin, hydraulically steerable, 360×135-6 or 360×135R6 nosewheels. All wheels retract forward. Designed for impact at vertical speed of 3 m (10 ft)/s, or 6.5 m (21 ft)/s in naval version, without flare-out. Rafale M has same mainwheels; but 520×140R10.5 nosewheels. Messier-Bugatti carbon brakes on all three units, controlled by fly-by-wire system.

Rafale M has 'jump strut' nosewheel leg which releases energy stored in shock-absorber at end of deck take-off run, changing aircraft's attitude for climb-out without need for ski-jump ramp. 'Jump strut' advantage equivalent to 9 kt (16 km/h; 10 mph) or 900 kg (1,984 lb) extra weapon load; not to be used aboard aircraft carrier *Foch*, which to have 8° 30' ramp giving 20 kt (37 km/h; 23 mph) or 2,000 kg (4,409 lb) advantage. Dowty Aerospace Yakima holdback fitting. Naval nosewheel steerable ±70°; or almost 360° under tow. Hydraulic (Rafale M) or tension stored (Rafale B/C) arrester hook. Landing gear management (braking and steering) by Thales computer.

POWER PLANT: Two SNECMA M88-2E4 augmented turbofans, each rated at 48.7 kN (10,950 lb st) dry and 72.9 kN (16,400 lb st) with afterburning. Stage 1 standard engines in first 13 (F1) production Rafales were limited to 300 hour hot-section TBO; Stage 4, flight tested from late 2000 and certified in December 2001, achieves initial 600 hours and intended for eventual 1,000 hours, had been retrofitted in all aircraft by late 2000. M88-3 of 88.3 kN (19,840 lb st) maximum rating offered as follow-on, and being developed for export Rafale.

Internal tanks in single-seat versions for approximately 5,900 litres (1,559 US gallons; 1,298 Imp gallons) of fuel. Rafale B internal fuel confirmed as 5,300 litres (1,400 US gallons; 1,166 Imp gallons). Fuel system by Lucas Air Equipement, Lebozec and Zenith

French Air Force Dassault Rafale B No. 305 in service with CEAM *(Jean-Louis Gaynecoetche)* 1153760

Dassault Rafale C *(François Robineau)* 1153761

Aviation; equipment by Intertechnique. Five 'wet' hardpoints: centreline, two inboard wing and two centre wing; all able to accommodate a 1,250 litre (330 US gallon; 275 Imp gallon) external tank; alternative 2,000 litre (528 US gallon; 440 Imp gallon) centreline and inboard; alternative conformal tanks on spine, length 7.50 m (24 ft 7¼ in); total capacity 2,300 litres (608 US gallons; 506 Imp gallons), and able to accept in-flight replenishment. Pressure refuelling in 7 minutes, or 4 minutes for internal tanks only. Fixed (detachable) in-flight refuelling probe on all versions.

ACCOMMODATION: Pilot only, on SEMMB (Martin-Baker) Mk 16 zero/zero ejection seat, reclined at angle of 29°. One-piece Sully Produits Spéciaux blister windscreen/canopy, hinged to open sideways to starboard. Canopy gold-coated to reduce radar reflection.

SYSTEMS: Technofan cockpit air conditioning system; Cryotechnologies avionics cooling system. Dual hydraulic circuits, pressure 350 bar (5,075 lb/sq in), each with two Messier-Bugatti pumps and Bronzavia ancillaries. Auxilec electrical system, with two 30/40 kVA Auxilec variable frequency alternators. Triplex digital plus one dual analogue fly-by-wire flight control system, integrated with engine controls and linked with weapons system. Air Liquide OBOGS; EROS oxygen system; L'Hotellier fire detection system; Microturbo APU below fin fillet.

AVIONICS: Provision for more than 780 kg (1,720 lb) of avionics equipment and racks.

Comms: Thales V/UHF and Thales TRA 6032 SATURN UHF radios; Thales SB25A transponder/interrogator. TEAM intercom; Thales voice-activated radio controls and voice alarm warning system. Chelton aerials.

Radar: GIE Radar (Thales) RBE2 look-down/shoot-down radar, able to track up to eight targets simultaneously, with automatic threat assessment and allocation of priority. RBE2 AA (active array) version offered for export Rafales from 2006. Radar access via port-hinged radome.

Flight: Thales TLS-2020 integrated ILS/MLS, VOR/DME; SAGEM Sigma 95N (RL-90) RLG INS (SAGEM Telemir interface with carrier's navigation on Rafale M); Thales AHV-17 radio altimeter and SFIM/Thales ESPAR static memory flight recorder.

Instrumentation: Digital display of fuel, engine, hydraulic, electrical, oxygen and other systems information on two 127 × 127 mm (5 × 5 in) lateral multifunction touch-sensitive colour LCD displays by Thales. Third cockpit screen is 20 × 20° head-level tactical navigation/sensor display. Thales CTH3022 wide-angle, holographic HUD (30 × 22° field of view) incorporating Signaal USFA OTA-1320 CCD camera and recorder. Both displays collimated at infinity. Thales/Intertechnique Topsight E helmet-mounted sight.

Mission: Thales OSF electro-optical sensors and SAGEM OSF infra-red sensors to be introduced by 2011-12. MIDS (Multifunctional Information Distribution System) datalink (equivalent to JTIDS/Link 16). Various reconnaissance, ECM, FLIR and laser designation pods, including Thales Damoclès target designator and projected Thales RECO-NG pod. Terrain-following system initially cleared (1999) to 152 m (500 ft); over land, reduced to 91 m (300 ft) by 2002, plus 30 m (100 ft) over sea; eventual goal is 30 m (100 ft) land and 15 m (50 ft) over water.

Self-defence: Spectra radar warning and ECM suite by Thales and MBDA. Thales DAL (*Détecteur d'Alerte Laser*) system. Flare launchers in rear wing/fuselage fairing.

EQUIPMENT: Integral, electrically operated, folding ladder in Rafale M.

ARMAMENT: One 30 mm Giat DEFA 791B cannon in side of starboard engine duct (except naval two-seat). Fourteen external stores attachments: two on fuselage centreline, two beneath engine intakes, two astride rear fuselage, six under wings and two at wingtips; of these, five stressed for heavy stores and fuel tanks. Forward centreline position deleted on Rafale M. Normal external load 6,000 kg (13,228 lb); maximum permissible, 9,500 kg (20,944 lb); see weapon options table. In strike role, one ASMP standoff nuclear weapon. In interception role, up to eight MICA AAMs (with IR or active homing) and two underwing fuel tanks; or six MICAs and three external fuel tanks. In air-to-ground role, typically sixteen 227 kg (500 lb) bombs, two MICAs and two 1,250 litre (330 US gallon; 275 Imp gallon) tanks; or two APACHE standoff weapon dispensers, two MICAs and three tanks; or FLIR pod, Damoclès laser designator pod, six 250 kg LGBs, four MICAs and single tank. In anti-ship role, two Exocet sea-skimming missiles, four MICAs and two external fuel tanks. Future weapons will include AASM (*Armement Air-Sol Modulaire*) powered LGB on F3 standard aircraft.

DIMENSIONS, EXTERNAL:

Wing span, incl wingtip missiles	10.80 m (35 ft 5¼ in)
Wing aspect ratio	2.6
Length overall	15.27 m (50 ft 1¼ in)
Height overall (Rafale D)	5.34 m (17 ft 6¼ in)

AREAS:

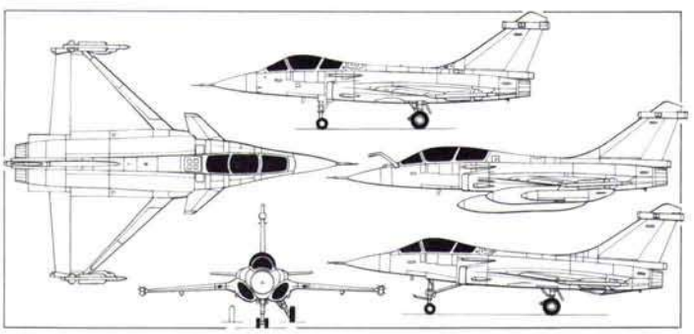
Wings, gross	45.70 m² (491.9 sq ft)

WEIGHTS AND LOADINGS (estimated):

Basic weight empty, equipped:	
Rafale C	9,850 kg (21,716 lb)
Rafale B	10,450 kg (23,038 lb)
Rafale M	10,460 kg (23,060 lb)
Rafale N	10,710 kg (23,611 lb)
External load (incl fuel): normal	6,000 kg (13,228 lb)
max	9,500 kg (20,944 lb)
Max fuel weight: internal:	
single seat	4,700 kg (10,362 lb)
two seat: Rafale B	4,350 kg (9,590 lb)
Rafale N	4,240 kg (9,348 lb)
underwing	7,500 kg (16,535 lb)
conformal	1,850 kg (4,079 lb)
Max T-O weight: Rafale M: initial	14,000 kg (30,864 lb)
subsequent	19,000 kg (41,887 lb)
developed version	24,500 kg (54,013 lb)
Max landing weight	22,500 kg (49,605 lb)
Max wing loading: Rafale M: initial	306.3 kg/m² (62.74 lb/sq ft)
subsequent	415.8 kg/m² (85.15 lb/sq ft)
developed version	536.1 kg/m² (109.80 lb/sq ft)
Max power loading: Rafale M: inititial	96 kg/kN (0.94 lb/lb st)
subsequent	130 kg/kN (1.28 lb/lb st)
developed version (M88-3)	141 kg/kN (1.38 lb/lb st)

PERFORMANCE (estimated):

Max level speed: at altitude	M1.8
at low level	750 kt (1,390 km/h; 864 mph)
Approach speed	120 kt (223 km/h; 139 mph)
Max rate of climb at S/L	approx 18,290 m (60,000 ft)/min
Roll rate	270°/s
Max instantaneous turn rate	up to 30°/s
Service ceiling	16,765 m (55,000 ft)
T-O distance: air defence	400 m (1,315 ft)
attack	600 m (1,970 ft)
Landing distance	450 m (1,480 ft)



Dassault Rafale C, with additional profiles of Rafale B (centre) and Rafale M (bottom) 1154515

Radius of action: low-level penetration with 12 × 250 kg bombs, four MICA AAMs and 4,000 litres (1,056 US gallons; 880 Imp gallons) of external fuel in three tanks ..... 570 n miles (1,055 km; 655 miles)
air-to-air, long-range with eight MICA AAMs and 6,000 litres (1,585 US gallons; 1,320 Imp gallons) of external fuel in four tanks, 12,200 m (40,000 ft) transit ..... 950 n miles (1,759 km; 1,093 miles)
Operational loiter ..... up to 3 h
g limits ..... +9.0/−3.2

DASSAULT FALCON 50

Spanish Air Force designation: T.16

TYPE: Business tri-jet.

PROGRAMME:

DEVELOPMENT MILESTONES

Falcon 50	
First flight	7 Nov 76
First flight, pre-production	13 Jun 78
Certification	27 Feb 79
First delivery	Jul 79
Subsequent versions	
Falcon 50EX	
Announced	26 Apr 95
First flight	10 Apr 96
Certification	15 Nov 96
First delivery	Feb 97

First flight of prototype Falcon 50 (F-WAMD) 7 November 1976; second prototype 18 February 1978; first (and only) preproduction 13 June 1978. French certification 27 February 1979; FAA certification 7 March 1979; deliveries began July 1979. Available in sigint version from 1994.

Falcon 50EX announced 26 April 1995. Long-range variant; uprated turbofans provide a 7 per cent improvement in fuel consumption and improved initial cruising altitude of 12,500 m (41,000 ft). Production of initial batch of 40 Falcon 50EX airframes began 1995. First flight (F-WOND, c/n 251) 10 April 1996; new avionics suite installed in Falcon 50 c/n 252 for integration flight testing leading to avionics certification by FAA on 15 July 1996; DGAC certification achieved 15 November 1996, followed by FAA approval 20 December; initial production aircraft (F-WWHA, c/n 253) first flight October 1996; flown in 'green' condition Le Bourget, Paris, to Teterboro, New Jersey, 16 November, thence to Orlando, Florida, for US debut at National Business Aircraft Association Convention; first customer delivery (to Volkswagen of Germany) February 1997. Total of 93 EXs delivered by December 2005. Estimated market for 150 to 200 of EX version over unspecified period.

CURRENT VERSIONS: **Falcon 50:** Previous version, now superseded by Falcon 50EX.

Falcon 50-40: Retrofit of earlier version with Honeywell TFE731-40 engines, each 16.46 kN (3,700 lb). See *Jane's Aircraft Upgrades*.

Falcon 50EX: *As described.*

Falcon 50M Surmar: Maritime surveillance version.

First flight (No. 36/F-ZWTA) November 1998; first delivery in January 2000; operational with Flottille 24 at Lann-Bihoué from September 2000. Final (fourth) delivery in early 2002.

Falcon 50 Sigint: Model of a potential signals intelligence Falcon 50 displayed at Dubai Air Show in November 1997.

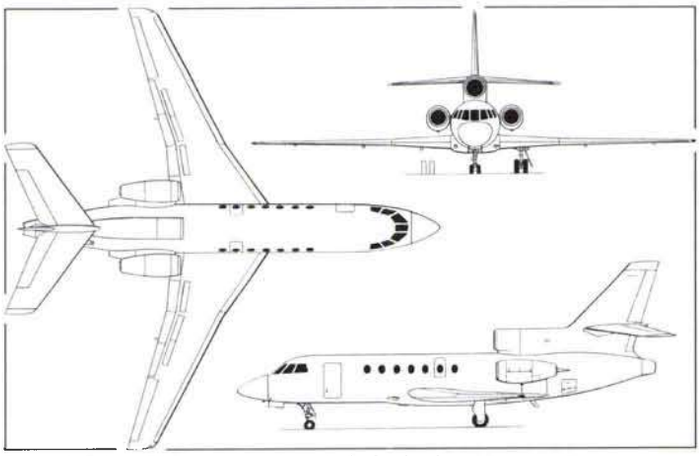
CUSTOMERS: Total 343 Falcon 50s and 50EXs delivered for outfitting by 30 September 2005, including 18 in 2000, 13 (all 50EXs) in 2001, 10 in 2002, eight in 2003, five in 2004 and five in 2005. Adopted by governments of Burundi, Djibouti, France, Iraq (later Iran), Italy, Jordan, Libya, Morocco, Portugal, Rwanda, South Africa, Spain, Sudan and Yugoslavia; three of Italian Air Force convertible for medevac.

COSTS: 50EX USD20.6 million (2004).

DESIGN FEATURES: Three-engine layout permits overflight of oceans and desert areas within public transport regulations. Sharply waisted rear fuselage and engine pod designed by computational fluid dynamics; wing has compound leading-edge sweep (24° 50' to 29° at quarter-chord) and optimised section.

FLYING CONTROLS: Fully powered controls with pushrods, dual-barrel hydraulic actuators and artificial feel; variable incidence anhedral tailplane with dual electrical actuation by screwjack; drooped leading-edge inboard and slats outboard; double-slotted flaps; three two-position airbrake/spoiler panels on each wing.

STRUCTURE: All-metal, circular-section fuselage with rear baggage compartment inside pressure cabin; wing boxes are integral fuel tanks bolted to carry-through box. Carbon fibre horizontal tail surfaces introduced during 2001. Latécoère, Potez, Reims Aviation, SEFCA and Socata are subcontractors on the programme; other suppliers include Dassault Equipements (flight controls, flaps, slats and airbrakes), Liebherr-Aerospace Toulouse (engine bleed air system); SARMA (flight control actuating rods) and Sully Produits Spéciaux (windscreen panels).



Dassault Falcon 50 long-range three-turbofan business transport *(Dennis Punnett)* 0507137

LANDING GEAR: Retractable tricycle type by Messier-Dowty, with twin wheels on each unit. Hydraulic retraction, main units inward, nosewheels forward. Nosewheels steerable ±60° for taxying, ±180° for towing. ABS wheels, brakes and braking system. Mainwheel tyres size 26×6.6 (14 ply) or 26×6.6R14 tubeless, pressure 14.55 bar (211 lb/sq in). Nosewheel tyres size 14.5×5.5-6 (14 ply) tubeless, pressure 9.31 bar (135 lb/sq in). Four-disc brakes designed for 400 landings with normal energy braking. Minimum ground turning radius (about nosewheels) 13.54 m (44 ft 5 in).

POWER PLANT: Three Honeywell TFE731-40 turbofans, each rated at 16.46 kN (3,700 lb st) at ISA + 17°C. Two engines pod-mounted on sides of rear fuselage, third attached by two top mounts. Thrust reverser on centre engine. Fuel in integral tanks, with capacity of 5,787 litres (1,529 US gallons; 1,273 Imp gallons) in wings and 2,976 litres (786 US gallons; 655 Imp gallons) in fuselage tanks. Total fuel capacity 8,763 litres (2,315 US gallons; 1,928 Imp gallons). Single-point pressure fuelling. Intertechnique fuel distribution and gauges.

ACCOMMODATION: Standard accommodation for two crew and nine passengers. In typical arrangement, cabin is divided into a forward section with four armchairs and two fold-out tables, and a rear section with three-seat sofa (convertible into a single bed) and two armchairs separated by a fold-out table; two galleys at forward end of cabin, toilet at rear. Alternative layouts to customer choice, with accommodation for a maximum of 19 passengers. Cabin and rear baggage compartment are pressurised and air conditioned; Barber-Colman temperature controls. Access is by separate door on port side.

SYSTEMS: Air conditioning system utilises bleed air from all three engines or APU. Maximum pressure differential 0.63 bar (9.14 lb/sq in). Pressurisation maintains a maximum cabin altitude of 2,440 m (8,000 ft) to a flight altitude of 14,935 m (49,000 ft). Two independent Messier-Bugatti and Vickers-Sterer hydraulic systems, pressure 207 bar (3,000 lb/sq in), with three engine-driven pumps and one emergency electric pump, actuate primary flying controls, flaps, slats, landing gear, wheel brakes, airbrakes and nosewheel steering. Plain reservoir, pressurised by bleed air at 1.47 bar (21 lb/sq in). 28 V DC electrical system, with a 9 kW 28 V DC Auxilec starter/generator on each engine and two 23 Ah batteries. Labinal electrical harnesses. Wing leading-edge, centre engine S-duct and engine nacelles have engine bleed air anti-icing. Automatic emergency oxygen system. Honeywell 36-150 APU standard.

AVIONICS: *Comms:* Dual Rockwell Collins VHF and mode S transponders; dual Rockwell Collins HF-9000 HF transceivers with Selcal; Teledyne Controls MagnaStar or Honeywell Flitefone 800 radiotelephones; cockpit voice recorder and ELT standard.

Radar: Rockwell Collins TWR 850 Doppler turbulence detection weather radar.

Flight: Dual Rockwell Collins VIR-432 VOR, ADF-462 and DME-442. Rockwell Collins APS-4000 autopilot, ADC-850C air data systems, dual Honeywell FHS-6100 with integrated GPS receiver, Honeywell EGPWS and dual Honeywell Laseref III laser gyro inertial reference systems standard. Dual Universal UNS-1C FMS optional, replacing GNS-XES.

Dassault Falcon 50 executive tri-jet *(Paul Jackson)* 1153767

Instrumentation: Rockwell Collins Pro Line 4 (EFIS-4000) four-tube EFIS; Thales three-tube LCD engine indicating electronic display (EIED).

DIMENSIONS, EXTERNAL:

Wing span	18.85 m (61 ft 10 in)
Wing chord (mean)	2.84 m (9 ft 3¾ in)
Wing aspect ratio	7.6
Length: overall	18.52 m (60 ft 9¼ in)
fuselage	17.66 m (57 ft 11 in)
Height overall	6.98 m (22 ft 10¾ in)
Tailplane span	7.74 m (25 ft 4¾ in)
Wheel track	3.98 m (13 ft 0¾ in)
Wheelbase	7.24 m (23 ft 9 in)
Passenger door: Height	1.52 m (4 ft 11¾ in)
Width	0.80 m (2 ft 7½ in)
Height to sill	1.30 m (4 ft 3¼ in)
Emergency exits (each side, over wing):	
Height	0.92 m (3 ft 0¼ in)
Width	0.51 m (1 ft 8 in)
Baggage door: Height	0.73 m (2 ft 4¾ in)
Width	0.99 m (3 ft 3 in)

DIMENSIONS, INTERNAL:

Cabin, incl forward baggage space and rear toilet:	
Length	7.16 m (23 ft 6 in)
Max width	1.86 m (6 ft 1 in)
Max height	1.80 m (5 ft 10¾ in)
Volume	20.2 m^3 (712 cu ft)
Baggage volume: external	2.55 m^3 (90.0 cu ft)
internal	0.71 m^3 (25 cu ft)

AREAS:

Wings, gross	46.83 m^2 (504.1 sq ft)
Horizontal tail surfaces (total)	13.35 m^2 (143.69 sq ft)
Vertical tail surfaces (total)	9.82 m^2 (105.70 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, equipped	9,603 kg (21,170 lb)
Basic operating weight	9,888 kg (21,800 lb)
Baggage capacity (rear)	1,000 kg (2,205 lb)
Max payload: normal	1,710 kg (3,770 lb)
with max fuel	1,170 kg (2,579 lb)
Max usable fuel	7,040 kg (15,520 lb)
Max T-O weight: standard	18,007 kg (39,700 lb)
optional	18,497 kg (40,780 lb)
Max ramp weight: standard	18,098 kg (39,900 lb)
optional	18,497 kg (40,780 lb)
Max zero-fuel weight	11,598 kg (25,570 lb)
Max landing weight	16,200 kg (35,715 lb)
Max wing loading	384.5 kg/m^2 (78.75 lb/sq ft)
Max power loading	365 kg/kN (3.58 lb/lb st)

PERFORMANCE:

Max operating Mach No. (MMO)	**0.86**
Max operating speed (VMO):	
at S/L	350 kt (648 km/h; 402 mph) IAS
at FL237	370 kt (685 km/h; 425 mph) IAS
Max cruising speed	M0.85 or 487 kt (902 km/h; 560 mph)
Normal cruising speed	M0.80 or 459 kt (850 km/h; 528 mph)
Long-range cruising speed at FL350	M0.75 (430 kt; 797 km/h; 495 mph)
Approach speed, eight passengers and NBAA IFR reserves	106 kt (196 km/h; 122 mph)
Initial cruising altitude	12,497 m (41,000 ft)
Max certified altitude	14,935 m (49,000 ft)
Time to climb to FL410	23 min
FAR Pt 25 balanced T-O field length, S/L, ISA with eight passengers and max fuel	1,490 m (4,890 ft)
FAR Pt 91 landing distance at MLW with eight passengers and NBAA IFR reserves	666 m (2,185 ft)
Range with eight passengers and NBAA IFR reserves:	
at M0.80	3,075 n miles (5,694 km; 3,538 miles)
at M0.75	3,285 n miles (6,083 km; 3,780 miles)

OPERATIONAL NOISE LEVELS:

T-O	83.0 EPNdB
Approach	95.2 EPNdB
Sideline	92.7 EPNdB

DASSAULT FALCON 900

Spanish Air Force designation: T.18

TYPE: Long-range business tri-jet.

PROGRAMME:

DEVELOPMENT MILESTONES

Falcon 900	
Announced	27 May 83
First flight	21 Sep 84
Certification	Mar 86
Subsequent versions	
Falcon 900EX	
Announced	Oct 94
Rolled out	13 Mar 95
First flight	1 Jun 95
Certification	31 May 96
First delivery	1 Nov 96
Falcon 900C	
Announced	Jun 98
First flight	17 Dec 98
Certification	15 Jun 99

Falcon 900 announced 27 May 1983; first flight of prototype (F-GIDE *Spirit of Lafayette*) 21 September 1984, second aircraft (F-GFJC) 30 August 1985; flew non-stop 4,305 n miles (7,973 km; 4,954 miles) Paris to Little Rock, Arkansas, September 1985; returned Teterboro, New Jersey, to Istres, France, at M0.84; French and US certification March 1986, including status close to FAR Pts 25 and 55 for damage tolerance of entire airframe.

Prototype Falcon 900 in use as testbed (first flight 12 April 1994) for new laminar flow wing section intended to provide significant reductions in drag. New section installed as sleeve on inner wing and designed to demonstrate hybrid laminar flow with boundary layer suction via seven channels in laser-drilled titanium skin over some 10 per cent chord of upper wing surface. Following test programme, modified aircraft has returned to Dassault Falcon Service to validate laminar flow capability under normal commercial operating conditions. The 250th Falcon 900 series aircraft was delivered in mid-2000.

CURRENT VERSIONS: **Falcon 900B:** French and UK certification received end 1991; complies with FAR Pt 36 Stage III and ICAO 16 noise requirements; approved for Cat. II approaches, for operations from unpaved fields; re-engined with TFE731-5BR-1C turbofans, to give 5.5 per cent power increase; initial cruising altitude 11,855 m (39,000 ft) and NBAA IFR range increased by 100 n miles (185 km; 115 miles); retrofit offered to existing operators. Supplanted by Falcon 900C.

Falcon 900C: Announced 26 June 1998. Combines airframe, engines and cabin of 900B with Honeywell Primus 2000 avionics of 900EX, but without autothrottles; 900B F-WWFP/F-GRDP (c/n 169) served as prototype for certification; first flown 17 December 1998; deliveries began in December 1999 (c/n 180 to Sony Aviation Corp in USA), replacing 900B on production line. French DGAC certification achieved 15 June 1999, with FAA approval following on 26 August 1999.

Detailed description applies to Falcon 900C, except where indicated.

Falcon 900DX: Announced at the European Business Aviation Convention and Exhibition at Geneva 24 May 2004 as replacement for Falcon 900C. Features the Falcon 900EX's Honeywell TFE731-60 engines and Dassault EASy flight deck, but with fuel capacity reduced to 8,541 kg (18,830 lb). Provisional data include: cost USD31.65 million (2004); operating cost five per cent less than that of Falcon 900C; equipped operating weight 11,099 kg (24,470 lb); maximum T-O weight 21,183 kg (46,700 lb); initial cruising altitude 12,497 m (41,000 ft); time to climb to FL370 17 minutes; T-O balanced field length 1,490 m (4,890 ft); maximum range with eight passengers at M0.75 with NBAA IFR reserves 4,100 n miles (7,593 km; 4,718 miles). First flight (F-WWFA) 13 May 2005. Certification by EASA October 2005 and by FAA 4 November 2005.

Falcon 900EX: Long-range development of 900B, announced October 1994. Re-engined with 22.24 kN (5,000 lb st) (ISA+17°C) Honeywell TFE731-60 turbofans, to give 5.8 per cent increase in retained thrust at 12,200 m (40,000 ft) and more than 8 per cent improvement in cruise specific fuel consumption. Engine nacelles, pylons, thrust reversers and portions of centre engine S-duct redesigned; maximum fuel capacity increased to 11,854 litres (3,132 US gallons; 2,608 Imp gallons), of which 11,765 litres (3,108 US gallons; 2,588 Imp gallons) usable, by addition of centre-fuselage tank of 591 kg (1,303 lb) capacity and tank in rear fuselage, capacity 240 kg (530 lb).

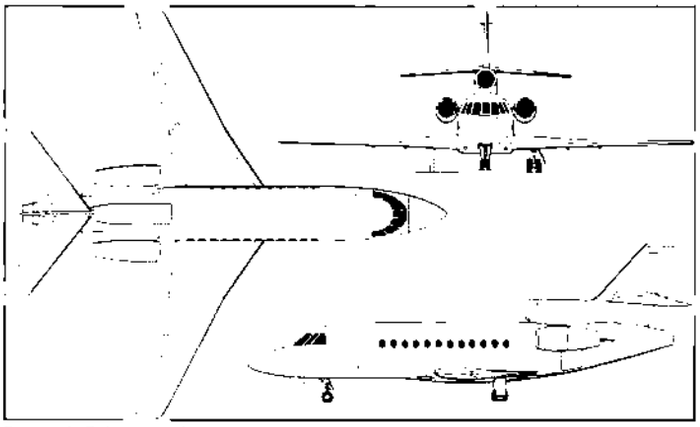
Upgraded standard avionics comprise fully integrated Honeywell Primus 2000 suite with five-tube 20 × 17.75 cm (8 × 7 in) colour EFIS; one engine instrument display; three IC-800 integrated avionics computers; dual FMZ-2000 flight management systems with a third optional; dual fail-operational autopilots; T-O to landing autothrottle; Honeywell EGPWS; dual Laseref III inertial reference systems with third optional; Primus colour weather radar; optional single or dual 12-channel GPS, multichannel satcom, communications management unit (CMU) and Flight Dynamics HGS-2850 head-up display. Dassault EASy integrated flight deck with four 330 × 254 mm (13 × 10 in) active matrix liquid crystal displays (AMLCDs) and trackball-type cursor control device introduced on **900EX EASy** from 2003. Other improvements include brake-by-wire system, new fuel quantity management computer, and new cabin pressure controller and emergency oxygen distribution system. First flight with EASy cockpit was made by F-WNCD (c/n 97) on 22 February 2002. EASA and FAA certification achieved 13/14 November 2003. EASy standard from c/n 120 onwards.

Risk-sharing partners, representing 20 per cent of total development investment, are Honeywell (engines and primary avionics), SABCA (centre engine intake cowlings), Hellenic Aircraft Industries (rear fuselage fuel tank), Latécoère (T5 fuselage section and engine pylons), and Alenia (nacelles and centre engine thrust reverser).

Prototype (F-WREX) rolled out 13 March 1995; first flight 1 June 1995; flew Luton, England, to Las Vegas, Nevada, non-stop on 24 September 1995, completing the 4,700 n mile (8,704 km; 5,409 mile) flight in 11 hours 40 minutes including 30 minutes hold for air traffic delays; DGAC certification 31 May 1996; FAA approval granted 19 July after 350-hour flight test programme; first customer delivery to Anheuser-Busch Companies Inc (N200L) 1 November 1996; production aircraft delivered to Little Rock, Arkansas, for outfitting.

Japan MSA: Two Falcon 900s for long-range maritime surveillance entered service with the Japan Maritime Safety Agency September 1989; US search radar, special communications radio, operations control station, U-125A-style search windows and drop hatch for sonobuoys, markers and flares.

Falcon 900 MPA: Maritime Patrol Aircraft, being proposed in mid-2005 for Indian Air Force requirement. Based on Falcon 900DX airframe with Thales Amascos mission equipment comprising Ocean Master maritime search radar, retractable FLIR sensor, tactical datalink and satcom suite; underwing pylons for weapons; and ECM suite. Crew would comprise two pilots, three mission systems operators and two observers. Mission capability could include anti-surface and anti-submarine warfare, target acquisition, intelligence gathering and SAR, with typical on-station time of three hours when operating 1,200 n miles (2,222 km; 1,381 miles) from base.



Dassault Falcon 900C (three Honeywell TFE731 turbofans) *(Dennis Punnett)*

0507138

Maiden flight of Dassault Falcon 900DX 1153796

CUSTOMERS: Total 203 Falcon 900s and 148 Falcon 900EXs delivered to completion centres by December 2004. Government/VIP versions operated by Algeria, Australia, Belgium, Equatorial Guinea, France, Gabon, Italy, Malaysia, Nigeria, Russia, Saudi Arabia, Spain, Syria and United Arab Emirates. Production totalled 20 in 1998, 24 in 1999, 29 (six 900C and 23 900EX) in 2000, 27 (six 900C and 21 900EC) in 2001, 21 (four 900C and 17 900EX) in 2002, 13 (three 900C, six 900EX and four 900EX EASy) in 2003, 18 (three 900C, one 900EX and 14 900EX EASy) in 2004, and 19 (one 900C, two 900DX and 16 900EX EASy) in 2005.

COSTS: Standard equipped 900C USD31.3 million (2004); 900EX EASy USD34.75 million (2004).

DESIGN FEATURES: Larger cross-section and cabin length than Falcon 50; added economy and further power increase of engines achieved by mixer compound nozzle tailpipe, mixing cold and hot flows.

Wing adapted from Falcon 50 but increased span and area, and optimised for M0.84 cruise; compound leading-edge sweep (24° 50' to 29° at quarter-chord); dihedral 0° 30'.

FLYING CONTROLS: Fully powered flying controls with artificial feel and variable-incidence tailplane as for Falcon 50; full-span slats and double-slotted Fowler flaps; three-position airbrakes.

STRUCTURE: Design and manufacture computer assisted; damage-tolerant structure; extensive use of carbon fibre and aramid (Kevlar); Kevlar radome, wingroot fairings and tailcone; secondary rear cabin pressure bulkhead allows access to baggage in flight and additional protection against pressure loss. Nosewheel doors of Kevlar; mainwheel doors of carbon fibre. Kevlar air intake trunk for centre engine, and rear cowling for side engines. Carbon fibre central cowling around all three engines.

New horizontal tail surface featuring cast titanium central box with resin transfer moulding composite spars and carbon fibre skin panels, resulting in a 13.6 kg (30 lb) reduction in weight, certified by the DGAC in December 1999 and introduced as standard on Falcon 900C and 900EX from December 2000 deliveries.

LANDING GEAR: Retractable tricycle type by Messier-Bugatti, with twin wheels on each unit. Hydraulic retraction, main units inward, nosewheels forward. Oleo-pneumatic shock-absorbers. Mainwheels fitted with Michelin radial tyres size 29×7.7-15, pressure: 900C 13.60 bar (197 lb/sq in), 900EX 13.80 bar (200 lb/sq in). Nosewheel tyres size 17.5×5.75R8, pressure: 900C 10.20 bar (148 lb/sq in, 900EX 10.90 bar (158 lb/sq in). Hydraulic nosewheel steering (±60° for taxying, ±180° for towing). Messier-Bugatti triple-disc carbon brakes and anti-skid system. Minimum ground turning radius (about nosewheels) 14.55 m (47 ft 8¾ in).

POWER PLANT: Three Honeywell TFE731-5BR-1C turbofans, each rated at 21.13 kN (4,750 lb st) at ISA + 10°C. Thrust reverser on centre engine. Fuel in two integral tanks in wings, capacity 3,428 litres (906 US gallons; 754 Imp gallons) and 3,437 litres (908 US gallons; 756 Imp gallons); forward fuselage tank, capacity 2,061 litres (544 US gallons; 453 Imp gallons), and rear fuselage tank capacity 1,899 litres (502 US gallons; 418 Imp gallons), for total fuel capacity of 10,825 litres.

ACCOMMODATION: Type III emergency exit on starboard side of cabin permits wide range of layouts for up to 19 passengers. Flight deck for two pilots, with central jump-seat. Flight deck separated from cabin by door, with crew wardrobe and baggage locker on either side. Galley at front of main cabin, on starboard side opposite main cabin door. Passenger area is divided into three lounges. Forward zone has four 'sleeping' swivel chairs in facing pairs with tables. Centre zone is dining area, with two double seats facing a transverse table. On starboard side, storage cabinet contains foldaway bench, allowing five to six persons to be seated around table, while leaving emergency exit clear. In rear zone, inward-facing three-seat settee on starboard side converts into a bed. On port side, two armchairs are separated by a table. At rear of cabin, a door leads to toilet compartment, on starboard side, and a second structural plug door to large rear baggage area. Baggage door is electrically actuated.

Other interior configurations available. Alternative eight-passenger configuration has bedroom at rear and three personnel seats in forward zone. A 15-passenger layout divides a VIP area at rear from six (three-abreast) chairs forward; full fuel can still be carried with 15 passengers. The 18-passenger scheme has four rows of three-abreast airline-type seats forward, and VIP lounge with two chairs and settee aft. Many optional items, including additional windows, front toilet unit, video system with one or more monitors, 'Airshow 200' navigation display system, compact disc deck, aft cabin partition, one or two couches in aft cabin convertible to bed(s), storage cabinet in baggage hold, aft longitudinal table, individual listening devices for passengers, lifejackets and rafts.

SYSTEMS: Air conditioning system uses engine bleed air or air from Honeywell GTCP36-150 APU installed in rear fuselage. Softair pressurisation system, with maximum differential of 0.64 bar (9.3 lb/sq in), maintains sea level cabin environment to height of 7,620 m (25,000 ft), and cabin equivalent of 2,440 m (8,000 ft) at 15,550 m (51,000 ft). Cold air supply by single oversize air cycle unit. Two independent hydraulic systems, pressure 207 bar (3,000 lb/sq in), with three engine-driven pumps and one emergency electric pump, actuate primary flying controls, flaps, slats, landing gear retraction, wheel brakes, airbrakes, nosewheel steering and thrust reverser. Bootstrap hydraulic reservoirs. DC electrical system supplied by three 9 kW 28 V Auxilec starter/generators and two 23 Ah batteries. Heated bleed air anti-icing of wing leading-edges, intakes and centre engine duct; electrically heated windscreens. Eros (SFIM/Intertechnique) oxygen system.

AVIONICS: *Comms:* Honeywell Primus 2000 as core system.

Radar: Honeywell Primus 870 colour weather radar.

Flight: Dual autopilot. Honeywell FMZ-2000 FMS with two AZ-840 micro air data systems and two Laseref III LINS; Rockwell Collins dual VIR-432 VOR/ILS marker receiver, dual ADF-462 and DME-442; Honeywell AA-300 radar altimeter and IC-800 autopilot; and Honeywell EGPWS.

Instrumentation: Honeywell Primus 2000 five-tube EFIS, comprising two MFDs, two PFDS and one EIED, each measuring 203 × 178 mm (8 × 7 in). Flight Dynamics HGS-2850 head-up guidance system optional.

DIMENSIONS, EXTERNAL:

Wing span	19.33 m (63 ft 5 in)
Wing chord: at root	4.08 m (13 ft 4¾ in)
at tip	1.12 m (3 ft 8 in)
Wing aspect ratio	7.6
Length overall	20.21 m (66 ft 3¾ in)
Fuselage: Max diameter	2.50 m (8 ft 2½ in)
Height overall	7.55 m (24 ft 9¼ in)
Tailplane span	7.74 m (25 ft 4¾ in)
Wheel track	4.45 m (14 ft 7¼ in)
Wheelbase	7.90 m (25 ft 11 in)
Passenger door: Height	1.72 m (5 ft 7¾ in)
Width	0.80 m (2 ft 7½ in)
Height to sill	1.64 m (5 ft 4½ in)
Emergency exit (overwing, stbd):	
Height	0.92 m (3 ft 0¼ in)
Width	0.53 m (1 ft 8¾ in)
Baggage door: Height	0.75 m (2 ft 5½ in)
Width	0.95 m (3 ft 1½ in)

DIMENSIONS, INTERNAL:

Cabin, excl flight deck, incl toilet, excluding baggage compartments:	
Length	10.11 m (33 ft 2 in)
Max width	2.34 m (7 ft 8¼ in)
Width at floor	1.91 m (6 ft 3¼ in)
Max height	1.88 m (6 ft 2 in)
Volume	35.8 m³ (1,264 cu ft)
Rear baggage compartment volume	3.6 m³ (127 cu ft)
Flight deck volume	3.8 m³ (132 cu ft)

AREAS:

Wings, gross	49.00 m² (527.4 sq ft)
Vertical tail surfaces (total)	9.82 m² (105.7 sq ft)
Horizontal tail surfaces (total)	13.35 m² (143.7 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, equipped (900C):	10,830 kg (23,875 lb)
900EX	10,829 kg (23,875 lb)
Basic operating weight: 900C	10,977 kg (24,200 lb)
900DX	11,099 kg (24,470 lb)
900EX	11,204 kg (24,700 lb)

Max payload: 900C ..... 1,823 kg (4,020 lb)
900DX ..... 2,900 kg (6,393 lb)
900EX ..... 2,796 kg (6,164 lb)
Payload with max fuel: 900C ..... 1,059 kg (2,335 lb)
900DX ..... 1,633 kg (3,600 lb)
900EX ..... 1,270 kg (2,800 lb)
Max usable fuel: 900C ..... 8,693 kg (19,165 lb)
900DX ..... 8,541 kg (18,830 lb)
900EX ..... 9,525 kg (21,000 lb)
Max ramp weight: 900C standard ..... 20,729 kg (45,700 lb)
900C optional ..... 21,183 kg (46,700 lb)
900DX ..... 21,273 kg (46,900 lb)
900EX standard ..... 22,000 kg (48,500 lb)
900EX optional ..... 22,317 kg (49,200 lb)
Max T-O weight: 900C standard ..... 20,640 kg (45,500 lb)
900C optional ..... 21,092 kg (46,500 lb)
900EX standard ..... 21,909 kg (48,300 lb)
900DX ..... 21,182 kg (46,700 lb)
900EX optional ..... 22,226 kg (49,000 lb)
Max landing weight:
900C, 900EX standard ..... 19,050 kg (42,000 lb)
900DX ..... 19,141 kg (42,200 lb)
900EX optional ..... 20,185 kg (44,500 lb)
Normal landing weight, eight passengers and fuel reserves: 900C ..... 12,639 kg (27,865 lb)
900EX ..... 12,750 kg (28,110 lb)
900DX ..... 12,846 kg (28,321 lb)
Max zero-fuel weight: 900C standard ..... 12,800 kg (28,220 lb)
900C optional, 900DX, 900EX ..... 14,000 kg (30,865 lb)
Max wing loading:
900C standard ..... 421.2 kg/m^2 (86.27 lb/sq ft)
900C optional ..... 430.5 kg/m^2 (88.17 lb/sq ft)
900DX ..... 432.3 kg/m^2 (88.55 lb/sq ft)
900EX standard ..... 447.1 kg/m^2 (91.58 lb/sq ft)
900EX optional ..... 453.6 kg/m^2 (92.91 lb/sq ft)
Max power loading:
900C standard ..... 326 kg/kN (3.19 lb/lb st)
900C optional ..... 333 kg/kN (3.26 lb/lb st)
900EX standard ..... 328 kg/kN (3.22 lb/lb st)
900EX optional ..... 333 kg/kN (3.27 lb/lb st)

PERFORMANCE (at AUW of 12,250 kg; 27,000 lb, except where indicated):
Max operating speed (VMO): 900C, 900DX, 900EX:
at S/L ..... M0.87 (350 kt; 648 km/h; 403 mph IAS)
between FL100 and FL250 ..... M0.84 (370 kt; 685 km/h; 425 mph IAS)
Max cruising speed:
900C, 900DX, 900EX ..... M0.84 or 481 kt (891 km/h; 554 mph)
Normal cruising speed:
900C, 900DX, 900EX ..... M0.80 or 459 kt (850 km/h; 528 mph)
Long-range cruising speed:
900C, 900DX, 900EX ..... M0.75 or 430 kt (796 km/h; 495 mph)
Approach speed, eight passengers and NBAA IFR fuel reserves:
900C ..... 107 kt (199 km/h; 124 mph)
900DX, 900EX ..... 109 kt (202 km/h; 126 mph)
Stalling speed:
900C, 900EX, clean ..... 106 kt (196 km/h; 122 mph)
900C, 900EX, landing configuration ..... 85 kt (158 km/h; 98 mph)
Initial cruising altitude:
900C, 900DX, 900EX ..... 11,885 m (39,000 ft)
Max certified altitude:
900C, 900DX, 900EX ..... 15,550 m (51,000 ft)
Balanced T-O field length, FAR Pt 25, at standard max T-O weight:
900C ..... 1,504 m (4,935 ft)
900DX ..... 1,490 m (4,890 ft)
900EX ..... 1,590 m (5,215 ft)
Landing run, FAR Pt 91:
900C ..... 716 m (2,350 ft)
900DX ..... 721 m (2,365 ft)
900EX ..... 724 m (2,375 ft)
Range with NBAA IFR reserves:
900C: with five passengers at M0.75 ..... 4,000 n miles (7,408 km; 4,603 miles)
at M0.80 ..... 3,830 n miles (7,093 km; 4,407 miles)
900EX with eight passengers:
at M0.84 ..... 3,825 n miles (7,083 km; 4,401 miles)
at M0.80 ..... 4,335 n miles (8,028 km; 4,988 miles)
at M0.75 ..... 4,500 n miles (8,334 km; 5,178 miles)

OPERATIONAL NOISE LEVELS:
T-O: 900C, 900DX, 900EX ..... 79.8 EPNdB
Approach: 900C ..... 91.7 EPNdB
900DX, 900EX ..... 92.3 EPNdB
Sideline: 900C ..... 91.2 EPNdB
900DX, 900EX ..... 90.5 EPNdB

DASSAULT FALCON 2000

TYPE: Business jet.

PROGRAMME:

DEVELOPMENT MILESTONES

Falcon 2000	
Announced	Jun 89
Launched	4 Oct 89
First order	4 Oct 89
First flight	24 Mar 93
First flight, production	10 May 94
Certification	30 Nov 94
Subsequent versions	
Falcon 2000EX	
Announced	10 Oct 00
Rolled out	19 Jul 01
First flight	25 Oct 01
First flight, EASy flight deck	29 Jan 03
Certification	21 Mar 03
First delivery	2Q 03

Dassault Falcon 2000 *(Paul Bowen, Dassault)* 1040452

Announced Paris Air Show 1989 as Falcon X; follow-on to Falcon 20/200; launched as Falcon 2000 on 4 October 1990, following first orders; Alenia joined as 25 per cent risk-sharing partner February 1991, with responsibility for rear fuselage section and engine nacelles; selection of CFE738 engine announced 2 April 1990; first flight (F-WNAV) 4 March 1993; one prototype only; third airframe (F-WWFA) was second to fly, on 10 May 1994; ferried 'green' to US subsidiary Dassault Falcon Jet Corporation at Little Rock, Arkansas, 13 July 1994 for completion as US demonstrator, and set two world speed records 31 October to 1 November 1994 flying Los Angeles (Chino) to Bangor, Maine, in 4 hours 36 minutes 27 seconds and Bangor to Paris in 5 hours 26 minutes 12 seconds; Dassault demonstrator, second airframe (F-WNEW), flew 11 July 1994.

JAA certification to JAR 25 obtained 30 November 1994, at which time five aircraft (prototype, two demonstrators and two customer aircraft) had accumulated 1,055.5 flight hours; FAR Pt 25 and FAR Pt 36 Stage 3 noise levels certification 2 February 1995; first delivery (F-WNEW/ZS-NNF to South African customer) 16 February 1995. Approved to operate into London City Airport during 1996. Commonwealth of Independent States certification 14 April 1997. HGS-2850 HUD first flown in prototype 8 December 1995; initial JAA certification granted 30 August 1996, followed by approval for low-visibility take-offs (down to 91 m; 300 ft RVR) and hand-flown Cat. II and Cat. IIIa instrument approach approved by FAA 30 July 1997. Full JAA certification 16 December 1997; FAA certification 18 May 1998.

CURRENT VERSIONS: **Falcon 2000**: Initial production version. *As described.*

Falcon 2000EX: Extended-range version. Development began October 1999; announced at the NBAA Convention in New Orleans, 10 October 2000. Prototype (c/n 01/F-WMEX) rolled out 19 July 2001 and first flown 25 October 2001; two aircraft (F-WMEX and c/n 02/F-WWGA). Completed 568 hours of flight testing in 242 flights, culminating in JAA and FAA certification on 21 March 2003; first three 'green' production airframes delivered to Little Rock completion centre in January 2003, with first customer deliveries of outfitted aircraft beginning in the second quarter of 2003 (Pro Line avionics). EASy flight deck available from second quarter of 2004. Falcon 2000EX manufactured in parallel with Falcon 2000.

New features include two Pratt & Whitney Canada PW308C turbofans, with FADEC, each rated at 31.1 kN (7,000 lb st) for take-off at ISA +15°C; Nordam advanced single pivot (ASP) thrust reversers; revised fuel system with 2,044 kg (4,506 lb) increase in usable fuel capacity to 9,497 litres (2,509 US gallons; 2,089 Imp gallons) gross; strengthened main landing gear with heavy-duty braking system brake/steering control unit, and Falcon 900EX nose landing gear; and new bleed air system. Early Falcon 2000EXs retained the Collins Pro Line 4 avionics suite, but aircraft delivered from 2004 equipped with Dassault EASy flight deck (major modification M1691) with four-tube flat panel displays based on those of the Honeywell Primus Epic modular avionics system and designated **Falcon 2000EX EASy**; first flight with EASy cockpit c/n 6/F-WXEY) 29 January 2003; EASA and FAA certification on 22 June 2004; equips aircraft Nos. 6 and 28 onwards.

Falcon 2000DX: Shorter-range variant of Falcon 2000EX; announced on eve of NBAA Convention in Orlando 8 November 2005; first flight scheduled for June 2007, with certification and first deliveries anticipated at the end of that year. Retains Falcon 2000EX EASy's engines, flight deck and systems, with ventral fuel tank of reduced capacity. Provisional data include max ramp weight and max T-O weights 136 kg (300 lb) less than those of Falcon 2000EX EASy; max fuel weight 6,622 kg (14,600 lb); time to climb to FL410 17 minutes; T-O run 1,463 m (4,800 ft); range with six passengers at M0.80 with NBAA IFR reserves 3,250 n miles (6,019 km; 3,740 miles). Replaces Falcon 2000 from late 2007, initial production aircraft being c/n 232.

CUSTOMERS: The 230th Falcon 2000 was delivered to a customer on 2 October 2006, while 106th Falcon 2000EX arrived at Little Rock on 31 October 2006. Production totalled 35 in 2001, 35 in 2002, 28 in 2003, 29 in 2004, (comprising 10 2000EXs and 19 2000EX EASys), 27 in 2005, (comprising six 2000s and 21 2000EX EASys), and 23 in the first nine months of 2006 (comprising six 2000s and 17 200EX EASys). Falcon 2000 No. 159/N259QS, delivered to Executive Jet on 11 September 2001, was also 1,500th Falcon/Mystère business jet produced by Dassault. Total of 72 Falcon 2000s, and 28 Falcon 2000EXs, ordered by NetJets and NetJets Middle East fractional ownership programmes in Europe, Middle East and USA, of which 92 were in operation by October 2004. Total market estimated at more than 300 in 10 years.

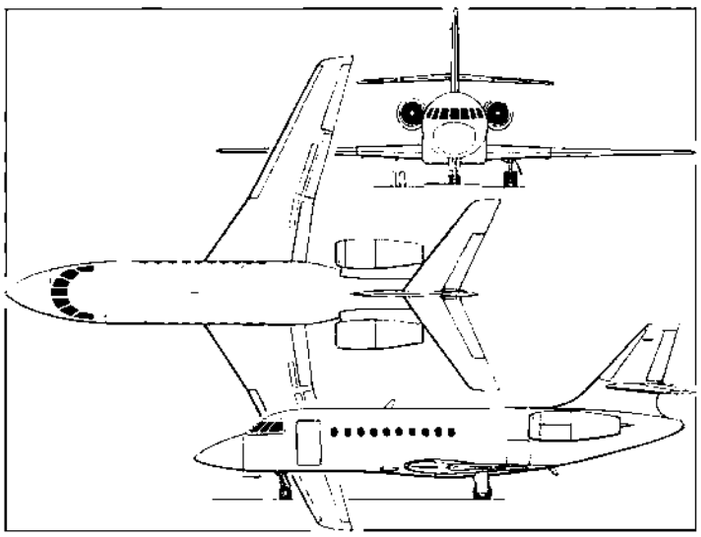
COSTS: Basic price 2000 USD23.2 million; 2000EX USD24.97 million (both 2004).

DESIGN FEATURES: Same fuselage cross-section as Falcon 900, but 1.98 m (6 ft 6 in) shorter. Falcon 900 wing with modified leading-edge and no inboard slats; sweepback at quarter-chord 24° 50' to 29°.

FLYING CONTROLS: Fully powered. Two-section flaps and three-section spoilers each side. Variable incidence tailplane. Leading-edge inboard slats. Maximum control surface movements: elevators +20°/–16°; ailerons +25° 20'/–24° 50'; rudder ±29°; flaps –40°; airbrakes, inboard +68°, centre +50°, outboard +37°; leading-edge slats –30°.

STRUCTURE: Largely as for Falcon 900. Rear fuselage, including engine pods and pylons, by Alenia and Piaggio; thrust reversers by Dee Howard. Agreement reached in early 2002 for production of fuselage components of 2000EX by Chengdu Aircraft of China. New horizontal tail surface featuring cast titanium central box with resin transfer moulding composite spars and carbon fibre skin panels, resulting in a 13.6 kg (30 lb) reduction in weight, certified by the DGAC in December 1999 and introduced as standard from December 2000 deliveries.

LANDING GEAR: Retractable tricycle type; mainwheels retract inwards, nosewheel forwards. Main tyres 26×6.6R14 (14 ply) tubeless; nose 14.5×5.5R6 tubeless. Tyre pressures: 2000



Dassault Falcon 2000 twin-engined business transport *(Dennis Punnett)*

1154673

main 13.6 bar (197 lb/sq in), nose 11.1 bar (161 lb/sq in); 2000EX main 15.1 bar (219 lb/sq in), nose 12.6 bar (183 lb/sq in). Steerable nosewheel (±60°). Minimum turning radius on ground 15.03 m (49 ft 3¾ in).

POWER PLANT: Two CFE CFE738-1-1B turbofans, each rated at 25.5 kN (5,725 lb st). Fuel of Falcon 2000 contained in six integral tanks (three each, outboard wing, inboard wing and centre wing box, port and starboard sides) plus two feeder tanks, combined capacity 6,927 litres (1,830 US gallons; 1,524 Imp gallons), of which 6,867 litres (1,814 US gallons; 1,510 Imp gallons) are usable. Falcon 2000X has 3,441 litres (909 US gallons; 757 Imp gallons in port wing; 3,452 litres (912 US gallons; 759 Imp gallons) in starboard wing; 1,109 litres (293 US gallons; 244 Imp gallons) in rear fuselage; 1,450 litres (383 US gallons; 319 Imp gallons) in rear fuselage for usable total of 9,452 litres (2,497 US gallons; 2,079 Imp gallons) or 9,497 litres (2,509 US gallons; 2,089 Imp gallons) gross. Dee Howard clamshell-type thrust reversers certified by FAA and JAA during 1995.

ACCOMMODATION: Up to 19 passengers and two flight crew; standard passenger accommodation is four seats in forward lounge and four seats and a two-person sofa in aft lounge. Pressurised, flight accessible baggage compartment at rear of cabin.

SYSTEMS: Honeywell GTCP36-150(F2M) APU, with start up approval to 10,668 m (35,000 ft).

AVIONICS: Rockwell Collins Pro Line 4.

Comms: Dual com/nav; dual TRD-94D Mode-S transponders; dual RTU-4420 radio tuning units; Rockwell Collins HF-9000 transceiver.

Radar: Rockwell Collins WXR-840 colour weather radar standard; TWR-850 Doppler weather radar optional.

Flight: Rockwell Collins FMS-6100 flight management system and Cat. II autopilot standard. Rockwell Collins dual DME-442, dual ADF-462; dual AHRS and dual digital air data computers linked to dual-channel integrated avionics processor system (IAPS). Dual Honeywell Laseref III. Honeywell EGPWS, IRS, second FMS (with GPS), flight data recorder, traffic alert and collision avoidance system (TCAS) and GPWS all optional.

Instrumentation: Rockwell Collins Pro Line 4 four-tube EFIS-4000. Sextant Avionique three-tube engine indicating electronic display (EIED); Flight Dynamics HGS-2850 HUD.

Mission: Optional satcom antenna in fintip pod.

Data below apply to Falcon 2000 and 2000EX unless otherwise indicated.

DIMENSIONS, EXTERNAL:

Wing span	19.33 m (63 ft 5 in)
Wing chord (mean)	2.89 m (9 ft 5¾ in)
Wing aspect ratio	7.6
Length overall	20.22 m (66 ft 4 in)
Height overall	7.06 m (23 ft 2 in)
Wheel track	4.45 m (14 ft 7¼ in)
Wheelbase	7.39 m (24 ft 3 in)
Passenger door: Height	1.72 m (5 ft 7¾ in)
Width	0.80 m (2 ft 7½ in)
Baggage door: Height	0.775 m (2 ft 6½ in)
Width	0.75 m (2 ft 5½ in)
Emergency exits (Type III): Height	0.92 m (3 ft 0¼ in)
Width	0.53 m (1 ft 8¾ in)

DIMENSIONS, INTERNAL:

Cabin: Length	7.98 m (26 ft 2¼ in)
Width: max	2.34 m (7 ft 8¼ in)
at floor level	1.91 m (6 ft 3¼ in)
Max height	1.88 m (6 ft 2 in)
Volume	29.0 m^3 (1,024 cu ft)
Baggage volume: 2000	3.8 m^3 (134 cu ft)
2000EX	3.7 m^3 (131 cu ft)

AREAS:

Wings, gross	49.02 m^2 (527.6 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, equipped: 2000	9,473 kg (20,885 lb)
2000EX	10,142 kg (22,360 lb)
Basic operating weight: 2000	9,798 kg (21,600 lb)
2000EX	10,519 kg (23,190 lb)
Max payload: 2000	3,202 kg (7,060 lb)
2000EX	2,953 kg (6,510 lb)
Max baggage weight: 2000, 2000EX	726 kg (1,600 lb)
Max usable fuel weight: 2000	5,513 kg (12,154 lb)
2000EX	7,557 kg (16,660 lb)
Max ramp weight: 2000: standard	16,329 kg (36,000 lb)
optional (mod M57)	16,647 kg (36,700 lb)
2000EX: standard	18,824 kg (41,500 lb)
optional (mod 1842)	19,232 kg (42,400 lb)
Max T-O weight: 2000: standard	16,238 kg (35,800 lb)
optional (mod M57)	16,556 kg (36,500 lb)
2000EX: standard	18,733 kg (41,300 lb)
optional (mod M1842)	19,232 kg (42,400 lb)
Max landing weight: 2000	14,970 kg (33,000 lb)
2000EX	17,826 kg (39,300 lb)
Max zero-fuel weight: 2000	13,000 kg (28,660 lb)
2000EX	13,472 kg (29,700 lb)
Max wing loading: 2000:	
standard	331.3 kg/m^2 (67.85 lb/sq ft)
optional	337.8 kg/m^2 (69.18 lb/sq ft)
2000EX: standard	384.0 kg/m^2 (78.65 lb/sq ft)
optional	392.3 kg/m^2 (80.36 lb/sq ft)
Max power loading:	
2000 standard	319 kg/kN (3.12 lb/lb st)
optional	325 kg/kN (3.19 lb/lb st)
2000EX: standard	302 kg/kN (3.49 lb/lb st)
optional	306.9 kg/kN (3.01 lb/lb st)

PERFORMANCE:

Max operating Mach No. (MMO): FL250 to FL420	0.86
above FL420	0.85
Max operating speed (VMO):	
FL100 to FL250	350 kt (648 km/h; 403 mph) IAS
above FL250	370 kt (685 km/h; 425 mph) IAS
Max cruising speed: 2000	M0.84 or 481 kt (891 km/h; 554 mph)
Normal cruising speed: 2000EX	M0.85
2000	M0.80 or 459 kt (850 km/h; 528 mph)
Long-range cruising speed:	
2000	M0.75 or 430 kt (796 km/h; 495 mph)
2000EX	M0.77
Approach speed: 2000	109 kt (202 km/h; 125 mph)
2000EX	112 kt (207 km/h; 129 mph)
Initial cruising altitude:	
2000 at M0.80	12,500 m (41,000 ft)
2000 at M0.75	13,100 m (43,000 ft)
2000EX at M0.77	12,500 m (41,000 ft)
Max certified altitude	14,330 m (47,000 ft)
Time to climb to FL410: 2000	24 min
2000EX	21 min
FAR Pt 25 balanced T-O field length, S/L, ISA:	
2000: with eight passengers and max fuel	1,603 m (5,260 ft)
at max T-O weight	1,658 m (5,440 ft)
2000EX:	
at standard MTOW	1,638 m (5,375 ft)
at optional MTOW	1,704 m (5,590 ft)
Landing field length:	
FAR Pt 91 with eight passengers and NBAA IFR reserves	780 m (2,560 ft)
at MLW	952 m (3,125 ft)
2000EX with six passengers and NBAA IFR reserves	797 m (2,615 ft)
Range with eight passengers and NBAA IFR reserves:	
2000: at M0.75	3,090 n miles (5,723 km; 3,556 miles)
at M0.80	3,000 n miles (5,556 km; 3,452 miles)
2000EX with max fuel, six passengers, at Mach 0.80, NBAA IFR reserves	3,800 n miles (7,037 km; 4,373 miles)
g limits	+2.64/−1

OPERATIONAL NOISE LEVELS, 2000:

T-O	79.4 EPNdB
Approach	93.1 EPNdB
Sideline	86.4 EPNdB

DASSAULT FALCON 7X

TYPE: Long-range business tri-jet.

PROGRAMME: Announced, under temporary name/designation Falcon Next/NXT, at the Paris Air Show in June 2001; then became Falcon FNX; formal designation Falcon 7X announced 29 October 2001. By September 2002, high- and low-speed wind tunnel tests had been conducted at the ONERA facilities in Modane and Toulouse and in the European Transonic Wind Tunnel at Cologne, Germany; design frozen and first metal cut May 2003. First fuselage delivered to final assembly plant on 16 July 2004; rolled out 15 February 2005.

First flight (F-WFBW) 5 May 2005 followed by second aircraft (F-WTDA) on 5 July and third (F-WSKY) on 20 September 2005; total of 100 flights and more than 330 hours completed by three test aircraft by 15 November 2005; public debut (No. 1) at Paris Air Show 13 June 2005; US debut (No. 3) at NBAA Convention, Orlando, Florida, 9 November 2005; fourth aircraft first flew (F-WWUA) 8 June 2006. By December 2006 the four aircraft had accumulated 1,300 hours in more than 450 test flights, which had included the entire performance and centre of gravity envelopes; cold soak trials by F-WTDA at Iqaluit and Resolute Bay, Northern Canada in April 2006; 35 flight hours in natural icing conditions by F-WTDA over France, Italy, Spain and UK in May 2006; flight testing with artificial ice shapes (F-WFBW); contaminated runway trials (F-WSKY) at Cranfield, UK in July 2006; hot weather trials in Tunisia; and high altitude testing in the Western United States in October 2006. First 'green' airframe, c/n 05, delivered to Little Rock completion centre on 12 December 2006. EASA and FAA certification expected in March 2007, and first deliveries in the second quarter of the year. Initial production rate 15 aircraft per year, rising to 40 per year.

CUSTOMERS: Market estimated at 400 aircraft over unspecified period. More than 125 orders held by December 2006. On 26 September 2006, NetJets Europe ordered 24 for delivery

For details of the latest updates to *Jane's All the World's Aircraft* online and to discover the additional information available exclusively to online subscribers please visit
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Dassault Falcon 7X after installation of winglets *(Paul Bowen, Dassault)* 1040448

between 2008 and 2014. First customer delivery will be to Serge Dassault in April 2007; first delivery to a US customer will be to Anheuser-Busch Companies.

COSTS: Development cost estimated at USD600 million to USD700 million. Unit cost USD40 million basically equipped (2006). NetJets order for 24 aircraft valued at USD1.1 billion (2006).

DESIGN FEATURES: Similar in configuration to Falcon 900C/900EX, but with cabin some 20 per cent longer, redesigned nose, double-curved windscreen panels and an entirely new high-subsonic section wing with 20 per cent fewer parts, 5° more sweepback, (34° on inboard section, 30° on outboard section), 40 per cent more area and featuring full-span, two-section leading-edge slats following initial testing the prototype was retrofitted with winglets which have been adopted as standard on production airframes. The wing design will be employed on future developments within the Falcon range, expected to be designated Falcon 5X and 9X.

FLYING CONTROLS: Fly-by-wire controls, with sidestick controllers.

STRUCTURE: Total of 21 programme partner suppliers announced by May 2003, including: CASA (horizontal stabiliser); Stork-Fokker (trailing-edge control surfaces); Hurel Hispano/Aermacchi (engine nacelles and thrust reversers); Latécoère (T5 fuselage section); Socata (T34 upper fuselage section and body fairing); Sonaca (wing leading-edges); Stork-Fokker (spoilers, flaps, airbrakes and ailerons); and Sully Saint Gobain (windscreen and cabin windows). Final assembly in new 23,226 m² (250,000 sq ft) Charles Lindbergh facility at Bordeaux, with capacity for four Falcon 7Xs per month.

POWER PLANT: Three Pratt & Whitney Canada PW307A turbofans, each flat-rated to 28.5 kN (6,400 lb st) at ISA +17°C. Usable fuel capacity 18,045 litres (4,767 US gallons; 3,969 Imp gallons).

LANDING GEAR: Retractable tricycle type by Messier-Dowty. Wheels and brakes by ABSC. Steerable nosewheel ± 60°. Minimum ground turning radius 8.80 m (61 ft 8 in).

ACCOMMODATION: Typical configuration will provide three lounge areas, berthing capability for six passengers, lavatories, galleys, crew rest area and a large flight-accessible baggage compartment. Pressurisation system will provide a 1,830 m (6,000 ft) cabin environment at high cruise altitudes. Target cabin noise level 52 dB.

SYSTEMS: Honeywell air management system. Pressurisation system maintains 1,830 m (6,000 ft) cabin environment at maximum operating altitude. Honeywell GTCP 36-150F2M APU. Honeywell/Parker hydraulic power generation system. Parker hydraulic system; Intertechnique oxygen system; L'Hotelier fire detection and extinguishing; TRW electrical generation and distribution.

AVIONICS: Dassault EASy flight deck as core system, incorporating Honeywell Primus Epic platform. EMS Technologies AMT-50 satcom antenna.

DIMENSIONS, EXTERNAL:

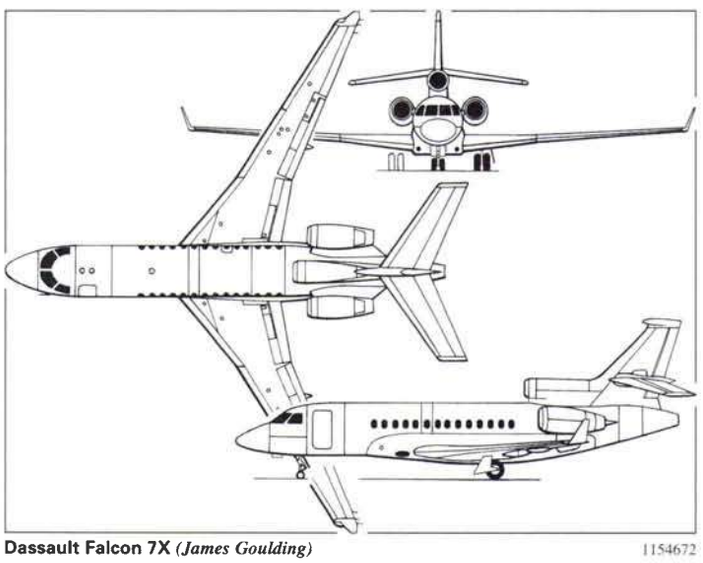
Wing span over winglets	26.21 m (86 ft 0 in)
Wing aspect ratio	9.7
Length overall	23.19 m (76 ft 1 in)
Height overall	7.79 m (25 ft 6¾ in)
Wheel track	9.75 m (31 ft 11¾ in)
Wheelbase	4.32 m (14 ft 2 in)
Passenger door: Height	1.72 m (5 ft 7¾ in)
Width	0.80 m (2 ft 7½ in)
Type III emergency exit: Height	0.91 m (3 ft 0 in)
Width	0.53 m (1 ft 9 in)

DIMENSIONS, INTERNAL:

Cabin	
Length, third flight deck seat to baggage compartment	11.91 m (39 ft 1 in)
Width: max	2.34 m (7 ft 8 in)
at floor level	1.91 m (6 ft 3¼ in)
Max height	1.88 m (6 ft 2 in)
Volume	43.95 m³ (1,554 cu ft)
Baggage compartment volume	4.0 m³ (141 cu ft)

AREAS:

Wings, gross	70.70 m² (761.00 sq ft)



Dassault Falcon 7X *(James Goulding)* 1154672

WEIGHTS AND LOADINGS:

Basic operating weight	15,546 kg (34,273 lb)
Payload: max	3,052 kg (6,728 lb)
with max fuel	1,355 kg (2,988 lb)
Max fuel weight	14,488 kg (31,941 lb)
Max T-O weight	31,297 kg (69,000 lb)
Max landing weight	28,304 kg (62,400 lb)
Max ramp weight	31,388 kg (69,200 lb)
Max zero-fuel weight	18,597 kg (41,000 lb)
Max wing loading	442.7 kg/m² (90.67 lb/sq ft)
Max power loading	366 kg/kN (3.59 lb/lb st)

PERFORMANCE:

Max operating Mach No. (MMO)	0.90
Max operating speed (VMO)	370 kt (685 km/h; 425 mph) IAS
Cruising speed: typical	M0.85
for long range	M0.80
Approach speed, landing weight of 16,828 kg (37,100 lb), 8 passengers, NBAA IFR reserves	104 kt (193 km/h; 120 mph)
Max certified altitude	15,545 m (51,000 ft)
FAR Pt 25 balanced T-O field length, S/L, ISA, with eight passengers and max fuel	1,678 m (5,505 ft)
FAR Pt 91 landing distance at max landing weight	1,196 m (3,925 ft)
Range: with three crew, eight passengers and NBAA IFR reserves:	
at M0.80	5,950 n miles (11,019 km; 6,847 miles)

DASSAULT FALCON SMS

At the NBAA Convention in Orlando Florida in October 2006 Dassault announced that, following certification of the Falcon 7X in early 2007 it would begin development of a super-midsize Falcon, provisionally designated SMS, that will be positioned in the Falcon range between the Falcon 50 and Falcon 2000. No further details were revealed.

DYN'AERO

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Dyn'Aéro formed 7 September 1992 by Christophe Robin, son of the founder of Avions Pierre Robin; his initials (CR) appear in aircraft designations. Initial product was CR100, flown two weeks before formation of company. Two new designs derived from CR100 announced in March 1995: CR110 and CR120; simultaneously, MCR01 also announced. The new MCR01 Club flew in June 1998 and a four-seat version in June 2000. Production facilities at Darois

aerodrome comprise 4,000 m² (43,050 sq ft) of workshops, storage and offices. Plans announced in February 2002 for establishment of a subsidiary, Dyn'Aéro Iberica at a new factory in Portugal, permitting an increase in annual production from 50 to 100 aircraft (initially of MCR ULC).

By early 2004, more than 400 Dyn'Aéro kits had been sold and the company workforce numbered 25 in France and 40 in Portugal.

DYN'AERO CR100, CR110 and CR120

TYPE: Side-by-side sportplane/kitbuilt.

PROGRAMME: Prototype CR100 (F-PDYN) first flew 27 August 1992; third aircraft (F-PAFC) was designated CR100D; first five CR100s flew total of 600 hours of aerobatics in first year of operations. Available factory-built or as a kit.

CURRENT VERSIONS: **CR100:** Baseline version. Prototype (F-WASP).

CR100T: Tricycle landing gear version, first flown December 2000.

Description applies to CR100, except where otherwise stated.

CR110: Uprated version with 149 kW (200 hp) Textron Lycoming engine.

CR120: High-agility version. First flight (F-PPCR) September 1996; second aircraft (F-PTCR) flying by 1998. Engine as CR110, but airframe all carbon fibre; longer span ailerons (2.70 m; 8 ft 10¼ in), no flaps, shorter wing span (7.77 m; 25 ft 6 in), 270°/s rate of roll at 140 kt (260 km/h; 162 mph) compared with CR100's 195°/s, 149 kW (200 hp) Textron Lycoming AEIO-360 engine driving MTV-12-B-C/C-183-17e two-blade propeller, 85 litres (22.4 US gallons; 18.7 Imp gallons) aerobatic fuel in starboard wingroot and 105 litres (27.7 US gallons; 23.1 Imp gallons) in port wingroot, tyre pressure 2.00 bar (29.0 lb/sq in). Aircraft are registered under CR100 designation.

CUSTOMERS: Two CR100s ordered March 1995 by l'Equipe de Voltige de l'Armée de l'Air at Salon de Provence, of which first (No. 22 'CJ') delivered 21 July 1995; however, both withdrawn by 1997 and sold in 2000, one to UK owner Cole Aviation. Total of at least 37 CR100/110/120 kits sold; of these, 16 had been registered by early 2002. There were no known completions or new sales between 2002 and 2005, but production is set to continue at a low rate, reflecting the specialised market for aerobatic aircraft.

COSTS: EUR76,200 as a kit without engine; about EUR137,200 assembled, with engine and instruments.

DESIGN FEATURES: Single-engined low-wing monoplane of conventional layout.

Aerofoil section NACA 21015/12 modified; dihedral 0°.

FLYING CONTROLS: Conventional and manual. Elevator tab for pitch trim. Ground-adjustable tab on ailerons on rudder. Plain flaps.

STRUCTURE: Wood and fabric, but including carbon fibre main wing spar.

LANDING GEAR: Tailwheel type; fixed. Wing-mounted, trousered, cantilever main legs with integral oleo-pneumatic shock-absorbers. Wheel fairings on main legs. Disc brakes. Mainwheel tyre size 380×150; pressure 2.30 bar (33.0 lb/sq in).

POWER PLANT: One 134 kW (180 hp) Textron Lycoming AEIO-360-B2F flat-four engine, driving either Evra Fixed-pitch or MT variable-pitch propeller. Compatible with alternative engines of 119 kW (160 hp) and above. Fixed-pitch or constant-speed propellers can be fitted. Fuel capacity for aerobatics 85 litres (22.4 US gallons; 18.7 Imp gallons), of which 82 litres (21.7 US gallons; 18.0 Imp gallons) are usable; max fuel capacity 160 litres (42.3 US gallons; 35.2 Imp gallons). Oil capacity 7.6 litres (2.0 US gallons; 1.7 Imp gallons).

ACCOMMODATION: Two seats, side by side, with dual controls. Fixed windscreen and rearward-sliding canopy.

SYSTEMS: Electrical system: 12 V 30 Ah battery.

AVIONICS: Customer specified.

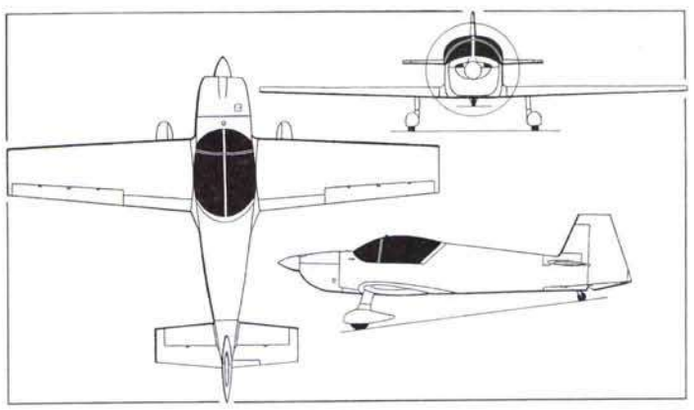
DIMENSIONS, EXTERNAL:

Wing span	8.50 m (27 ft 10½ in)
Wing aspect ratio	6.8
Length overall	7.50 m (24 ft 7¼ in)
Tailplane span	2.80 m (9 ft 2¼ in)
Wheel track	2.37 m (7 ft 9¼ in)
Propeller diameter	1.90 m (6 ft 3 in)

AREAS:

Wings, gross	10.65 m² (114.6 sq ft)
Ailerons (total)	1.215 m² (13.08 sq ft)
Trailing-edge flaps (total)	1.21 m² (13.02 sq ft)
Vertical tail surfaces (total)	1.71 m² (18.40 sq ft)
Horizontal tail surfaces (total)	2.20 m² (23.68 sq ft)

Dyn'Aéro CR100 1159268



General arrangement of the Dyn'Aéro CR100 *(Paul Jackson)* 1159376

WEIGHTS AND LOADINGS:

Weight empty	550 kg (1,213 lb)
Max T-O weight: Aerobatic	760 kg (1,676 lb)
Normal	850 kg (1,873 lb)
Max wing loading: Aerobatic	71.5 kg/m² (14.64 lb/sq ft)
Normal	80.0 kg/m² (16.38 lb/sq ft)
Max power loading: Aerobatic	5.66 kg/kW (9.31 lb/hp)
Normal	6.34 kg/kW (10.41 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	205 kt (379 km/h; 235 mph)
Max level speed	165 kt (305 km/h; 190 mph)
Max cruising speed	151 kt (280 km/h; 174 mph)
Manoeuvring speed (VA)	140 kt (260 km/h; 161 mph)
Max rate of climb at S/L	480 m (1,575 ft)/min
T-O run	153 m (500 ft)
T-O to 15 m (50 ft)	351 m (1,150 ft)
Range: normal fuel	302 n miles (560 km; 348 miles)
max fuel	604 n miles (1,120 km; 696 miles)
g limits	+8/−6

DYN'AERO MCR01

TYPE: Side-by-side kitbuilt; side-by-side ultralight kitbuilt.

PROGRAMME: Composites version of the metal MC100 Ban-Bi designed by Michel Colomban; fuselage first shown at RSA Rally in July 1995. Continues to be referred to by some sources as **Ban Bi**. MCR identifies Michel Colomban/Christophe Robin. Prototype (F-PECH) flew 1995.

CURRENT VERSIONS: **MCR01 VLA:** Certified version meeting JAR-VLA requirements; **VLA 912** or **VLA 914**, according to engine. JAR-VLA certification awarded 26 June 2001 in France and 7 December 2001 in Peru.

MCR01 Club: Version of MCR01 VLA intended for flight training. First flight (F-PCLB) June 1998. Certification to JAR-VLA was due in 2001.

MCR01 ULM: Ultralight version meeting FAI ULM requirements; 59.7 kW (80 hp) engine. **MCR01 ULC** has 490 kg (1,080 lb) MTOW and is also known as the **MCR01 SLA** in the UK, where the first example (G-BZXG) made its first flight on 30 November 2001. DGAC certification received 1 March 2001.

Motor Glider: Proposed 'Winggrid' wingtips developed in conjunction with La Roche Consulting of Switzerland; 59.7 kW (80 hp) engine, best glide ratio 30:1; programme since abandoned.

MCR M: Tailwheel version with oleo-pneumatic heavy-duty landing gear. Also known as **MCR Montagne** when marketed in Italy for rough field operation. Certification issued 26 June 2002.

Electra-Plane: Being developed by Advanced Technology Products; stated to be world's first fuel cell-powered aircraft. Prototype is based on MCR01; second prototype will utilise a Hoffmann H-36 Dimona as base aircraft. Three stages planned: first, with lithium-ion batteries, will have 86 n mile (160 km; 100 mile) range; second, with combination of batteries and 10 to 15 kW (13 to 20 hp) fuel cell, will have 217 n mile (402 km; 250 mile) range. Final version will be powered solely with fuel cells and have 434 n mile (804 km; 500 mile) range.

Description applies to all versions except where indicated.

CUSTOMERS: Over 320 kits sold by July 2006, in Austria, Germany, Italy, Japan, Netherlands, New Zealand, Spain, Switzerland, UK and USA. More than 230 flying by early 2005.

COSTS: Kits, less engine and instruments: Sportster EUR28,300, ULC/ULM EUR33,100, Club EUR31,300 (all 2003).

DESIGN FEATURES: Single-engined low-wing monoplane with T tail; design goals include extremely low structural weight, fast kit production and high performance in comfort and safety.

FLYING CONTROLS: Manual. All-moving tailplane with trim tab, which is full span on ULM version; electrically actuated flaps and pitch trim; ULM and M versions have full-span double-slotted flaperons; VLA has flaperons (both three-position: 0, 17, 45°); Club has separate double slotted flaps and ailerons.

STRUCTURE: Wing and control surfaces built on carbon fibre spars and cellular ribs, to which preformed aluminium skins are glued in partial vacuum; monocoque carbon fibre fuselage; quoted build time of 500 to 1,000 hours from three modular kits without special tools. Airframe disassembles for storage or road-towing, with recommended disassembly/reassembly time of 4 minutes, single-handed. Dyn'Aero proprietary aerofoil. Wing dihedral 3°, incidence 20', twist 0°.

LANDING GEAR: Tricycle type; fixed, fuselage-mounted spring cantilever mainwheel legs with wheel fairings on all three units; nosewheel steerable. Large wheels optional for rough field operation. Tailwheel configuration optional on MCR01 Club and MCR01 ULC versions, which have further option of wing-mounted, trousered cantilever main legs with integral shock-absorbers. Skis tested on MCR M during winter 2002–03.

POWER PLANT: One 59.6 kW (79.9 hp) Rotax 912 UL; 63.4 kW (85 hp) JPX 4T75; or 73.5 kW (98.6 hp) normally aspirated Rotax 912 ULS or turbocharged Rotax 914 flat-four driving an EVRA 156-178-106 two-blade fixed-pitch propeller optimised for cruise; three-blade MT Propeller MTV-7-A/152-106 or MTV-6-A/152-106 constant-speed propeller optional. Jabiru-powered version first flown 19 April 2002. Standard fuel capacity 80 litres (21.1 US gallons; 17.6 Imp gallons) in all versions; optional additional 90 litre (23.75 US gallon; 19.8 Imp gallon) tank in Club and ULM or 264 litre (69.7 US gallon; 58.1 Imp gallon) tank in VLA.

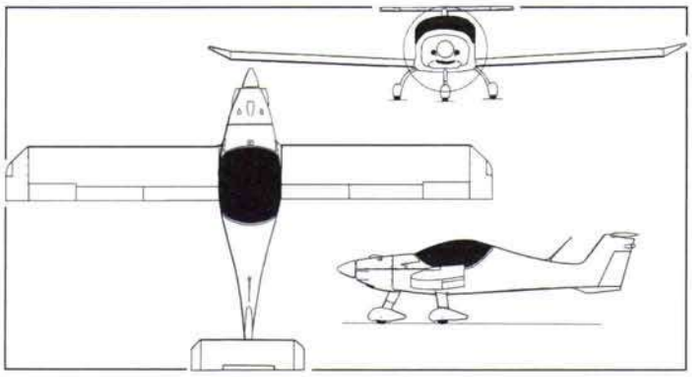
AVIONICS: To customer's choice.

EQUIPMENT: Optional road-towing trailer/storage hangar. BRS ballistic parachute recovery system optional on ULM.

DIMENSIONS, EXTERNAL:

Wing span: VLA	6.66 m (21 ft 10¼ in)

Dyn'Aéro MCR01 Club version *(Paul Jackson)* 1159341



MCR01 in its ULC/ULM/VLA form *(Paul Jackson)* 0547128

Club ..... 6.90 m (22 ft 7½ in)
ULM, M ..... 8.64 m (28 ft 4¼ in)
Motor Glider ..... 9.80 m (32 ft 1¾ in)
Wing chord (constant): VLA ..... 0.80 m (2 ft 7½ in)
Club, ULM, M ..... 0.96 m (3 ft 1¾ in)
Wing aspect ratio: VLA 8.5
Club 7.0
ULM 8.6
Length overall: all ..... 5.53 m (18 ft 1¾ in)
Height overall: Club, ULM ..... 1.53 m (5 ft ¼ in)

DIMENSIONS, INTERNAL:
Cabin max width: all ..... 1.12 m (3 ft 8 in)

AREAS:
Wings, gross: VLA ..... 5.20 m² (56.0 sq ft)
Club ..... 6.45 m² (69.4 sq ft)
ULM, M ..... 8.31 m² (89.4 sq ft)
Motor Glider ..... 9.35 m² (100.6 sq ft)

WEIGHTS AND LOADINGS:
Weight empty, equipped: VLA ..... 235 kg (518 lb)
Club ..... 245 kg (540 lb)
ULM, M ..... 250 kg (551 lb)
Motor Glider ..... 262 kg (578 lb)
Baggage capacity ..... 15 kg (33 lb)
Max T-O weight: VLA, ULM ..... 450 kg (992 lb)
Club ..... 490 kg (1,080 lb)
M ..... 544 kg (1,199 lb)

PERFORMANCE (59.7 kW; 80 hp engine):
Never-exceed speed (VNE):
normal: VLA ..... 172 kt (320 km/h; 198 mph)
Club, ULM ..... 162 kt (300 km/h; 186 mph)
M ..... 170 kt (315 km/h; 195 mph)
with BRS: all ..... 145 kt (270 km/h; 167 mph)
Max level speed: VLA 912 ..... 163 kt (302 km/h; 188 mph)
VLA 914 ..... 197 kt (364 km/h; 226 mph)
Club ..... 151 kt (281 km/h; 174 mph)
ULM ..... 150 kt (278 km/h; 172 mph)
Motor Glider ..... 135 kt (250 km/h; 155 mph)
Max cruising speed at 75% power:
at FL80:
VLA 912 ..... 158 kt (292 km/h; 181 mph)
Club ..... 150 kt (278 km/h; 173 mph)
ULM ..... 146 kt (270 km/h; 168 mph)
Motor Glider ..... 130 kt (240 km/h; 149 mph)
M ..... 119 kt (221 km/h; 137 mph)
at FL110:
VLA 914 ..... 154 kt (286 km/h; 178 mph)
ULM ..... 143 kt (265 km/h; 165 mph)
Stalling speed, flaps down:
VLA ..... 50 kt (91 km/h; 57 mph)
Club ..... 43 kt (79 km/h; 49 mph)
ULM ..... 34 kt (63 km/h; 40 mph)
Motor Glider ..... 30 kt (55 km/h; 35 mph)
M ..... 38 kt (70 km/h; 44 mph)
Max rate of climb at S/L: Sportster, Club ..... 609 m (2,000 ft)/min
ULM ..... 426 m (1,400 ft)/min
T-O run: VLA ..... 285 m (935 ft)
Club ..... 210 m (689 ft)
ULM ..... 195 m (640 ft)
T-O to 15 m (50 ft): VLA, Club ..... 424 m (1,395 ft)
ULM ..... 203 m (666 ft)
Range at econ cruising speed and altitude:
with normal fuel: VLA ..... 894 n miles (1,657 km; 1,029 miles)
Club ..... 829 n miles (1,536 km; 954 miles)
ULM ..... 834 n miles (1,545 km; 960 miles)
with max optional fuel:
VLA ..... 3,452 n miles; (6,394 km; 3,973 miles)
Club ..... 1,623 n miles (3,006 km; 1,867 miles)
ULM ..... 1,611 n miles (2,985 km; 1,854 miles)
g limits: all except VLA ..... +4/−2
VLA ..... +3.8/−1.9

DYN'AERO MCR4S

TYPE: Four-seat kitbuilt.

PROGRAMME: Mockup first shown at Aero '99, Friedrichshafen, April 1999. Kits available from late 1999. Prototype (F-WWUZ) first flew 14 June 2000 and displayed at PFA International Air Rally, Cranfield, UK, 23–25 June 2000. First customer aircraft, built by noted French light aircraft designer/manufacturer Pierre Robin, flew in mid-2001 and DGAC certification achieved 26 June 2001. PFA approval was being sought in mid-2003 and was expected during 2005.

Dyn'Aéro MCR4S *(Paul Jackson)* 1159342

CURRENT VERSIONS: **MCR2S Ibis:** Two-seat version with generous baggage space; marketed by Italian agents, Aerodream Group SRL of Voghera Rivanazzano (www.aerodream.net) and approved for local Ultralight category.

Three-seat: With 59.6 kW (79.9 hp) Rotax 912 UL or JPX 4TX75 engine; 640 kg (1,411 lb) MTOW.

Four-seat: With 73.5 kW (98.6 hp) Rotax 912 UL-S normally aspirated engine and MT-Propeller MTV-7-A/156-122 fixed-pitch propeller; 750 kg (1,653 lb) MTOW.

Four-seat Performance: 84.6 kW (113.4 hp) Rotax 914 UL turbocharged engine and constant-speed propeller; optimised for cruise at 3,050 m (10,000 ft).

CITEC: On 29 July 2001, Dyn'Aero and Wilksch Airmotive of the UK announced a joint programme to develop the MCR4S CITEC, powered by the Wilksch WAM-120 diesel engine. Launch customer for this version was M. Serge Blanchard.

CUSTOMERS: Total 71 kits sold by July 2006, of which 36 were then flying in France alone.

COSTS: Kit EUR48,100, less engine; EUR86,600, EUR91,900 or EUR131,700 with Rotax 912 ULS plus three-blade fixed-pitch propeller, 912 ULS plus constant-speed two-blade MT propeller or 914 plus two-blade constant-speed propeller (2003).

DESIGN FEATURES: Three/Four-seat version of MCR01, having 75 per cent commonality. Dihedral 3°. Winglets introduced in 2001, and modified in 2002.

Description generally as for MCR01, except that below.

FLYING CONTROLS: Ailerons, plus two-segment flaps. Aileron max deflection −20°/+10°. Tailplane (all moving) max deflection +3.5°/−10°. Rudder deflection ±20°. Double-slotted flaps, deflections 0, 17 and 30°.

LANDING GEAR: Tricycle type; fixed. Wing-mounted, trousered, cantilever main legs with integral shock-absorbers. Fairing on all three wheels.

POWER PLANT: See Current Versions. Fuel in two wing tanks; standard capacity 130 litres (34.3 US gallons; 28.6 Imp gallons); optionally two 100 litre (26.4 US gallon; 22.0 Imp gallon) tanks can be fitted. In both cases, 2 litres (0.5 US gallons; 0.4 Imp gallons) is unusable.

ACCOMMODATION: Four persons, in two side-by-side pairs. Forward-hinged, two-piece canopy/windscreen, plus two fixed side windows.

EQUIPMENT: Ballistic parachute optional.

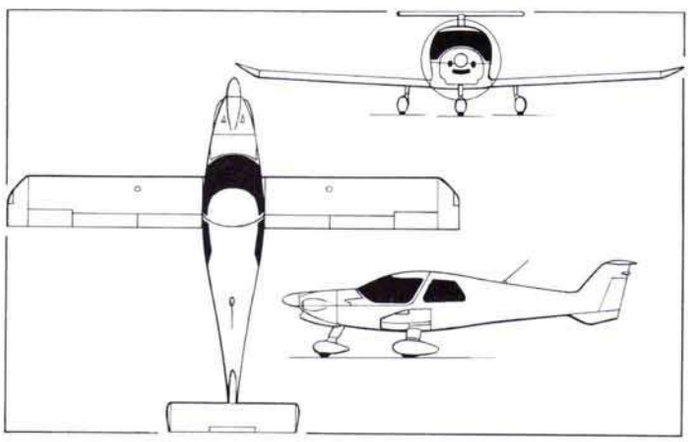
DIMENSIONS, EXTERNAL:
Wing span ..... 8.72 m (28 ft 7¼ in)
Wing chord (constant) ..... 0.96 m (3 ft 1¾ in)
Wing aspect ratio 9.2
Length overall ..... 6.70 m (21 ft 11¾ in)
Height overall ..... 1.90 m (6 ft 2¾ in)
Tailplane span ..... 2.50 m (8 ft 2½ in)
Wheel track ..... 2.33 m (7 ft 7¾ in)
Propeller max diameter: two blade ..... 1.70 m (5 ft 7 in)
three-blade ..... 1.56 m (5 ft 1½ in)

DIMENSIONS, INTERNAL:
Cabin max width ..... 1.20 m (3 ft 11¼ in)

AREAS:
Wings, gross ..... 8.30 m² (89.3 sq ft)

WEIGHTS AND LOADINGS:
Weight: empty ..... 300 kg (661 lb)
equipped ..... 350 kg (772 lb)
Baggage capacity ..... 40 kg (88 lb)
Max T-O weight ..... 640–750 kg (1,411–1,653 lb)

PERFORMANCE (Rotax 912, 912 ULS and 914 UL engines):
Never-exceed speed (VNE) ..... 145 kt (270 km/h; 167 mph)
Max level speed: 912 ..... 143 kt (265 km/h; 165 mph)
912 ULS ..... 156 kt (288 km/h; 179 mph)
914 UL ..... 173 kt (320 km/h; 199 mph)
Manoeuvring speed ..... 118 kt (219 km/h; 136 mph)
Max cruising speed: 912 ..... 136 kt (252 km/h; 157 mph)
912 ULS ..... 150 kt (277 km/h; 172 mph)
914 UL ..... 155 kt (287 km/h; 178 mph)
Econ cruising speed: 912 ..... 127 kt (236 km/h; 147 mph)
912 ULS, 914 UL ..... 147 kt (272 km/h; 169 mph)



Dyn'Aéro MCR4S three/four-seat tourer with current wingtip configuration *(Paul Jackson)* 1159377

Stalling speed: flaps up ..... 54 kt (100 km/h; 63 mph)
flaps down ..... 45 kt (83 km/h; 52 mph)
Max rate of climb at S/L: 912 ..... 228 m (750 ft)/min
914UL ..... 274 m (900 ft)/min
T-O run with c/s prop: 912 ..... 350 m (1,148 ft)
912 ULS ..... 203 m (670 ft)
914 UL ..... 153 m (505 ft)
T-O to 15 m (50 ft) with c/s prop: 912 ..... 455 m (1,495 ft)
912 ULS ..... 295 m (970 ft)
914 UL ..... 221 m (725 ft)
Landing run with c/s prop: 912 ULS ..... 201 m (660 ft)
Range with max fuel: ..... 996 n miles (1,846 km; 1,147 miles)
g limits ..... +3.8/−1.5

ESPACE LIBERTE

ESPACE LIBERTÉ SARL

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DIRECTOR: Charles Guérin

Having worked on design of the DEA Yuma STOL lightplane in Italy, Charles Guérin returned to France to pursue development of a modified version, incorporating refinements including the option of three stages of high-lift wing. However, the company was placed in receivership on 6 December 2005; it became G1 Aviation in March 2006; promotion of the aircraft continues with the new company.

EURO PINGOUIN

EURO PINGOUIN TEAM

Les Guérins, F-05130 Sigoyer
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Web: www.pingouin152.com
DIRECTOR: J B Bonnet

Based at Gap-Tallard aerodrome, Euro Pingouin was established to market a European version of a South American ultralight based on a North American lightplane.

EURO PINGOUIN 152

TYPE: Side-by-side ultralight kitbuilt.
PROGRAMME: Prototype conceived and built in South America. Acquired by French company and re-engineered for European market. Parts fabricated in Eastern Europe; assembly centres sought for flyaway version.
COSTS: Kit EUR47,000 including engine, or EUR34,000 excluding engine, plus tax (2006).
DESIGN FEATURES: General appearance based on Cessna 152. High, constant-chord wing with single, streamlined bracing strut each side. Low tailplane and sweptback fin, mutually rod-braced. Quoted build time 100 to 150 hours.
FLYING CONTROLS: Conventional and manual. Flaps; max deflection 40°. Flaps and elevator trim electrically actuated.
LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring cantilever mainwheel legs; cantilever nosewheel leg. Mainwheel disc brakes.
POWER PLANT: One Rotax flat-four piston engine driving an Ivoprop three-blade, constant-speed propeller; option of 58.8 kW (78.9 hp) 912 UL or 73.5 kW (98.6 hp) 912 ULS. Fuel capacity 90 litres (23.8 US gallons; 19.8 Imp gallons).
EQUIPMENT: Optional ballistic recovery parachute.
DIMENSIONS, EXTERNAL:
Wing span ..... 7.80 m (25 ft 7 in)
Length overall ..... 7.15 m (23 ft 5½ in)
Height overall ..... 2.00 m (6 ft 6¾ in)
DIMENSIONS, INTERNAL:
Cabin max width ..... 1.12 m (3 ft 8 in)
AREAS:
Wings, gross ..... 12.00 m² (129.2 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 275 kg (606 lb)
T-O weight: without parachute ..... 450 kg (992 lb)
with parachute ..... 472.5 kg (1,041 lb)
PERFORMANCE (Rotax 912 UL):
Max level speed ..... 113 kt (210 km/h; 130 mph)
Stalling speed, flaps down ..... 34 kt (63 km/h; 40 mph)
Max rate of climb at S/L ..... 300 m (984 ft)/min
T-O run ..... 60 m (200 ft)
Landing run ..... 90 m (295 ft)

Euro Pingouin 152 two-seat ultralight variant on a Cessna theme *(R W Simpson)* 1158848

G1 AVIATION

G1 AVIATION

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Web: www.g1aviation.com
DIRECTOR: Charles Guerin

Former Espace Liberté became G1 Aviation in March 2006 and continued with promotion and production of the G1 lightplane. Flight testing and distribution is undertaken at Aérodrome Gap-Tallard.

G1 AVIATION G1

TYPE: Side-by-side ultralight/kitbuilt.
PROGRAMME: Development began 1994 as DEA Yuma. Adaptations of design, leading to G1, began in 2002; several trials aircraft. Series production aircraft '00' shown at Aero '03, Friedrichshafen, in April 2003; No. 01 then intended to fly by mid-2003. Progress apparently overtaken by company being placed in receivership on 5 December 2005.
CUSTOMERS: Total of 15 flying plus 10 more under construction, by April 2005.
COSTS: V3 EUR53,435; V2 EUR51,145; V1 EUR46,295; all plus tax (2004).
DESIGN FEATURES: Objectives included better performance than existing STOL light aircraft, but without sacrifice of cruising speed; effective and harmonised controls; foldable wings. Aircraft can be folded for transport by one person in 10 minutes.
High wings with V-struts; sweptback fin with ventral fillet. Quoted build time (optional kit) 250 hours.

G1 Aviation G1 with starboard wing folded *(Paul Jackson)* 1121770

FLYING CONTROLS: Conventional and manual. Large, cable-actuated control surfaces for effectiveness of response at slow speeds. Slats on wing leading edge; trailing-edge electrically-operated plain flaps.

STRUCTURE: Generally of heat-treated and corrosion-proofed aluminium alloy; skins bonded before riveting. Welded tubular 4130 steel frame cockpit structure; steel alloy wing struts. Control surfaces covered in Dacron fabric. Wing leading-edge slats of carbon fibre. Composites tips to wing and empennage. Composites engine cowling. Lexan windscreen; polycarbonate side windows.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted aluminium spring cantilever mainwheel legs with optional wheel fairings. Steerable, telescoping nosewheel leg. Mainwheels 8.00–6 (optionally larger); nosewheel 15x6.00–6. Hydraulic disc brakes. Mainwheel and parking brakes. Optional floats and skis.

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS flat-four. Fuel in wing tanks and header tank, total capacity 84 litres (22.2 US gallons; 18.5 Imp gallons). Duc Tripale Swirl three-blade, carbon fibre propeller, ground- or flight-adjustable.

EQUIPMENT: Ballistic parachute. Optional agricultural spraying equipment.

DIMENSIONS, EXTERNAL:

Wing span	9.91 m (32 ft 6¼ in)
Length overall	6.73 m (22 ft 1 in)
Height overall	2.34 m (7 ft 8¼ in)

DIMENSIONS, INTERNAL:

Cabin max width	1.20 m (3 ft 11¼ in)

AREAS:

Wings, gross	14.76 m² (158.9 sq ft)

WEIGHTS AND LOADINGS:

Weight empty (incl parachute)	290 kg (639 lb)
Max T-O weight	450 kg (992 lb)

PERFORMANCE:

Never-exceed speed (VNE)	118 kt (220 km/h; 136 mph)
Cruising speed at 75% power	84 kt (155 km/h; 96 mph)
Stalling speed, power off, flaps down	27 kt (50 km/h; 31 mph)
Max rate of climb at S/L	457 m (1,500 ft)/min
T-O run	50 m (165 ft)
Landing run	60 m (200 ft)
Range	324 n miles (600 km; 372 miles)
g limits	+4/–3

GUIMBAL

HELICOPTERES GUIMBAL SA

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Web: www.guimbal.com
DIRECTOR: Bruno Guimbal

While working as head of research for Eurocopter at Marignane Bruno Guimbal designed, built and flew a prototype of the Cabri G2 light helicopter, receiving some sponsorship from his company for final preparation and flight testing. The programme lapsed in the mid-1990s, but M Guimbal left Eurocopter on 1 October 2000 and formed Hélicoptères Guimbal to continue the project and by the following year had eight employees at Aix-les-Milles aerodrome. This had increased to 30 by 2005, when 40 industrial partners were collaborating on the re-launched project. Certification target of late 2005 was not achieved.

At Paris Air Show in June 2005, Eurocopter and Hélicoptères Guimbal signed an agreement for the creation of Vertivision company to develop, market, manufacture and support helicopter UAVs with military applications.

GUIMBAL G2 CABRI

TYPE: Two-seat helicopter.

PROGRAMME: Privately designed and developed during the late 1980s; first flight (F-PILA) at Marignane 11 April 1992; flight testing continued privately at Aix en Provence.

On 21 May 1996, M Guimbal broke the FAI E-1a category record for distance flown by a helicopter under 500 kg by covering the 259.9 n miles (481.32 km; 299.1 miles) from Paris to Valence without landing or refuelling. Flew 150 hours between 1992 and 1998.

At Paris in June 2003, Eurocopter announced selection of Cabri G2 as basis for its Orka 1200 UAV. The vehicle is contesting a requirement sponsored by France's DGA armaments agency for a UAV (Devin — *drone à envol vertical interarmées*) to be operated by both the army and navy from 2012-13 onwards.

Second prototype (F-WYHG) flew at Aix on 31 March 2005, exhibiting several external refinements, including revised door transparencies; raised horizontal stabiliser; and modified fin/underfin shapes. Established records for helicopters under 500 kg at Rouen on 21 August 2005 during public debut at World Helicopter Championship: height of 6,656 m (21,837 ft) and 6 min 42 s to height of 3,000 m (9,840 ft).

Certification to EASA/FAR Pt 27 was due in late 2005, followed by deliveries from 2006 onwards. However, up to June 2006, neither event had taken place and the company had not published a revised specification for the latest version, the data following being largely based on the original machine.

DESIGN FEATURES: Intended to compete with Robinson R22, but promotion was initially deterred by high number of accidents then in private light helicopter sphere. Current design includes safety features including crash-resistant seats and fuel system.

Three-blade rotor, moderate control power (apparent hinge offset 4.8 per cent) and fail-safe design; design avoids mast bumping, minimises dynamic roll-over or over-control and allows wide CG travel; rotor inertia lies between that of Bell JetRanger and Bell 47 to give best practical autorotation performance; Spheriflex main rotor hub, with forked blade-ends picking up single elastomeric centrifugal bearings and mast-mounted droop stops, designed for low maintenance; drag dampers and simple elastomeric; patented driveshaft runs in an oblique groove in top of tail pylon; bearingless seven-blade Fenestron tail rotor has Kevlar starplate hub giving integral pitch change freedom and offers good control with protection from contact with long grass and harder obstacles; tailplane has lifting aerofoil designed to unload Fenestron in cruising flight and save power. Industrial participants include SNR for bearings; Sauter & Bachmann gears; Manoir forgings; SEFEE wiring looms; SARMA, CBA and Jacottet controls; Lourd rotor lamifications; Zodiac-Aérazur fuel tanks; EADS-Composites Aquitaine central structures; ATN International rear structure; and Vega Industries electrical system. Main rotor rpm 597; Fenestron rpm 5,734.

FLYING CONTROLS: Unboosted mechanical dual control with friction damper at base of cyclic stick acting as attitude trim.

Second prototype Guimbal Cabri G2 light helicopter *(André Tarditi, Guimbal)* 1133982

STRUCTURE: Carbon-epoxy airframe shell weighs 70 kg (154.3 lb), accounting for 22 per cent of empty weight; based on central box of GFRP sandwich carrying instrument console, two integral fuel tanks, transmission, landing skids, engine and tailboom; lateral shells contain seats, windows and pylon fairing; GFRP tailboom, Fenestron and fin integral, but detachable from fuselage.

LANDING GEAR: Two fixed aluminium skids high energy-absorption landing gear bows of filament-wound R-glassfibre giving 4 m (13.12 ft)/s impact absorption.

POWER PLANT: One 112 kW (150 shp) Textron Lycoming O-320 flat-four engine, mounted horizontally, nose forward, with 4 into 1 straight exhaust to reduce engine noise; downdraught cooling fan, fed by ram intake in pylon fairing and mounted on alternator on top of engine, driven through 90° by belt from crankshaft; engine drives transmission by four-sheave V-belt with reduction ratio 0.91:1; belt tensioned by rotating pulley bearing by eccentric lever driven by small electric actuator; main driveshaft drives Fenestron and main transmission; reductions by simple spiral bevel gears (4:1 for main rotor and 1:2.5 for Fenestron); rotor pylon is stationary with splined driveshaft inside. Fuel capacity 154 litres (40.7 US gallons; 33.9 Imp gallons) in two interconnected integral tanks with single filler cap.

DIMENSIONS, EXTERNAL:

Main rotor diameter	6.50 m (21 ft 4 in)
Main rotor blade chord	0.16 m (6.3 in)
Fenestron diameter	0.54 m (1 ft 9¼ in)
Fenestron blade chord	0.038 m (1½ in)
Length overall	5.75 m (18 ft 10½ in)
Fuselage max width	1.18 m (3 ft 10½ in)
Height to top of rotor head	2.10 m (6 ft 10¾ in)

DIMENSIONS, INTERNAL:

Baggage volume	0.18 m³ (6.35 cu ft)

AREAS:

Main rotor disc	33.18 m² (357.2 sq ft)
Fenestron disc	0.23 m² (2.47 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	320 kg (705.5 lb)
Max T-O weight	550 kg (1,212 lb)
Max disc loading	16.58 kg/m² (3.39 lb/sq ft)
Max power loading	4.92 kg/kW (8.08 lb/hp)

PERFORMANCE (calculated):

Max level speed, 75% power:	108 kt (200 km/h; 124 mph)
Cruising speed	97 kt (180 km/h; 112 mph)
Service ceiling	2,200 m (7,215 ft)
Range	539 n miles (1,000 km; 621 miles)
Endurance	5 h

HUMBERT

HUMBERT AVIATION

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Web: www.humbert-aviation.com
DESIGNER: Jean-Jacques Humbert

Formed by Jacques Humbert in 1984, the company's most recent design is the Tétras, although the earlier Moto du Ciel remains available.

Humbert Tétras two-seat ultralight *(Pierre Gaillard)* 1159269

HUMBERT TETRAS

TYPE: Side-by-side ultralight/kitbuilt.

PROGRAMME: Prototype unveiled at 1992 RSA Rally at Moulins. Named for a fish of the genus *Characidae*. Marketing began in 1994.

CURRENT VERSIONS: **Tétras B:** Standard version with HW2000 or Rotax 912 UL engine; *as described.*

Tétras BS: Higher-powered version with Rotax 912 ULS engine.

CUSTOMERS: At least 10 on French ultralight register by December 2001; one further by July 2006. Has also been evaluated by Centre d'Essais en Vol (CEV) for possible military applications, and supplied to Niger for insecticide spraying.

COSTS: Kit, with Rotax 912 UL engine, EUR15,000; flyaway EUR31,500 (2001).

DESIGN FEATURES: High wing with single bracing strut on each side; strut-braced tailplane. Wing section NACA 23012. Quoted build time 150 to 250 hours.

FLYING CONTROLS: Conventional and manual. Three-position plain flaps, deflections 0, 15 and 45°.

STRUCTURE: Steel tube fuselage with Dacron covering; composites wing; light alloy ailerons and flaps.

LANDING GEAR: Tailwheel type; fixed. Two faired-in side Vs hinged to lower longerons, plus half-axles sprung under centreline with bungee cord and attached to compression frame.

POWER PLANT: One 53.7 kW (72 hp) Humbert-Volkswagen HW 2000 or 59.6 kW (79.9 hp) Rotax 912 UL flat-four, driving a two-blade DUC FC composites propeller. Other options available, including JPX engine and 73.4 kW (98.4 hp) Rotax 912 ULS. Fuel in two wing tanks, combined capacity 60 litres (15.9 US gallons; 13.2 Imp gallons); can be increased to 85 litres (22.5 US gallons; 18.7 Imp gallons) for aircraft in countries other than France.

EQUIPMENT: Spray system optional.

DIMENSIONS, EXTERNAL:

Wing span	10.10 m (33 ft 1¾ in)
Length overall	6.50 m (21 ft 4 in)
Height overall	2.06 m (6 ft 9 in)
Propeller diameter	1.71 m (5 ft 7¼ in)

AREAS:

Wings, gross	15.70 m² (169.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	277 kg (611 lb)
Max T-O weight	450 kg (992 lb)

PERFORMANCE (Rotax 912 UL):

Max level speed	105 kt (194 km/h; 121 mph)
Cruising speed at 75% power at FL100	101 kt (187 km/h; 116 mph)
Stalling speed, flaps down	30 kt (55 km/h; 35 mph)
Max rate of climb at S/L	381 m (1,250 ft)/min
T-O run	50–80 m (164–262 ft)
g limits	+4/–2

ISSOIRE

ISSOIRE AVIATION

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DIRECTOR: Laurent Bourdier
SALES MANAGER: Yves Moyne-Bressand
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Issoire Aviation was established in 1978 as a successor to Wassmer Aviation and its CERVA lightplane division. A subsidiary, Rex Composites, is responsible for carbon fibre airframes including that of Sagem Sperwer UAV. Current product is the APM-20/30 lightplane, which is in very low-rate production. An unmanned version is planned.

Prototype Issoire APM-30 Lion *(Paul Jackson)* 1153795

ISSOIRE APM-20 LIONCEAU AND APM-30 LION

English name: Lion Cub

TYPE: Two-seat lightplane; three-seat lightplane.

PROGRAMME: Design (as Moniot APM-20) started 1992 by Les Industries de Composites d'Auvergne Réunités (ICAR); prototype (F-WWMP) exhibited at Paris Air Show 1995 before first flight on 21 November 1995; third (second flying) aircraft (F-WWXX) exhibited statically at Paris Air Show, June 1997, fitted with JPX flat-four engine, which is not offered on production aircraft. No. 4 (also F-WWXX) exhibited at Paris in June 1999 and No. 5 (F-GRRE) in 2001. Certified to JAR-VLA 17 May 1999 and to JAR-21 in 2000. First all-carbon fibre, single-engine aircraft to gain JAR-VLA certification. APM-21 will follow at unspecified date. Tailwheel and diesel-engined variants were under consideration in early 2003.

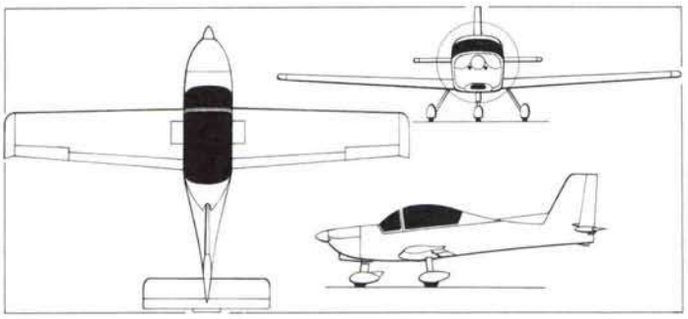
CURRENT VERSIONS: **APM-20:** Primary trainer *As described.*

APM-21 Lion: Aerial work version powered by 73.5 kW (98.6 hp) Rotax 912 ULS engine driving a two-blade, constant-speed Hoffmann propeller. Fitted with winglets. Prototype (F-WWMP, modified from prototype Lionceau) demonstrated at Paris Air Show in June 1999. Development halted in favour of APM-30.

APM-22 Liondo: Prototype APM-21 equipped with large winglets and exhibited at Paris, 15–22 June 2003, as representative of this UAV proposal, with 24-hour endurance and 556 kg (1,225 lb) MTOW.

APM-30 Lion: Three-seat version; EASA certification due 2006 for night VFR. Prototype F-WWXX first flew 2 June 2005 and made public debut at the Paris Air Show, 13 June

CUSTOMERS: Three flying prototypes; one static test airframe (No. 02). Total of 12 production aircraft registered by late 2005. Break-even point estimated at 200 aircraft.



APM-20 Lionceau (Rotax 912A engine) *(James Goulding)* 0064443

COSTS: EUR110,000 APM-20; EUR130,000 APM-30; both including tax (2005).

DESIGN FEATURES: Low wing, NACA 63418 aerofoil, thickness/chord ratio 18 per cent, dihedral 3°, incidence 1°30', twist 1°.

FLYING CONTROLS: Conventional and manual. Ailerons maximum deflections +15/-25°; horizontal tail surface aerofoil section Wortmann E10; fin/rudder aerofoil section NACA 64020 at root, NACA 64015 at tip; rudder maximum deflection +/-25°; spring elevator tab for pitch trim. Electrically operated slotted flaps to about two-thirds span, maximum deflection 25°.

STRUCTURE: Carbon fibre/epoxy; two-spar wing.

LANDING GEAR: Fixed tricycle type, with wheel fairings. Fuselage-mounted GFRP cantilever mainwheel legs with steerable oleo-sprung nosewheel. Mainwheels and nosewheel size 330 × 130; maximum pressure 2.35 bar (34 lb/sq in).

POWER PLANT: One 59.6 kW (79.9 hp) Rotax 912A (APM-20) or 73.5 kW (98.6 hp) Rotax 912S (APM-30) four-cylinder four-stroke driving an Evra AL1 two-blade, fixed-pitch wooden propeller. Fuel capacity 68 litres (18.0 US gallons; 15.0 Imp gallons), of which 65 litres (17.2 US gallons; 14.3 Imp gallons) are usable. Refuelling point on port side of fuselage. Oil capacity 4 litres (1.1 US gallons; 0.9 Imp gallon).

ACCOMMODATION: Two, side by side under rearward-sliding tinted canopy; third seat at rear in APM-30. Dual controls (sticks) and four-point harnesses standard. Baggage compartment at rear of seats in APM-20. Fixed step forward of wing leading-edge on each side.

AVIONICS: *Instrumentation:* VFR panel standard.

DIMENSIONS, EXTERNAL:

Wing span	8.66 m (28 ft 5 in)
Wing chord: at root	1.10 m (3 ft 7¼ in)
at tip	0.84 m (2 ft 9 in)
Wing aspect ratio	7.9
Length overall	6.60 m (21 ft 7¾ in)
Max width of fuselage	1.15 m (3 ft 9¼ in)
Height overall	2.40 m (7 ft 10½ in)
Tailplane span	2.68 m (8 ft 9½ in)
Wheel track	1.80 m (5 ft 10¾ in)
Propeller diameter	1.64 m (5 ft 4½ in)
Propeller ground clearance	0.31 m (1 ft 0¼ in)

DIMENSIONS, INTERNAL:

Cabin max width	1.06 m (3 ft 5¾ in)

AREAS:
- Wings, gross ..... 9.50 m² (102.3 sq ft)
- Ailerons (total) ..... 0.52 m² (5.60 sq ft)
- Trailing-edge flaps (total) ..... 1.36 m² (14.64 sq ft)
- Fin ..... 0.85 m² (9.15 sq ft)
- Rudder ..... 0.26 m² (2.80 sq ft)
- Tailplane ..... 1.74 m² (18.73 sq ft)
- Elevator, incl tab ..... 0.50 m² (5.38 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty: APM-20 ..... 380 kg (838 lb)
- APM-30 ..... 418 kg (922 lb)
- Baggage capacity ..... 20 kg (44 lb)
- Max fuel ..... 49 kg (108 lb)
- Max T-O weight:
  - APM-20 ..... 634 kg (1,397 lb)
  - APM-30 ..... 708 kg (1,560 lb)
- Max wing loading ..... 65.3 kg/m² (13.37 lb/sq ft)
- Max power loading ..... 10.39 kg/kW (17.06 lb/hp)

PERFORMANCE (APM-20/30, except as stated):
- Never-exceed speed (VNE) ..... 135 kt (250 km/h; 155 mph)
- Max cruising speed at FL55: APM-20 ..... 124 kt (230 km/h; 143 mph)
  - APM-30 ..... 130 kt (241 km/h; 150 mph)
- Econ cruising speed: APM-20 ..... 95 kt (176 km/h; 109 mph)
  - APM-30 ..... 100 kt (185 km/h; 115 mph)
- Manoeuvring speed ..... 108 kt (200 km/h; 124 mph)
- Stalling speed: flaps up ..... 56 kt (104 km/h; 65 mph)
  - flaps down: APM-20 ..... 44 kt (80 km/h; 50 mph)
  - APM-30 ..... 45 kt (84 km/h; 52 mph)
- Max rate of climb at S/L ..... 192 m (630 ft)/min
- T-O to 15 m (50 ft) ..... 499 m (1,640 ft)
- Landing from 15 m (50 ft) ..... 468 m (1,535 ft)
- Endurance ..... 4 h

KIEGER

ANDRE KIEGER

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Kieger (Junkers Profly) AK3 ultralight 1158655

M Kieger has been responsible for the design and construction of three low-wing, two-seat light aircraft, including the AK-01T of 1989 (F-PZMO, a tailwheel variant) and AK-2R, produced in 1998. The latter (F-PARJ) has now flown more than 1,200 hours as a tug at the Haguenau gliding club while a second example of the former (F-PAKT, tricycle landing gear) has been used by the Haguenau flying club since 2001.

KIEGER AK3

TYPE: Side-by-side ultralight.

PROGRAMME: Prototype (67-AAK, F-ZJTZ) had flown 10 hours up to time of public launch at Blois RSA meeting, August 2006. Series manufacture then scheduled to begin by Junkers in September 2006 at three per month.

COSTS: EUR59,800 plus tax (2006).

DESIGN FEATURES: Low-mounted wing and tailplane; sweptback fin; rectangular section lower fuselage; ovoid upper surface.

FLYING CONTROLS: Conventional and manual. Horn balances on rudder and elevators. Flaps.

STRUCTURE: Fuselage built on four longerons; plywood covering. Single-spar wing attached to fuselage by four steel (sailplane type) pins to facilitate rapid removal for storage; leading edge of plywood; false spar mounts control surfaces. Plywood empennage. Carbon fibre engine cowling.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring glass/carbon fibre laminate cantilever mainwheel legs; trailing link nosewheel on forward-raked cantilever leg. Hydraulic disc brakes on mainwheels.Wheel fairings.

POWER PLANT: One 58.8 kW (78.9 hp) Rotax 912 UL flat-four driving a Duc Swirl three-blade propeller. Fuel tank in fuselage, capacity 60 litres (15.9 US gallons; 13.2 Imp gallons); optional wing fuel tanks, combined capacity 70 litres (18.5 US gallons; 15.4 Imp gallons).

DIMENSIONS, EXTERNAL:
- Wing span ..... 8.00 m (26 ft 3 in)
- Length overall ..... 6.15 m (20 ft 2¼ in)

DIMENSIONS, INTERNAL:
- Cockpit max width ..... 1.13 m (3 ft 8½ in)

AREAS:
- Wings, gross ..... 10.40 m² (111.9 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty ..... 288 kg (635 lb)
- Max T-O weight ..... 472.5 kg (1,041 lb)

PERFORMANCE:
- Max level speed ..... 124 kt (230 km/h; 143 mph)
- Normal cruising speed ..... 108 kt (200 km/h; 124 mph)
- Stalling speed, flaps down ..... 34 kt (63 km/h; 40 mph)
- T-O and landing run ..... 100 m (330 ft)

LH

LH AVIATION

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Web: www.lhaviation.com
e-mail: info@lhaviation.com

DIRECTOR: Sébastien Lefebvre

ENGINEERS:
- Matthieu Founi
- Matthieu Billet

Sebastien Lefebvre and Frédéric Hubschwerlen formed LH Aviation in May 2004 to market the LH-10 Ellipse, an aircraft they designed themselves. International marketing began at Aero '05, Friedrichshafen, April 2005. In early 2007, the company had six employees.

LH-10 ELLIPSE

TYPE: Tandem-seat kitbuilt.

PROGRAMME: Design began June 2003; prototype construction started September 2003; announced at AviaExpo, Lyon, France, 18 June 2004, when a full-scale fuselage mockup was displayed. By late 2005 the prototype had been fitted with wings and landing gear, making first engine run on 30 December that year. First flight (F-WWMV) 10 November 2006. Investigation was under way in 2005 of Microjet Engineering's 97.0 kW (130 shp) HPX650 turboprop as a possible power plant.

Taxying trials of LH Aviation LH-10 Ellipse 1209323

DESIGN FEATURES: Objectives included wide speed range, permitting long-range travel at 200 kt (370 km/h; 230 mph) or pleasure flying at 100 kt (185 km/h; 115 mph) using only 5 litres (1.3 US gallons; 1.1 Imp gallons) per hour; operation from small airfields through use of high-lift devices; and large and comfortable cockpit.

Mid-mounted engine and pusher propeller; high aspect ratio wings with thickened root gloves; broad underfin; extended wheelbase achieved by forward-raked nosewheel; dual sidestick controls. Designed to FAR Pt 23 criteria.

Marketed as quick-build kit, with most composites structural parts bonded and ready for assembly. Builder assistance programme available.

FLYING CONTROLS: Manual. Full-span flaperons; horn-balanced rudder; all-moving tailplane.

STRUCTURE: Generally of composites.

LANDING GEAR: Tricycle type; fixed main gear and hydraulically-retractable castoring nosewheel. Rubber-in-compression shock-absorber on main legs; cantilever sprung nosewheel.

POWER PLANT: One 70.8 kW (95 hp) UL Power UL 260i flat-four piston engine in mid-fuselage, driving a three-blade, ground-adjustable pitch, pusher propeller via a carbon fibre drive shaft. Fuel capacity 70 litres (18.5 US gallons; 15.4 Imp gallons).

ACCOMMODATION: Two in tandem, under separate, single-piece canopies, front also as windscreen. Dual controls including sidesticks.

DIMENSIONS, EXTERNAL:

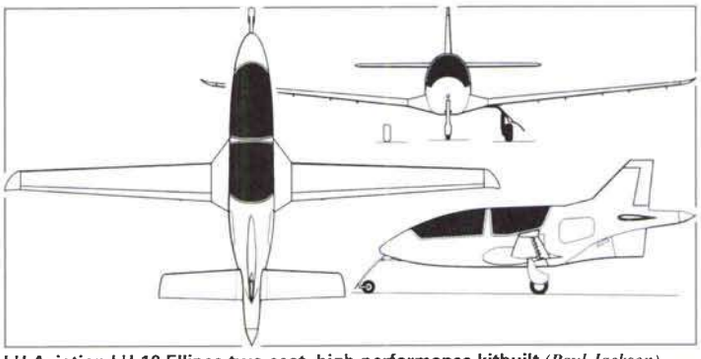
Wing span	8.00 m (26 ft 3 in)
Wing aspect ratio	14.2
Length overall	5.11 m (16 ft 9¼ in)
Height overall	2.14 m (7 ft 0¼ in)

DIMENSIONS, INTERNAL:

Cockpit max width	0.68 m (2 ft 2¾ in)

AREAS:

Wings, gross	4.50 m² (48.4 sq ft)



LH Aviation LH-10 Ellipse two-seat, high-performance kitbuilt *(Paul Jackson)*
1158957

WEIGHTS AND LOADINGS:

Weight empty	250 kg (551 lb)
Max T-O weight	490 kg (1,080 lb)

PERFORMANCE (estimated):

Never-exceed speed (VNE)	270 kt (500 km/h; 310 mph)
Max level speed	200 kt (370 km/h; 230 mph)
Cruising speed at 75% power	100 kt (185 km/h; 115 mph)
Stalling speed	53 kt (99 km/h; 61 mph)
T-O to 15 m (50 ft)	259 m (850 ft)
Landing from 15 m (50 ft)	259 m (850 ft)
g limits	+4.4/−2.2

LIFTIUM

LIFTIUM SA

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e-mail: didiercostes@wanadoo.fr
Web: www.perso-wanadoo.fr/liftium/liftium
MANAGING DIRECTOR: Gérant Didier Costes
PILOT: Thierry Garçon

Liftium's founder, Gérant Didier Costes, was a member in 1990–92 of a team which developed a human-powered airship known as the Zeppy-2 Continent. His Liftium is an unusual design of airship which is intended to become a family ranging in size from 250 to 6,000 m³ (8,830 to 211,900 cu ft), with even larger freight versions.

LIFTIUM LIFTIUM SERIES

TYPE: Helium semi-rigid airship.

PROGRAMME: First flight 7 November 2002 at Calvi, Corsica, by Liftium-1 prototype (W-91RG); later designated Model 250. This demonstrated excellent manoeuvrability and ease of piloting, but envelope fabric was poorly resistant to tearing; improved versions will utilise stronger fabric, while retaining power plant, tail surfaces, landing gear and other aspects of Liftium-1.

CURRENT VERSIONS: **Liftium 250:** Two-seat open cockpit ultralight version. Volume 250.0 m³ (8,830 cu ft). *As described.*

Liftium 500: Second stage development. Tandem seats in enclosed gondola; ultralight; volume 500.0 m³ (17,660 cu ft); suitable for sporting, patrol and training duties.

Liftium 1000: Four-seat version. Volume 1,000 m³ (35,315 cu ft); ultralight.

Liftium 6000: Capacity 20 passengers in side-by-side pairs. Volume 6,000 m³ (211,900 cu ft).

Liftium Fret 20T: Length 95 m (312 ft). Suspended load 20 tonnes. Rear engines augmented by horizontal sustaining rotors each side of gondola to provide additional lift.

Prototype Liftium-1 (Model 250) 1112130

Liftium Fret 35T: Length 125 m (410 ft). Suspended load 35 tonnes; two sustaining rotors.

Liftium Fret 300T: Length not given. Suspended load 300 tonnes; four sustaining rotors.

DESIGN FEATURES: 'Envelope' is in the form of a *flechette*, or dart, consisting of three inflated lobes of narrow delta planform, arranged in inverted Y configuration and powered by a pusher engine. Four-lobe version also possible.

FLYING CONTROLS: Elevator/rudder on each trailing-edge. Pitch equilibrium is maintained by transfer of water ballast between bow and stern.

STRUCTURE: Triple-lobe, dart-shaped envelope, with lower supplementary lobe above ventrally suspended gondola. Elastic ties permit variations in volume, obviating need for internal air ballonets. Lobes terminate in inflated fins, trailing-edges of which are braced by a three-tube structure supporting outboard pusher engine that vectors with the trailing-edge rudders. Flexible tubes, in sheaths along the grooves of each lobe, improve rigidity during partial deflation and are connected by shorter tubes at the stern.

POWER PLANT: Two 5.0 kW (6.7 hp) piston engines, in pusher configuration at tail, each driving a two-blade pusher propeller.

ACCOMMODATION: One or two seats.

DIMENSIONS, EXTERNAL:

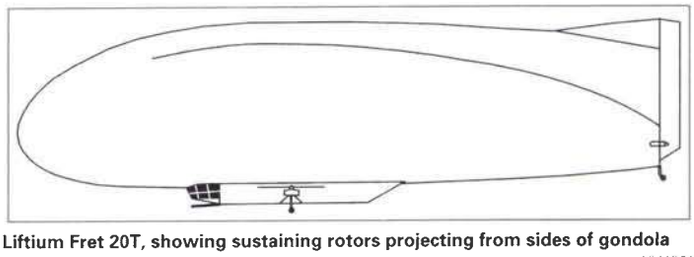
Length overall	18.00 m (59 ft 0¾ in)

DIMENSIONS, INTERNAL:

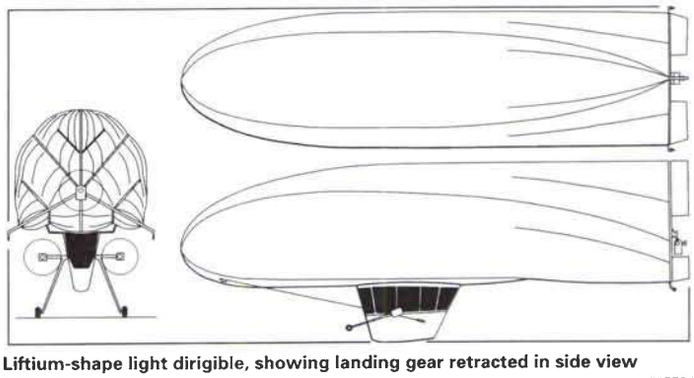
Envelope/wings volume, total	250.0 m³ (8,830 cu ft)

PERFORMANCE:

Max level speed	27 kt (50 km/h; 31 mph)



Liftium Fret 20T, showing sustaining rotors projecting from sides of gondola
1046951



Liftium-shape light dirigible, showing landing gear retracted in side view *(Paul Jackson)*
1047724

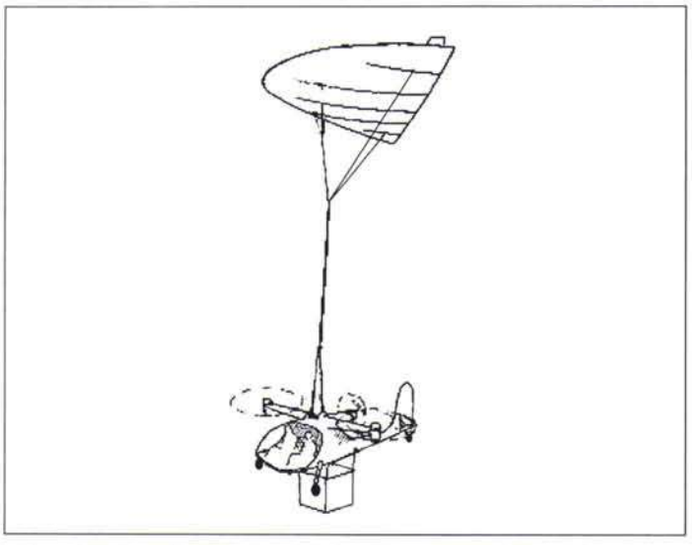
LIFTIUM HAL

TYPE: Lifting vehicle.

PROGRAMME: Design study.

DESIGN FEATURES: *Hélicoptère Allégé* (Reduced Helicopter). Combines helicopter with propeller and auxiliary lifting surface in the form of a thick, inflatable, delta aerofoil from which the fuselage is suspended by cables; intended for carriage of external loads.

Twin helicopter rotors (without cyclic pitch control) provide vertical lift capability; forward motion supplied by pusher propeller amidships, above cutaway rear fuselage; conventional tailfin. At cruising speed, the auxiliary aerofoil offloads the rotors, which are then stopped. Twin fins on upper surface of the aerofoil maintain its orientation in the direction of the relative wind, thereby balancing lift. The aerofoil can be drawn down and picketed alongside the fuselage when the aircraft is parked.



Designer's sketch of Liftium HAL. Note aerofoil orientated with the relative wind 1046950

NOIN

NOIN AERONAUTIQUE ALPAERO

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Web: www.alpaero.com
DIRECTOR: Claude Noin

Company formed 1976. The Exel is the fourth design produced by Claude Noin, whose father was a noted soaring pilot of the 1950s and was first to cross the Alps by glider. The company's earlier Sirius motor glider (22 produced) is no longer available, although it will return to active status if interest in design is increased.

NOIN CHOUCAS

English name: Jackdaw

TYPE: Side-by-side ultralight kitbuilt.

PROGRAMME: Design started 1994 by Claude Noin; construction of prototype started 1995; first flight (05-CO) February 1996; second aircraft flown 30 July 2004. Marketed as basic kit for advanced builders, quoted build time 1,200 hours. A special version for physically handicapped pilots is to be launched, if there is sufficient demand. From May 2006 a fast-build kit and a ready-to-fly version were released.

CUSTOMERS: Two flying and one under construction by early 2005.

COSTS: Kit (glass fibre) EUR7,738, (carbon fibre) EUR8,756; fast-build kit EUR26,670; ready-to-fly with Rotax 503 EUR50,125, excluding taxes (all 2006).

DESIGN FEATURES: Tail-less design, stated to be stallproof and spinproof; design aimed at meeting ultralight category certification requirements while matching performance of modern gliders and conventional three-axis ultralight aircraft. Dihedral 4°; zero twist.

FLYING CONTROLS: Unconventional flying wing; pitch control by elevators in inboard wing trailing-edge; ailerons outboard; large rudder. Trim tabs on elevators; spoilers/airbrakes on upper surface of wing.

STRUCTURE: Standard fuselage moulded in half-shells of carbon fibre/epoxy; glass fibre/epoxy fuselage available at lower cost for advanced builders, but with weight penalty; composites wing structure with carbon fibre main spar, glass fibre/epoxy-stiffened Styrofoam ribs and birch plywood D-section leading-edge, covered with heat-shrink Dacron; moulded carbon fibre/epoxy ailerons; Lexan/polycarbonate canopy with carbon fibre frame. Optional 0.65 m (2 ft 1½ in) wing extension available.

LANDING GEAR: Tailwheel type, fixed. Fuselage-mounted spring cantilever mainwheel legs with wheel fairings; drum brakes.

POWER PLANT: One 37.0 kW (49.6 hp) Rotax 503 UL-2V with 2.58:1 reduction gear driving a two-blade ground-adjustable DUC 20 carbon fibre propeller. Fuel capacity 36 litres (9.5 US gallons; 7.9 Imp gallons), of which 35 litres (9.25 US gallons; 7.7 Imp gallons) are usable.

ACCOMMODATION: Two, side by side beneath one-piece upward-hinging canopy; baggage shelf to rear of seats.

SYSTEMS: 14 V DC alternator provides electrical power.

AVIONICS (factory-built aircraft): *Comms:* VHF comm and intercom.

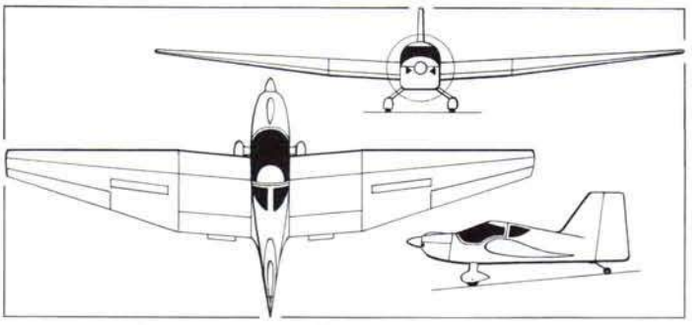
Instrumentation: ASI, altimeter, variometer, slip indicator, compass, tachometer, fuel gauge, chronometer, CHT and EGT gauges and voltmeter.

EQUIPMENT: BRS 5 ballistic parachute recovery system optional.

DIMENSIONS, EXTERNAL:

Wing span	14.35 m (47 ft 1 in)
Length overall	5.35 m (17 ft 6½ in)
Height overall	1.95 m (6 ft 4¾ in)
Propeller diameter	1.60 m (5 ft 3 in)

First Noin Choucas ultralight kitbuilt 1159271



Noin Choucas tail-less light aircraft *(Jane's/James Goulding)* 1159378

DIMENSIONS, INTERNAL:

Cabin max width	0.97 m (3 ft 2 in)

AREAS:

Wings, gross	21.30 m² (229.3 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	260–290 kg (573–639 lb)
Max T-O weight:	
FAI ultralight certification	450 kg (992 lb)
motor glider certification	510 kg (1,124 lb)

PERFORMANCE, POWERED:

Max level speed	97 kt (180 km/h; 111 mph)
Cruising speed at 75% power	70 kt (130 km/h; 81 mph)
Stalling speed	33 kt (60 km/h; 38 mph)
Max rate of climb at S/L	180 m (590 ft)/min
T-O run	100 m (330 ft)
Landing run	150 m (495 ft)
Range at 75% power, no reserves	175 n miles (325 km; 201 miles)

PERFORMANCE, UNPOWERED:

Best glide ratio	23
Min rate of sink	less than 1.00 m (3.28 ft)/s

NOIN EXEL

TYPE: Single-seat ultralight/motor glider/kitbuilt.

PROGRAMME: Design started 1997; first flight of prototype September 1998; construction of first production aircraft began 1999. Marketed as fast-build kit or ready to fly.

CUSTOMERS: Total of nine ordered and delivered by end 2005, including one export to Chile.

COSTS: Kit less engine, propeller and instruments, EUR23,900; ready-to-fly EUR33,000 plus tax (2006).

DESIGN FEATURES: Pod-and-boom configuration, with T tail. Aimed at meeting FAI ultralight and JAR 22 certification criteria. Quoted construction time of fast-build kit, 300 hours.

FLYING CONTROLS: Conventional and manual; cable-operated elevators, flaperons and rudder; three-position flaps, deflections −5, 0 and +5°. Airbrakes on upper wing surfaces.

STRUCTURE: Fuselage moulded in half-shells of glass fibre/epoxy with plywood bulkheads. Wings have carbon fibre spar caps and glass fibre skins. Fabric-covered rudder. Optional winglets. Quoted build time 300 hours.

Noin Exel single-seat ultralight motor glider 1159272

LANDING GEAR: Monowheel type; fixed. Tailwheel incorporated in base of rudder for directional control on the ground; small outrigger wheel at each wingtip. Drum brake on mainwheel.

POWER PLANT: One 13.4 kW (18 hp) JPX D-320 two-stroke flat twin with 2.38:1 reduction drive to a carbon fibre two-blade folding pusher propeller (three-blade propeller being tested October 2001). A 20.9 kW (28 hp) Hirth F-33 was being tested during early 2006. Fuel capacity 19 litres (5.0 US gallons; 4.2 Imp gallons).

EQUIPMENT: Optional ballistic parachute recovery system.

DIMENSIONS, EXTERNAL:

Wing span	13.74 m (45 ft 1 in)
Length overall	5.90 m (19 ft 4¼ in)
Propeller diameter	1.28 m (4 ft 2½ in)

AREAS:

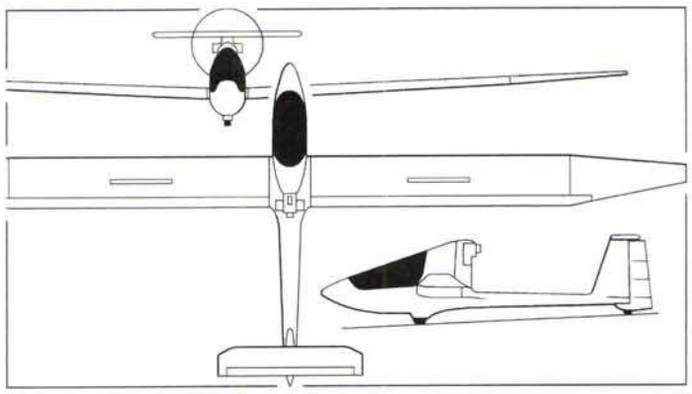
Wings, gross	11.62 m² (125.1 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	196 kg (432 lb)
Max T-O weight	310 kg (683 lb)

PERFORMANCE, POWERED:

Never-exceed speed (VNE)	97 kt (179 km/h; 111 mph)
Cruising speed at 75% power	65 kt (120 km/h; 75 mph)
Stalling speed	34 kt (63 km/h; 40 mph)
Max rate of climb at S/L	120 m (394 ft)/min
T-O run	150 m (492 ft)
Landing run	140 m (459 ft)
Endurance	3 h
g limits	+4.4/–2.2



Noin Exel (JPX D-320 engine) *(Paul Jackson)* 1159379

PERFORMANCE, UNPOWERED:

Best glide ratio	30
Min rate of sink	0.75 m (2.5 ft)/s

PROTOPLANE

PROTOPLANE AIRCRAFT DESIGN & PROTOTYPING

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Fax: (+33 5) 62 95 45 27
e-mail: info@protoplane.net
Web: www.protoplane.net
DIRECTOR: Béla Nogrady
WORKS MANAGER: Martine Zampieri

Company formed in 1999 to develop Massaï and Ultra series of aircraft and has subsequently branched into design and embodiment of structural modifications of business aircraft, airliners and helicopters.

M Nogrady, an amateur aircraft constructor since the age of 19, has also been involved in design of other aircraft, including the Campana Aviation Campana.

PROTOPLANE MASSAÏ

TYPE: Side-by-side ultralight motor glider/kitbuilt.

PROGRAMME: First reported in early 2002, when maiden flight said to be imminent. However, only a mockup was displayed at Paris in June 2003, since which time no further reports have been received, although low-intensity promotion was continuing in 2006.

A short-wing, tricycle gear version was developed and has become the Ultra, described separately.

DESIGN FEATURES: Low-wing motor glider with retractable landing gear and retractable propeller behind forward-sliding nosecone. Constant-chord inboard wing; outer panels with curved taper on leading- and trailing-edges. Constant-chord tailplane at base of sweptback fin. JAR 22 conformal.

Wing section FX66-17AII-182/26 at root; FX60-126.1/26 at tip. Dihedral 3°. Tailplane section FX71-L-150/35; fin FX71-L-117/33.

FLYING CONTROLS: Conventional and manual. Two-section ailerons extend over tapered and constant-chord sections. Flaps, max deflection 35°. Schempp-Hirth airbrakes.

STRUCTURE: Composites throughout.

LANDING GEAR: Monowheel type; retractable, including retractable (inward) outriggers at one-third span. Semi-buried tailwheel, mainwheel size 5.00–5; outriggers 125×45. Hydraulic disc brake.

POWER PLANT: One 48.0 kW (64.5 hp) Rotax 582 piston engine driving a 1.68 m (5 ft 6¼ in) diameter two-blade Protoplane wood and glass fibre folding ('Z-type') propeller via a belt reduction system. Fuel capacity 70 litres (18.5 US gallons; 15.4 Imp gallons).

ACCOMMODATION: Two persons, side by side, beneath single piece, forward-hinged canopy.

EQUIPMENT: Provision for surveillance sensors.

DIMENSIONS, EXTERNAL:

Wing span	16.38 m (53 ft 8¾ in)
Length overall, propeller retracted	7.42 m (24 ft 4¼ in)

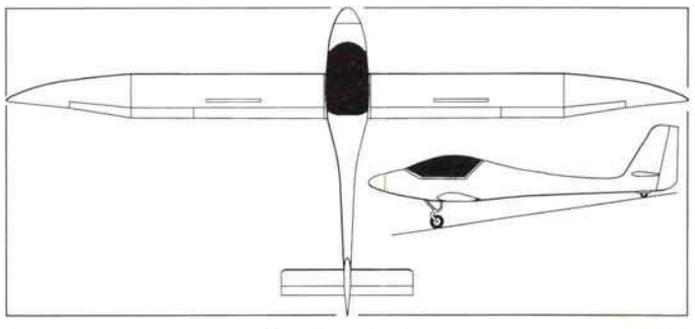
AREAS:

Wings, gross	15.46 m² (166.4 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	250 kg (551 lb)
Max T-O weight	450 kg (992 lb)

Protoplane Massaï at Paris In June 2003 *(Paul Jackson)* 0567725



Two elevations of Protoplane Massaï *(Paul Jackson)* 1158262

PERFORMANCE, POWERED:

Cruising speed	119 kt (220 km/h; 137 mph)
Max rate of climb at S/L	330 m (1,083 ft)/min
T-O run	73 m (240 ft)
Landing from 15 m (50 ft)	195 m (640 ft)
Range	449 n miles (832 km; 517 miles)
g limits	+5.73/-3.73

PERFORMANCE, UNPOWERED:

Stalling speed, flaps down	30 kt (55 km/h; 35 mph)
Best glide ratio	36
Min rate of sink	0.61 m (2.00 ft)/s

PROTOPLANE ULTRA

TYPE: Side-by-side ultralight/kitbuilt.

PROGRAMME: Short-wing, tricycle-gear version of Massaï powered glider. Public debut by prototype (registered F-WAAM) at Blois, France, September 2004, when marketed as Songh'Air Songhai. Licensing agreement with Songh'Air of Carcasonne was later cancelled, and at 2005 Blois show the aircraft had been renamed as above.

CURRENT VERSIONS: **Ultra:** Baseline version; glass fibre-Herex construction.

Ultra S: Carbon fibre construction, including Kevlar/Rohacell empennage. *As described.*

COSTS: Kit EUR37,800 or Ultra S EUR44,300; flyaway, EUR64,600 or Ultra S EUR71,100, all plus tax (2006).

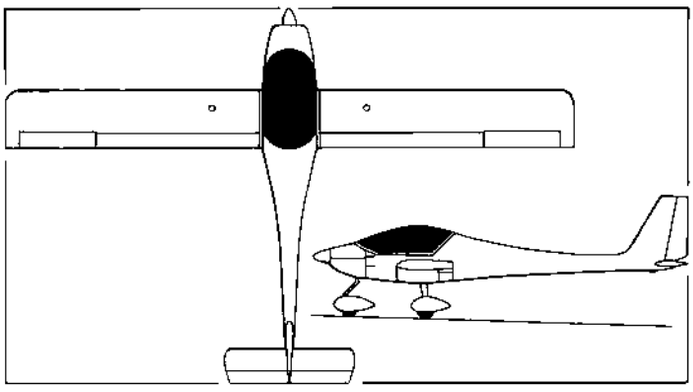
DESIGN FEATURES: Conforms to CS-VLA requirements. Low, constant-chord, high aspect ratio wing; offers high cruising speed on low power. Wings removable for storage by two persons.

Wing section FX66-17AII-182/26; tailplane section FX71-L-150/35; fin section NACA 0009.

FLYING CONTROLS: Conventional and manual. Pushrod actuation throughout. Three-position flaps; 0, 15 and 35°.

STRUCTURE: Generally of glass fibre/epoxy-Herex sandwich composites, with carbon fibre-epoxy wing spar and local fuselage strengthening. Fuselage of left, right and lower shells,

Protoplane Ultra two-seat ultralight 1158267



General arrangement of Protoplane Ultra *(Paul Jackson)* 1158259

glued and reinforced by carbon frames; wing shells top and bottom, reinforced by four carbon ribs. Empennage of Kevlar/epoxy-Rohacell sandwich. Engine cowling, cockpit interior and wheel fairings of glass fibre.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring Zicral alloy cantilever mainwheel legs with optional wheel fairings. Trailing link nosewheel with fairing. All tyres 5.00-5. Hydraulic mainwheel brakes.

POWER PLANT: One 59.7 kW (80 hp) Jabiru 2200 flat-four driving an Arplast TD152 two-blade propeller. Two structural fuel tanks in wing leading-edges; total capacity 90 litres (23.8 US gallons; 19.8 Imp gallons).

DIMENSIONS, EXTERNAL:

Wing span	11.00 m (36 ft 1 in)
Length overall	7.24 m (23 ft 9 in)
Height overall	2.32 m (7 ft 7¼ in)

DIMENSIONS, INTERNAL:

Cockpit max width	1.10 m (3 ft 7¼ in)

AREAS:

Wings, gross	12.10 m² (130.2 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	250 kg (551 lb)
Max T-O weight	450 kg (992 lb)

PERFORMANCE, POWERED:

Never-exceed speed (VNE)	147 kt (272 km/h; 169 mph)
Max level speed	132 kt (245 km/h; 152 mph)
Cruising speed	124 kt (229 km/h; 142 mph)
Max rate of climb at S/L	480 m (1,574 ft)/min
T-O run	48 m (160 ft)
Landing from 15 m (50 ft)	220 m (725 ft)
Range with max fuel	842 n miles (1,560 km; 969 miles)
g limits	+5.3/–2.65

PERFORMANCE, UNPOWERED:

Stalling speed, clean (flaps 35°)	30 kt (55 km/h; 35 mph)
Best glide ratio	22
Min sink rate at 53 kt (98 km/h; 61 mph)	1.11 m (3.64 ft)/s

REIMS

REIMS AVIATION INDUSTRIES

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DIRECTOR GENERAL: Philippe Denavit
VICE-PRESIDENT, MARKETING AND SALES: Philippe Denaoit
AREA SALES MANAGER: Laurent Mesmin
EXTERNAL RELATIONS: Max Boirame

Originally Avions Max Holste, founded 1933; Cessna acquired 49 per cent share in February 1960; name then changed to Reims Aviation, which licensed to manufacture Cessna aircraft for sale in Europe, Africa and Asia, but stopped making small piston-engined types when Cessna did; Reims had built 6,351 aircraft of all types by late 2001. Reims developed twin-turboprop F406 Caravan II (see below); but Cessna sold its share in Reims Aviation to Compagnie Française Chaufour Investissement (CFCI) in early 1989.

Filed for bankruptcy protection on 30 October 2002 following loss of aerostructures work in wake of Fairchild Dornier's bankruptcy. Company sold in two separate parts, with aerostructures and light aircraft maintenance becoming Reims Aerospace under ownership of Austrian group, Ventana.

Caravan production, marketing and maintenance activities purchased by Green Recovery venture capital group, becoming Reims Aviation Industries. Employees in 2003 totalled 40. Expansion plans included manufacture of four aircraft in 2004, but this not achieved in that or the following year.

REIMS F406 CARAVAN II

TYPE: Utility turboprop twin.

PROGRAMME: Announced mid-1982; first flight (F-WZLT) 22 September 1983; French certification 21 December 1984, FAA 28 August 1986; first flight production F406 (F-ZBEO) 20 April 1985.

CURRENT VERSIONS: **F406 Caravan II:** Initial production version, available in passenger, freight (with underbelly cargo pod), medevac, skydiving, aerial survey, training, navaid calibration and target towing variants. These retrospectively known as **F406 Mark I**.

F406 Mark II: Upgraded version announced (as F406 NG New Generation) in October 2000. Features include 473.5 kW (635 shp) PT6A-135A engines driving four-blade propellers; reduced structural weight; same MZFW; increase in maximum take-off weight to 4,700 kg (10,361 lb); quick-release access panels for easier maintenance; new lightweight instrument panel with liquid crystal displays; redesigned cabin interior by Air Esthetic featuring composites panels that can be painted or upholstered, improved acoustic and thermal insulation, new ergonomically designed seats with integral harnesses for improved comfort on long missions and integral window blinds; and standard Bendix/King Silver Crown avionics with Silver Crown Plus comms and two-tube EFIS display. Three standard cabin interiors offered: commuter, special missions and VIP. Take-off, climb and OEI rate of climb performance are improved, and endurance increased by up to one hour.

Additionally, six versions of the basic **Special Missions** configuration, each with a ventral 360° radar:

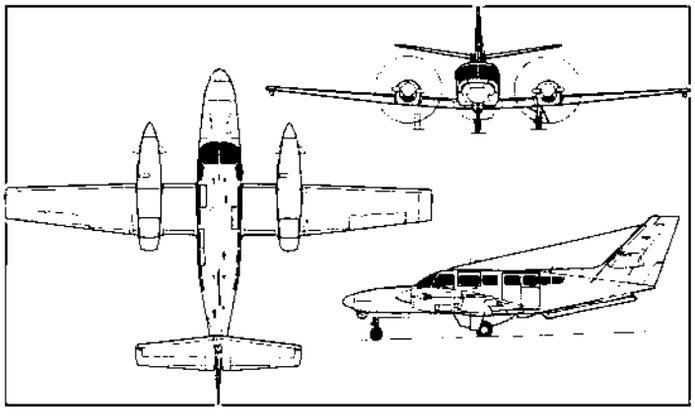
Vigilant: Surveillance version (land or sea) with mission equipment to suit customer requirement, including (in latest configuration) Thales Airborne Maritime Situation Control System (AMASCOS) which comprises belly-mounted Telephonics AN/APS-143, Texas Instruments 1022 or Thales/DASA Ocean Master 100/200 360° surveillance radars, chin-mounted FLIR turret for FSI Ultra, Inframetrics Mk III, SAGEM Hesis, Star Safire, Thales Chlio or Wescam FLIR, mission management and communications systems and single operator's console in Srs 100 form; or with additional console for electronic surveillance operator in Srs 200. BAE Systems Seaspray 2000 radar for Scottish Fisheries; Texas Instruments AN/APS-134 radar for Australian Customs.

Vigilant Frontier: Border patrol and anti-drug surveillance version with mission equipment including surveillance radar in anti-drug configuration, FLIR and datalink.

Vigilant Polmar II: Pollution surveillance (maritime police) version with SAGEM Cyclope 2000 IR linescanner and Ericsson or Terma SLAR.

Vigilant Polmar III: As Polmar II, but with updated survey systems and LLTV camera in chin turret. One upgrade ordered by French Customs in 2001 and delivered to Lorient-Lann Bihoué on 23 November 2004.

Vigilant Surmar: Surveillance (maritime) version with 360° radar, such as Texas Instruments AN/APS-134 or Telephonics AN/APS-143 and optional equipment including



Reims F406 Vigilant Surpolmar maritime surveillance aircraft 0547130

L-3 Wescam MX-15 FLIR turret and Litton night vision system. In 1996 Reims developed underwing hardpoints for the F406 which enable it to carry light weapons such as machine gun pods or rocket launchers, or camera pods or SAR liferafts.

Vigilant Surpolmar: Maritime surveillance version for Hellenic Coast Guard, combining Surmar and Polmar missions. Equipment specific to Greek aircraft comprises Surmar suite of Honeywell 1500B radar and FLIR. Systems Star Safire turret aided by Caledonian Airborne Systems track-while-scan system for 20-target tracking; and Polmar suite of Ericsson SLAR, Swedish Space Corporation MSS 5000 and SAGEM Cyclope 2000 IR linescan.

Vigilant Imint: Dedicated imaging intelligence version with L-3 Wescam MX20 gyro-stabilised, retractable turret in ventral camera port. Promoted in 2005.

Vigilant Comint/Imint: Dedicated communications and imaging intelligence version of the Caravan II, developed jointly with Thomson-CSF Communications, first shown at Paris '97. Equipped with Thomson TCC SAS airborne elint system, an operator's console with MS Windows NT-based workstation and an array of direction-finding antennas housed in a ventral radome. Is also first Vigilant with a pair of underwing pylons for carriage of stores which can include gun or rocket pods and airdroppable SAR equipment.

F406 Cartography: Equipped with Vexcel camera and IGN France International mission system. Initial aircraft (c/n 092) delivered to Biruni Remote Sensing Centre of Libya on 5 April 2005.

CUSTOMERS: One prototype and 91 production aircraft built by mid-2005. Further four sold, including two to Scottish Fisheries, and one (second of type) to Namibian Ministry of Fisheries, last named (c/n 093) for delivery in 2006.

French Customs Service received 10 in Surmar and two in Polmar I/II configuration. One in Polmar III configuration (No. 90), ordered in late 2000 and intended for delivery in 2002 but delayed until first quarter 2004. First Surmar (No. 74, although registered as a Vigilant) handed over 11 January 1995, followed by Nos. 75 and 77 on 12 September 1995, the latter two replacing Cessna 404s in Martinique, French Antilles.

Recent customers for the F406 include the Republic of Korea Navy, which ordered five in target tug configuration, the first delivered on 23 November 1998 and the last in mid-June 1999, total contract value being USD24 million (1997); and the Hellenic Coast Guard, which, in June 1999, ordered two for delivery in late 2000 as Surpolmar variants and additional one in November 1999; the first Surpolmar (F-WWSS/AC-21) for this contract made its maiden flight on 21 August 2000 and was delivered on 27 March 2001; remaining two received by December 2001, at which time a fourth was under negotiation. One to Air Saint-Pierre in mid-2003, fitted with TCAS II (first produced by Reims Aviation Industries). Total 92 sold by October 2003 (excluding prototype). An agreement with the Brazilian government signed in April 1998 provides for the purchase of three aircraft in multisensor configurations. Puerto Rico Police Force ordered one in Vigilant Surmar configuration, for delivery in mid-2005

COSTS: Standard commuter aircraft USD2.4 million (2003). Maritime patrol versions typically USD4 million to USD6 million with mission equipment. Korean Navy contract for five aircraft valued at USD24 million, including technician training and one-year technical support (1997). Greek contract for two Surmars valued at FFr90 million (1999); single Polmar FFr33 million (1999). Direct operating cost USD338 per hour (1997).

Reims F406 Caravan II operated on UK fisheries patrol by Directflight, fitted with RDR115 radar, FLIR turret and interferometer *(Paul Jackson)* 1128952

DESIGN FEATURES: Extrapolated from Cessna Conquest airframe; wing section NACA 23018 at root and 23012 at tip; dihedral 3° 30' on centre-section, 4° 55' on outer panels; twist −3°; incidence 2° at root; fin offset 1° to port; tailplane dihedral 9°; cabin not pressurised.

FLYING CONTROLS: Conventional and manual. Trim tabs in elevators, port aileron and rudder; hydraulically operated inboard and outboard Fowler flaps with 10, 20 and (inboard only) 30° fixed settings. Control surface movements: ailerons +25/−14°; elevators +14/17°; rudder ±32°.

STRUCTURE: Conventional light metal with three-spar fail-safe wing centre-section to SFAR 41C; two-spar outer wings.

LANDING GEAR: Hydraulically retractable tricycle type with single wheel on each unit. Mainwheel tyre size 22×7.75−10, nosewheel 6.00-6. Main units retract inward into wing, nosewheel rearward. Emergency extension by means of a 138 bar (2,000 lb/sq in) rechargeable nitrogen bottle. Cessna oleo-pneumatic shock-absorbers. Main units of articulated (trailing link) type. Single-disc hydraulic brakes. Parking brake.

POWER PLANT: Two Pratt & Whitney Canada PT6A-112 turboprops (each 373 kW; 500 shp), each driving a McCauley 3GFR34C701/93KB-0 three-blade, reversible-pitch, and automatically feathering metal propeller. Fuel in two wing tanks, combined capacity 1,823 litres (481 US gallons; 401 Imp gallons) of which 1,798 litres (475 US gallons; 395.5 Imp gallons) usable. Oil capacity 17.2 litres (4.5 US gallons; 3.8 Imp gallons).

ACCOMMODATION: Crew of two and up to 12 passengers, in pairs facing forward, with centre aisle, except at rear of cabin in 12/14-seat versions. Alternative basic configurations for six VIP passengers in reclining seats in business version, and for operation in mixed passenger/freight role. Business version has partition between cabin and flight deck, and lavatory on starboard side at rear. Split main door immediately aft of wing, on port side, with built-in airstair in downward-hinged lower portion. Optional cargo door forward of this door to provide single large opening. Overwing emergency exit on each side. Passenger seats removable for cargo carrying, or for conversion to ambulance, air photography, maritime surveillance and other specialised roles. Baggage compartments in nose, with three doors, at rear of cabin and in rear of each engine nacelle. Ventral cargo pod optional.

SYSTEMS: Freon air conditioning system of 16,000 BTU capacity, plus engine bleed air and electric boost heating. Electrical system includes 28 V 250 A starter/generator on each engine and 39 Ah Ni/Cd battery. Hydraulic system, pressure 120 bar (1,750 lb/sq in), for operation of landing gear. Separate hydraulic system for brakes. Optional Goodrich pneumatic de-icing of wings and tail unit, and electric windscreen de-icing.

AVIONICS: Standard Bendix/King Silver Crown; Gold Crown optional.

Comms: Dual Bendix/King transceivers.

Radar: Honeywell RDR 2000 weather radar optional. Maritime surveillance radar as described under Current Versions.

Flight: Dual ADF and marker beacon receiver. Autopilot optional.

Instrumentation: Provision for equipment to FAR Pt 135A standards, including dual controls and instrumentation for co-pilot.

EQUIPMENT: Optional cargo interior includes heavy-duty sidewalls, utility floorboards, cabin floodlighting and cargo restraint nets. Optional pylons under each wing for carriage of stores including gun or rocket pods and airdroppable SAR equipment. Optional camera hatch in lower rear fuselage; installed in 34 aircraft up to 2005.

DIMENSIONS, EXTERNAL:

Wing span	15.08 m (49 ft 5½ in)
Wing aspect ratio	9.7
Length overall	11.89 m (39 ft 0¼ in)
Height overall	4.01 m (13 ft 2 in)
Tailplane span	5.87 m (19 ft 3 in)
Wheel track	4.28 m (14 ft 0½ in)
Wheelbase	3.81 m (12 ft 6 in)
Propeller diameter	2.36 m (7 ft 9 in)
Cabin door: Height	1.27 m (4 ft 2 in)
Width	0.58 m (1 ft 10¾ in)
Cargo double door (optional):	
Total width	1.24 m (4 ft 1 in)

DIMENSIONS, INTERNAL:

Cabin (incl flight deck): Length	5.71 m (18 ft 8¾ in)
Max width	1.42 m (4 ft 8 in)
Max height	1.31 m (4 ft 3¼ in)
Min height (at rear)	1.21 m (3 ft 11½ in)
Width of aisle	0.29 m (11½ in)
Volume	8.6 m³ (305 cu ft)
Baggage compartment (nose):	
Length	2.00 m (6 ft 6¾ in)
Volume	0.74 m³ (26.0 cu ft)
Nacelle lockers: Length	1.55 m (5 ft 1 in)
Width	0.73 m (2 ft 4¾ in)
Baggage volume: total, internal	2.2 m³ (79 cu ft)
incl cargo pod	3.5 m³ (124 cu ft)

AREAS:

Wings, gross	23.48 m² (252.8 sq ft)
Ailerons (total)	1.36 m² (14.64 sq ft)
Trailing-edge flaps	3.98 m² (42.84 sq ft)
Fin	4.05 m² (43.59 sq ft)
Rudder, incl tab	1.50 m² (16.15 sq ft)
Tailplane	5.81 m² (62.54 sq ft)
Elevators, incl tabs	1.66 m² (17.87 sq ft)

WEIGHTS AND LOADINGS:

Standard empty weight	2,283 kg (5,033 lb)
Max payload	2,219 kg (4,892 lb)
Max fuel weight	1,444 kg (3,183 lb)
Max ramp weight: except FAA	4,502 kg (9,925 lb)
FAA	4,279 kg (9,435 lb)
Max T-O and landing weight: except FAA	4,468 kg (9,850 lb)
FAA	4,245 kg (9,360 lb)
Max zero-fuel weight	3,856 kg (8,500 lb)
Max wing loading	190.3 kg/m² (38.97 lb/sq ft)
Max power loading	5.99 kg/kW (9.85 lb/shp)

PERFORMANCE:

Max operating Mach No. (MMO)	0.52
Max operating speed (VMO)	229 kt (424 km/h; 263 mph) IAS
Max cruising speed	246 kt (455 km/h; 283 mph)
Econ cruising speed	200 kt (370 km/h; 230 mph)
Stalling speed:	
wheels and flaps up	94 kt (174 km/h; 108 mph) IAS
wheels and flaps down	81 kt (150 km/h; 93 mph) IAS
Max rate of climb at S/L	564 m (1,850 ft)/min
Rate of climb at S/L, OEI	121 m (397 ft)/min
Max certified altitude	9,145 m (30,000 ft)
Service ceiling, OEI	4,935 m (16,200 ft)
T-O run	526 m (1,725 ft)
T-O to 15 m (50 ft)	803 m (2,635 ft)
Landing from 15 m (50 ft), without reverse pitch	674 m (2,215 ft)
Range with max fuel, at max cruising speed, 45 min reserves	1,153 n miles (2,135 km; 1,327 miles)
g limits	+3.6/−1.44

OPERATIONAL NOISE LEVELS:

Flyover	72.0 EPNdB

ROBIN

ROBIN AVIATION

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Web: www.apex-aircraft.com
NON-EXECUTIVE CHAIRMAN: Philippe Corne
CEO AND GENERAL MANAGER: Guy Pellissier
SALES MANAGER, EUROPE: Pierre Pelletier

Formed October 1957 as Centre Est Aéronautique; name changed to Avions Pierre Robin 1969; acquired July 1988 by Compagnie Française Chaufour Investissement (CFCI) and incorporated into Aéronautique Service group (now Apex International) with Robin SA (after-sales support company of Dijon Val-Suzon); Pierre Robin left company 1990. Total of some 3,770 aircraft produced by late 2004 (excluding 35 Sperwer UAVs). Factory area (Constructions Aéronautiques de Bourgogne) 9,000 m^2 (96,875 sq ft).

Former Robin subdivisions, Constructions Aéronautiques de Bourgogne and Aéronautique Finance et Services, are now separate companies. The first-mentioned is responsible for the construction of Robin aircraft, as explained in the entry for Aéronautique Service.

Latest production addition to Robin range is R 2120 Alpha trainer, introduced 2001. However, on 25 June 2004 Alpha Aviation of New Zealand announced its plans to acquire the R 2120 programme and transfer manufacture from Europe, leaving Robin to concentrate on its range of wooden aircraft.

Robin's parent company, Apex Aircraft, emerged from voluntary receivership 25 August 2003.

ROBIN DR 400 DAUPHIN

English name: Dolphin

TYPE: Four-seat lightplane.

PROGRAMME: First flight original DR 400 Petit Prince 15 May 1972; based on DR 300, but with forward-sliding canopy; DR 400/100 Cadet (two-seat) and DR 400/108 Dauphin 80 included among early versions. French and UK certification 1977; DR 400 Dauphin introduced 1979; improvements introduced 1988 and 1993.

CURRENT VERSIONS: **DR 400/100:** Discontinued. Former names: 2+2, Tricycle and Cadet.

DR 400/120 Dauphin 2+2: Production version with 88.0 kW (118 hp) engine, to carry two adults and two children. Based on former DR 400/120 Petit Prince, but with extra cabin windows.

DR 400/125i: Version of Dauphin 2+2 with fuel-injected 93.2 kW (125 hp) Teledyne Continental IO-240 driving three-bladed Mühlbauer constant-speed propeller, diameter 1.70 m (5 ft 7 in); prototype (F-WNNK) first flown 1995 and made its public debut at the Paris Air Show in June 1995; engine/propeller combination improves take-off, climb and cruising performance and reduces noise levels; one delivered in 1996. Weights and performance data in 2000–01 and earlier editions. No further production.

DR 400/135 Ecoflyer: Version of Dauphin 2+2 with 99 kW (132.8 hp) Thielert Centurion 1.7 aero diesel engine driving an MT variable-pitch propeller; prototype (D-ECDI) completed ground running tests in August 2003 and first flew 10 October 2003. All DR 400/135s are built as DR 400/140Bs and converted before delivery to customers. EASA certification July 2005; first delivery 25 July 2005, PH-VSQ to Vliegclub Seppe, Netherlands.

DR 400/140B Dauphin 4: Full four-seater with 119 kW (160 hp) engine. Previously known as Major 80, which replaced DR 400/140 Major and Earl.

DR 400/160 and DR 400/180: *Described separately.*

CUSTOMERS: Some 1,881 of DR 400 series built by late 2005. Exports mainly to Germany, Switzerland and UK.

ROBIN DR 300/400/500 PRODUCTION (1968-2005)

Variant	Qty	Qty	Qty	First aircraft	Date
DR 315	100			F-BPKY	1968
DR 340	61			F-BPOO	1968
DR 360	30			F-BPOQ	1968
DR 380	22			F-BRCP	1969
DR 300-108	92			F-BRVV	1970
DR 300-120	3			F-ZVMG	1971
DR 300-125	41			F-BRZR	1970
DR 300-140	2			F-BPXX	1970
DR 300-180R	42			F-BPXY	1970
Subtotal	**393**				
DR 400-100		153		G-BAGS	1972
DR 400-108		1		F-BTKZ	1973
DR 400-120		395		F-BTKC	1972
DR 400-120A		16		F-BUPJ	1973
DR 400-120D		18		D-EGWU	1981
DR 400-120P		1		F-WLKJ	1992
DR 400-125		19		F-BTBA	1972
DR 400-135TDi				D-ECDI	2003
DR 400-140		66		G-BAGC	1972
DR 400-140B		185		F-BUHE	1973
DR 400-160		175		F-OCSR	1972
DR 400-160D		4		D-EEVA	1982
DR 400-180		412		D-ENTB	1973
DR 400-180C		1		TC-FAM	1985
DR 400-180R		366		OE-DSB	1973
DR 400-180RD		1		LN-DFK	2003
DR 400-180RP		31		F-WIEQ	1985
DR 400-180S		15		HB-KAT	1985
DR 400-200R		14		F-ZWWX	1993
DR 400-200i		1		F-WZZY	1997
DR 400-V65		1		F-WGXT	1995
DR 400-NGL		1		F-WGXT	1988
Not known		6			
Subtotal		**1,881**			
DR 500-200i			40	F-WZZY	
DR 500C			1	F-WZZY	2002
Subtotal			**41**		
Prototypes:					

Robin DR 400/120, lowest-powered of current Dauphins *(Paul Jackson)*
1128953

Variant	Qty	Qty	Qty	First aircraft	Date
DR 315-01	1			F-WOFT	1968
DR 340-01	1			F-WOFP	1968
DR 360-01	1			F-WOFS	1968
DR 380-01	1			F-WPXC	1968
DR 400-125-02		1		F-WSQT	1972
DR 400-160-03		1		F-WSQZ	1972
DR 400-180-01		1		F-WSQQ	1972
Total	**397**	**1,884**	**41**		

[1] Conversions of DR 400/140B

DESIGN FEATURES: Typical Jodel-type design with low wing of constant chord inboard, but tapered, dihedral outer panels. Mid-positioned tailplane and swept fin leading-edge.

Wing section NACA 23013.5 modified with leading-edge droop; centre panels parallel chord, slight twist; outer panels tapered with dihedral 14°; twist −6°.

FLYING CONTROLS: Manual. Conventional ailerons and rudder. All-moving tailplane with trimmable anti-balance tab on each side; plain flaps.

STRUCTURE: All-wood; single box spar with ribs threaded over box; plywood-covered leading-edge box; polyester fabric covering elsewhere; fuselage plywood-covered; flaps all-metal and interchangeable; ailerons interchangeable.

LANDING GEAR: Non-retractable tricycle type, with long-stroke oleo-pneumatic shock-absorbers and hydraulically actuated disc brakes. All three wheels and tyres are size 380×150, pressure 1.57 bar (23 lb/sq in) on nose unit, 1.77 bar (26 lb/sq in) on main units. Nosewheel steerable via rudder bar. Fairings over all three legs and wheels. Tailskid with damper. Toe operated disc brakes and parking brake.

POWER PLANT: *Dauphin 2+2:* One 88.0 kW (118 hp) Textron Lycoming O-235-L2A flat-four engine, driving a Sensenich 72CKS6-0-56 two-blade, fixed-pitch aluminium propeller, or Hoffmann two-blade wooden propeller.

Dauphin 4: One Textron Lycoming O-320-D2A flat-four engine developing 104 kW (140 hp) at 2,300 rpm and 119 kW (160 hp) at 2,700 rpm. Sensenich 74DM6S5-2-64 propeller.

DR400/135 cdi Ecoflyer: One TAE Centurion 1.7 diesel engine, rated at 99.0 kW (132.8 hp), driving an MT-Propeller, three-blade, variable-pitch metal propeller. Fuel tank in fuselage, capacity 110 litres (29.1 US gallons; 24.2 Imp gallons) with filler port on left side; Dauphin 4 has optional 51 litre (13.5 US gallon; 11.2 Imp gallon) auxiliary tank, with filler port on right side. Oil capacity 5.7 litres (1.5 US gallons; 1.25 Imp gallons).

ACCOMMODATION: Enclosed cabin, with fore-and-aft adjustable seats for three or four persons. Three-point inertia-reel harnesses standard. Maximum weight of 154 kg (340 lb) on front pair and 136 kg (300 lb), including baggage, at rear in Dauphin 2+2. Additional 55 kg (121 lb) of disposable load in Dauphin 4. Access via forward-sliding jettisonable transparent canopy. Dual controls standard. Cabin heated and ventilated. Baggage compartment with internal access.

SYSTEMS: Standard equipment includes a 12 V 50 A alternator, 12 V 32 Ah battery, electric starter, audible stall warning and windscreen de-icing.

AVIONICS: To customer's choice, typically Bendix/King KX 155 nav/com, KI 208 VOR/LOC indicator, KT 76C transponder with ACK 30 altitude encoder, Garmin 150 XL GPS, and SPA 400 intercom system, four microphone and headset jack plugs, and PTT switch on each control stick.

Instrumentation: Standard equipment includes ASI, sensitive altimeter, rate of climb indicator, artificial horizon, directional gyro, electric turn co-ordinator, magnetic compass, recording tachometer, eight-light annunciator/warning panel with dimmer, oil pressure and temperature gauges, fuel quantity gauges, fuel pressure gauge, and flight time recorder. 135 CDI has electronic engine instrumentation. Options include OAT gauge, CHT gauge, EGT gauge, and carburettor air temperature indicator.

EQUIPMENT: Standard equipment includes navigation lights, taxying and landing light, anti-collision strobe light, instrument panel lighting, and overall polyurethane paint with two-colour scheme. Options include pitot heat, external power socket, alternative static source, and additional exhaust silencer.

DIMENSIONS, EXTERNAL:

Wing span ..... 8.72 m (28 ft 7¼ in)
Wing chord:
centre-section, constant ..... 1.71 m (5 ft 7½ in)
at tip ..... 0.90 m (2 ft 11½ in)

Cockpit of Robin Ecoflyer *(Jane's/Jamie Hunter)*
1128920

First Robin DR 400/135 cdi Ecoflyer on British civil aircraft register *(Jane's/Jamie Hunter)* 1128919

Wing aspect ratio 5.6
Length overall ..... 6.96 m (22 ft 10 in)
Height overall ..... 2.23 m (7 ft 3¾ in)
Tailplane span ..... 3.20 m (10 ft 6 in)
Wheel track ..... 2.60 m (8 ft 6¾ in)
Wheelbase ..... 5.20 m (17 ft 0¾ in)
Propeller diameter: 2+2 ..... 1.83 m (6 ft 0 in)
4 ..... 1.88 m (6 ft 2 in)

DIMENSIONS, INTERNAL:
Cabin: Length ..... 1.62 m (5 ft 3¾ in)
Max width ..... 1.10 m (3 ft 7¾ in)
Max height ..... 1.23 m (4 ft 0½ in)
Baggage volume ..... 0.39 m³ (13.8 cu ft)

AREAS:
Wings, gross ..... 13.60 m² (146.4 sq ft)
Ailerons, total ..... 1.15 m² (12.38 sq ft)
Flaps, total ..... 0.70 m² (7.53 sq ft)
Fin ..... 0.61 m² (6.57 sq ft)
Rudder ..... 0.63 m² (6.78 sq ft)
Horizontal tail surfaces, total ..... 2.88 m² (31.00 sq ft)

WEIGHTS AND LOADINGS:
Weight empty, equipped: 2+2 ..... 550 kg (1,212 lb)
4 ..... 580 kg (1,279 lb)
135 cdi ..... 628 kg (1,385 lb)
Max baggage: 2+2, 4 ..... 40 kg (88 lb)
Max T-O and landing weight: 2+2 ..... 900 kg (1,984 lb)
135 cdi ..... 980 kg (2,160 lb)
4 ..... 1,000 kg (2,205 lb)
Max wing loading: 2+2 ..... 66.2 kg/m² (13.56 lb/sq ft)
135 cdi ..... 72.0 kg/m² (14.75 lb/sq ft)
4 ..... 73.5 kg/m² (15.05 lb/sq ft)
Max power loading: 2+2 ..... 10.23 kg/kW (16.81 lb/hp)
135 cdi ..... 9.89 kg/kW (16.26 lb/hp)
4 ..... 8.38 kg/kW (13.78 lb/hp)

PERFORMANCE:
Never-exceed speed (VNE):
2+2, 4 ..... 166 kt (308 km/h; 191 mph)
Max level speed at S/L:
2+2 ..... 130 kt (241 km/h; 150 mph)
4 ..... 143 kt (265 km/h; 165 mph)
Cruising speed at 75% power:
2+2 ..... 116 kt (215 km/h; 133 mph)
135 cdi ..... 126 kt (233 km/h; 145 mph)
4 ..... 128 kt (237 km/h; 147 mph)
Stalling speed, flaps down:
2+2 ..... 45 kt (82 km/h; 51 mph)
4 ..... 47 kt (87 km/h; 54 mph)
Max rate of climb at S/L: 2+2 ..... 183 m (600 ft)/min
135 cdi ..... 200 m (656 ft)/min
4 ..... 264 m (865 ft)/min
Service ceiling: 2+2 ..... 3,660 m (12,000 ft)
4 ..... 4,265 m (14,000 ft)
T-O run: 2+2 ..... 235 m (775 ft)
4 ..... 245 m (805 ft)
135 cdi ..... 440 m (1,443 ft)
T-O to 15 m (50 ft): 2+2 ..... 535 m (1,755 ft)
4 ..... 485 m (1,595 ft)
Landing from 15 m (50 ft): 2+2 ..... 460 m (1,510 ft)
4, 135 cdi ..... 470 m (1,541 ft)
Landing run: 2+2 ..... 200 m (660 ft)
4 ..... 220 m (725 ft)
Range with standard fuel at 65%, no reserves: 2+2 ..... 495 n miles (916 km; 569 miles)
4 ..... 447 n miles (828 km; 514 miles)
135 cdi ..... 648 n miles (1,200 km; 745 miles)
Range, with optional fuel at 65% power, no reserves
4 ..... 645 n miles (1,195 km; 742 miles)
135 cdi ..... 971 n miles (1,800 km; 1,118 miles)

ROBIN DR 400/160 MAJOR

TYPE: Four-seat lightplane.

PROGRAMME: First flight of original DR 400/160 Chevalier 29 June 1972; certified France and UK same year; also marketed under translated name, Knight; Major introduced 1980, being based on DR 400/140B Major 80 with additional cabin windows.

CUSTOMERS: Some 179 built up to 2005; production continues at low rate.

DESIGN FEATURES: Main differences from Dauphin are external baggage compartment door on port side and extended wingroot leading-edges to house additional fuel tanks.

Differences from Dauphin listed below:

POWER PLANT: One 119 kW (160 hp) Textron Lycoming O-320-D2A flat-four engine, driving a Sensenich 74DM6S5-2-64 two-blade, fixed-pitch aluminium propeller. Fuel tank in fuselage, capacity 110 litres (29.1 US gallons; 24.2 Imp gallons), and two tanks in wingroot leading-edges, giving total capacity of 190 litres (50.2 US gallons; 41.8 Imp gallons), of which 182 litres (48.1 US gallons; 40.0 Imp gallons) are usable. Provision for auxiliary tank, raising total capacity to 240 litres (63.4 US gallons; 52.8 Imp gallons). Oil capacity 7.6 litres (2.0 US gallons; 1.7 Imp gallons).

ACCOMMODATION: Seating for four persons, on adjustable front seats (maximum load 154 kg; 340 lb total) and rear bench seat (maximum load 154 kg; 340 lb total). Forward-sliding transparent canopy, but port rear window/door provides outside access to baggage area. Up to 40 kg (88 lb) of baggage can be stowed aft of rear seats when four occupants are carried.

AVIONICS: To customer's choice, typically Garmin GNS430 GPS/com/nav/ILS with GI 106 indicator, Bendix/King KX 155 nav/com 2, Bendix/King KI 203 indicator, Garmin GTX 327 transponder, with ACK 30 altitude encoder, and Garmin GMA 340 audio panel.

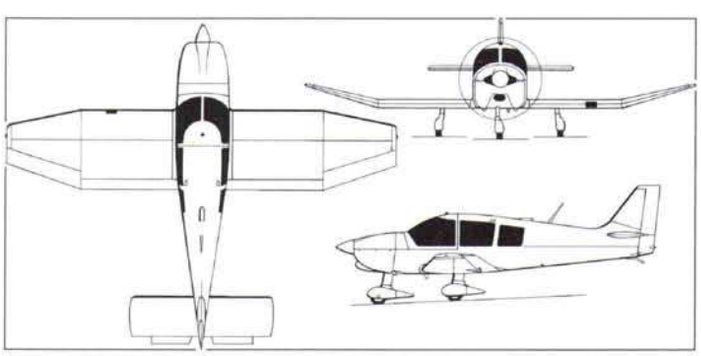
DIMENSIONS, EXTERNAL:
Propeller diameter ..... 1.83 m (6 ft 0 in)
Baggage door: Height ..... 0.47 m (1 ft 6½ in)
Width ..... 0.55 m (1 ft 9½ in)

Robin DR 400/160 *(Paul Jackson)* 1128954

AREAS:
Wings, gross ..... 14.20 m² (152.8 sq ft)
WEIGHTS AND LOADINGS:
Weight empty, equipped ..... 598 kg (1,318 lb)
Max T-O and landing weight ..... 1,050 kg (2,315 lb)
Max baggage weight ..... 60 kg (132 lb)
Max wing loading ..... 74.0 kg/m² (15.15 lb/sq ft)
Max power loading ..... 8.81 kg/kW (14.47 lb/hp)
PERFORMANCE:
Never-exceed speed (VNE) ..... 166 kt (308 km/h; 191 mph)
Max level speed at S/L ..... 146 kt (271 km/h; 168 mph)
Max cruising speed at 75% power at 2,440 m (8,000 ft) ..... 132 kt (245 km/h; 152 mph)
Econ cruising speed at 65% power at 3,200 m (10,500 ft) ..... 130 kt (241 km/h; 150 mph)
Stalling speed: flaps up ..... 56 kt (103 km/h; 64 mph)
flaps down ..... 50 kt (93 km/h; 58 mph)
Max rate of climb at S/L ..... 255 m (836 ft)/min
Service ceiling ..... 4,115 m (13,500 ft)
T-O run ..... 295 m (970 ft)
T-O to 15 m (50 ft) ..... 590 m (1,940 ft)
Landing from 15 m (50 ft) ..... 545 m (1,790 ft)
Landing run ..... 250 m (820 ft)
Range at econ cruising speed, no reserves:
standard fuel ..... 813 n miles (1,505 km; 935 miles)
optional fuel ..... 1,026 n miles (1,900 km; 1,180 miles)

ROBIN DR 400/180 REGENT

TYPE: Four seat lightplane.
PROGRAMME: First flight (F-WSQO) 27 March 1972; certified 10 May 1972. Later versions with additional cabin windows.
CUSTOMERS: Total 413 built by late 2005, excluding glider tug variants.
DESIGN FEATURES: Generally as for DR 400 series; two-seat rear bench.
Differences from DR 400/160 listed below:
POWER PLANT: One 134 kW (180 hp) Textron Lycoming O-360-A3A flat-four engine driving a Sensenich 76EM8S5-0-64 two-blade, fixed-pitch aluminium propeller. Fuel tankage unchanged.
ACCOMMODATION: Basically as for DR 400/160.
DIMENSIONS, EXTERNAL:
Propeller diameter ..... 1.93 m (6 ft 4 in)
WEIGHTS AND LOADINGS:
Weight empty, equipped ..... 610 kg (1,345 lb)
Max T-O and landing weight ..... 1,100 kg (2,425 lb)
Max wing loading ..... 77.48 kg/m² (15.87 lb/sq ft)
Max power loading ..... 8.21 kg/kW (13.47 lb/hp)
PERFORMANCE (at max T-O weight):
Max level speed at S/L ..... 150 kt (278 km/h; 173 mph)
Max cruising speed at 75% power at 2,285 m (7,500 ft) ..... 140 kt (260 km/h; 162 mph)
Econ cruising speed at 60% power at 3,660 m (12,000 ft) ..... 132 kt (245 km/h; 152 mph)
Stalling speed: flaps up ..... 57 kt (105 km/h; 65 mph)
flaps down ..... 52 kt (95 km/h; 59 mph)
Max rate of climb at S/L ..... 252 m (825 ft)/min
Service ceiling ..... 4,720 m (15,475 ft)
T-O run ..... 315 m (1,035 ft)
T-O to 15 m (50 ft) ..... 515 m (1,690 ft)
Landing from 15 m (50 ft) ..... 530 m (1,740 ft)
Landing run ..... 249 m (820 ft)
Range, no reserves:
standard fuel ..... 753 n miles (1,395 km; 866 miles)
optional fuel ..... 950 n miles (1,760 km; 1,094 miles)



Robin DR 400/180 Régent (Textron Lycoming O-360-A engine) *(Mike Keep)*
0507141

ROBIN DR 400/180R REMO 180

TYPE: Glider tug.
PROGRAMME: First flight and certification 1972 as DR 400/180R (*Remorqueur*, abbreviated Remo); flown 1985 with Porsche PFM 3200 engine as DR 400RP or Remo 212; became first Porsche-powered aircraft to be certified; Remo 212 production ceased 1990 after 31 had been built, several being subsequently converted with other engines, including DR **400/235** with 175 kW (235 hp) Textron Lycoming IO-540-A4D5 flat-six.
CURRENT VERSIONS: **DR 400/180R:** *As described.*
DR 400/180S: As-180R, but with Swiss and German engine silencing modifications.
DR 400/180RP: With 158 kW (212 hp) Porsche PFM 3200 engine.
DR 400/180RD: Lycoming engine and MT-Propeller MTV-22B/174-12 four blade, constant-speed propeller. First aircraft (LN-DFK) built 2003 for Drammen Flyklubb, Norway.
CUSTOMERS: Total 382 Lycoming-engined Remo 180s delivered by late 2004, including 15-180S variants. No production in 2005.
DESIGN FEATURES: Same as Régent, except no external baggage door, and baggage compartment covered in transparent Plexiglas to maximise rearward view; towing hook under tail; Dauphin wing (13.60 m²; 146.4 sq ft) without extended wingroot leading-edges.
Differences from DR 400/180 listed below:
POWER PLANT: One 134 kW (180 hp) Textron Lycoming O-360-A flat-four engine, driving (for glider towing) a Sensenich 76EM8S5-0-58 or Hoffmann HO27HM-180/138 two-blade, fixed-pitch metal propeller. For touring, a coarser pitch Sensenich 76EM8S5-0-64 propeller can be fitted. Fuel 110 litres (29.1 US gallons; 24.2 Imp gallons) normal; additional 50 litre (13.2 US gallon; 11.0 Imp gallon) tank optional.
AVIONICS: Options include S-Tec 30 or S-Tec 55 autopilot, Garmin 150XL GPS, and L-3 Stormscope WX 500 or WX 900.
WEIGHTS AND LOADINGS:
Weight empty, equipped ..... 592 kg (1,305 lb)
Max T-O and landing weight ..... 1,000 kg (2,205 lb)
Max wing loading ..... 73.5 kg/m² (15.05 lb/sq ft)
Max power loading ..... 7.46 kg/kW (12.25 lb/hp)
PERFORMANCE (A: with 300 kg; 661 lb glider; B: with 600 kg; 1,323 lb glider):
Max level speed ..... 146 kt (270 km/h; 168 mph)
Cruising speed at 70% power at FL80 ..... 124 kt (230 km/h; 143 mph)
Stalling speed, flaps down: A ..... 47 kt (87 km/h; 54 mph)
B ..... 45 kt (84 km/h; 52 mph)

Robin DR 400/180R Remo 180 glider tug 1128956

Max rate of climb at S/L: A ..... 282 m (925 ft)/min

Robin DR 400/180 Régent *(Paul Jackson)* 1128955

B ..... 210 m (690 ft)/min
Service ceiling ..... 6,100 m (20,000 ft)
T-O run: A ..... 205 m (675 ft)
B ..... 300 m (985 ft)
T-O to 15 m (50 ft): A ..... 400 m (1,315 ft)
B ..... 470 m (1,545 ft)
Landing from 15 m (50 ft) ..... 470 m (1,545 ft)
Range, 65% power at best altitude, no reserves:
max normal fuel ..... 494 n miles (915 km; 568 miles)
with supplementary fuel ..... 1,026 n miles (1,900 km; 1,180 miles)

ROBIN DR 400/200R REMO 200

TYPE: Glider tug.
PROGRAMME: Prototype (F-ZWWX) flown 1993.
CUSTOMERS: Total 14 built, excluding one conversion, up to 2001. None in following four years.
Differences from DR 400/180R listed below:
POWER PLANT: One 149 kW (200 hp) Textron Lycoming IO-360 flat-four engine, driving a constant-speed propeller.
WEIGHTS AND LOADINGS:
Weight empty, equipped ..... 650 kg (1,433 lb)
Max T-O and landing weight ..... 1,100 kg (2,425 lb)
Max wing loading ..... 77.5 kg/m² (15.87 lb/sq ft)
Max power loading ..... 7.38 kg/kW (12.12 lb/hp)
PERFORMANCE (A: with 300 kg; 661 lb glider, B: with 600 kg; 1,323 lb glider):
Cruising speed at 75% power ..... 135 kt (250 km/h; 155 mph)
Max rate of climb at S/L: A ..... 312 m (1,024 ft)/min
B ..... 258 m (846 ft)/min
T-O to 15 m (50 ft): A ..... 400 m (1,312 ft)
B ..... 415 m (1,362 ft)
Landing from 15 m (50 ft) ..... 415 m (1,362 ft)
Range, no reserves:
max normal fuel ..... 447 n miles (828 km; 514 miles)
with supplementary fuel ..... 610 n miles (1,130 km; 702 miles)

Robin DR 400/200R Remo glider tug *(Paul Jackson)*

ROBIN DR 500 PRESIDENT

TYPE: Four-seat lightplane.
PROGRAMME: Prototype (F-WZZY), then known as DR 400/200i, first flew 5 June 1997; revealed at Paris Air Show, 13 June. Renamed as above but certified as **DR 400/500**.
CURRENT VERSIONS: **DR 500/200i Président:** *As described.*
DR 500 Super Régent: 180 hp engine, lacks fuel injection. None built.
DR 500C: Prototype, F-WZZY (c/n 27), flown in 2002 with 134 kW (180 hp) Textron Lycoming O-360 and Sensenich metal, fixed-pitch propeller of 1.63 m (5 ft 4 in) diameter — which may be reduced to 1.57 m (5 ft 4 in) on production version. Total of some 300 hours flown by mid-2004, although certification then still under way. Optimised for flying schools requiring upgrade from DR 400; has DR 500's wider fuselage, but economies and simplicity of carburettor and fixed-pitch propeller.
CUSTOMERS: Deliveries began in 1998 with eight aircraft. Total 40 built by mid-2002 for owners in France, Germany, New Zealand, Spain, Switzerland and UK; none further until 41st delivered on 27 October 2005 to UK owner.
DESIGN FEATURES: Uprated version of DR 400/180 Régent, including that version's 14.20 m² (152.8 sq ft) wing; 149 kW (200 hp) Textron Lycoming IO-360-A1B6 engine driving a Hartzell F7 666A-2 constant-speed propeller; width of cabin increased by 10 cm (4 in) and headroom by same amount; IFR instrumentation as standard; Honeywell avionics, including KAP 140 autopilot. Fuel capacity increased. Flaps electrically operated.
Differences from DR 400/180 listed below:
LANDING GEAR: Nosewheel size 15 × 6.00-5, maximum pressure 1.8 bar (26 lb/sq in); mainwheel size 330×150, pressure 2.0 bar (29 lb/sq in). Cleveland disc brakes.
POWER PLANT: One 149 kW (200 hp) Textron Lycoming IO-360-A1B6 driving a Hartzell two-blade, constant-speed metal propeller. Fuel contained in four tanks: two, each of capacity 40 litres (10.6 US gallons; 8.8 Imp gallons), in wingroots; main tank, capacity 105 litres (27.7 US gallons; 23.1 Imp gallons), below cabin floor; and fourth tank, capacity 90 litres (23.8 US gallons; 19.8 Imp gallons), below baggage compartment. Total capacity of 275 litres (72.6 US gallons; 60.5 Imp gallons).
ACCOMMODATION: Four adults, or two plus three children on fore-and-aft adjustable leather seats. Baggage shelf at rear of seats; upward-opening rear window on port side doubles as external access to baggage compartment.
AVIONICS: To customer's choice, typically Bendix/King KX 155 nav/com, KI 208 VOR/LOC indicator, KT 76C transponder with ACK 30 altitude encoder, Garmin 150 XL GPS, and SPA 400 intercom system, four microphone and headset jack plugs, and PTT switch on each control stick. Options include S-Tec 30 or S-Tec 55 autopilot and L-3 Stormscope WX 500 or WX 900.
Instrumentation: As for DR 400/180 except: dual altimeters, fuel flow/manifold pressure gauge, four fuel quantity gauges, and ammeter, all standard. Sandel Electronics HIS optional.
EQUIPMENT: Electric rudder trim, alternate static source, and three strobe lights (on upper fuselage and at wingtips), all standard.
DIMENSIONS, EXTERNAL:
Length overall ..... 7.22 m (23 ft 8¼ in)
Propeller diameter ..... 1.88 m (6 ft 2 in)
DIMENSIONS, INTERNAL:
Cabin max width ..... 1.20 m (3 ft 11¼ in)
WEIGHTS AND LOADINGS:
Weight empty ..... 560 kg (1,235 lb)
Baggage capacity ..... 60 kg (132 lb)
Max T-O weight ..... 1,059 kg (2,335 lb)
Max wing loading ..... 74.6 kg/m² (15.28 lb/sq ft)
Max power loading ..... 7.11 kg/kW (11.68 lb/hp)
PERFORMANCE:
Max level speed ..... 147 kt (272 km/h; 169 mph)
Cruising speed at 75% power ..... 143 kt (265 km/h; 165 mph)
Max rate of climb at S/L ..... 255 m (837 ft)/min
T-O to 15 m (50 ft) ..... 463 m (1,520 ft)
Landing from 15 m (50 ft) ..... 530 m (1,739 ft)
Range, standard fuel, no reserves:
at 75% power ..... 995 n miles (1,842 km; 1,145 miles)
at 65% power, best altitude ..... 1,001 n miles (1,855 km; 1,152 miles)

Robin DR 500/200i Président *(Paul Jackson)* 1128957

SAUPER

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The company was purchased by ALMS on 1 February 2006 and details of its two designs can be found under that entry in *Jane's All the World's Aircraft*.

SKYDESIGN

GECI INTERNATIONAL

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Formed in 1979, GECI International is a transport-orientated engineering and consulting company with a staff of 400. It has contributed to the Fairchild Dornier 728 and various business jet and Airbus airliner programmes. In 2001, it formed Skydesign SAS to develop the Skylander transport, formal launch of which was then intended to take place in the second half of 2003.

Launch failed to take place, but in mid-2006 GECI was assembling USD160 million from private and government investors to establish production plant at Evora, Portugal.

SKYDESIGN SB100 SKYLANDER

TYPE: Twin-turboprop light transport.

PROGRAMME: Announced 17 October 2001 at Seoul Air Show. Design supervision by the late Desmond Norman, co-designer of the BNG Islander. First metal scheduled to be cut in January 2004; first of two prototypes expected to fly in May 2005, but this postponed until at least 2007. First deliveries two years after initial flight.

Programme structured for joint funding (initially USD120 million) by three risk-sharing partners, Korean Aerospace Industries being first, on 17 October 2001, to pledge USD30 million to secure responsibility for wing production.

CURRENT VERSIONS: **Skylander**: *As described.* Freighter, passenger and maritime patrol versions.

Skylander L: Lightened version with 559 kW (750 shp) PT6A engines, 2,000 kg (4,400 lb) payload and reduced price.

COSTS: Estimated USD3.6 million unit cost for 'green' airframe; estimated direct operating cost USD435 per hour, based on annual utilisation of 1,500 flying hours (both 2003). Break-even estimated at 115 airframes. Sales goal over 20 years is some 1,300, being equivalent to 30 per cent of estimated market for 4,485 aircraft in this class.

DESIGN FEATURES: Intended for operation from rough airfields with minimal maintenance facilities. Fixed landing gear and conventional alloy structure; unpressurised. Certifiable to FAR Pt 23.

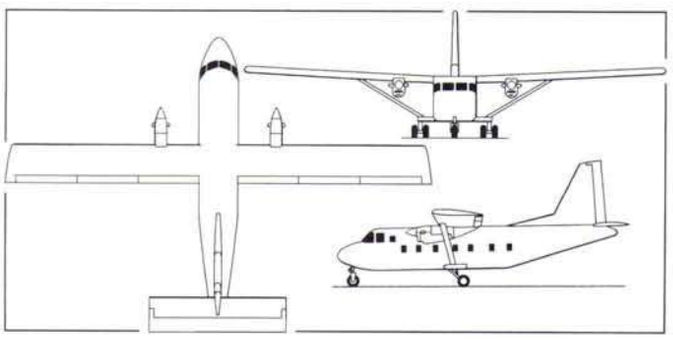
Fuselage of square cross-section, with upswept rear; tailplane at base of fin. High wing with single bracing strut each side.

Wing section NACA 23015.

FLYING CONTROLS: Conventional and manual, by cable. Electrically actuated flaps. Horn-balanced rudder.

STRUCTURE: Principally of aluminium alloy.

Artist's impression of Skydesign Skylander 1159800



Provisional general arrangement of Skydesign SB100 Skylander *(Paul Jackson)* 1159831

LANDING GEAR: Tricycle type; fixed. Twin mainwheels mounted on sponsons. Single, steerable nosewheel. Tyre size 8.50-10 (all).

POWER PLANT: Two Pratt & Whitney Canada PT6A-65B turboprops, each 820 kW (1,100 shp), driving Hartzell five-blade propellers. Fuel contained in two integral wing tanks, combined capacity 3,285 litres (868 US gallons; 723 Imp gallons).

ACCOMMODATION: Two pilots; 18 passengers (two plus one abreast) and one cabin attendant. Alternative combi (nine to 12 passengers ahead of LD3 container and separated by 9 g bulkhead) and all-freight configurations. Latter include three LD3s plus 4.0 m^3 (141 cu ft) to rear; and four 1.83 × 1.40 m (72 × 55 in) pallets plus 5.4 m^3 (191 cu ft). Baggage hold beneath flight deck.

Crew door forward, port; double freight door (divided vertically, with forward- and rearward-opening elements) rear, port.

SYSTEMS: Electrical system includes 28 V 3004 starter/generator. Hydraulic system for brakes and nosewheel steering. Wing and tail surface leading-edges de-iced by pneumatic boots.

AVIONICS: Bendix /King avionics fit, with EFIS display.

DIMENSIONS, EXTERNAL:

Wing span	21.60 m (70 ft 10½ in)
Wing chord, constant	2.00 m (6 ft 6¾ in)
Wing aspect ratio	10.9
Length overall	14.78 m (48 ft 6 in)
Height overall	6.15 m (20 ft 2 in)
Tailplane span	6.92 m (22 ft 8½ in)
Tailplane chord, constant	1.46 m (4 ft 9½ in)
Wheel track (c/l shock-absorbers)	3.47 m (11 ft 4½ in)
Wheelbase	5.85 m (19 ft 2¼ in)
Propeller diameter	2.82 m (9 ft 3 in)
Distance between propeller centres	5.66 m (18 ft 6¾ in)

DIMENSIONS, INTERNAL:

Hold: Length: parallel section	5.64 m (18 ft 6 in)
total flat floor	6.17 m (20 ft 3 in)
Width: max	1.94 m (6 ft 4½ in)
mean	1.88 m (6 ft 2 in)
at floor	1.83 m (6 ft 0 in)
Max height	1.83 m (6 ft 0 in)
Volume	28.0 m^3 (989 cu ft)
Baggage hold volume	0.85 m^3 (30.0 cu ft)

AREAS:

Wings, gross	42.63 m^2 (458.9 sq ft)

WEIGHTS AND LOADINGS:

Max payload	3,300 kg (7,275 lb)
Max fuel weight	2,450 kg (5,401 lb)
Max T-O and landing weight	8,390 kg (18,496 lb)
Max ramp weight	8,440 kg (18,607 lb)
Max wing loading	196.8 kg/m^2 (40.31 lb/sq ft)
Max power loading	5.12 kg/kW (8.41 lb/shp)

PERFORMANCE (estimated):

Cruising speed: max	231 kt (428 km/h; 266 mph)
econ	190 kt (352 km/h; 219 mph)
Max rate of climb at S/L	610 m (2,000 ft)/min
Rate of climb at S/L, OEI	183 m (600 ft)/min
T-O run	420 m (1,378 ft)
T-O to 11 m (35 ft)	550 m (1,805 ft)
Landing run	385 m (1,263 ft)
Landing from 15 m (50 ft)	690 m (2,265 ft)
Range:	
with max fuel	1,200 n miles (2,222 km; 1,381 miles)
with max payload	150 n miles (277 km; 172 miles)

SOCATA

SOCATA SOCIÉTÉ DE CONSTRUCTIONS D'AVIONS DE TOURISME ET D'AFFAIRES (SUBSIDIARY OF EADS)

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Formed 1966 as a subsidiary of Aerospatiale responsible for light aircraft. Produces TBM700 utility turboprop, but terminated manufacture of TB series of lightplanes in 2003, except for special orders. In 1999, sold and delivered 40 TBs; sold 16 and delivered 21 TBM 700s Reduced deliveries of 45 TBs and 33 TBMs in 2000; target for 2001 was 100+ and 33, respectively, but 63 and 33 actually achieved; 2002 deliveries totalled 70 TBs and 34 TBMs, 2003 totalled 40 and 34; 2004 totalled five and 31, and 2005 totalled nine and 31.

Also makes components for Airbus A300/320/330/340/380/400M, Lockheed Martin C-130, ATR 42/72, Dassault Falcons, including 7X, Eurocopter Super Puma, Dauphin, Ecureuil and EC 130, and Embraer 170 and 190, satellite structures. Covered floor area 80,000 m² (861,100 sq ft); workforce in 2004 was 1,060. Turnover in 2004 was EUR174 million.

Following formation of EADS on 10 July 2000, Socata is 100 per cent owned by that company

SOCATA TB 9 TAMPICO, TB 10 and TB 200 TOBAGO GT

TYPE: Four-seat lightplane.

PROGRAMME: Design of original TB series launched 1975; first flight of original TB 10 (F-WZJP), powered by 119 kW (160 hp) Textron Lycoming O-320, 23 February 1977; second prototype powered by 134 kW (180 hp) Textron Lycoming.

In June 1999, Socata announced its Nouvelle Génération (New Generation) series of single piston-engined models The title Generation Two (GT) was subsequently adopted. These featured aerodynamic and other improvements that may subsequently be incorporated in the Socata MS diesel-engined light aircraft described elsewhere in this entry. Modifications included a curved dorsal fairing for the fin, upturned wingtips, raised cabin roofline with new single-piece carbon fibre/honeycomb roof, revised window pillar design, flush-mounted windows, larger baggage door, redesigned interior and new fuel filler door. From 201st TB in mid-2003 (TB 10 F-GOIH c/n 2200, displayed at Paris, 15 to 22 June 2003) all aircraft fitted with Moritz engine control panel.

The TB9C Tampico Club, TB 9 Sprint, TB 10 Tobago, TB 10 Tobago Privilège and TB 200 Tobago XL are now out of production, having been replaced in February 2000 by the GT series. Production of this version was drastically curtailed at the end of 2003, although a few were built in 2004 and 2005 to meet specific orders.

CURRENT VERSIONS: **TB 9 Tampico Sprint GT:** Baseline model. 119 kW (160 hp) Textron Lycoming O-320-D2A flat-four engine driving a Sensenich two-blade fixed-pitch metal propeller. Fuel capacity 158 litres (41.7 US gallons; 34.8 Imp gallons), of which 152 litres (40.2 US gallons; 33.4 Imp gallons) are usable Oil capacity 8 litres (2.1 US gallons; 1.8 Imp gallons).

TB 10 Tobago GT: 134 kW (180 hp) Textron Lycoming O-360-A1AD flat-four engine.

Detailed description applies to this version

TB 200 Tobago GT: Similar to TB 10 Tobago GT, but with 134 kW (180 hp) fuel-injected Textron Lycoming IO-360-A1B6 engine

CUSTOMERS: Total of 468 Tampicos and Tampico Clubs in service by June 1999 with customers in Africa and Middle East, Asia-Pacific, Australasia, Europe, and North America. Total of 637 Tobagos and 87 Tobago XLs delivered by June 1999, to customers in Africa and Middle East, Australasia, Europe, North America and elsewhere. Production of first-generation TBs (9, 10, 200, 20 and 21) totalled 1,928, including prototypes

Recent customers include the Indonesian Navy, which ordered five Tobago GTs in February 2004, of which two were scheduled for delivery in June 2004 and the remainder in early 2005

TB GT PRODUCTION 2000-2004

TB 9 Tampico GT	7
TB 10 Tobago GT	20
TB 200 Tobago GT XL	21
TB 20 Trinidad GT	124
TB 21 Trinidad GT TC	49
Untraced	6
Prototype (TB 20)	1
Total	**228**[1]

[1] Plus small-scale production in 2005

TAMPICO AND TOBAGO GT DELIVERIES

Year	TB 9 GT	TB 10 GT	TB 200 GT
2000	2	1	nil
2001	2	8	8
2002	3	7	2
2003	2	7	3
2004	nil	3	nil
2005	1	4	nil

DESIGN FEATURES: Conventional light tourer and trainer

Wing section RA 16.3C3; thickness/chord ratio 16 per cent; dihedral 4° 30'

FLYING CONTROLS: Manual, with pushrod actuation for ailerons, rudder and all-moving tailplane; cable-actuated anti-balance tab on tailplane, plus ground-adjustable tabs on ailerons and rudder; strakes on lower edges of fuselage just aft of wing control turbulence under rear fuselage; electrically actuated flaps.

STRUCTURE: Conventional light alloy; single-spar wing; GFRP tips, engine cowlings, cabin roof structure and dorsal strake. Triple anti-corrosion protection.

LANDING GEAR: Non-retractable tricycle type Wing-mounted, trousered, cantilever main legs with integral oleo-pneumatic shock absorbers and trailing-link suspension; steerable nosewheel, oleo-pneumatic shock absorber; glass fibre wheel fairings on all three units. Mainwheel tyres size 6.00-6 (6 ply), pressure 2.30 bar (33 lb/sq in) on TB 10 GT/200 GT; 15×6.00–6 (6 ply) on TB 20 GT/21 GT. Nosewheel 5.00-5 on TB 10 GT/200 GT and 5.00-4 on TB 20 GT/21 GT. Hydraulic disc brakes. Parking brake.

POWER PLANT: One 134 kW (180 hp) Textron Lycoming O-360-A1AD flat-four engine, driving a Hartzell two-blade constant-speed propeller. Two integral fuel tanks in wing leading-edges; total capacity 210 litres (55.5 US gallons; 46.2 Imp gallons), of which 204 litres (53.9 US gallons; 44.9 Imp gallons) are usable. Oil capacity 8 litres (2.1 US gallons; 1.8 Imp gallons).

ACCOMMODATION: Four or five seats in enclosed cabin, with dual controls. Separate, adjustable front seats with inertia reel seat belts Two separate rear seats or removable three-place bench seat with safety belts. Sharply inclined low-drag windscreen. Access via upward-hinged window/doors of glass fibre. Baggage compartment aft of cabin, with external door on port side. Cabin carpeted, soundproofed, heated and ventilated. Windscreen defrosting standard

SYSTEMS: Electrical system includes 28 V 70 A alternator and 24 V 10 A battery Hydraulic system for brakes only.

AVIONICS: Honeywell Silver Crown avionics suite to customer choice, including Bendix/King KLN 90 GPS.

Instrumentation: Typical IFR package includes dual altimeters; dual true airspeed indicators; dual artificial horizons; vertical speed indicator, electric turn co-ordinator; directional gyro, tachometer; oil temperature, oil pressure, fuel pressure, fuel quantity, manifold pressure, CHT/EGT and OAT gauges; ammeter, voltmeter and compass.

EQUIPMENT: Includes armrests for all seats, map pockets, anti-glare visors, stall warning indicator, tiedown fittings and towbar, landing and navigation lights, four individual cabin lights and instrument panel lighting.

DIMENSIONS, EXTERNAL (TB 9 GT, TB 10 GT and TB 200 GT):

Wing span	10.01 m (32 ft 10 in)
Wing chord, constant	1.22 m (4 ft 0 in)
Wing aspect ratio	8.0
Length overall: TB 9 GT	7.72 m (25 ft 4 in)
TB 10 GT/200 GT	7.75 m (25 ft 5 in)
Height overall	3.02 m (9 ft 11 in)
Tailplane span	3.20 m (10 ft 6 in)
Wheel track	2.30 m (7 ft 6½ in)
Wheelbase	1.96 m (6 ft 5 in)
Propeller diameter	1.88 m (6 ft 2 in)
Propeller ground clearance	0.10 m (4 in)
Cabin doors (each): Width	0.90 m (2 ft 11½ in)
Height	0.76 m (2 ft 6 in)
Baggage door: Width	0.64 m (2 ft 1¼ in)
Max height	0.53 m (1 ft 9 in)

DIMENSIONS, INTERNAL (TB 9, TB 9C, TB 10 and TB 200):

Cabin:	
Length: firewall to rear bulkhead	2.53 m (8 ft 3½ in)
panel to rear bulkhead	2.00 m (6 ft 6¾ in)
Max width: at rear seats	1.28 m (4 ft 2¼ in)
at front seats	1.15 m (3 ft 9¼ in)
Max height	1.20 m (3 ft 11¼ in)

AREAS (TB 9 GT, TB 10 GT and TB 200 GT):

Wings, gross	11.90 m² (128.1 sq ft)
Ailerons (total)	0.91 m² (9.80 sq ft)
Trailing-edge flaps (total)	3.72 m² (40.04 sq ft)
Fin	0.88 m² (9.47 sq ft)
Rudder	0.63 m² (6.78 sq ft)
Horizontal tail surfaces (total)	2.56 m² (27.56 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, with unusable fuel and oil:	
TB 9 GT	684 kg (1,508 lb)
TB 10 GT	730 kg (1,609 lb)
TB 200 GT	745 kg (1,642 lb)
Baggage: all	**65 kg (143 lb)**
Max T-O weight: TB 9 GT	**1,060 kg (2,336 lb)**
TB 10 GT, TB 200 GT	**1,150 kg (2,535 lb)**
Max wing loading: TB 9 GT	**89.1 kg/m² (18.25 lb/sq ft)**
TB 10 GT, TB 200 GT	**96.6 kg/m² (19.79 lb/sq ft)**
Max power loading: TB 9 GT	**8.91 kg/kW (14.64 lb/hp)**
TB 10 GT	**8.57 kg/kW (14.08 lb/hp)**
TB 200 GT	7.72 kg/kW (12.68 lb/hp)

PERFORMANCE:

Max cruising speed:	
TB 9 GT at 70% power at FL60	115 kt (213 km/h; 132 mph)
TB 10 GT at 75% power at FL60	127 kt (235 km/h; 146 mph)
TB 200 GT at 75% power at FL85	130 kt (240 km/h; 149 mph)
Econ cruising speed:	
TB 9 GT at 65% power at FL80	105 kt (194 km/h; 121 mph)
TB 10 GT at 60% power at FL80	109 kt (202 km/h; 125 mph)
TB 200 GT at 60% power at FL85	115 kt (213 km/h; 132 mph)
Stalling speed:	
flaps up: TB 9 GT	58 kt (107 km/h; 67 mph)
TB 10 GT	61 kt (112 km/h; 70 mph)
flaps down: TB 9 GT	48 kt (89 km/h; 56 mph)
TB 10 GT	52 kt (97 km/h; 60 mph)
TB 200 GT	**53 kt (98 km/h; 61 mph)**
Max rate of climb at S/L: TB 9 GT	203 m (665 ft)/min
TB 10 GT	240 m (787 ft)/min
TB 200 GT	286 m (937 ft)/min
Max certified altitude: TB 9 GT	3,350 m (11,000 ft)
TB 10 GT	3,965 m (13,000 ft)
TB 200 GT	4,875 m (16,000 ft)
T-O to 15 m (50 ft):	
TB 9 GT	570 m (1,870 ft)
TB 10 GT	505 m (1,657 ft)
TB 200 GT	**475 m (1,558 ft)**
Landing from 15 m (50 ft): TB 9 GT	**420 m (1,378 ft)**

TB 10 GT ..... 460 m (1,509 ft)
TB 200 GT ..... 449 m (1,473 ft)
Max range: TB 9 GT ..... 564 n miles (1,046 km; 650 miles)
TB 10 GT ..... 697 n miles (1,290 km; 802 miles)
TB 200 GT ..... 637 n miles (1,179 km; 733 miles)

SOCATA TB 20 and TB 21 TRINIDAD

TYPE: Four-seat lightplane.

PROGRAMME: First flight TB 20 (F-WDBA) 14 November 1980; French certification 18 December 1981; FAA certification 27 January 1984; first delivery (F-WDBB) 23 March 1982; first flight TB 21, 24 August 1984; French certification 23 May 1985; FAA certification 5 March 1986.

Earlier TB 20 Trinidad, TB 20 Trinidad Excellence, TB 20 C and TB 21 Trinidad TC variants (of which some 700 built) no longer in production. TB 20 Trinidad GT and TB 21 Trinidad GT TC continued in production until 2003, although remaining available to special order. Total of at least 126 TB 20 GTs and 49 TB 21 GTs built.

CURRENT VERSIONS: **TB 20 Trinidad GT:** At the Paris Air Show in June 1999, Socata announced its Nouvelle Génération (New Generation) series of single piston-engined aircraft, the prototype of which, TB 20 NG F-WWRG, had first flown on 21 April 1999. The title Generation Two (GT) was subsequently adopted. The TB 20 GT received DGAC certification on 31 January 2000. The GT series was formally launched at Tarbes on 2 February 2000 with roll-out of the first production TB 20 GT, which became US demonstrator (N163GT c/n 2000) and was exhibited at Sun 'n' Fun, April 2000.

GT variants feature aerodynamic and other improvements that will be incorporated in the Socata Morane diesel-engined series described below. Identifying features include upturned wingtip, similar to those on the TBM 700 turboprop; a curved dorsal fillet; raised cabin roofline with new single-piece carbon fibre/honeycomb roof; revised cabin window/pillar design with flush-mounted windows; plus redesigned interior, larger baggage door, new fuel filler door, retractable footstep and optional three-blade Hartzell propeller.

In June 2003, Socata launched **Premium 2003** version of TB 20 Trinidad GT with additional features as standard, including Hartzell Scimitar propeller (with liquid de-icing), Garmin GNS 530 VHF/VOR/ILS/GPS, GNS 430, GTX 327 transponder and Bendix/King KFC 225 autopilot.

TB 21 Trinidad GT TC: As above, but with computer-controlled turbocharger. **Premium 2003** version launched at Paris in June 2003, with standard features as for concurrent TB 20.

CUSTOMERS: At time of launch of GT series, the Aeronautical Academy of Europe in Evora, Portugal, took options on four TB 20 GTs. By mid-2000, TB 20 GTs had been delivered to customers in France, UK and USA from planned first year production of 72. Orders in 2000 included 69 from New Avex, distributor for US West Coast; early customers included the Nigerian College of Aviation Technology (NCAT) of Zaria, Kaduna State, which ordered 10 Trinidad GTs for delivery beginning mid-2001 and French training school SEFA, which ordered 10 TB 20 GTs in June 2002, of which the first four were delivered in July 2002.

TRINIDAD DELIVERIES

Year	TB 20 GT	TB 21 GT
2000	30[1]	12[1]
2001	33	12
2002	44	14
2003	19	9
2004	2	nil
2005	1	3

[1] Approximately

DESIGN FEATURES: Mainly as for Tobago; dihedral 6° 30'.

FLYING CONTROLS: As Tobago, but rudder trim and flap preselector added.

STRUCTURE: Largely as Tobago.

LANDING GEAR: Hydraulically retractable tricycle type, with single wheel on each unit. Free-fall emergency extension. Steerable nosewheel retracts rearward. Main units, with trailing-link suspension, retract inward into fuselage. Hydraulic disc brakes. Parking brake.

POWER PLANT: *TB 20 GT:* One 186 kW (250 hp) Textron Lycoming IO-540-C4D5D flat-six, driving a two-blade Hartzell constant-speed propeller.

TB 21 GT: One 186 kW (250 hp) Textron Lycoming TIO-540-AB1AD turbocharged flat-six. Two-blade Hartzell constant-speed propeller; three-blade propeller optional.

Fuel in two integral wing tanks, total capacity 336 litres (88.8 US gallons; 73.9 Imp gallons), of which 326 litres (86.1 US gallons; 71.7 Imp gallons) usable. Oil capacity 12.6 litres (3.3 US gallons; 2.8 Imp gallons).

ACCOMMODATION: Generally as for TB 9 Sprint GT, TB 10 Tobago GT and TB 200 XL GT; new headrests for all seats introduced on GT variants; rear seat can be removed for carrying 250 kg (551 lb) of cargo.

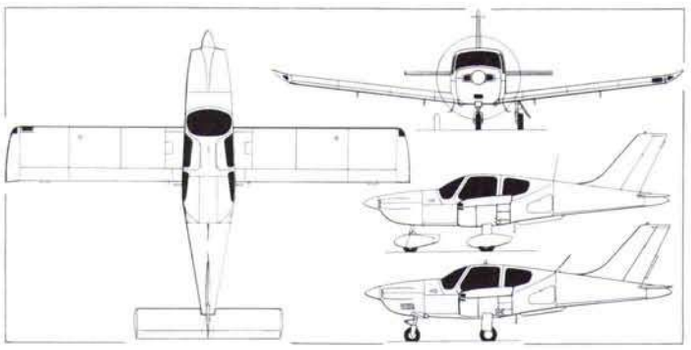
SYSTEMS: Electrical system comprises 28 V 70 A alternator and 24 V 10 Ah battery.

AVIONICS: TB 20/21 GT basic navigation package comprises single nav/com and VOR receiver. IFR packages and EFIS optional.

SPECIFICATIONS:

DIMENSIONS, EXTERNAL: As for TB 10 GT, except:
Wing span ..... 9.97 m (32 ft 8½ in)
Wing aspect ratio 8.2
Length overall ..... 7.75 m (25 ft 5 in)
Height overall ..... 2.85 m (9 ft 4¼ in)

Socata TB 21 Trinidad GT TC from 2003 production *(Paul Jackson)* 1128904



Socata TB 21 Trinidad GT, with additional side view (upper) of TB 10 Tobago GT *(Dennis Punnett)* 0110866

Tailplane span ..... 3.68 m (12 ft 0¾ in)
Wheel track ..... 2.17 m (7 ft 1½ in)
Wheelbase ..... 1.91 m (6 ft 3¼ in)
Propeller diameter ..... 2.03 m (6 ft 8 in)

DIMENSIONS, INTERNAL (TB 20 GT):
Cabin: Width ..... 1.28 m (4 ft 2½ in)
Max height ..... 1.20 m (3 ft 11¼ in)

AREAS: As for TB 10 GT, except:
Horizontal tail surfaces (total) ..... 3.06 m² (32.94 sq ft)

WEIGHTS AND LOADINGS:
Operating weight empty: TB 20 GT ..... 800 kg (1,764 lb)
TB 21 GT ..... 867 kg (1,911 lb)
Max baggage: TB 20 GT, TB 21 GT ..... 65 kg (143 lb)
Max T-O and landing weight:
TB 20 GT, TB 21 GT ..... 1,400 kg (3,086 lb)
Max wing loading:
TB 20 GT, TB 21 GT ..... 117.6 kg/m² (24.10 lb/sq ft)
Max power loading:
TB 20 GT, TB 21 GT ..... 7.51 kg/kW (12.35 lb/hp)

PERFORMANCE:
Cruising speed at 75% power:
TB 20 GT at FL65 ..... 163 kt (302 km/h; 188 mph)
TB 21 GT at FL250 ..... 190 kt (352 km/h; 219 mph)
Econ cruising speed at 65% power:
TB 20 GT at FL85 ..... 150 kt (278 km/h; 173 mph)
TB 21 GT at FL250 ..... 169 kt (313 km/h; 194 mph)
Rate of climb at S/L: TB 20 GT ..... 366 m (1,200 ft)/min
TB 21 GT ..... 344 m (1,130 ft)/min
TB 21 GT at FL170 ..... 244 m (800 ft)/min
Certified ceiling: TB 20 GT ..... 6,100 m (20,000 ft)
TB 21 GT ..... 7,620 m (25,000 ft)
T-O to 15 m (50 ft): TB 20 GT ..... 595 m (1,955 ft)
TB 21 GT ..... 595 m (1,955 ft)
Landing from 15 m (50 ft):
TB 20 GT, TB 21 GT ..... 540 m (1,775 ft)
Max range:
TB 20 GT ..... 1,100 n miles (2,037 km; 1,265 miles)
TB 21 GT ..... 1,035 n miles (1,916 km; 1,191 miles)

SOCATA TBM 700

TYPE: Business turboprop.

PROGRAMME: Since early 2006, all TBM 700 production has been of the 700N version, which is marketed as the TBM 850 and described separately. Further TBM 700s will be produced only if Socata receives sufficient orders to initiate production of a commercially viable batch.

SOCATA TBM 850

Engineering designation: TBM 700N

TYPE: Business turboprop.

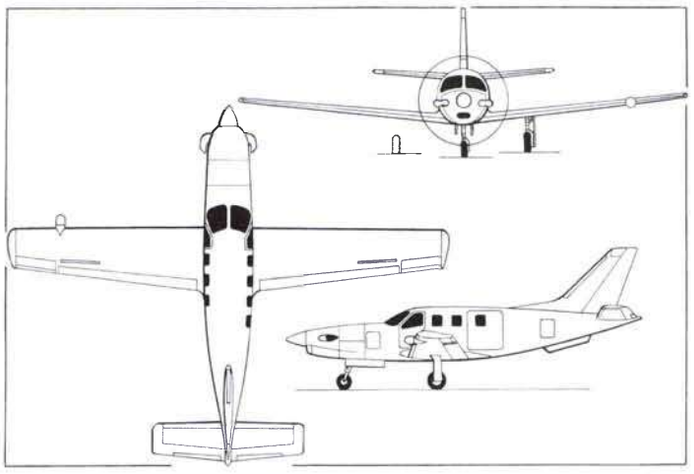
PROGRAMME: TBM 850 programme began August 2004; first flown February 2005 as conversion of second TBM 700 prototype F-WKPG. Eight-month trial programme of 103 sorties and 162 hours; EASA certification November 2005. Version publicly announced 13 December 2005. FAA certification 23 January 2006. First production aircraft F-WWRE/N850TB flew 23 January 2006.

TBM 700 originated in collaborative project by Socata (70 per cent) and Mooney of the US (30 per cent), launched 12 June 1987 by TBM SA company. Valmet of Finland joined in June 1988, but withdrew in the following year. Socata responsible for technical development and certification, plus manufacture of forward fuselage and empennage; Mooney assigned rear fuselage and wings and intended US production line but withdrew in 1991.

Three prototypes built: first flights 14 July 1988 (F-WTBM), 3 August 1989 (F-WKPG) and 11 October 1989 (F-WKDL); French certification received 31 January 1990; FAR Pt 23 type approval awarded 28 August 1990; first delivery 21 December 1990; Canadian public transport certification 1993. Wider, single-piece, upward-opening door replaced horizontally split door, port side, rear, from late 1998 and is standard. Aircraft optimised for freighting (TBM 700B) have optional crew door, port, forward. Increased weight version (TBM 700C2) announced late 2002 and achieved FAR 23 certification on 7 March 2003, followed by Brazilian approved on 7 February 2005 and Civil Aviation Safety Authority of Australia (CASA) certification on 9 September 2005.

CURRENT VERSIONS: **TBM 850:** Engineering designation TBM 700N (Mod 70-0188-00). Uprated version of TBM 700C, of which first of two prototypes (c/n 205 F-WWRL/N778C) flew February 2002; officially announced 10 September 2002 at NBAA Convention, Orlando, Florida; second aircraft (c/n 240 F-WWRO/N811SW) followed as a 700C2. Changes included option of increased (TBM 700C2) or original (TBM 700C1) MTOW,

Socata TBM 850 business turboprop *(Paul Jackson)* 1040403



General arrangement of Socata TBM 850 *(James Goulding)* 1158280

according to local certification rules; strengthened spar box and wing attachments; stronger wheels and 10-ply tyres; additional (unpressurised) baggage compartment to rear of cabin; new interior with 20*g* seats; improved air conditioning. Sole variant from late 2002; first production 700C1 was c/n 244 (F-WWRI/N700DY); first production 700C2 c/n 245 (F-WWRM/N6750Y) completed November 2002. All aircraft had structural and interior modifications, but 700C1 retained original seats (not 20*g*) and landing gear; later upgrade to 700C2 is possible from c/n 299 onwards (278th production); all TBM 700Cs RVSM-approved on delivery.

A quick-change air ambulance installation for the TBM 700C2 was introduced at the NBAA Convention in Las Vegas on 12 October 2004, featuring the Lifeport Inc AeroSled PLUS (Patient Loading Utility System) self-contained module with full life-support capability. AeroSled PLUS weighs less than 72.6 kg (160 lb) and mounts directly to existing hardpoints and tracks via a loading ramp that enables the patient to be loaded at door level, requiring no lifting once inside the aircraft. Total fleet time (270 aircraft) stood at more than 380,000 hours in June 2005.

CUSTOMERS: Total three prototypes and 348 production TBM 700s delivered by October 2006, including 217 700/700Bs and 107 700Cs. TBM 850 introduced at 325th production (c/n 346); 25 delivered by October 2006, at which time further 45 on order.

Deliveries of TBM 700 to French Air Force began 27 May 1992 with first of initial six for liaison duties with Groupe Aérien d'Entrainement et de Liaison (GAEL) and ETE 43; further six supplied 1993-94 (also for ETE 41 and ETE 44, plus CEAM); total Air Force requirement is 22 (of which 17 funded by mid-1998); two officially handed over to French Air Force 13 January 1995 for 3 GHL at Rennes, followed by six more, last three of which delivered (in TBM 700B configuration) 28 June 2000. Total of 24 delivered in 2000, 33 in 2001, 34 in 2002, 34 in 2003, 31 in 2004 and 31 in 2005. Recent production almost totally to US.

COSTS: USD2.576 million, basically equipped; USD2.800 million with typical avionics (2006).

DESIGN FEATURES: TBM 850 version primarily intended for US market, in competition with new generation of very light personal jets. Max cruising speed at FL260 increased by 20 kt (37 km/h; 23 mph) from TBM 700's 300 kt (556 km/h; 345 mph); time to FL260 reduced by 9 minutes from TBM 700's 24 minutes.

Conceived (TBM 700) as high-speed, long-range, single-turboprop business transport. Low wing; twin strakes under rear fuselage; sweptback fin (with dorsal fin) and mass balanced rudder; non-swept tailplane with mass balanced elevators. Airframe life 12,000 cycles/16,000 hours from TBM 700C.

Wing of Aerospatiale RA 16-43 root section with 6° 30' dihedral from roots.

FLYING CONTROLS: Conventional and manual. Pushrod and cable actuated with electric trim tab in port aileron, rudder and each elevator; 'scaled-down ATR' single-slotted Fowler flaps, also electrically actuated, along 71 per cent of each wing trailing-edge; slotted spoiler forward of each flap at outer end, linked mechanically to aileron; yaw damper.

STRUCTURE: Mainly of light alloy and steel except for control surfaces, flaps, most of tailplane and fin of Nomex honeycomb bonded to metal sheet; wing leading-edges and landing gear doors GFRP/CFRP; tailcone and wingtips GFRP; two-spar torsion box forms integral fuel tank in each wing.

LANDING GEAR: Hydraulically retractable tricycle type, with emergency manual operation. Inward-retracting main units of trailing-link type; rearward-retracting steerable nosewheel (±28°). Main tyres 18x5.5 (8 ply; 10 ply on 700C2) tubeless; nose 5.00-5 (10 ply) tubeless. Parker hydraulic disc brakes. Minimum ground turning radius (based on nosewheel) 23.98 m (78 ft 8 in).

POWER PLANT: One 1,361 kW (1,825 shp) Pratt & Whitney Canada PT6A-66D turboprop, flat rated at 634 kW (850 shp), although certification limits T-O power to 522 kW (700 shp). Hartzell HC-E4N-3/E9083S(K) four-blade constant-speed, fully feathering, reversible-pitch, metal propeller. Fuel in integral tank in each wing, combined capacity 1,100 litres (290.5 US gallons; 242 Imp gallons), of which 1,066 litres (282 US gallons; 234 Imp gallons) usable. Gravity filling point in top of each tank. Oil capacity 12 litres (3.2 US gallons; 2.6 Imp gallons).

ACCOMMODATION: Adjustable seats for one or two pilots at front. Dual controls standard. Four seats in club layout aft of these, with centre aisle, or five seats in high-density layout. Optional 24 V power points (two). Accommodation pressurised, heated and ventilated; air conditioning optional.

Large upward-opening door on port side aft of wing; overwing emergency exit on starboard side. Oxygen system, comprising three under-seat bottles with individual emergency oxygen mask for each passenger and masks with integral microphones for crew. Pressurised baggage compartment at rear of cabin, with internal access only; additional unpressurised compartments in nose, between engine and firewall, and behind cabin, both with external access via doors on port side. From TBM 700C version onwards, nose compartment reduced in size by two-thirds, compared with 700B, due to installation of environmental control system. Optional crew door, port side, front, is maker's OPT 70-52-002.

SYSTEMS: Bendix/King KFC 325 autopilot with altitude preselect. Engine bleed air pressurisation (to 0.43 bar; 6.2 lb/sq in) and Honeywell environmental control system/vapour control system. Hydraulic system for landing gear only. Electrical system powered by one 28 V 180 A (main) and one 28V 57 Ah engine-driven starter/generator, and a 28 V 43 Ah lead/acid (optionally Ni/Cd) battery. Pneumatic rubber-boot de-icing of wing/tailplane/fin leading-edges. Propeller blades, pitot tubes and stall warning sensor; anti-iced, electrically heated engine inlet. Electric anti-icing and hot air demisting of windscreen. Gaseous oxygen system.

AVIONICS: *Comms:* Dual Garmin GNS 530 VHF com/VOR/ILS/GPS with GI 106A VOR/ILS indicator; dual GTX 327 Mode C transponders; GMA 340 stereo audio panel with marker beacon and music input; tri-band ELT; dual Bose X headsets with noise attenuation, all standard.

Radar: Honeywell RDR-2000 weather radar optional.

Flight: Bendix/King KCS 55 A heading and KI 525 A HSI indicators; KR 87 SC+ ADF; KRA 405 B radar altimeter with KNI 415 indicator; KN 63 DME with twin KI 574 indicators all standard. WX 500 Stormscope; and KMH 880 TCAS and TAWS, all optional.

Instrumentation: Bendix/King EFIS 40 two-tube EFIS; KMD 850 MFD; electric artificial horizon; standby vacuum artificial horizon; ASI; VSI; KEA 346 encoding drum altimeter; KNI 582 RMI indicator; KDI 574 DME indicator; rate of climb indicator; magnetic compass; torque indicator; propeller tachometer; ITT indicator; OAT gauge; electric generator control and monitoring on overhead panel; annunciator panel with master caution, master warning and aural warnings; cabin temperature gauge; cabin altitude and differential pressure indicator; flight time hours meter; and digital chronometer, all standard. Thommen needle chronometer (replaces digital chronometer), and engine hours meter (replaces flight time hours meter), optional.

DIMENSIONS, EXTERNAL:

Wing span	12.68 m (41 ft 7¼ in)
Wing chord, mean aerodynamic	1.51 m (4 ft 11½ in)
Wing aspect ratio	8.9
Length overall	10.645 m (34 ft 11 in)
Height overall	4.355 m (14 ft 3¼ in)
Tailplane span	4.99 m (16 ft 4½ in)
Wheel track	3.87 m (12 ft 8¼ in)
Wheelbase	2.91 m (9 ft 6½ in)
Propeller diameter	2.31 m (7 ft 7 in)
Crew door (optional): Height	1.02 m (3 ft 4 in)
Width	0.78 m (2 ft 6¾ in)
Cabin door: Height	1.19 m (3 ft 10¾ in)
Width	1.08 m (3 ft 6½ in)
Rear baggage door: Height	0.39 m (1 ft 3¼ in)
Width	0.25 m (9¾ in)

DIMENSIONS, INTERNAL:

Cabin: Length	4.05 m (13 ft 3½ in)
Max width	1.21 m (3 ft 11¾ in)
Max height	1.22 m (4 ft 0 in)
Cargo floor area	3.15 m² (33.91 sq ft)
Volume	3.5 m³ (124 cu ft)
Baggage compartment volume: front	0.08 m³ (2.8 cu ft)
rear	0.10 m³ (3.5 cu ft)

AREAS:

Wings, gross	18.00 m² (193.75 sq ft)
Vertical tail surfaces (total)	2.56 m² (27.55 sq ft)
Horizontal tail surfaces (total)	4.76 m² (51.24 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, basic	2,132 kg (4,700 lb)
Max baggage weight (all areas)	135 kg (298 lb)
Payload: max	605 kg (1,333 lb)
with max fuel	385 kg (849 lb)
Max fuel weight (usable)	866 kg (1,910 lb)
Max T-O weight	3,354 kg (7,394 lb)
Max ramp weight	3,370 kg (7,430 lb)
Max zero-fuel weight	2,736 kg (6,032 lb)
Max landing weight	3,186 kg (7,024 lb)
Max wing loading	186.3 kg/m² (38.16 lb/sq ft)
Max power loading: T-O	5.72 kg/kW (9.48 lb/shp)
cruise	less than 5.29 kg/kW (8.70 lb/shp)

PERFORMANCE:

Max cruising speed at FL260	320 kt (593 km/h; 368 mph)
Econ cruising speed at FL310	252 kt (467 km/h; 290 mph)
Stalling speed: clean	82 kt (152 km/h; 95 mph) IAS
flaps and landing gear down	65 kt (121 km/h; 75 mph) IAS

For details of the latest updates to ***Jane's All the World's Aircraft*** online and to discover the additional information available exclusively to online subscribers please visit
jawa.janes.com

Max rate of climb at S/L ..... 725 m (2,380 ft)/min
Time to FL260 ..... 15 min
Time to FL310 ..... 20 min
Max certified altitude ..... 9,450 m (31,000 ft)
T-O to 15 m (50 ft) ..... 866 m (2,845 ft)
Landing from 15 m (50 ft) ..... 741 m (2,435 ft)

Range, NBAA IFR reserves:
with max payload: econ cruise ..... 1,100 n miles (2,037 km; 1,265 miles)
max cruise ..... 1,005 n miles (1,861 km; 1,156 miles)
with max fuel: econ cruise ..... 1,520 n miles (2,815 km; 1,749 miles)
max cruise ..... 1,365 n miles (2,528 km; 1,570 miles)
g limits ..... +3.8/-1.5

VOLIRIS

VOLIRIS SARL

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e-mail: info@voliris.com
Web: www.voliris.com
PRESIDENT: Simon Theuveny

HEADQUARTERS: Centre d'Affaires de Moulins, Aérodrome Moulins-Montbeugny, F-03400 Toulon sur Allier

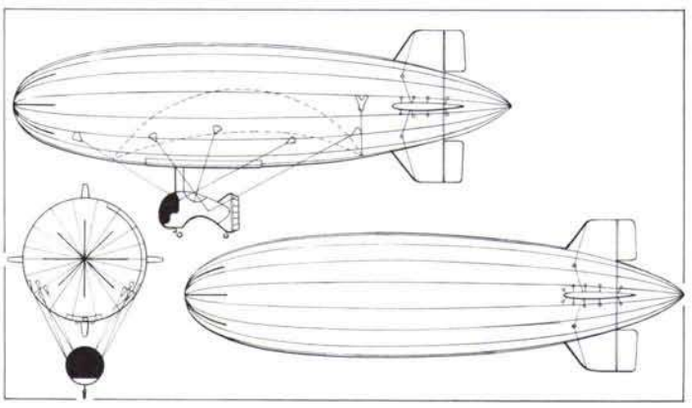
Voliris was formed in February 1999 and has since produced a number of small remotely controlled airships. A prototype of its first piloted product, the Voliris 900, flew on 26 June 2003, followed by a second airship in 2005.

VOLIRIS 900

TYPE: Helium non-rigid airship.
PROGRAMME: Development process included 9.5 m (31.2 ft) long, 25 m³ (883 cu ft) radio-controlled model. Assembly of full-scale prototype completed in June 2002 and engine fitted early in following month. First helium inflation 21 June 2002; revealed publicly 26 June 2002 at Meudon. First flight at Clermont-Ferrand air base on 26 June 2003, registered (F-)WAAN. Re-registered in ultralight series as 03-VS by early 2005; promotional tour of Gabon in November 2005.
DESIGN FEATURES: Envelope is modified version of RosAeroSystems Au-12 (which see); first, for prototype, was delivered in May 2002. Gondola is French-built.
POWER PLANT: One 74.6 kW (100 hp) four-cylinder two-stroke engine, with fuel injection, driving pusher propeller at rear of gondola. One patented 18.6 kW (25 hp) two-cylinder four-stroke engine, driving an auxiliary propeller in duct in centre of gondola, provides additional upward and downward movement control for ground manoeuvring.

Voliris 900 helium non-rigid airship 1128936

Gondola of Voliris 900 prototype 1128937



Voliris 900 with production-style gondola *(James Goulding)* 1159080

ACCOMMODATION: Pilot and one passenger.
DIMENSIONS, EXTERNAL:
Length overall ..... 31.00 m (101 ft 8½ in)
Envelope max diameter ..... 8.00 m (26 ft 3 in)
DIMENSIONS, INTERNAL:
Envelope volume ..... 996 m³ (35,175 cu ft)
Helium volume ..... 900 m³ (31,783 cu ft)
AREAS:
Envelope surface area ..... 615.0 m² (6,620 sq ft)
PERFORMANCE:
Max level speed ..... 45 kt (85 km/h; 52 mph)
Cruising speed ..... 40 kt (75 km/h; 47 mph)
Max operating altitude ..... 1,500 m (4,920 ft)
Endurance ..... 5 h

YAK AERO

YAK AERO SARL

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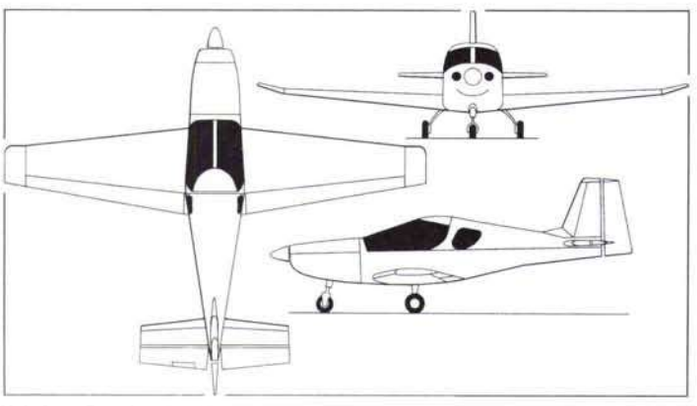
In 2006, Yak Aero launched a version of the Lucas L 11 at the RSA Rally at Blois.

YAK AERO BENELOS

TYPE: Side-by-side ultralight.
PROGRAMME: Emile Lucas (emile.lucas.9@online.fr) designed L 11 (prototype W33PM) for amateur assembly from plans (EUR400 per set); recommended power plant is 59.7 kW (80 hp) Jabiru 2200; intended L 12 offers simpler manufacture through employment of constant-chord wings.
Factory-built version offered by Yak Aero from 2006 as Benelos.
DESIGN FEATURES: Low-mounted, rhomboidal wing and tailplane; increased dihedral at wingtips. Sweptback, rhomboidal fin. Lower fuselage swept upwards aft of cockpit.

Lucas L 11, basis of Yak Aero Benelos 1158660

FLYING CONTROLS: Conventional and manual. Four-position flaps. Tailplane trim tab.
STRUCTURE: Generally of riveted 2024 aluminium.
LANDING GEAR: Tricycle type; fixed. Fuselage-mounted, spring cantilever mainwheel legs; trailing link nosewheel. Hydraulic mainwheel brakes.
POWER PLANT: One 59.7 kW (80 hp) Yamaha YE80 Diesel-fuelled motorscooter engine driving a two-blade propeller. Fuel in wingroot tanks, combined capacity 80 litres (21.1 US gallons; 17.6 Imp gallons).
EQUIPMENT: Optional ballistic recovery parachute.
DIMENSIONS, EXTERNAL:
Wing span ..... 7.80 m (25 ft 7 in)
Length overall ..... 5.60 m (18 ft 4½ in)
AREAS:
Wings, gross ..... 9.15 m² (98.5 sq ft)



Yak Aero Benelos *(Paul Jackson)* 1159582

WEIGHTS AND LOADINGS:
Weight empty ..... 282 kg (622 lb)
Max T-O weight ..... 498 kg (1,097 lb)
PERFORMANCE:
Normal cruising speed ..... 100 kt (185 km/h; 115 mph)
Stalling speed ..... 36 kt (65 km/h; 41 mph)
Max rate of climb at S/L ..... 312 m (1,023 ft)/min
Endurance ..... 6 h 30 min
g limits ..... +6/ 3

Georgia

TBILAVIAMSHENI

TBILAVIAMSHENI JSC (TBILISI AEROSPACE MANUFACTURING JSC)

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CHAIRMAN: Pantiko Tordia
DIRECTOR GENERAL: Nodar Beridze
FIRST DEPUTY GENERAL DIRECTOR AND CHIEF ENGINEER: Gocha Goguadze

Former Tbilisi Aviation State Association (TASA) became Tbilisi Aerospace Manufacturing (TAM) upon privatisation in 2000, adopting present name when incorporated as a joint stock company in 2002. TASA was established 15 December 1941 when No. 448 Engine Manufacturing plant was augmented by the evacuated No. 31 Aircraft Factory from Taganrog and No. 45 Aircraft Repair Plant from Sevastopol; began aircraft production with the LaGG-3 fighter, and progressed through La-5, Yak-3, Yak-15, Yak-17/17UTI, Yak-23, MiG-15 and MiG-17 to building 1,677 MiG-21U/UMs (for which it offers an upgrade programme) between 1957 and 1984. The plant also began Su-25/25U production in 1978 and has produced 875 basic single-seat versions, including 50 Su-25BM target-tugs. In total, it has built over 8,070 manned aircraft, 2,555 UAVs and over 36,000 AAMs (30,000 R-60/AA-8s and 6,000 R-73/AA-11s). Continues to support Kela ultralight, first built in 1970s. Offers upgrades and overhauls for Mil helicopters.

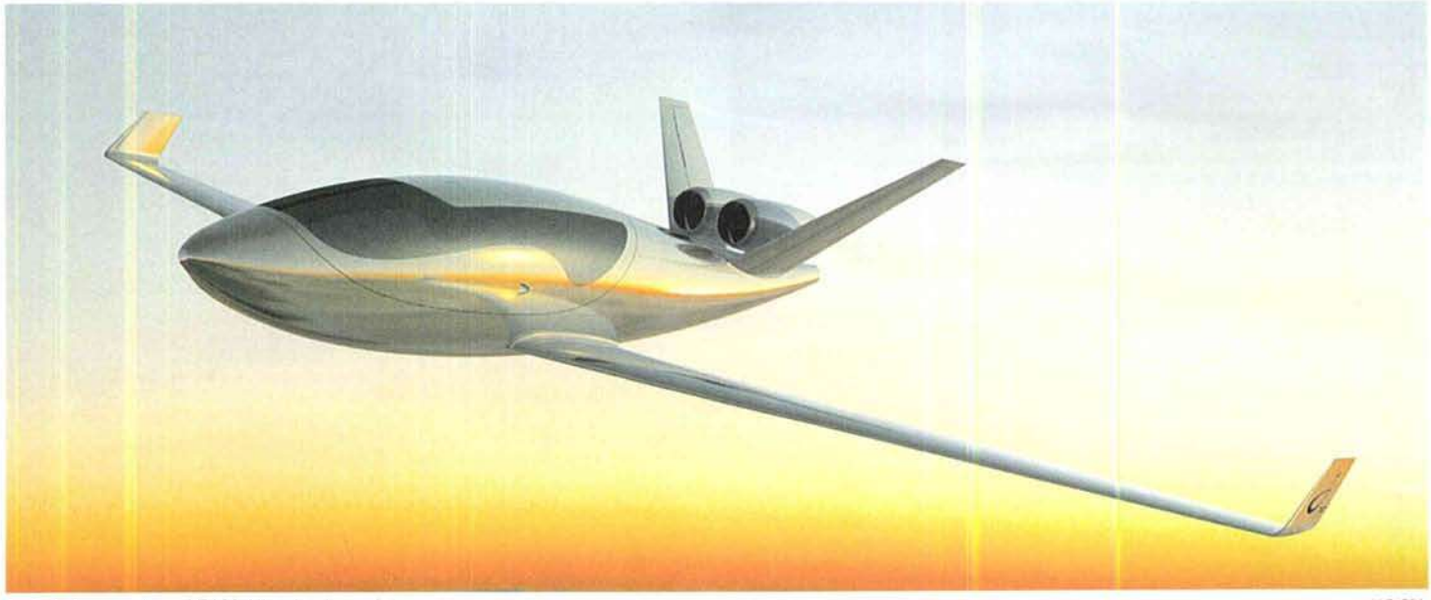
Current manufacture, at low rate, is of the Su-25UB two-seat trainer; also produced small batch of its Su-25T (Su-39) derivative. Production is also stated to be under way of a batch of 20 Yak-58 light transports, although there is no evidence of recent sales. Upgrade activities include a 'Frogfoot' modernisation, the Su-25KM Scorpion, a prototype of which flew in 2001.

The 250,000 m² (2,691,000 sq ft) TAM plant employed 15,000 personnel at its peak, but currently has a workforce of about 2,300. A 1999 alliance with Kelowna Flightcraft of Canada provides for TAM to assist with production of materials for the Convair 5800 conversion programme and eventually undertake the entire programme, if demand warrants. TAM additionally plans to fabricate components for the US-designed ViperJet two-seat kitbuilt.

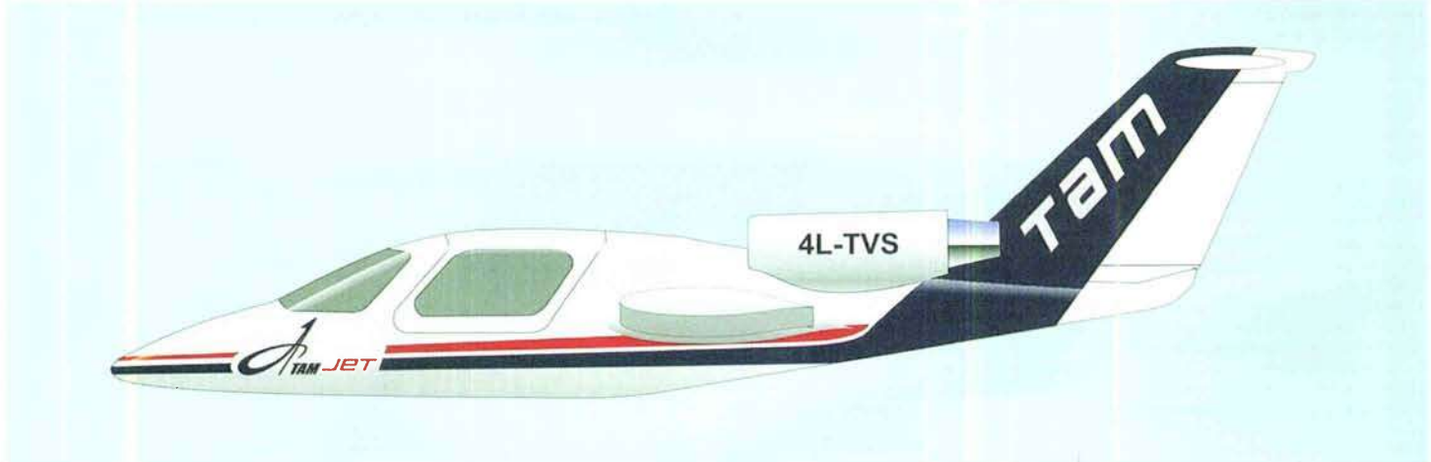
Also reported in late 2003 to have built two Leader light business jets, following agreement with Maverick, also of US. However, TAM terminated the Maverick agreement in January 2004, 10 months after it had begun, and before the first aircraft could be flown. Unofficial report of November 2005 claimed Maverick, also known as TAMjet, made first flight earlier in 2005, while in late 2005 company was continuing to promote TAMjet.

By August 2004 had been appointed by Aircraft Investor Resources of USA to build fuselage, wing and empennage for Epic LT turboprop and also is investing partner in AIR Epic Jet, to be marketed initially in US Experimental (home-assembled) category. Epic Jet will be assembled by Tbilaviamsheni for European, Middle East and Asian markets under the name, **Elite**. A follow-on design for a business jet, named **Alien**, is under design, with styling by fellow Tbilisi company, Tsikolia Design.

Non-aviation products include ground power units, domestic space heaters, combined harvesters and roofing materials.



Artist's impression of TAM Alien business jet 1154290



TAMjet profile from late-2005 literature 1154291

Germany

328 SUPPORT SERVICES

328 SUPPORT SERVICES GMBH

Corporate Jet Services, Hangar 2, Southampton Airport, Hampshire SO18 2HG, United Kingdom

WORKS:

Flugplatz Oberpfaffenhofen, PO Box 1103, D-88230 Wessling

MANAGING DIRECTOR: Wolfgang Walter

Bankrupt AvCraft Aerospace GmbH was purchased on 15 December 2005 by Corporate Jet Services, the parent company of executive charter operator Club 328. AvCraft was formally taken over on 2 January 2006 and renamed 328 Support Services. The acquisition covers engineering, maintenance and refurbishment, product support, the spare parts business and the type certificate for the Dornier 328 and 328JET.

The new company planned only to complete the last three Dornier 328s on the assembly line before devoting itself wholly to maintenance and support of the 220 or so remaining examples of the aircraft, including its turboprop predecessor, with the assistance of two-thirds of the original workforce of 140. Following a change of plan, only one aircraft was completed before manufacture was terminated.

DORNIER 328JET

TYPE: Regional jet airliner.

PROGRAMME: Development of Dornier 328 turboprop twin begun in mid-1980s, but then suspended; relaunched 3 August 1988; rolled out 13 October 1991; first flight (D-CHIC) 6 December 1991; first flight of first production 328-100 (D-CITI) 23 January 1993. JAA 25 certification 15 October 1993; FAA certification 10 November 1993; first delivery, to Air Engiadina, 21 October 1993. Production (including three prototypes) totalled 111; final aircraft (OE-LKC) delivered to Air Alps Aviation, Austria, 13 October 1999.

Twin turbofan version announced 5 February 1997 and formally launched at Paris Air Show in June 1997; marketed as 328JET, engineering designation being 328-300; known as 328Jet from 2003. High-speed wind tunnel tests, confirming cruise performance, and ground vibration tests completed by November 1997; prototype D-BJET, converted from second prototype 328 turboprop (D-CATI), rolled out 6 December 1997; first flight 20 January 1998; public debut 4 February 1998; three further prototypes built on the production line; second (D-BWAL) dedicated to performance certification testing, flew 20 May 1998; third (D-BEJR), used for avionics certification, flew 10 July 1998; fourth (D-BALL), used for function and reliability testing and simulated airline operation trials, flew on 15 October 1998; JAA certification was achieved on 8 July 1999 after completion of 1,560 flight hours in 950 sorties; FAA certification 15 July 1999; high gross weight certification achieved April 2000.

Last Dornier 328JET built by 328 Support Services, March 2006 1040387

First delivery in July 1999 to Skyway Airlines (N351SK); total of 15 delivered in 1999 and 33 in 2000. By June 2001 the in-service fleet of aircraft had logged 100,000 hours, with a 99.23 per cent flight completion rate; high-time aircraft, operated by Hainan Airlines, had then logged nearly 4,000 hours. Production suspended by late 2002, following Fairchild Dornier's bankruptcy.

Programme purchased by AvCraft in January 2003; assets included 18 'white tail' aircraft in complete condition and five on production line; deliveries began on 11 September 2003 with B-3948 to Hainan Airlines; production relaunched in December 2003 16 'whitetails' sold by late January 2004. First new production aircraft (D-BADA, c/n 3224) delivered in March 2005, but Avcraft filed for bankruptcy in same month and final four incomplete aircraft transferred to 328 Support Services in January 2006. One immediately completed for Club 328; this was D-BDXC, c/n 3220, delivered to Iceland 21 March 2006, becoming TF-NPA with Nordic Wings (leased to City Star). Completion of c/ns 3221, '22 and '23 was then abandoned.

CURRENT VERSIONS: **328Jet:** Regional airliner, *as described*; 32 passengers at 79 cm (31 in) seat pitch. Engineering designations **328-300** and **328-310**.

328Jet SMA: Proposed multirole special missions aircraft for troop transport, VIP missions, surveillance, SAR, AEW and medevac. Under study in 2002.

Freighter: All-cargo version with large door in aft fuselage for loading of containers or palletised freight. No longer being promoted.

Envoy: Business jet and corporate shuttle version, launched at the 1997 National Business Aviation Association Convention in Dallas, Texas; known as Envoy 3 until 2003. Subvariants are Envoy **Executive** with accommodation for 12 passengers and forward service galley and wardrobe and aft galley and lavatory; Envoy **Executive Shuttle** accommodating 22 to 32 passengers; and Envoy **Convertible** for 14 and 18 passengers and with forward galley. Executive standard fuel weight 5,042 kg (11,116 lb); Shuttle and **Convertible** have standard 328Jet capacity, with option of extra tanks.

Total of 10 Envoy orders by December 2001. Announced customers include Aircraft Jetcharter, which has ordered a Corporate Shuttle variant for operation on behalf of an Ohio-based customer, and Grupo Protexa of Monterey, Mexico, which has ordered one aircraft in executive configuration. Aircraft Completions of Tyler, Texas, is US completions centre.

Dornier 428: Developed version; programme suspended on 8 August 2002.

AEROSTYLE

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DIRECTOR: Ralf Magnussen

The company's first product, the Breezer, is in production as a kit and is being marketed by Ikarus in complete form. LSA version sales by Sportsplanes.com of US. The aircraft are built in Kamenz.

AEROSTYLE BREEZER

TYPE: Side-by-side ultralight/kitbuilt; two-seat lightplane.

PROGRAMME: Designed by Ralf Magnuson. Prototype (D-MOOV) exhibited unflown at Aero'99 at Friedrichshafen in April 1999; first flight was made in December 1999. Noise tests under way in mid-2000; German certification was achieved in second quarter of 2001. Prototype was exhibited at Friedrichshafen in April 2001 with modifications including steerable nosewheel replacing original trailing-link type. In 2002 an Experimental version with empty weight of 320 kg (705 lb) and max T-O weight of 580 kg (1,278 lb) was being offered. UK and US marketing began in 2005 after LSA approval achieved that year. Short-wing version introduced in 2006 with 8.03 m (26 ft 4¼ in) span; gives weight saving of 4 kg (9 lb).

CURRENT VERSIONS: **Aerostyle Breezer:** European Ultralight. MTOW 472.5 kg (1,041 lb).

Aerosport Breezer: Factory-built LSA for US market. MTOW 598 kg (1,320 lb). Distributed by Aerosport of Draper, Utah.

CUSTOMERS: A combined total of 76 kits and complete aircraft sold by Aerostyle up to December 2005. Production of complete aircraft now undertaken by Grilz of Kamenz with marketing by Ikarus at Höhentengen.

COSTS: EUR23,700 excluding taxes (2005). Complete Ikarus Breezer EUR55,300 (2005).

DESIGN FEATURES: Low, constant-chord wing, with wingtips upturned at rear. Sweptback fin. Wing aerofoil section NACA 4414. Quoted build time 600-800 hours.

FLYING CONTROLS: Conventional and manual. Horn-balanced elevators and rudder; plain ailerons; trim tab in port elevator; mechanical (electric optional) half-span Fowler flaps with external mass balance.

STRUCTURE: Mainly riveted aluminium, with glass fibre for some non-structural fairings, such as wingtips, cowling and rear fuselage.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted, spring composites cantilever mainwheel legs with wheel fairings; composites steerable nose leg; with wheel fairings. Hydraulic brakes on mainwheels. Mainwheel size 14×4, nosewheel 4.00×4.

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS engine driving a three-blade ground-adjustable Neuform T3 propeller; other optional engines include the 59.7 kW (80 hp) Jabiru 2200 and 89.4 kW (120 hp) Jabiru 3300. Optionally a 59.6 kW (79.9 hp) Rotax 912 UL can be fitted. Fuel capacity 70 litres (18.5 US gallons; 15.4 Imp gallons).

SYSTEMS: 12V battery.

EQUIPMENT: Optional Junkers or BRS-5-UL ballistic parachute.

DIMENSIONS, EXTERNAL:

Wing span	8.71 m (28 ft 7 in)
Length overall	6.36 m (20 ft 10½ in)
Height overall	2.12 m (6 ft 11½ in)

DIMENSIONS, INTERNAL:

Cockpit max width	1.17 m (3 ft 10 in)

AREAS:

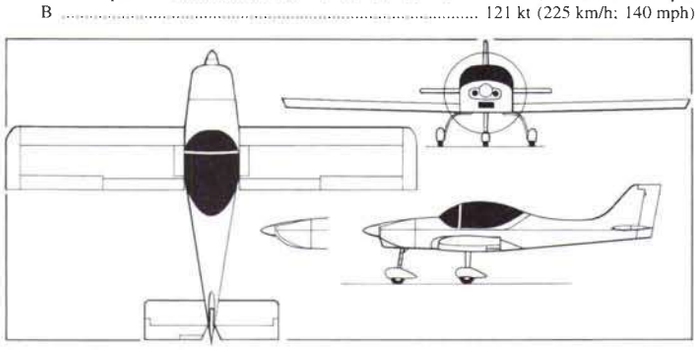
Wings, gross	11.85 m² (127.6 sq ft)

WEIGHTS AND LOADINGS (estimated):

Weight empty	285–295 kg (628–650 lb)
Max T-O weight	600 kg (1,322 lb)

PERFORMANCE (estimated, A: 67.1 kW/90 hp engine; B: 73.5 kW/98.6 hp engine):

Max level speed: A	116 kt (215 km/h; 134 mph)
B	121 kt (225 km/h; 140 mph)



Aerostyle Breezer all-metal two-seat ultralight aircraft, with scrap view of Rotax engine nose *(James Goulding)* 1121719

US demonstrator of Aerostyle Breezer being promoted for Light Sport category 1159273

Cruising speed: A	105 kt (195 km/h; 121 mph)
B	108 kt (200 km/h; 124 mph)
Stalling speed: A, B	36 kt (65 km/h; 41 mph)
Max rate of climb at S/L: A	270 m (886 ft)/min
B	360 m (1,181 ft)/min
T-O run: A	135 m (395 ft)
B	95 m (312 ft)
Landing run: A, B	140 m (460 ft)
Range	459 n miles (850 km; 528 miles)
g limits	+4/−2

AQUILA

AQUILA TECHNISCHE ENTWICKLUNGEN GMBH

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DIRECTORS:
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Alfred Schmiderer
Markus Wagner

MARKETING MANAGER: Siegfried Dörfler

Company formed August 1996 to develop A 210; employed 12 staff at Schönhagen aerodrome by April 2000; increased to 20 during 2001 and reached 38 by December 2003, and 43 by May 2004; following mid-2000 commissioning of new production hangar; capacity 50 aircraft per year. Distrubutors for France, the Netherlands, Scandinavia and Switzerland have been appointed. On 19 January 2005, Aquila filed for bankruptcy; administrator permitted resumption of production on 1 March 2005 and deliveries resumed immediately.

AQUILA A 210

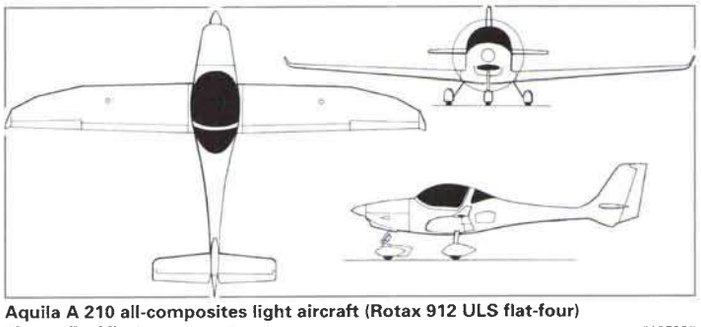
Engineering designation: AT 01

TYPE: Two-seat lightplane.

PROGRAMME: Launched 1995; design, using CAD/CAM techniques, began 1997, assisted by Berlin Technical University; prototype (D-EQUI) displayed at Aero'99, Friedrichshafen, in April 1999; first flight 5 March 2000; initially flew without winglets; certification, as AT 01, to JAR-VLA received September 2001; deliveries began July 2002 with first aircraft (D-ETHG) to Flugschule Hans Grade at Schönhagen. Certification in USA awarded 4 November 2003; Australia, France and Switzerland also completed during 2003; certification in Austria, Scandinavia and the UK was expected during 2004.

CUSTOMERS: Total 51 firm orders by May 2004, including pilot trainers for Lufthansa, and club aircraft for EADS Aéroports de Paris and airline Swiss. Total 28 (including prototype) completed by end of 2004, when bankruptcy temporarily intervened. On resumption of manufacture on 1 March 2005, Aquila had order backlog extending into 2006 at rate of two aircraft per month. Total of 50 (including prototype) completed by June 2006 for customers in Austria, Belgium, France, Germany, Russian Federation and Switzerland.

Aquila A 210 used for pilot training at Graz, Austria *(Paul Jackson)* 1158288



Aquila A 210 all-composites light aircraft (Rotax 912 ULS flat-four) *(James Goulding)* 0137230

COSTS: EUR121,000 excluding tax (2005).

DESIGN FEATURES: Design goals included crashworthy cabin structure, forgiving handling characteristics and low operating costs. Low wing with sharply tapered fuselage aft of cabin and sweptback fin; high aspect ratio wing with upturned tips.

Laminar flow wing section Horstmann/Quast HQ-42 modified. Dihedral 4° 30'.

FLYING CONTROLS: Conventional and manual. Actuation via pushrods for elevators and ailerons; cables for rudder. Integral fixed-angle rudder tab and balanced ailerons. Externally hinged, single-slotted Fowler flaps, deflections 15 and 35°.

STRUCTURE: Entirely CFRP/GFRP. Fuselage is a GFRP monocoque with CFRP stringers and GFRP/CFRP frames; wing shell structure and tail unit and control surfaces are GFRP/polyurethane foam sandwich with CFRP wingspar, load-bearing structures and local reinforcements.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring steel mainwheel legs; steerable nose leg with rubber-in-compression suspension; all wheels size 5.00-5; speed fairings on all wheels; hydraulic brakes; combined ventral fillet/tailskid.

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912S flat-four engine driving an MT-Propeller MTV-21-A/175-05 two-blade, variable-pitch (hydraulic) propeller. Fuel in two integral wing tanks, total capacity 120 litres (31.7 US gallons; 26.4 Imp gallons). Fuel filler in upper surface of each wing.

ACCOMMODATION: Two persons side by side under forward- and upward-opening windscreen/canopy; baggage door on port side of aft wing. Four-point safety harnesses for both occupants. Accommodation heated and ventilated. Choice of leather or cloth seating.

SYSTEMS: 14 V electrical system, including 40 Ah alternator and 12 V 19 Ah battery. Heavy duty 29 Ah battery optional.

AVIONICS: *Comms:* Bendix/King KX 125 com/nav; KT 76A transponder; encoding altimeter, PS Engineering PM 501 intercom, and ELT, all standard. Becker AR 4201 second com, Bendix/King KT 76C Mode C digital transponder with encoder, Bendix/King KT 73 Mode S datalink transponder, Garmin GTX 327 transponder, KMA 28 audio panel, GMA 340 audio panel, and 406 MHz ELT, all optional.

Flight: Bendix/King KX 155 com/nav with GI 106A VOR/LOC/GS indicator and KMD 150 GPS with colour MFD, Garmin GNS 430 com/nav/GPS with GI 106A VOR/LOC/GS indicator, optional.

Instrumentation: Three-point altimeter, ASI, VSI, magnetic compass, artificial horizon, directional gyro, turn co-ordinator, CHT gauge, oil temperature/pressure gauges, fuel gauge, tachometer, manifold pressure gauge, OAT gauge, Hobbs hour meter, Davtron M800 chronometer, all standard.

EQUIPMENT: Navigation, anti-collision and landing lights and tiedown fittings, standard. Optional equipment includes auxiliary/external power receptacles, tinted canopy, fire extinguisher and aero-tow system.

DIMENSIONS, EXTERNAL:

Wing span, excl winglets	10.30 m (33 ft 9½ in)
Wing aspect ratio	10.1
Length overall	7.30 m (23 ft 11½ in)
Height overall	2.30 m (7 ft 5½ in)
Fuselage max width	1.20 m (3 ft 11¼ in)
Tailplane span	3.00 m (9 ft 10 in)
Wheel track	1.94 m (6 ft 4½ in)
Wheelbase	1.66 m (5 ft 5½ in)
Propeller diameter	1.75 m (5 ft 9 in)
Baggage door: Max width	0.51 m (1 ft 8 in)

DIMENSIONS, INTERNAL:

Cabin max width	1.20 m (3 ft 11¼ in)
Baggage volume	0.50 m³ (17.66 cu ft)

AREAS:

Wings, gross	10.50 m² (113.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	490 kg (1,080 lb)
Baggage capacity	40 kg (97 lb)
Max T-O weight	750 kg (1,653 lb)
Max wing loading	71.4 kg/m² (14.63 lb/sq ft)
Max power loading	10.20 kg/kW (16.76 lb/hp)

PERFORMANCE:

Max level speed	165 kt (306 km/h; 190 mph)
Max cruising speed	130 kt (241 km/h; 150 mph)
Cruising speed: at 75% power at FL50	121 kt (224 km/h; 139 mph)
at 55% power at FL50	103 kt (191 km/h; 119 mph)
Stalling speed: flaps up	50 kt (93 km/h; 58 mph)
flaps down	43 kt (80 km/h; 50 mph)
Max rate of climb at S/L	229 m (750 ft)/min
Service ceiling	4,420 m (14,500 ft)
T-O run	250 m (820 ft)
T-O to 15 m (50 ft)	470 m (1,542 ft)
Landing from 15 m (50 ft)	500 m (1,640 ft)
Landing run	200 m (656 ft)
Range with max fuel at 75% at FL50	535 n miles (990 km; 615 miles)
55% power at FL50, 45 min reserves	620 n miles (1,148 km; 713 miles)
Max endurance	6 h 5 min

AUTOGYRO EUROPE

AUTOGYRO EUROPE GMBH

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AutoGyro Europe was formed to market the MT-03 autogyro, previously developed by the founders under the business name of UL-Flugschule Höxter. Sales accelerated during 2005; dealerships established in UK, South Africa and elsewhere.

AUTOGYRO EUROPE MT-03

TYPE: Two-seat autogyro ultralight.

PROGRAMME: Developed from an earlier Spanish design; first autogyro to gain modern German certification. Gained UK BCAR Section T certification in 2006.

CUSTOMERS: Sales of 45 by June 2006.

COSTS: EUR42,800 to EUR51,000, depending on specification, plus taxes (2006).

DESIGN FEATURES: Open, tandem seating, pod-and-boom configuration with sweptback central fin, plus stabilising fins at tailplane ends; rudder on central fin only. Prerotation by metal tube drive with universal joints.

Rotor design by Air Copter of France; aerofoil section NACA 8H12.

STRUCTURE: Welded, rectangular, stainless steel tube chassis and composites pod and empennage of carbon fibre and glass fibre. Aluminium rotor.

LANDING GEAR: Tricycle type, fixed. Cantilever composites spring mainwheel legs with speed fairings and hydraulic brakes. All tyres 4.80/4.00-8.

POWER PLANT: One Rotax flat-four: 73.5 kW (98.6 hp) 912 ULS or 84.5 kW (113.3 hp) turbocharged 914 UL. Three-blade, carbon fibre, fixed-pitch propeller. Fuel tank beneath rear seat, capacity 32 litres (8.5 US gallons; 7.0 Imp gallons) normal; 69 litres (18.2 US gallons; 15.2 Imp gallons) optional.

DIMENSIONS, EXTERNAL:

Rotor diameter	8.40 m (27 ft 6¾ in)
Length overall	5.10 m (16 ft 8¾ in)

AutoGyro Europe MT-03 used for UK trials *(Paul Jackson)* 1159343

Height overall	2.60 m (8 ft 6¼ in)
Width overall	1.80 m (5 ft 10¾ in)

WEIGHTS AND LOADINGS:

Weight empty	239 kg (527 lb)
Max T-O weight	450 kg (992 lb)

PERFORMANCE (Rotax 914 engine):

Never-exceed speed (VNE)	88 kt (163 km/h; 101 mph)
Cruising speed	70 kt (130 km/h; 81 mph)
Max rate of climb at S/L	300 m (984 ft)/min
T-O run	up to 70 m (230 ft)
Landing run	up to 15 m (50 ft)
Max range	216 n miles (400 km; 248 miles)

B&F

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PRESIDENT: Peter Funk

The FK series, which began in 1959 with the Grief 1a sailplane, is designed by father and/or son, Dipl Ing Otto Funk and Peter Funk. Latest products are the nostalgic FK 12 and FK 14 Polaris composites ultralights and a Mk IV version of FK 9.

Work on B&F's new 900 m² (9,700 sq ft) factory on the same airfield began in January 2002.

In 2003, B&F employed six people at its headquarters plus a further 45 at its Krosno, Poland, factory.

B&F FK 9

TYPE: Side-by-side ultralight.

PROGRAMME: Earlier versions of B&F's FK 9 were built at Krosno, Poland, employing metal tube fuselages and composites wings, both fabric-covered. The Mark 3 all-composites version was announced in 1997; 85 per cent of airframe is manufactured in Poland, for completion in Germany. Launched at Friedrichshafen Air Show, April 1997; UK sales promotion from July 1998. Following trials in earlier FK 9 (D-MCFK), 60.3 kW (80.9 hp) Mercedes M160 three-cylinder turbocharged engine, developed from that of DaimlerChrysler Smart motorcar, offered as alternative power plant from 2000 in version designated **FK 9 Smart**; first aircraft delivered 5 May 2004. LSA approval achieved 3 December 2005 for marketing in US.

CURRENT VERSIONS: **FK 9 Mark 3:** Baseline composites version, now superceded by Mk IV.

FK 9 Mark 3B: Sold by Brazilian dealership as Alpha Bravo FK-9. Span 10.33 m (33 ft 10¾ in); wing area 12.22 m² (131.5 sq ft). At least one exported to Portugal.

FK 9 Club: Utility version; launched at Aero '03, Friedrichshafen, April 2003 in Mark 3 form; now available as Mark 4.

FK 9 Mark IV: Replacement for Mk 3; has wider (4 cm; 1½ in), longer (8 cm; 3¼ in) cabin and larger flaps and tailplane. Prototype (D-MBKA) first flown by October 2003. *Detail description applies to this version.*

FK 9 Mark IV SW: Short-wing (9.25 m; 30 ft 4¼ in) wing span, compared to baseline version has improved forward visibility.

FK 9 Mark IV Utility: Utility version for flight training and towing. Nosewheel or tailwheel.

CUSTOMERS: Over 300 FK 9s of all series built by July 2006; 300th aircraft delivered 19 June 2006.

COSTS: Kit EUR29,580; standard flyaway version EUR51,852, LSA version EUR55,100, both including tax (2006).

FLYING CONTROLS: Conventional and manual. Flaps.

STRUCTURE: Glass fibre fuselage with steel tube cockpit frame; wing of carbon fibre structure and leading-edge with skin (incl ailerons) of carbon fibre (Mk IV) or Ceconite fabric (Mk IV Utility). Aluminium flaps and tailplane. Optional 'fully carbon fibre' wing; optional wing folding.

LANDING GEAR: Fixed; tricycle type (TG = trigear) standard; tailwheel type ('Classic') optional for FK 9 Explorer. Fuselage-mounted spring cantilever mainwheel legs with wheel fairings. Trailing-link nosewheel with wheel fairing; steerable. Mainwheels 6.00-6. Optional Czech Air Works 1150 floats can be fitted.

POWER PLANT: One 59.6 kW (79.9 hp) Rotax 912 UL (standard), 73.5 kW (98.6 hp) Rotax 912 ULS or 60.3 kW (80.9 hp) Mercedes M160/1 driving a Junkers three-blade, ground-adjustable pitch, carbon fibre propeller. Normal fuel capacity 70 litres (18.5 US gallons; 15.4 Imp gallons), of which 65 litres (17.2 US gallons; 14.3 Imp gallons) are usable. Optional extra 18 litre (4.8 US gallon; 4.0 Imp gallon) tank can be installed.

EQUIPMENT: Optimal BRS 5 ballistic parachute.

B&F FK 9 Mark 4 US demonstrator *(Paul Jackson)* 1159344

Views of B&F FK 9 Explorer tailwheel version 1159274

DIMENSIONS, EXTERNAL:
- Wing span ... 9.85 m (32 ft 3¾ in)
- Length overall ... 5.85 m (19 ft 2¼ in)
- Height overall (nosewheel) ... 2.15 m (7 ft 0¾ in)

AREAS:
- Wings, gross ... 11.60 m² (124.9 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty: tricycle ... 265 kg (584 lb)
- tailwheel ... 263 kg (580 lb)
- Max T-O weight ... 520 kg (1,146 lb)

PERFORMANCE (Rotax 912 UL):
- Never-exceed speed (VNE) ... 124 kt (230 km/h; 143 mph)
- Cruising speed:
  - at 75% power ... 104 kt (192 km/h; 119 mph)
  - at 65% power ... 97 kt (180 km/h; 112 mph)
- Stalling speed ... 35 kt (64 km/h; 40 mph)
- Max rate of climb at S/L ... 300 m (984 ft)/min
- T-O run ... 120 m (395 ft)
- Landing run ... 220 m (722 ft)
- Range ... 540 n miles (1,000 km; 621 miles)
- g limits ... +6.1/–3

B&F FK 12 COMET

TYPE: Tandem-seat ultralight biplane/kitbuilt.

PROGRAMME: Design, by Peter Funk, started late 1994; construction of prototype began 1995; first flight (D-MPLI) March 1997; first flight of production aircraft May 1997; certification received in 1999. Banner tow tests started 2 March 2006.

CUSTOMERS: 57 Flying by January 2003.

COSTS: Kit EUR34,162, ready-to-fly EUR60,900 with Rotax 912 UL, including taxes (2006).

DESIGN FEATURES: Wings, of laminar aerofoil section, have sweepback, and fold back for storage. Quoted build time 500 hours.

FLYING CONTROLS: Conventional and manual rudder and elevator; full-span flaperons on upper and lower wings, with optional spade-type balances.

STRUCTURE: Welded steel tube forward fuselage with riveted aluminium tube rear section; composites and GFRP laminate skinning; wings have carbon fibre main spar and leading-edge with aluminium secondary spar and flaperons, rear section fabric-covered.

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted spring cantilever mainwheel legs with wheel fairings. Mainwheels 6.00-6.

POWER PLANT: One 59.6 kW (79.9 hp) Rotax 912 UL, 73.5 kW (98.6 hp) Rotax 912 ULS or turbocharged 84.6 kW (113.4 hp) Rotax 914 driving an MT-Propeller two-blade wooden propeller; Mühlbauer two-blade wooden or Duc constant-speed propeller optional. Ring-style engine mounting and revised cowl with diffuser cooling introduced in February 2005. Fuel tank in fuselage, capacity 42 litres (11.1 US gallons; 9.2 Imp gallons). Optional replacement 58 litre (15.3 US gallon; 12.8 Imp gallon) tank or additional 18 litre (4.75 US gallon; 4.0 Imp gallon).

ACCOMMODATION: Options of interchangeable enclosed or open cockpit; change effected in short time.

EQUIPMENT: Optional BRS5 ballistic parachute.

DIMENSIONS, EXTERNAL:
- Wing span ... 6.70 m (21 ft 11¾ in)
- Length overall ... 5.60 m (18 ft 4½ in)
- Height overall ... 1.98 m (6 ft 6 in)

AREAS:
- Wings, gross ... 13.40 m² (144.2 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty ... 265 kg (584 lb)
- Max T-O weight: standard ... 450 kg (992 lb)
- where permitted ... 520 kg (1,146 lb)

PERFORMANCE (Rotax 912 ULS):
- Never-exceed speed (VNE) ... 118 kt (220 km/h; 136 mph)
- Max level speed ... 109 kt (202 km/h; 126 mph)
- Cruising speed at 75% power ... 97 kt (180 km/h; 112 mph)
- Stalling speed, flaperons down ... 36 kt (65 km/h; 41 mph)
- Max rate of climb at S/L ... 420 m (1,378 ft)/min
- T-O run to 15 m (50 ft) ... 180 m (590 ft)
- Range with max fuel ... 351 n miles (650 km; 403 miles)
- g limits at 450 kg AUW ... +9/–3.5

B&F FK 12 Comet 1159275

B&F FK 14 POLARIS

TYPE: Side-by-side ultralight.

PROGRAMME: Development began early 1998; prototype (D-MVFK), then unflown, exhibited at Aero '99 at Friedrichshafen in April 1999 and first flown May 1999. In production by 2000.

CURRENT VERSIONS: **FK 14:** Baseline version; *as described.*

FK 14B: First shown at Aero '03, Friedrichshafen, at which time prototype (D-MVFK upgraded) not then flown. New carbon wing and larger fuel tank; higher canopy opening angle for easier access; modified engine cowling; baggage locker behind seats. Mainwheels as baseline version.

CUSTOMERS: Total of 50 sold by November 2004; five sold in Germany in 2004.

COSTS: Kit EUR37,004 ready to fly, EUR71,688 with Rotax 912 and EUR73,912 with Rotax 912S, all including tax (2006).

DESIGN FEATURES: Low wing with upturned wingtips incorporating navigation lights; wing section designed with assistance of Stuttgart University wind tunnel.

FLYING CONTROLS: Conventional and manual; electrically operated Fowler flaps extend on rails to 20°; spring trim system; horn-balanced rudder.

STRUCTURE: Mainly glass fibre sandwich, with aluminium ailerons, tailplane and flaps; elevators and rudder fabric-covered. Carbon fibre wing.

LANDING GEAR: Fixed, tricycle type standard; tailwheel type (solid tailwheel) optional. Fuselage-mounted spring composites cantilever mainwheel legs; steerable nosewheel; drum brakes; speed fairing on all wheels. 4 inch mainwheels standard, optionally 6.00-6.

POWER PLANT: One 59.6 kW (79.9 hp) Rotax 912 UL (standard) or 73.5 kW (98.6 hp) Rotax 912 ULS driving a Junkers or DUC three-blade, ground-adjustable pitch, carbon fibre propeller. Fuel contained in single tank behind cockpit, capacity 65 litres (17.2 US gallons; 14.3 Imp gallons), optionally 72 litres (19.0 US gallons; 15.8 Imp gallons) with enlarged tank.

EQUIPMENT: Optional BRS 5 emergency parachute recovery system.

DIMENSIONS, EXTERNAL:
- Wing span ... 9.04 m (29 ft 8 in)
- Length overall ... 5.69 m (18 ft 8 in)
- Height overall (nosewheel) ... 2.00 m (6 ft 6¾ in)

AREAS:
- Wings, gross ... 9.40 m² (101.2 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty: tricycle ... 275.5 kg (607 lb)
- tailwheel ... 273.5 kg (603 lb)
- Max T-O weight: Ultralight ... 472.5 kg (1,041 lb)
- Experimental ... 520 kg (1,146 lb)

PERFORMANCE:
- Never-exceed speed (VNE) ... 156 kt (290 km/h; 180 mph)
- Cruising speed at 75% power ... 131 kt (243 km/h; 151 mph)
- Min flying speed ... 35 kt (64 km/h; 40 mph)
- Max rate of climb at S/L ... 330 m (1,083 ft)/min
- T-O to 15 m (50 ft) ... 205 m (675 ft)
- Range ... 350 n miles (648 km; 403 miles)
- g limits, Experimental ... +6.4/–4.0

B&F FK 14 Polaris complete and in fast-build kit form 1159276

C+C FLYING

C+C FLYING GMBH

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CHIEF DESIGNER: Dr Ernst Alban

In 2003, C+C was building a prototype of its latest design, the CC/03; the earlier CC/01 and CC/02 remain available. A further aircraft, the CC/04, is under development. Known details last appeared in the 2006-2007 *Jane's All the World's Aircraft*.

DEWALD

DEWALD MELOS 3000

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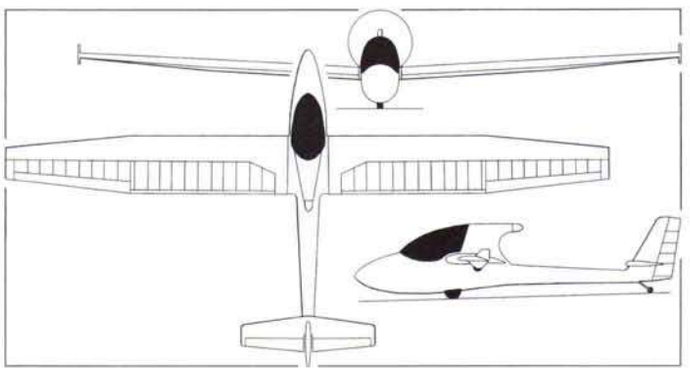
BUSINESS DEVELOPMENT MANAGER: Clemens Engler

Dewald markets a wide range of light aircraft and accessories, including the Interplane Skyboy and Dewald Sunny series of single- and two-seat ultralights and the French series of Adventure paramotors. At Aero '05 in Friedrichshafen, the company launched the Melos 3000 motor glider. The Dewald Leonardo flying wing, tandem-seat motor glider and Springmaus (Hopping Mouse) ultralight single-seat remain under development.

DEWALD MELOS 3000

TYPE: Single-seat motor glider ultralight.
PROGRAMME: Melos DFB-1A, designed by Manfred Derschug, first flew in France (F-PMLS) in 2000, employing König engine; awarded 'most outstanding construction' at RSA meeting in 2002; renamed Melos 2000; exhibited at Friedrichshafen in April 2005 to represent Melos 3000 version to be produced in Germany from 2007.
CUSTOMERS: Three of original version built.
DESIGN FEATURES: Mid-mounted wing with tapered outer panels and winglets; folding, pusher propeller; cruciform empennage with sweptback fin. Can be dismantled for storage.
FLYING CONTROLS: Conventional and manual. Schempp-Hirth airbrakes.
STRUCTURE: Glass fibre fuselage with foam local reinforcement. Wooden wings with fabric covering to rear of leading-edge.
LANDING GEAR: Monowheel type; fixed. Auxiliary solid wheels at wingtips and tail.
POWER PLANT: Option of two piston engines, comprising 20.6 kW (27.6 hp) DSA 250 two-cylinder, four-stroke and similarly-rated Hirth F33 single-cylinder motors. Three-blade, carbon fibre, folding, pusher propeller. Fuel capacity 30 litres (7.9 US gallons; 6.6 Imp gallons).
EQUIPMENT: Ballistic parachute.
DIMENSIONS, EXTERNAL:
Wing span ..... 11.00 m (36 ft 1 in)
Length overall ..... 5.95 m (19 ft 6¼ in)
Height overall ..... 1.50 m (4 ft 11 in)
AREAS:
Wings, gross ..... 10.50 m² (113.0 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 195 kg (430 lb)
Max T-O weight ..... 315 kg (694 lb)
PERFORMANCE, POWERED:
Normal cruising speed ..... 78 kt (145 km/h; 90 mph)
Max rate of climb at S/L ..... 180 m (591 ft)/min
Range ..... 325 n miles (600 km; 372 miles)
g limits ..... +6/–4

Melos 2000 prototype, generally representative of Melos 3000 *(Paul Jackson)*
1159345


Dewald Melos 3000 general arrangement 1159380

PERFORMANCE, UNPOWERED:
Stalling speed ..... 35 kt (64 km/h; 40 mph)
Best glide ratio 25

EQUATOR

EQUATOR AIRCRAFT COMPANY

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In early 2007, Equator was seeking orders and financial backing to launch production of an aircraft family suitable for utility and corporate transport duties. A modular approach gives the Equator four-, six-, eight-, 10- or 12-passenger capacity, with configurations ranging from low-price landplane with fixed gear and single piston engine single up to a pressurized, twin-turboprop amphibian. Key elements of the design include cabane-mounted engine(s) above the aircraft's centre of gravity; composites structure; and (as amphibian) 'float wing' design which eliminates wingtip floats by using the wing's lower surface as a stabilising sponson.

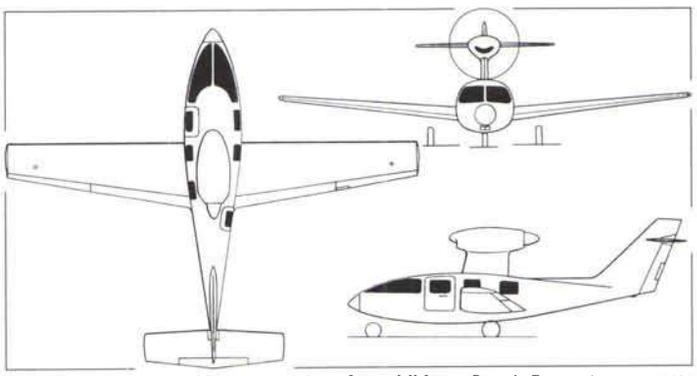
Pöschel Aircraft GmbH became Equator Aircraft in 1974; made several appearances in *Jane's All the World's Aircraft* since late 1960s with P-300 and P-400 series aircraft, which mounted tractor propellers atop the fin. P-300 A1 landplane (D-EULM), with fixed landing

In-flight views of Equator P-300 A1 prototype and P-420 1158907

Manufactured image, based on P-300RG, of Equator amphibian in current configuration 1158908

gear, first flew 27 February 1971, powered by 216 kW (290 hp) Textron Lycoming IO-540; P-420 Turbo Equator amphibian, with 313 kW (420 shp) Allison (now Rolls-Royce) 250-B17C flew (D-EMGF) February 1977 but was lost on eighth flight due to engine failure on take-off.

At 1980 Hannover air show, mockup was shown of P-300RG, differing considerably from P-300A1, most notably in having cabane-mounted engine with pusher propeller; this was later marked D-EULM, which registration also appears on artist's impressions of proposed new variant.



General appearance of Equator series of amphibians *(Dennis Punnett)* 1158920

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Company makes a range of aerial advertising and inflatable media (balloons, radio-controlled unmanned blimps and tethered aerostats). It described its FS 200, revealed in 2003, as "the world's first true ultralight airship", but no evidence of completion or flight had emerged by mid-2006.

EXTRA

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CHIEF DESIGNER: Walter Extra
GENERAL MANAGER: Extra GmbH: Corvin Huber
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The former Extra Flugzeugbau GmbH, founded by Walter Extra, was forced to curtail activities in early 2003 as a consequence of insolvency. By mid-2003 the company had been restructured under US ownership as Extra Aircraft LLC. Research, development and manufacturing activities remain in Germany, with establishment of a US completions centre under consideration after 2004. Main production is of EA-300, although EA-200 in low rate manufacture.

EXTRA EA-200

Engineering designation: EA-300/200

TYPE: Aerobatic two-seat sportplane.

PROGRAMME: Prototype (D-ETEL) first flown 2 April 1996 and almost immediately shipped to USA for demonstrations and public debut at EAA Sun 'n' Fun in Lakeland, Florida, later that month; second prototype and principal flight test aircraft (D-EAZG) exhibited at ILA, Berlin, May 1996; German certification scheduled for 15 June 1996, followed by FAA certification (initially in Experimental/Exhibition Category) on 20 December 1996. May former the basis for future development of a new low-cost aerobatic aircraft.

CUSTOMERS: Prototype and five production aircraft delivered in 1996; 15 in 1997; five in 1998; further two in mid-1999; and one in mid-2000; further two completed in late 2001 for customers in USA and Ireland; none in 2002 or 2003; one each in 2004 and 2005; four in first half of 2006; total 37. Most exported to US. Total of six scheduled for manufacture in 2006.

COSTS: EUR175,000 (2006).

Data generally as for Extra EA-300, except that below:

FLYING CONTROLS: Control surface movements: ailerons ±30°; elevators ±22°; rudder ±30°; trim tab ±15°.

POWER PLANT: One 149 kW (200 hp) Textron Lycoming AEIO-360-A1E flat-four engine with Gomolzig exhaust, driving an MT-Propeller MTV-12-B-C/C183-17e three-blade, constant-speed propeller. Standard fuel capacity 122 litres (32.3 US gallons; 26.8 Imp gallons), of which 117 litres (30.9 US gallons; 25.7 Imp gallons) are usable; optional long-range tanks increase usable capacity to 185 litres (48.9 US gallons; 40.7 Imp gallons). Aerobatic usable fuel limited to 36 litres (8.5 US gallons; 7.0 Imp gallons). Unusable fuel 5 litres (1.3 US gallons; 1.1 Imp gallons) in all cases.

DIMENSIONS, EXTERNAL:
Wing span ..... 7.50 m (24 ft 7¼ in)
Wing aspect ratio 5.4
Length overall ..... 6.50 m (22 ft 10¼ in)
Height overall ..... 2.70 m (8 ft 4¾ in)
Propeller diameter ..... 1.83 m (6 ft 0 in)

AREAS:
Wings, gross ..... 10.40 m² (111.9 sq ft)

WEIGHTS AND LOADINGS:
Weight empty, equipped ..... 562 kg (1,239 lb)
Max T-O weight: Aerobatic, solo ..... 700 kg (1,543 lb)
Aerobatic, two-seat ..... 800 kg (1,763 lb)
Normal ..... 840 kg (1,851 lb)
Max wing loading:
Aerobatic, solo ..... 67.31 kg/m² (13.78 lb/sq ft)
Aerobatic, two-seat ..... 76.92 kg/m² (15.76 lb/sq ft)
Normal ..... 80.77 kg/m² (16.54 lb/sq ft)
Max power loading:
Aerobatic, solo ..... 4.69 kg/kW (7.71 lb/hp)
Aerobatic, two-seat ..... 5.36 kg/kW (8.81 lb/hp)
Normal ..... 5.63 kg/kW (9.25 lb/hp)

PERFORMANCE (N: at Normal category T-O weight, SA: at solo Aerobatic weight):
Never-exceed speed (VNE):
N ..... 217 kt (402 km/h; 250 mph)
Manoeuvring speed ..... 154 kt (285 km/h; 177 mph)
Cruising speed at 75% power:
N ..... 150 kt (278 km/h; 173 mph)
Stalling speed: N ..... 59 kt (110 km/h; 68 mph)
SA ..... 53 kt (99 km/h; 61 mph)
Max rate of climb at S/L: N ..... 488 m (1,600 ft)/min
SA ..... 686 m (2,250 ft)/min
Service ceiling: N ..... 4,575 m (15,000 ft)
Range with single pilot at 75% power at FL80, 45 min reserves, N:
standard fuel ..... 450 n miles (833 km; 517 miles)
optional fuel ..... 600 n miles (1,111 km; 690 miles)
g limits: SA ..... ±10

Extra EA-200 aerobatic sportplane *(Paul Jackson)* 1128906

EXTRA EA-300 and EA-330

TYPE: Aerobatic two-seat sportplane.

PROGRAMME: Design began January 1987; first flight (D-EAEW) 6 May 1988; LBA certification 16 May 1990; certified FAR Pt 23 Amendment 33 Normal and Aerobatic categories for USA 26 February 1993; production started October 1988.

CURRENT VERSIONS: **EA-300:** Baseline, mid-wing, two-seat aircraft. Lateral vision panels in fuselage sides, below wing.

Details apply to Extra EA-300 except where indicated.

Demonstrator Extra EA-300SP *(Paul Jackson)* 1158284

Extra 300L aerobatic sportplane flown by UK champion Mark Jeffries *(Paul Jackson)* 1128907

EA-300L: Low-wing, two-seat version with other structural changes; low wing enhances visibility during take-off and landing and eases installation of full IFR instrumentation; new ailerons give slightly higher roll rate (approximately 400°/s) and improved snap-rolling capability, both erect and inverted; shorter fuselage with all-composites side and belly access panels; cockpit interior modified for more comfort, with new reclined carbon fibre seats with optional leather trim; first aircraft (D-EUWH) delivered November 1994. FAA certification 31 March 1995. Current production version.

EA-300L Touring Edition: First shown (D-EDGE, c/n 1175) at ILA, Berlin, May 2004. Cost USD245,000. Features include leather seats with three way adjustment, heater, high quality paint, electric rudder pedal adjustment and option of upgraded instrument panel.

EA-300LP: Improved version of EA-300L; announced 15 July 2005 and first aircraft, N202LP c/n 1202, displayed at EAA Air Venture, Oshkosh, later that month. P indicates 'performance'; redesigned engine cowling for improved engine air flow; titanium firewall; and various weight reduction measures saving more than 14 kg (30 lb), including carbon fibre honeycomb fuselage shells; carbon fairings; titanium wheel and brake fairings; lightweight oil cooler; and Teflon hoses.

EA-300S: Single-seat version of EA-300 with same power plant, wing shortened by 50 cm (19½ in) and more powerful ailerons; first flight (D-ESEW) 4 March 1992, certified March 1992, FAA certification 28 October 1993.

EA-300SP: Prototype single-seat 300SP (D-EXSS) flying by late 2005, cowling and weight modifications as EA-300LP. Further refined version for Red Bull Air Races to be designated **EA-300LR**.

EA-300SHP: Further upgrade of 300S for aerobatic pilot Mike Goulian; first aircraft, N821MG revealed May 2006. Weight reduced 45 kg (99 lb); empennage redesigned for increased agility; C of G moved aft.

EA-330LX: Strengthened version of EA-300L with CFRP fuselage panels, fin and rudder; wider-chord rudder and elevators, all with horn balances; 246 kW (330 hp) Textron Lycoming AEIO-580 engine. Prototype (D-ESEW, modified from prototype EA-300S) first flown January 1998 and since converted to EA-330L. First production aircraft (D-EPET) flew 11 May 1998 and delivered to Hungarian aerobatic pilot Peter Besenyei; normally flown with single-seat cockpit canopy; first public performance at North Weald, UK, 29 May 1998. Third, D-EDGE (marked '300LX') built 1999; none further known.

EA-330XS: Designation applied to the former EA-300S (including D-EJKS of Aerobatics unlimited and N76PK of display pilot Gene Soucy) retrofitted with wide-chord rudder.

CUSTOMERS: Total 66 (including prototype) two-seat original ('mid-wing') EA 300s delivered by April 1997; additional one to USA in November 1998. (One further, c/n 1068, laid down in 2005.) Further 28 EA-300Ss built by August 1995, plus additional ones in 1997, 1999, 2002, 2004 and 2005; two in first half of 2006; total 35, most recent being 300SP versions. EA-300L production totalled 232 by mid-2006, including 34 after re-formation of company. EA-330L/LX production two (excluding prototype). Thus, 308 of all EA-300/330 by early 2006. Total of eight were scheduled for production in 2003, then 36 in 2004, rising to maximum capacity of 48 in 2005, but targets only half achieved.

COSTS: Basic prices: EA-300L EUR215,000; EA-300SP EUR249,00 (both 2006).

DESIGN FEATURES: Designed for unlimited competition aerobatics; tapered, square-tipped mid-mounted wing with 4° leading edge sweepback; aerofoil symmetrical MA-15S at root, MA-12S at tip; no twist or dihedral.

FLYING CONTROLS: Conventional and manual. Rod and cable operated; nearly full-span ailerons, assisted by spade-type suspended tabs; trim tab in starboard elevator. Controls surface movements: ailerons ±30°; elevators ±26°; rudder ±30°; trim tab ±15°. Dual controls standard.

STRUCTURE: Fuselage (excluding tail surfaces) of steel tube frame with part aluminium, part fabric covering; wing spars of carbon composites and shells of carbon composite sandwich; tail surfaces of carbon spars and glass fibre shells.

LANDING GEAR: Non-retractable tailwheel type. Fuselage-mounted spring cantilever GFRP mainwheel legs each with single polyamide-faired wheel; leaf-sprung steerable tailwheel. Cleveland heavy-duty disc brakes.

POWER PLANT: One 224 kW (300 hp) Textron Lycoming AEIO-540-L1B5 or AEIO-540-L1B5D flat-six engine, with Gomolzig exhaust, driving an MT-Propeller MTV-9-B-C/C200-15 three-blade, constant-speed composites propeller with Woodward governor (four-blade MTV-14-B-C/C190-17 optional). With either standard or optional propeller and Gomolzig System 3 silencer, Extra 300s meet German and US noise limits. Christen Industries inverted oil system. Dual oil coolers standard. Fuel capacity 171 litres (45.1 US gallons; 37.6 Imp gallons), of which 165 litres (43.7 US gallons; 36.3 Imp gallons) usable; on EA-300L, 300LP, and 169 litres (44.6 US gallons; 37.2 Imp gallons) on EA-300S and 300SP; optional long-range tanks raise total fuel capacity to 208 litres (55.1 US gallons; 45.9 Imp gallons), of which 200 litres (52.8 US gallons; 44.0 Imp gallons) usable. Aerobatic category usable fuel restricted to 45 litres (12 US gallons; 10 Imp gallons) on EA-300L and 300SP, and 49 litres (12.9 US gallons; 10.8 Imp gallons) on EA-300S and 300SP.

ACCOMMODATION: Pilot and co-pilot/passenger in adjustable tandem composites seats under single-piece canopy opening to starboard; additional transparencies in lower sides of cockpit. Hooker harness with ratchet adjustment in rear seat. Electrically adjustable rudder pedals in rear cockpit.

SYSTEMS: 70 A alternator. Lightweight electric starter standard. Smoke system optional.

AVIONICS: To customer's choice, including Garmin GNS 430/530 GPS; Garmin 150XL or 250XL GPS/com; Becker AR 4201 com/intercom with PTT switch; Bendix/King KT 76 or Garmin GTX 327 transponder; ELT with remote panel control; and David Clark or Bose Series II headsets.

Instrumentation: Dual ASIs and altimeters. Digital g-meter in front cockpit. Rear cockpit features as standard magnetic compass; manifold pressure/fuel flow indicator; digital tachometer with recording time; hours meter; digital accelerometer/g-meter; oil temperature/pressure gauge; CHT/EGT gauge; ammeter; alternator warning light. Optional instrumentation includes: front cockpit: slip indicator and analogue accelerometer; rear cockpit: VSI; turn-and-bank indicator; slip indicator for erect/inverted flight; DG; electric artificial horizon; Shadin Mini-Flow L fuel computer; and digital clock.

EQUIPMENT: Standard equipment includes stall warning system; wingtip strobe lights; tiedown rings; and external paint scheme in three colours. Optional equipment includes titanium firewall; brake fairings; leather seats and cockpit trim; Hooker harness with ratchet for front seat; canopy lock; single-seat canopy; cabin heater; removable aerobatic sequence card holder, 45/90° wingtip sighting devices; audio/video recording and downlink systems; battery charging system; external power socket; glider towhook; polyurethane tape wing walk protection; fitted airframe cover; custom exterior paint schemes.

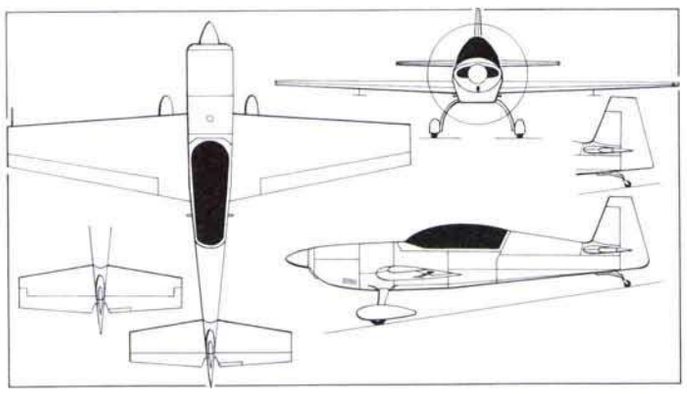
DIMENSIONS, EXTERNAL:

Wing span: 300L	8.00 m (26 ft 3 in)
300LP, 300S, 300SP	7.50 m (24 ft 7¼ in)
Wing chord:	
at root: all	1.85 m (6 ft 0¾ in)
at tip: all	0.83 m (2 ft 8¾ in)
Wing aspect ratio, 300L	6.0
300LP, 300S, 300SP	5.3

First Extra EA-300SHP, flown by Mike Goulian 1159097

Extra EA-300LP 'performance' version *(Paul Jackson)* 1158285

Extra 300 mid-wing version remains in limited production *(Paul Jackson)*
1158286



Extra EA-300L competition aerobatic aircraft, with scrap views of Extra 330 tail surfaces *(James Goulding)*
0064457

Length overall: 300, 300L, 300S, 300SP ..... 6.96 m (22 ft 10 in)
Height overall: 300, 300L, 300LP, 300S, 300SP ..... 2.60 m (8 ft 7 in)
Tailplane span: all ..... 3.20 m (10 ft 6 in)
Wheel track: all ..... 1.80 m (5 ft 10¾ in)
Propeller diameter: MTV-9 ..... 2.00 m (6 ft 6¾ in)
MTV-14 ..... 1.90 m (6 ft 2¾ in)

AREAS:
Wings, gross: all ..... 10.70 m² (115.2 sq ft)
Ailerons, total: all ..... 1.71 m² (18.41 sq ft)

WEIGHTS AND LOADINGS:
Weight empty: 300L ..... 672 kg (1,481 lb)
300LP ..... 660 kg (1,455 lb)
300S, 300SP ..... 629 kg (1,387 lb)
Max T-O weight:
300L, 300LP Aerobatic, solo ..... 820 kg (1,808 lb)
300L, 300LP Aerobatic, two-seat ..... 870 kg (1,918 lb)
300L, 300LP Normal ..... 950 kg (2,095 lb)
300S, 300LP Normal ..... 920 kg (2,028 lb)
300S, 300SP Aerobatic Solo ..... 820 kg (1,808 lb)
Max wing loading:
300L, 300LP, 300S, 300SP, Aerobatic, solo ..... 76.6 kg/m² (15.69 lb/sq ft)
300L, 300LP, 300S, 300SP, Aerobatic, two-seat ..... 81.3 kg/m² (16.65 lb/sq ft)
300L, 300LP, Normal ..... 88.8 kg/m² (18.18 lb/sq ft)
300S, 300SP, Normal ..... 86.0 kg/m² (17.61 lb/sq ft)
Max power loading:
300L, 300LP, 300S, 300SP, Aerobatic, solo ..... 3.67 kg/kW (6.03 lb/hp)
300L, 300LP, 300S, 300SP, Aerobatic, two-seat ..... 3.89 kg/m² (6.39 lb/hp)
300L, 300LP, Normal ..... 4.25 kg/m² (6.98 lb/hp)
300S, 300SP, Normal ..... 4.11 kg/m² (6.76 lb/hp)

PERFORMANCE:
Never-exceed speed (VNE), all ..... 220 kt (407 km/h; 253 mph)
Max level speed: 300S ..... 185 kt (343 km/h; 213 mph)
Max manoeuvring speed, all ..... 158 kt (293 km/h; 182 mph)
Stalling speed:
300L, 300LP at T-O weight 700 kg (1,543 lb) ..... 55 kt (102 km/h; 64 mph)
300L, 300LP at T-O weight 950 kg (2,095 lb) ..... 60 kt (111 km/h; 69 mph)
300S, 300SP at T-O weight 820 kg (1,808 lb) ..... 55 kt (102 km/h; 64 mph)
300S, 300SP at T-O weight 920 kg (2,028 lb) ..... 59 kt (110 km/h; 68 mph)
Max rate of climb at S/L:
300L, 300S ..... 975 m (3,200 ft)/min
Service ceiling: 300L, 300S ..... 4,875 m (16,000 ft)
T-O run: 300L ..... 115 m (375 ft)
T-O to 15 m (50 ft): 300L ..... 248 m (815 ft)
Landing run: 300L ..... 177 m (580 ft)
Range at 65% power cruising speed at FL80, 45 min reserves:
300S ..... 440 n miles (814 km; 506 miles)
Range at 45% power cruising speed, at FL80, 45 min reserves:
300L, standard fuel ..... 414 n miles (766 km; 476 miles)
300L, long-range fuel ..... 510 n miles (944 km; 586 miles)
Endurance: 300S ..... 2h 30 min
g limits: Aerobatic, solo ..... ±10
Two-seat Aerobatic ..... ±8

EXTRA EA-400

TYPE: Business prop.

PROGRAMME: Announced February 1993; designed in collaboration with Delft University; first flight (D-EBEW) 4 April 1996; initial LBA certification to FAR Pt 23 received 23 April 1997. Second prototype (D-EGBU) flew April 1998, featuring downturned wingtips and ventral stake, both of which had been added to first aircraft before its retirement in 1997. This aircraft lost on delivery to first customer, 21 August 1998. FAA certification 15 April 1998.

CURRENT VERSIONS: **Extra EA-400:** *As described.*
Extra EA-500: Turboprop. Described separately.

CUSTOMERS: Two prototypes and 25 production aircraft completed by mid-2003; further one in 2004 by Extra Aircraft. Additional two airframes almost complete in 2004 but not flown by early 2006.

COSTS: Typically equipped, USD895,000 (2003).

DESIGN FEATURES: Cantilever high-wing NLF aerofoil section, T tail layout; spacious cabin; optimised for low internal and external noise.

FLYING CONTROLS: Conventional and manual. Frise ailerons, maximum deflections +27/–19°; two-section electrically actuated Fowler flaps approximately two-thirds of span, deflection 0, 15 and 30°; horn-balanced elevators, maximum deflection +33/–18°; trim tab in starboard elevator, maximum deflection +30/–20°; rudder maximum deflection ± 25°; ground-adjustable tab on rudder. Interconnected aileron and rudder controls, with override. Electric pitch trim.

STRUCTURE: Composites throughout. Airframe consists of skin with integral longerons and frames. Wing built on double front spar and rear spar, interconnected by ribs; tailplane has front and rear spar. Skins generally of carbon fibre facings and honeycomb; longerons, frames, spars and ribs of carbon fibre with foam core; wing leading-edge of glass fibre with honeycomb and glass fibre ribs. Service life 25 years/20,000 hours/30,000 cycles/22,500 pressurisation cycles.

LANDING GEAR: Hydraulically retractable tricycle type; designed and manufactured by Gomolzig; single wheels throughout; main units retract forward into fuselage sides; nosewheel retracts rearwards. Mainwheel size 15×6.0-6, nosewheel size 5.00-5. Minimum turning radius 20.4 m (67 ft). Independent hydraulic brakes on mainwheels. Nosewheel steerable ±30°.

POWER PLANT: One 261 kW (350 hp) Teledyne Continental Voyager TSIOL-550-C six-cylinder turbocharged and intercooled liquid-cooled engine, with tuned exhaust system, driving an MT-Propeller MTV-14-D/195-30a four-blade, constant-speed (hydraulic) composites propeller; three-blade propeller optional. Fuel in two integral wing tanks, combined capacity 468 litres (123.6 US gallons; 102.9 Imp gallons), of which 404 litres (107 US gallons; 88.9 Imp gallons) are usable. Oil capacity 12.3 litres (3.2 US gallons; 2.7 Imp gallons).

ACCOMMODATION: Pilot and five passengers in pressurised cabin; four-way adjustable pilot's and co-pilot's seats; rear seats in club configuration; retractable shoulder harnesses for all occupants; single door on port side is horizontally split, with airstair in bottom half; top half hinges upwards. Emergency exit starboard side, opposite door. Cabin is heated and air conditioned with remote activation control, defrosting system and ventilation fan.

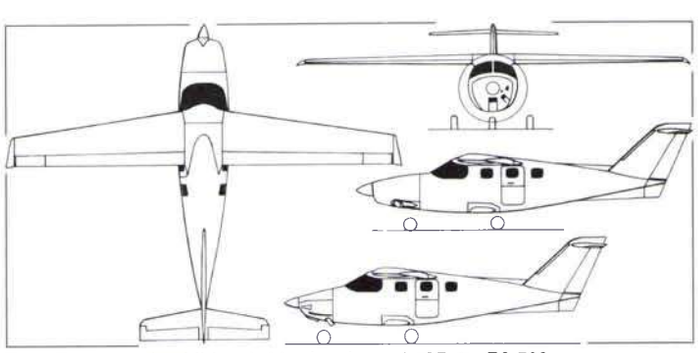
SYSTEMS: Electrical system 24 V, with direct-driven 28V 100 A alternator, belt-driven 85 A alternator and 24 V battery in tailcone. External power receptacle in tailcone. Pressurisation system, maximum differential 0.38 bar (5.5 lb/sq in). Wing and empennage leading-edges de-iced by Goodrich pneumatic estane (silver) inflatable boots.

AVIONICS: Standard Garmin avionics suite, comprising GNS 530 and GNS 430 GPS/nav/coms, each with colour LCD MFD; GI-106A nav indicator with glideslope; GMA 340 audio panel with marker beacon receiver and six-place Bose X intercom interfaces; GTX 327 transponder; Honeywell EO461 EADI EFIS; Honeywell EADI EFIS attitude indicator; Litef LCR-92/CCU EA-85511 laser gyro platform; S-Tec 55X autopilot with altitude and vertical speed preselect, auto and command electric trim and electronic yaw trim; Pointer 3000 ELT; and Bose pilot's and co-pilot's headsets. Optional avionics include second GTX 327; GTX 330 Mode S transponder; remote-mounted Bendix/King KN 62 DME; Honeywell RDR-2000 colour weather radar in wingtip pod; Garmin GDL 49 weather uplink system; L-3 Communications Skywatch TCAS; and Aircell ACT02 voice/data system.

Instrumentation: Standard instrument includes dual ASIs, attitude indicators and directional gyros; pilot's Bendix/King KEA 130A encoding altimeter; co-pilot's standard altimeter; VSI; turn co-ordinator; magnetic compass; Moritz digital engine instrumentation system; Alcor CHT gauge; and master warning and annunciator panel. Options include EDM-800 graphic engine monitor with data recording facility, Thommen encoding drum altimeter; and Shadin air data computer.

EQUIPMENT: Standard equipment includes heated propeller, pilot's windscreen, pitot heads and stall vane; dual cockpit dome lights; multiple LED eyebrow panel lights; four overhead cabin reading lights; ice detection light; wingtip navigation and strobe lights; wing-mounted recognition lights; cowling-mounted landing light; grey leather seats and armrests; alcantara ultrasuede cabin headliner and sidewalls; grey chequerboard wool blends carpet; and stowaway writing desk. Options include video/audio entertainment cabinet (replaces one cabin seat); wood and carbon fibre cabin trim; cockpit/cabin privacy curtain; window shades; galley A-frame; golf bag restraint; cabin and engine preheat winter package; and pinstripes or customised exterior paint scheme.

DIMENSIONS, EXTERNAL:
Wing span ..... 11.50 m (37 ft 8¾ in)
Wing aspect ratio 9.3
Length overall ..... 9.56 m (31 ft 4½ in)
Max width of fuselage ..... 1.46 m (4 ft 9½ in)
Height overall ..... 3.09 m (10 ft 1¾ in)
Tailplane span ..... 3.80 m (12 ft 5½ in)



Extra EA-400 with additional side view (upper) of Extra EA-500 *(Paul Jackson)*
0137336

Extra EA-400 business prop *(Paul Jackson)*

1128908

Wheel track ..... 2.20 m (7 ft 2½ in)
Wheelbase ..... 2.56 m (8 ft 4¾ in)
Propeller diameter ..... 1.95 m (6 ft 4¾ in)
Cabin door: Width ..... 0.68 m (2 ft 2¾ in)
Height ..... 1.15 m (3 ft 9¼ in)

DIMENSIONS, INTERNAL:

Cabin (between forward and aft bulkheads):
Length ..... 4.11 m (13 ft 6 in)
Max width ..... 1.40 m (4 ft 7 in)
Max height ..... 1.22 m (4 ft 0 in)

AREAS:

Wings, gross ..... 14.26 m² (153.5 sq ft)
Horizontal tail surfaces ..... 2.81 m² (30.25 sq ft)
Vertical tail surfaces ..... 2.41 m² (25.94 sq ft)

WEIGHTS AND LOADINGS:

Basic operating weight empty ..... 1,389 kg (3,062 lb)
Baggage capacity ..... 90 kg (198 lb)
Useful load ..... 522 kg (1,150 lb)
Max T-O and landing weight ..... 1,999 kg (4,407 lb)
Max zero-fuel weight ..... 1,772 kg (3,907 lb)
Max wing loading ..... 140.2 kg/m² (28.71 lb/sq ft)
Max power loading ..... 7.66 kg/kW (12.58 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE) ..... 221 kt (409 km/h; 254 mph) IAS
Manoeuvring speed ..... 156 kt (289 km/h; 179 mph) IAS
Max cruising speed at 75% power at FL200 ..... 212 kt (393 km/h; 244 mph)
Econ cruising speed at 65% power at FL200 ..... 188 kt (348 km/h; 216 mph)
Stalling speed in landing configuration ..... 59 kt (110 km/h; 68 mph)
Max rate of climb at S/L ..... 326 m (1,070 ft)/min
Max certified altitude ..... 7,620 m (25,000 ft)
T-O run ..... 500 m (1,640 ft)
T-O to 15 m (50 ft) ..... 860 m (2,820 ft)
Landing from 15 m (50 ft) ..... 625 m (2,050 ft)
Landing run ..... 275 m (900 ft)
Range, with reserves ..... 1,060 n miles (1,963 km; 1,219 miles)
g limits ..... +4.0/−1.6

EXTRA EA-500

Engineering designation: EA-400-500

TYPE: Business turboprop.

PROGRAMME: Turboprop version of Extra EA-400; prototype (D-EKEW, later registered N501EX), employing previously reserved airframe, first flew 26 April 2002; damaged in forced landing during third sortie, 30 April 2002; announced at, but unable to participate in, Berlin Air Show 6 to 12 May 2002. Repaired and resumed flight testing within three months. Public debut at the NBAA convention in Orlando, Florida, 7 October 2003, at which time the prototype had flown some 70 hours. EASA day VFR certification achieved 16 July 2004. Second prototype, D-EHEW exhibited, unflown, at Friedrichshafen, April 2005; maiden flight was due in mid-2006. First deliveries were expected in June 2006.

Second Extra EA-500 when in use as static demonstrator *(Paul Jackson)*

1128909

CUSTOMERS: First year's production (unspecified) sold following NBAA debut in October 2003. Second aircraft, D-EHEW, completed in production configuration and exhibited statically in 2004 and 2005, with first flight expected in 2006.

Data generally as for Extra EA-400, except that below.

COSTS: USD1,495,000 (2003).

POWER PLANT: One 336 kW (450 shp) Rolls-Royce 250-B17F/2 turboprop, driving a five-blade MT-Propeller MTV-5-1-D-C-F-R(A)/CFR210-56 composites, constant-speed, reversible-pitch propeller with Woodward governor. Fuel in two integral tanks in wings, combined capacity, 680 litres (180 US gallons; 150 Imp gallons, of which 652 litres (172 US gallons; 143 Imp gallons) are usable.

ACCOMMODATION: Four-point pilot and co-pilot safety harnesses and three-point passenger harnesses, and baggage and cargo tiedowns, standard.

SYSTEMS: Electrical system has 28V 200A generator with long-life GCU automatic start and cut-off, 20A back-up alternator with regulator, and 24 V 28Ah battery in fire-resistant container. Cabin has bleed air heating and air conditioning and electrical defrosting system with ventilation fan, plus DC-powered air conditioning with external control. Goodrich pneumatic Estane/Teflon de-icing and heated propeller.

AVIONICS: Honeywell APEX as core system.

Comms: Garmin GMA 340 audio panel with MKR; Garmin GTX 327 transponder (Mode S); six-place intercom; dual Bose-X headsets; pilot and co-pilot PTT switches.

Flight: Garmin GNS 530 GPS/nav/com; GNS 430 GPS/nav/com with GI-106A nav display; Traffic advisory; EGPWS; Bendix/King KFC 225 flight director/autopilot. Optional TCAS, DME.

Instrumentation: Honeywell EHSI ED 461 EFIS and EADI attitude indicator. Two 264 mm (10.4 in) active matrix LCDs for PFD/MFD functions.

EQUIPMENT: Engine chip detector, and heated inlet ring, standard. Metallised exterior paint, optional.

DIMENSIONS, EXTERNAL:

Wing span ..... 11.53 m (37 ft 10 in)
Length overall ..... 10.10 m (33 ft 1½ in)
Height overall ..... 3.40 m (11 ft 1¾ in)
Propeller diameter ..... 2.00 m (6 ft 6¾ in)

DIMENSIONS, INTERNAL:

Cabin length ..... 4.11 m (13 ft 6 in)
Cabin max width ..... 1.40 m (4 ft 7 in)
Cabin max height ..... 1.24 m (4 ft 1 in)

WEIGHTS AND LOADINGS:

Weight empty ..... 1,445 kg (3,186 lb)
Max baggage weight ..... 90 kg (198 lb)
Max T-O weight ..... 2,130 kg (4,695 lb)
Max fuel weight ..... 553 kg (1,220 lb)
Max zero-fuel weight ..... 882 kg (1,945 lb)
Max landing weight ..... 2,000 kg (4,409 lb)
Max wing loading: EASA ..... 149.4 kg/m² (30.59 lb/sq ft)
Max power loading: EASA ..... 6.35 kg/kW (10.43 lb/shp)

PERFORMANCE:

Never-exceed speed (VNE) ..... 207 kt (383 km/h; 238 mph) IAS
Max operating speed ..... 209 kt (387 km/h; 240 mph)
Manoeuvring speed ..... 156 kt (289 km/h; 180 mph)
Cruising speed at mid-cruise weight:
90% power at FL120 ..... 226 kt (419 km/h; 260 mph)
75% power at FL250 ..... 200 kt (370 km/h; 230 mph)
40% power at FL250 ..... 173 kt (320 km/h; 199 mph)
Stalling speed ..... 61 kt (113 km/h; 71 mph)
Max rate of climb at S/L ..... 407 m (1,335 ft)/min
Max certified altitude ..... 7,620 m (25,000 ft)
T-O run ..... 381 m (1,250 ft)
T-O to 15 m (50 ft) ..... 625 m (2,050 ft)
Landing from 15 m (50 ft) ..... 610 m (2,000 ft)
Landing run ..... 259 m (850 ft)
Range, with reserves:
204 kg (450 lb) useful load ..... 1,600 n miles (2,963 km; 1,841 miles)
363 kg (800 lb) useful load ..... 1,000 n miles (1,852 km; 1,151 miles)
454 kg (1,000 lb) useful load ..... 700 n miles (1,296 km; 805 miles)
Endurance:
at 90% power ..... 4 h 6 min
at 75% power ..... 7 h 36 min

FLÄMING AIR

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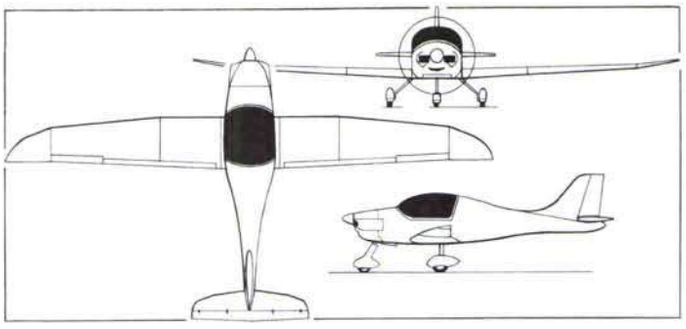
In addition to operating a flying school and air charter business, Fläming Air imports and sells Eastern European aircraft to the German market. These include the ATEC Zephyr, Urban Lambáda/Samba, Podešva Trener Baby, which is marketed under the Fläming Air name, although built in the Czech Republic, and a two-seater originally known as the FSU Saphir.

In late 2003, the company announced it was preparing to fly the FA 02 Smaragd, an ultralight motorglider based on the Saphir. By mid-2004, however, this had been renumbered FA 03, the Saphir being retrospectively designated FA 01 Smaragd and FA 02 Smaragd VLA.



Fläming Air FA 01 Smaragd (Rotax 912 UL four-stroke ***(James Goulding)***

1159381

FLÄMING AIR FSU SMARAGD

English name: Emerald

TYPE: Side-by-side ultralight/kitbuilt.

PROGRAMME: Incomplete prototype of aircraft then known as Saphir (Sapphire) exhibited at Aero 2001 at Friedrichshafen in April 2001; first flight then scheduled for August or September 2001; D-MATR exhibited at Berlin, May 2002. Certification to LTF-UL regulations received in late 2003, at which time a second prototype was nearing completion.

Renamed Smaragd in mid-2004, coincident with upgrade including adjustable seats, individual mainwheel brakes, new instrument panel and strengthened canopy with increased opening angle.

CURRENT VERSIONS: **FA 01 Smaragd 80:** Ultralight version; *as described.*

FA 01 Smaragd K: Short *(kurze)* wing ultralight; span 8.80 m (28 ft 10½ in); wing area 8.52 m² (91.7 sq ft). Any engine option.

FA 01 Smaragd 100: As Saphir 80 but with 73.5 kW (98.6 hp) Rotax 912 ULS for glider- and banner-towing.

FA 01 Smaragd J: As Saphir 80 but with 59.7 kW (80 hp) Jabiru 2200.

FA 01 Smaragd D: Proposed version with 59.7 kW (80 hp) Diesel Air D-280.

FA 02 Smaragd VLA: Kitbuilt lightplane version to JAR-VLA; empty weight 340 kg (750 lb) maximum T-O weight 600 kg (1,322 lb); span and wing area as Smaragd K. Prototype D-EERJ (with 78.9 kW; 58.8 hp Diesel-Air D-280 engine) exhibited incomplete at Berlin, May 2004, then known as Super Saphir.

Smaragd Experimental: Generally as VLA, but with K (short) wing, except petrol engine, MTOW 650 kg (1,433 lb) and increased empty weight of 350 kg (772 lb).

CUSTOMERS: First two aircraft completed in 2003. Seven sold in Germany in 2004. At least nine FA 01s and 23 FA 02s produced by 2006.

COSTS: Kit: Smaragd 80 EUR65,500; Smaragd 100 EUR66,500; Smaragd J EUR64,500 (including instruments and taxes) (all 2005). Flyaway prices on application.

DESIGN FEATURES: Low-wing monoplane with slightly sweptback wings and upturned wingtips; winglets optional. Combines elements of two Czech aircraft: wing and tail unit of Urban UFM 10 Samba with cockpit section of ATEC Zephyr, both of which are described in the Czech Republic section. Urban Samba XXL has same combination, but detail differences.

Wing section SM 701.

FLYING CONTROLS: Conventional and manual. One-piece elevator; plain flaps. Electrically actuated elevator trim tab and flaps.

STRUCTURE: All-composites.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring cantilever mainwheel legs. Mainwheel diameter 400 mm, nosewheel 300 mm. Hydraulic brakes. Speed fairings on all three wheels.

POWER PLANT: One 59.6 kW (79.9 hp) Rotax 912 UL (Smaragd 80), 73.5 kW (98.6 hp) Rotax 912 ULS (Smaragd 100) or 59.7 kW (80 hp) Jabiru 2200, driving a Kremen SR 200 three-blade, ground-adjustable pitch wooden propeller; optional Kremen SR 2000 variable-pitch (electric), wooden propeller. Smaragd D offered with 59.7 kW (80 hp) Diesel Air D-280 power plant, 82.3 kW (110.4 hp) Laukötter LD-284 (Wooler-type four piston) two-cylinder diesel engine is optional. Fuel in two integral wing tanks, combined capacity 60 litres (15.9 US gallons; 13.2 Imp gallons) standard, optionally 120 litres (31.7 US gallons; 26.4 Imp gallons), of which 118 litres (31.2 US gallons; 26.0 Imp gallons) usable.

DIMENSIONS, EXTERNAL:

Wing span	10.10 m (33 ft 1½ in)
Length overall	5.80 m (19 ft 4¼ in)
Height overall	2.13 m (6 ft 11¾ in)
Propeller diameter	1.70 m (5 ft 7 in)

DIMENSIONS, INTERNAL:

Cabin max width	1.10 m (3 ft 7¼ in)

AREAS:

Wings, gross	9.25 m² (99.6 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	270 to 290 kg (595 to 639 lb)
Max T-O weight	472.5 kg (1,042 lb)

PERFORMANCE, POWERED:

Max level speed	146 kt (270 km/h; 167 mph)
Cruising speed	119 kt (220 km/h; 137 mph)
Stalling speed	36 kt (65 km/h; 41 mph)

PERFORMANCE, UNPOWERED:

Best glide ratio	19
Min rate of sink	1.50 m (4.92 ft)/s

Fläming Air FA 01 Smaragd with winglet option ***(Paul Jackson)***

1159346

FLÄMING AIR FA 03 SMARAGD TMG

English name: Emerald

TYPE: Side-by-side ultralight motor glider kitbuilt.

PROGRAMME: Announced late 2003; partly complete prototype (subsequently D-KERH) exhibited at ILA, Berlin, May 2004, when first flight planned for two months later. Not flown, however, and empennage redesigned before appearance at ILA, Berlin, May 2006, at which time first flight was scheduled for late 2006.

COSTS: Kit estimated EUR60,000, less engine; flyaway EUR95,000 incl tax (2006).

DESIGN FEATURES: Development of company's FA 01/02 Smaragd lightplane with stretched fuselage, T tail, tailwheel and increased wingspan. Laminar profile wing.

Data generally as for Smaragd, except that below.

FLYING CONTROLS: Conventional and manual. Airbrakes.

STRUCTURE: Composites wing with carbon fibre reinforcement and landing edge; glass fibre and carbon fibre fuselage.

LANDING GEAR: Mainwheels 360×120; tailwheel 210×50.

POWER PLANT: Optimised for 73.5 kW (98.6 hp) Rotax 912 S piston engine and Mühlbauer propeller.

Fuel in two wing tanks, combined capacity 120 litres (31.7 US gallons; 23.4 Imp gallons).

DIMENSIONS, EXTERNAL:

Wing span	16.00 m (52 ft 6 in)
Length overall	7.40 m (24 ft 3¼ in)
Height overall	1.53 m (5 ft 0¼ in)

AREAS:

Wings, gross	13.60 m² (146.4 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	400 kg (882 lb)
Max T-O weight	650 kg (1,433 lb)

PERFORMANCE:

Cruising speed at 75% power	108 kt (200 km/h; 124 mph)
Stalling speed	41 kt (75 km/h; 47 mph)

Fläming Air FA 03 Smaragd in its 2006 guise with T tail ***(Paul Jackson)***

1159347

FLIGHT DESIGN

FLIGHT DESIGN GMBH

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DIRECTOR: Alexandre Nieprimtz

Flight Design's current product is the CT. Fabrication of parts is at Flight Design's 40,000 sq ft (3,715 m²) Ukrainian factory producing composites to German specifications. In 2005, Flight Design had a workforce exceeding 280 and was also involved in the engineering and production of paragliders. Sales in US during 2005 of 70 aircraft (of which 45 delivered) prompted near-doubling of capacity, with 220/240 scheduled for manufacture in 2006.

FLIGHT DESIGN CT

TYPE: Two seat lightplane; side by side ultralight.

PROGRAMME: Original CT version certified in Germany on 6 June 1997, having flown some 1,000 hours. CT and kitbuilt CTX version now discontinued.

CURRENT VERSIONS: **CT2K**: Standard version, *as described*. Lighter airframe; downturned wingtips; German certified maximum T-O weight increased to 472.5 kg (1,042 lb) in October 2003.

CTU: Longer span version to achieve 38 kg/m² (7.78 lb/sq ft) wing loading required in some countries; extra 1.00 m (3 ft 3¼ in) span and 1.20 m² (12.9 sq ft) increase in area; available to order only.

CTsw: Short span version (8.53 m; 28 ft), max T-O weight 472.5 kg (1,042 lb). First exhibited at Berlin in May 2004. Approved for US LSA and imported into US prior to, and in parallel with, CTsw 2006.

CTsw 2006: US LSA approved version launched at Sun 'n' Fun, Lakeland, Florida, 4 to 10 April 2006. Fin chord increased; weight empty 300 kg (661 lb) including parachute; MTOW 598 kg (1,320 lb); reinforced landing gear. Standard equipment includes BRS 1350 ballistic recovery parachute; 6.00-4 mainwheels and 5.00-4 nosewheel; strobe and position lights and various avionics packages including EFIS with Dynon D100 screen port, D120 starboard, Garmin GPSMap 396, Bendix/King KY 97A radio and KT76A transponder, plus standby gauges. Never-exceed speed 145 kt (268 km/h; 166 mph); stalling speed 44 kt (82 km/h; 51 mph) clean, 39 kt (73 km/h; 45 mph) flaps down. EFIS-equipped cost USD111,000 flyaway; basic USD89,900.

CUSTOMERS: More than 600 of all versions built by April 2006.

COSTS: Complete, with Rotax 912 UL 2, propeller and Junkers ballistic recovery system EUR61,480 excluding tax (2004). Kits no longer available.

DESIGN FEATURES: Optimised for safe handling, speed and range. High-mounted, cantilever, constant chord wing, sharply waisted fuselage and sweptback fin with large underfin. CT2K features new trim tab and optional downturned wingtips.

Wing dihedral 1° 40'; no incidence, twist or washout.

FLYING CONTROLS: Conventional ailerons and horn balanced rudder, manually actuated; all-moving tailplane with anti-balance tab. Externally-hinged slotted ailerons. Electrically actuated plain flaps, deflection −12° and +40°; internal (external on early aircraft) mass balances for ailerons and tailplane.

STRUCTURE: Principally of composites, including carbon/glass fibre and carbon/aramid sandwich construction.

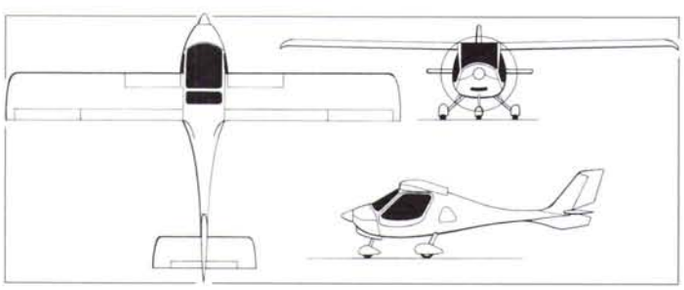
LANDING GEAR: Tricycle type; fixed. Fuselage-mounted, forward-swept spring aluminium tube cantilever mainwheel and nosewheel legs; steerable nosewheel. Mainwheels typically 4.00-6; nosewheel 4.00-4. Optional speed fairings on all wheels. Hydraulic mainwheel brakes.

POWER PLANT: One 59.6 kW (79.9 hp) Rotax 912 UL-2 or 73.5 kW (98.6 hp) Rotax 912 ULS flat four, driving a Neuform two blade C2 V variable-pitch or C2 fixed-pitch propeller. Fuel in two wing leading edge tanks, combined capacity 130 litres (34.3 US gallons; 28.6 Imp gallons).

ACCOMMODATION: Two persons, side by side; dual controls; upward-hinged door with gas spring for each occupant. Baggage space behind seats, with external door on each side.

Flight Design CTsw two-seat lightplane and ultralight *(Paul Jackson)* 1158007

Typical instrument panel of CT SW 2006, including twin Dynon EFIS screens (D100, port, and D120) and GPSMap 396 *(Paul Jackson)* 1158009



General arrangement of the Flight Design CT2K *(James Goulding)* 0110593

AVIONICS: Optional avionics include Honeywell KY97A com, KX 125 nav/com, KT 76A Mode A/C transponder, Skyforce IIIC GPS, Flightcom headsets and ELT.

Instrumentation: Winter variometer and Rotax FlyDat engine management system optional.

EQUIPMENT: Optional equipment includes cabin comfort pack; anti-collision and position lights; and Junkers High Speed or BRS UL 1050 ballistic parachute recovery systems.

DIMENSIONS, EXTERNAL:

Wing span: CT 2K	9.31 m (30 ft 6½ in)
CTsw	8.53 m (27 ft 11¾ in)
Wing chord, constant: both	1.17 m (3 ft 10 in)
Wing aspect ratio	8.0
Length overall	6.215 m (20 ft 4½ in)
Height overall	2.165 m (7 ft 1¼ in)

CTsw 2006 displaying increased rudder chord of this version 1158008

Tailplane span ..... 2.38 m (7 ft 9¾ in)
Tailplane chord ..... 0.70 m (2 ft 3½ in)
Wheel track ..... 1.70 m (5 ft 7 in)
Wheelbase ..... 1.45 m (4 ft 9 in)
Propeller diameter ..... 1.73 m (5 ft 8 in)
Propeller ground clearance ..... 0.28 m (11 in)

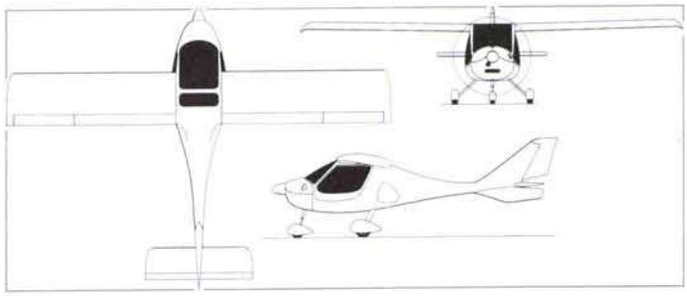
DIMENSIONS, INTERNAL:
Cabin max width ..... 1.24 m (4 ft 0¾ in)

AREAS:
Wings, gross: CT2K ..... 10.80 m² (116.3 sq ft)
CTsw ..... 9.98 m² (107.4 sq ft)
Ailerons (total): CT2K ..... 0.98 m² (10.55 sq ft)
CTsw ..... 0.80 m² (8.61 sq ft)
Flaps (total) ..... 1.51 m² (16.25 sq ft)
Fin and rudder (total) ..... 1.14 m² (12.27 sq ft)
Tailplane (total incl elevators and tab) ..... 1.65 m² (17.76 sq ft)

WEIGHTS AND LOADINGS:
Weight empty ..... 262 kg (578 lb)
Max T-O weight ..... 600 kg (1,322 lb)[1]
Max baggage weight ..... 60 kg (132 lb)
Max wing loading: CT2K ..... 55.6 kg/m² (11.38 lb/sq ft)
CTsw ..... 60.1 kg/m² (12.31 lb/sq ft)
Max power loading: 912 UL ..... 10.07 kg/kW (16.54 lb/hp)
912 ULS ..... 8.16 kg/kW (13.41 lb/hp)

[1] *or 472.5 kg (1,042 lb) to meet national limits*

PERFORMANCE (downturned wingtips, A: 912 UL; B: 912 ULS):
Never-exceed speed (VNE): A, B ..... 167 kt (310 km/h; 192 mph) IAS
Max level speed: A, B ..... 146 kt (270 km/h; 168 mph) IAS
Cruising speed at 75% power:
A ..... 121 kt (225 km/h; 140 mph) IAS
B ..... 127 kt (235 km/h; 146 mph) IAS
Stalling speed at 450 kg (992 lb) MTOW:
A, B ..... 34 kt (62 km/h; 39 mph) IAS
Service ceiling: A, B ..... 4,270 m 14,000 ft)
Max rate of climb at S/L: A ..... 210 m (689 ft)/min
B ..... 300 m (984 ft)/min
T-O run ..... 90 m (295 ft)
T-O to 15 m (50 ft) ..... 160 m (525 ft)
Range with max fuel, 30 min reserves ..... 1,079 n miles (2,000 km; 1,242 miles)
g limits: A, B:
at 450 kg (992 lb) MTOW ..... +6
at 600 kg (1,322 lb) MTOW ..... +4.3



Flight design CTsw 2006 *(Paul Jackson)* 1158032

FLUG WERK

FLUG WERK GMBH

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Formed on 13 June 1996 and specialising in the reproduction of classic German aircraft, Flug Werk plans to augment its Fw 190 project with resumed manufacture of the Messerschmitt Bf 109 (for which it produces 'spare' parts for existing aircraft) and wings for the P-51 Mustang. A Heinkel He 112 replica was reported to be under consideration, but no further news has been received of this project or the planned Arado Ar 96B reproduction, the latter known to have been suspended in 2003. New 600 m² (6,450 sq ft) hangar inaugurated 31 March 2000; this has been outgrown and the company is looking to move to Ingoldstadt/Manching, where it has hired hangar space before constructing new facilities.

It was at Ingoldstadt on 22 July 2004 that the first Fw 190 was flown. Other recent activities include repair of a genuine Bf 109G after a taxying accident, overhaul of a North American T-6 and construction of components for the P-51 Mustang and plans to market a kit of the P-51 Mustang under the designation AP-51 Palomino. Company is capable of building complete replacement wings and fuselages for Mustangs and can supply major components for Bf 109 restorations. Earlier work on Fw 190s included refurbishment of WNr 173056, a genuine aircraft belonging to Don Hansen of Baton Rouge, Louisiana, for which an ASh-82 engine conversion kit was also engineered and supplied.

In late 2004, FW received airframes of one Bf 109E and one Bf 109F for restoration, the latter to be reverse-engineered for subsequent manufacture of further airframes with new DB 601 engines. A less complete Bf 109G-2 was also received in 2004 for restoration and resale on behalf of a third party. A North American T-28 Trojan was being overhauled in 2004-05 and a Fouga CM170 Magister has also been completed.

Co-director Hans Günther Wildmoser died in September 2003.

FLUG WERK FW 190

TYPE: Single-seat sportplane kitbuilt.

PROGRAMME: Flug Werk GmbH started assembling a batch of 12 Focke-Wulf Fw 190 Second World War fighters in June 1996, these to be in FW 190A-8/N and FW 190D-9/N configurations, their /N designation indicating *nachbau*: replica. Components are being manufactured in seven countries (principally in Romania by Aerostar) from original drawings, resulting in airframes said to be 98 per cent faithful to the original.

Power plant of the 10 A-8s is a 1,400 kW (1,877 hp) ASh-82FN 14-cylinder twin-row radial engine, a Russian version of the original BMW 801D, driving a three-blade, 3.30 m (10 ft 10 in), constant-speed MT wood/composites propeller. The first aircraft (WNr 8900001, D-FWWC) shown statically, April 2000, but due to integration problems with the power plant, first engine runs were postponed to the third quarter of 2002; first flight was planned for August 2003, but not achieved until 22 July 2004. Three FW 190A-8/Ns will be sold in Europe, the remaining seven going to the USA, South Africa and Australia; all had found firm buyers by early 2002. Price for kits (including engine, but not avionics, instruments, oxygen system, electrical wiring looms or paint) is EUR555,000 ex-works (2004).

Flug Werk FW 190 prototype after repainting in Second World War colours
1133384

FW-built aircraft are 450 kg (992 lb) lighter than the original, due to omission of military items, and carry 880 litres (232 US gallons; 194 Imp gallons) of fuel – an increase of 230 litres (61 US gallons; 51 Imp gallons) – although they are otherwise 98 per cent faithful to the original, including genuine Second World War tailwheel assemblies discovered in storage; Boeing 737-400 nosewheel assemblies and tyres are used for the FW190's mainwheels.

The remaining two aircraft, advertised in 2002, are the long-nose Fw 190D-9/N 'Dora', the original having a 1,402 kW (1,880 hp) Jumo 213; the new aircraft having a specially modified Allison V-1710 V-12 engine.

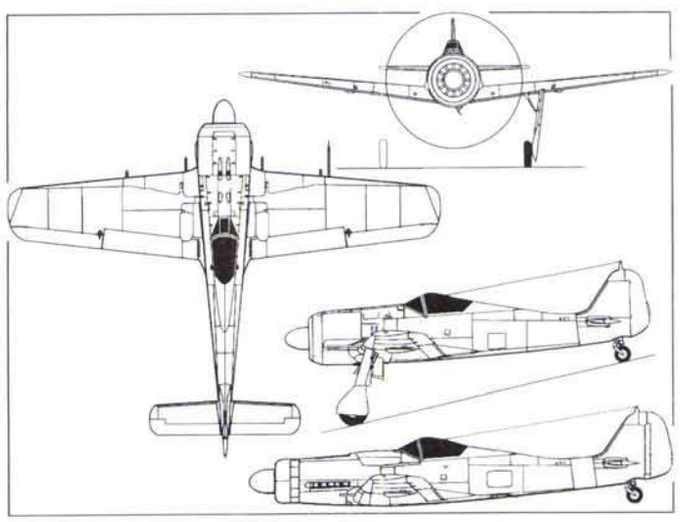
Brief data for new-built FW 190A include:

DIMENSIONS, EXTERNAL:
Wing span ..... 10.50 m (34 ft 5½ in)
Length overall ..... 9.10 m (29 ft 10¼ in)
Height overall, fuselage ..... 3.95 m (12 ft 3¼ in)

AREAS:
Wings, gross ..... 18.300 m² (197.0 sq ft)

WEIGHTS AND LOADINGS:
Weight empty ..... 2,900 kg (6,393 lb)
Max T-O weight ..... 3,800 kg (8,377 lb)

PERFORMANCE:
Max level speed at FL200 ..... 343 kt (635 km/h; 395 mph)
Cruising speed at 2,300 rpm ..... 316 kt (585 km/h; 364 mph)
Unstick speed ..... 89 kt (165 km/h; 103 mph)
Approach speed ..... 100 kt (185 km/h; 115 mph)
Initial rate of climb at S/L ..... 1,219 m (4,000 ft)/min
Range, VFR reserves ..... 534 n miles (990 km; 615 miles)



Focke-Wulf Fw 190A, with additional side view of Fw 190D *(Paul Jackson)*
1159382

GEFA-FLUG

GESELLSCHAFT ZUR ENTWICKLUNG UND FÖRDERUNG AEROSTATISCHER FLUGSYSTEME GMBH (AEROSTATIC FLIGHT SYSTEMS DEVELOPMENT AND PROMOTION COMPANY)

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MANAGING DIRECTOR: Karl-Ludwig Busemeyer
MARKETING DIRECTOR: W Mainzer
SALES DIRECTOR: J Leisten

GEFA-Flug was established 1975 to operate advertising and passenger-carrying hot-air balloons; has R&D department to develop airships for manned and unmanned civil and environmental research applications such as aerial photogrammetry and pollution monitoring.

Company currently operates more than six hot-air balloons, hot-air airships and a number of remotely controlled aerostats, and has sold about 100 systems (mostly unmanned and remotely controlled) worldwide. Is current manufacturer of former Colt AS 105 GD hot-air airship. Future market seen as survey projects for environmental research; GEFA-Flug also developing scientific measuring equipment in partnership with German Mining Technology, a partly government-funded body.

GEFA-FLUG AS 105 GD

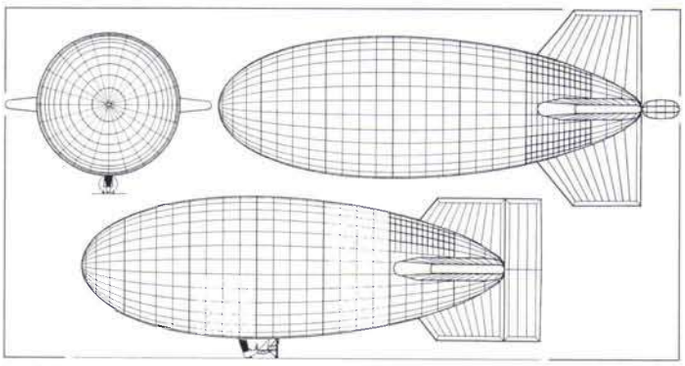
TYPE: Hot-air non-rigid.

PROGRAMME: Modified version of AS 105 Mk II first flown 1990 and built until 1994 by Thunder & Colt (and Cameron) in UK; German development began 1993. Certification (by UK CAA) and first production AS 105 GD completed in 1996; certified by German LBA on 29 December 1999, this being transferred to EASA on 2 June 2005 for daytime VFR flight.

CUSTOMERS: Total of 19 built in Germany by early 2005 (see table), of which at least eight (from 2000 onwards) have German-certified four-seat gondolas. GEFA-Flug assigns unified sequence of campaign numbers, which include allocations to UK-built AS 105s imported (and re-imported) for specific contracts. Campaign number H00037 was completed on 23 November 2005.

GEFA-FLUG HOT AIR NON-RIGIDS

Campaign No.	c/n	Constructor	Registration and name	Remarks
H00001	1641	T&C	D-GEFAFLUG/Adler(1)	ex G-BSLY
H00002	2372	T&C	D-ORCA/Adler(2)	
H00003	3685	Cameron	G-BWKE/Banner(1)	
H00004	1999	T&C	G-BTSW/Adler(3)	
H00005	3936	T&C	G-BXEY/Banner(2)	
H00006	0006	G-F	D-OCAC/Warsteiner(1)	
H00007	1578	Cameron	G-BROL/Warsteiner(2)	
H00008	4231	Cameron	G-BXNV/Bodytone	
H00009	0009	G-F	D-ODAT/Adler(4)	
H00010	4433	Cameron	G-BXYF/Volkswagen	
H00011	3775	Cameron	G-BWMV/Opel	
H00012	1501	Cameron	G-OVAX/Banner(3)	
H00013	not used			
H00014	0014	G-F	HB-QIQ/Warsteiner(3)	ex D-OGAC
H00015	0015	G-F	D-OKFP/Warsteiner(4)	
H00016	0016	G-F	D-OZDP/Deutsche Post(1)	
H00017	0017	G-F	D-OLMW/Möbel-Walther	
H00018	0018	G-F	D-OMMU/Möbel-Mutschler	



GEFA-Flug AS 105 GD hot-air non-rigid airship *(Paul Jackson)* 1046948

Campaign No.	c/n	Constructor	Registration and name	Remarks
H00019	0019	G-F	D-OHHO/Festo(1)	
H00020	1999	T&C	G-BTSW/Adler(5)	see H0004
H00021	0021	G-F	I-NORG/Tim	ex D-OATV/G-BZUR
H00022	0022	G-F	D-OTTA/Banner(4)	
H00023	0023	G-F	D-OLFI/WDR2	
H00024	0024	G-F	D-OEBW/EnBW	
H00025	0025	G-F	D-OZDQ/Deutsche Post(2)	
H00026	0026	G-F	HB-QIP/Zuger-Kantonalbank	
H00027	0027	G-F	D- Deutsche Post(3)	
H00028	0028	G-F	D-ORTA/Ratiopharm	
H00029	0029	G-F	D-OOHH/Festo(2)	
H00030	0030	G-F	D-OAVE/Linde	
H00031	0031	Cameron	G-CDFT	
H00032	0032	G-F	D-OTHS/Thomapyrin	

Notes: All are AS 105 GD except H0001 and H0002, which are AS 80 GD. Constructors are Thunder & Colt, Cameron and GEFA-Flug

COSTS: Development programme DM1.4 million; standard airship approximately EUR160,000 (2002).

DESIGN FEATURES: Longer and slimmer envelope than UK-built version; cruciform tail surfaces with rudder on each vertical fin; twin catenary load suspension system distributes loads of gondola weight and power plant forces evenly into envelope.

FLYING CONTROLS: Burners located inside envelope and operated electrically, with manual override; pilot lights fitted with electric spark and piezoelectric ignition, specially modified to operate directly underneath inflation fan without blowing out; steering by rudder on each vertical fin, operated by cables connecting them to gondola.

STRUCTURE: Envelope made from Carrington Hyperlast high-tenacity and high temperature-resistant fabric; engine drives generator supplying electric fan used to pressurise envelope; additional air for envelope pressurisation via scoop located in propeller slipstream. Gondola is a chromoly aircraft-grade steel tube spaceframe with Macrolon skin panels; windscreen, of polycarbonate sheet, forms partially enclosed cockpit.

LANDING GEAR: Non-retractable; two front and two rear wheels; spring shock-absorbers.

POWER PLANT: One 47.8 kW (64.1 hp) Rotax 582 UL two-cylinder water-cooled engine, driving a Helix four-blade carbon fibre pusher propeller. Fuel capacity 28 litres (7.4 US gallons; 6.2 Imp gallons). Cameron Mk 4 Shadow double gas burner for hot air generation.

ACCOMMODATION: Pilot, co-pilot and two passengers in pairs. Optionally (originally) two persons in tandem.

AVIONICS: *Comms:* Dittel FSG 71 720-channel VHF transceiver; FSG 2T transponder optional. *Instrumentation:* Standard VFR.

GEFA-Flug AS 105 GD with four-seat gondola 1128939

DIMENSIONS, EXTERNAL:
- Envelope: Length overall ..... 41.00 m (134 ft 6¼ in)
- Max diameter ..... 12.80 m (42 ft 0 in)
- Fineness ratio 3.2
- Tail unit span ..... 18.00 m (59 ft 0¾ in)
- Propeller diameter ..... 1.60 m (5 ft 3 in)
- Propeller ground clearance ..... 0.10 m (4 in)

DIMENSIONS, INTERNAL:
- Envelope volume ..... 2,973 m³ (105,000 cu ft)
- Gondola cabin: Length ..... 4.00 m (13 ft 1½ in)
- Max width ..... 1.60 m (5 ft 3 in)
- Max height ..... 1.80 m (5 ft 10¾ in)

WEIGHTS AND LOADINGS:
- Weight empty ..... approx 450 kg (992 lb)
- Max T-O weight: two-seat ..... 850 kg (1,873 lb)
- four-seat ..... 900 kg (1,984 lb)

PERFORMANCE:
- Max level speed ..... 22 kt (40 km/h; 25 mph)
- Max cruising speed ..... 20 kt (37 km/h; 23 mph)
- Econ cruising speed ..... 15 kt (28 km/h; 17 mph)
- Max rate of climb at S/L ..... 183 m (600 ft)/min
- Endurance: with max payload ..... 1 h
- with pilot only ..... 3 h

GERMAN AIRCRAFT

GERMAN AIRCRAFT GMBH

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CEO: Ralf Voigt

German Aircraft has taken over production and sales of the SAI G97 Spotter, previously produced in Italy; the product has been retitled Sky-MAXX. The company plans to raise further funds with a share issue in 2008

GERMAN AIRCRAFT SKY-MAXX

TYPE: Multisensor surveillance lightplane; side-by-side ultralight kitbuilt.

PROGRAMME: Design, by SAI of Italy, began June 1997; construction of prototype G97 ultralight started November 1997; first flight June 1998, powered by 47.8 kW (64.1 hp) Rotax 582; first G97V lightplane (I-OPIS) had public debut at Aero '01, Friedrichshafen, in April 2001 and first flew 15 May 2001. Construction of first production G97 began September 2000; initial flight March 2001. Certification of G97V was due late 2001, that for Germany awarded March 2006. Purchase of programme by German Aircraft has resulted in no distinction between lightplane and ultralight versions.

CURRENT VERSIONS: **Sky-MAXX (former G97V Spotter):** Certified light aircraft to Italian ENAC V.EL (elementary aircraft) standard. Differs from G97 prototype in having stretched forward fuselage.

Sky-MAXX (former G97 Spotter): As above, but in Ultralight category; assembled from kit.

CUSTOMERS: Six aircraft of all versions (including prototypes) flying by September 2001. Total 30 delivered to Italy, South America, South Africa, Spain and USA by mid-2003. German production was due to start in 2006.

COSTS: Sky-MAXX kit USD49,500; ready-to-fly USD99,700 with Rotax 912UL (2006).

DESIGN FEATURES: Advanced ultralight able to transition to certified aircraft category; intended for police/civil protection agency use, with helicopter-like view for crew assured by pusher propeller, side-by-side seating and absence of wing external bracing. Also suitable for private flying, training and light transport. Prime design objectives included sacrifice of speed to ensure utility; configuration overcomes related problems of ground cooling for engine, aerodynamic balance with large CG range, comfort in turbulent air and cabin noise. Computer modelling used in design, particularly with pod/boom interface and aerofoil tested in Department of Aircraft Design, Naples University.

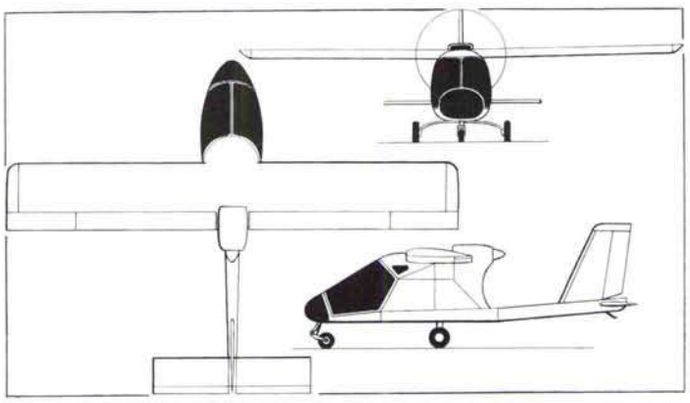
Pod-and-boom fuselage; cantilever, constant chord wings, detachable for storage. Sweptback fin; tailplane below propeller slipstream.

German Aircraft quoted build time of 120 hours for kit.

Purpose-designed Giordano VG1-13H high-lift aerofoil; no sweep; no twist; thickness-chord ratio 13.1 per cent; dihedral 1°; incidence 2° 30'.

FLYING CONTROLS: Manual. Frise differential ailerons, rudder and all-moving tailplane with anti-balance tab and electrically actuated trim. Electrically actuated slotted flaps on 71 per cent of wing trailing-edge.

STRUCTURE: Mostly aluminium alloy structure and skin, except rudder and part of tailplane Dacron covered; wing/fuselage fairing, wingtips and tailcone of glass fibre.



German Aircraft Sky-MAXX *(James Goulding)* 1159392

LANDING GEAR: Tricycle type; fixed. Cantilever-sprung mainwheel legs of single carbon fibre/glass fibre piece, attached to fuselage by four bolts. Nosewheel with rubber shock-absorber. Hydraulic disc brakes on mainwheels operated by lever in cockpit. Steerable nosewheel. Main tyres size 6.00-5; nose 11×4.00-5.

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS flat-four driving a Tonini two-blade, wooden propeller of 1.44 m (4 ft 8½ in) pitch. Two wing leading-edge fuel tanks in early aircraft, combined capacity 70 litres (18.5 US gallons; 15.4 Imp gallons), of which 66 litres (17.4 US gallons; 14.5 Imp gallons) are usable. By 2003, fuel capacity increased to 90 litres (23.8 US gallons; 19.8 Imp gallons). Option of 74.0 kW (99 hp) Hirth 3701ES, and three-blade Helix propeller in later versions. Jabiru J2200 (59.7 kW; 80 hp). Jabiru J3300 (89.5 kW; 120 hp).

ACCOMMODATION: Two persons, side by side, with four-point harnesses. Upward-opening door each side. Dual controls, including central throttle; ventilation. Baggage compartment behind seats.

SYSTEMS: Electrical system has 12 V battery and 100 W alternator. Optional BRS ballistic recovery parachute.

AVIONICS: To customer's requirements.

DIMENSIONS, EXTERNAL:
- Wing span ..... 8.25 m (27 ft 0¾ in)
- Wing chord, constant ..... 1.25 m (4 ft 1¼ in)
- Wing aspect ratio 6.7
- Length overall ..... 6.24 m (20 ft 5½ in)
- Height overall ..... 2.30 m (7 ft 6½ in)
- Tailplane span ..... 2.90 m (9 ft 6¼ in)
- Wheel track ..... 2.14 m (7 ft 0¼ in)
- Wheelbase ..... 1.60 m (5 ft 3 in)
- Propeller diameter: normal ..... 1.66 m (5 ft 5¼ in)
- max ..... 1.72 m (5 ft 7¾ in)

SAI G97 Spotter (now German Aircraft Sky-MAXX) ultralight kitbuilt *(Paul Jackson)* 0583535

DIMENSIONS, INTERNAL:
Cabin: Length 1.16 m (3 ft 9¾ in)
Max width 1.08 m (3 ft 6½ in)
Baggage volume 0.40 m³ (14.1 cu ft)
AREAS:
Wings, gross 10.30 m² (110.87 sq ft)
Tailplane 1.97 m² (21.20 sq ft)
WEIGHTS AND LOADINGS:
Weight empty: ultralight 283 kg (624 lb)
certified 298 kg (657 lb)
Max T-O weight: ultralight 450 kg (992 lb)[1]
ultralight alternative 530 kg (1,168 lb)[1]
certified 530 kg (1,168 lb)
Max wing loading: ultralight 43.8 kg/m² (8.95 lb/sq ft)
ultralight alternative, certified 51.5 kg/m² (10.54 lb/sq ft)
Max power loading: ultralight 7.56 kg/kW (12.4 lb/hp)
ultralight alternative, certified 8.90 kg/kW (14.62 lb/hp)

[1] *According to local regulations*

PERFORMANCE (Rotax 912 ULS):
Never-exceed speed (VNE) 129 kt (240 km/h; 149 mph)
Max level speed at S/L 119 kt (220 km/h; 137 mph)
Cruising speed at 75% power 108 kt (200 km/h; 124 mph)
Econ cruising speed 86 kt (160 km/h; 99 mph)
Stalling speed, power off:
flaps up 38 kt (69 km/h; 43 mph)
flaps down 36 kt (67 km/h; 42 mph)
Max rate of climb at S/L 427 m (1,400 ft)/min
Service ceiling 3,505 m (11,500 ft)
T-O and landing run 50 m (165 ft)
Range with enlarged tanks 432 n miles (800 km; 497 miles)
g limits +4/−2

GROB

BURKHART GROB LUFT- UND RAUMFAHRT E K (ASSOCIATED WITH GROB-WERKE E K)

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OWNER: Dr hc Dipl Ing Burkhart Grob
OWNER'S REPRESENTATIVE: Dipl Ing Christian Grob
CCO: Dr Andreas Plesske
SALES MANAGER: Dipl Ing Hans Doll

Company founded 1928; began aviation activities in 1971, since when has built more than 3,500 aircraft; name changed in 1988 from Burkhart Grob Flugzeugbau (formed 1974) to Burkhart Grob Luft- und Raumfahrt GmbH with light and heavy sections; light section produces sailplanes, supports G 103 glider, G 109 motor glider and the G 115, G 120, G 140 and G 160 powered aircraft; heavy section supports continued operations by earlier Egrett and Strato 2C and deals with space activities in support of Weltraum-Institut Berlin. Factory covered area 28,000 m² (301,400 sq ft). G 180 twin-jet under development. G115 has been out of production since 2001, but remains available to order.

GROB G 120A

Israel Defence Force name: Snunit (Cyclone).

TYPE: Aerobatic two-seat lightplane.

PROGRAMME: First flight (D-ELHU; unannounced) 1999; development of G 115 series to meet modern airline pilot and military training requirements, having advanced features including EFIS. With retractable landing gear and 194 kW (260 hp) Textron Lycoming AEIO-540 flat-six engine.

Announced January 2001, when Lufthansa ordered three (plus four options, of which three taken up in June 2001) for its US Airline Training Center Arizona (ATCA) operation at Goodyear, near Phoenix. German LBA provisional certification achieved 22 November 2001, followed by FAA FAR Pt 23 approval on 29 January 2002 and full LBA certification on 27 February 2002. Deliveries began (with N861AF) in February 2002.

CURRENT VERSIONS: **G 120A:** Baseline version; aerobatic MTOW 1,350 kg (2,976 lb).

G 120A-I Snunit: Israel Defence Force version. Certified by LBA on 27 September 2002 and by Israeli CAA on 14 October 2002. *As described.*

G 120A-C: Canadian version with additional cockpit heating. Canadian Type Certificate issued 17 February 2006.

G 120A Observer: Long-range/endurance version; usable fuel capacity 378 litres (99.8 US gallons; 83.2 Imp gallons).

CUSTOMERS: Lufthansa, seven. On 19 February 2002, Cyclone Aviation, a subsidiary of Elbit Systems, contracted by Israel Defence Force/Air Force to supply pilot screening and primary training services over 10 years with company-owned and -operated fleet of up to 27 G 120A-Is; first three handed over at Hatzerim AFB on 27 October 2002; however, initial Israeli order covered only 17 aircraft, last of which delivered in July 2003. One further aircraft (25th production) as company demonstrator. Total 26, including prototype, built by mid-2004.

On 24 May 2005, Kelowna Flightcraft Ltd of British Columbia, Canada, announced an order for nine G 120As, plus three options, for the Allied Wings Consortium to provide flight screening and primary flight instruction at No 3 Canadian Forces Flying Training School at Portage la Prairie, Manitoba under the contracted Flying Training and Support programme. All delivered April 2006, increasing total production to 34, plus prototype.

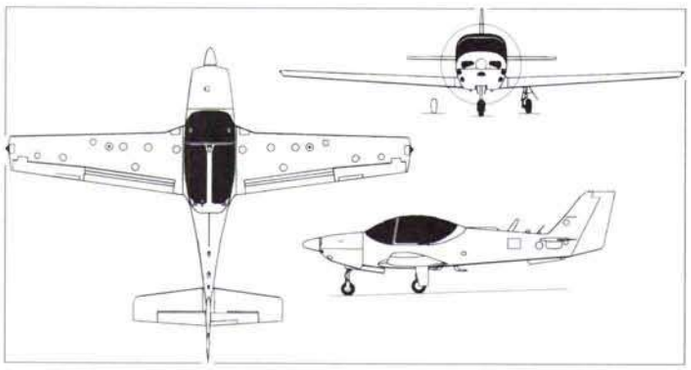
Description for G 120A generally as for G 115, except that below:

DESIGN FEATURES: Aerofoil Eppler E884; dihedral 2°; incidence 0°. Tailplane aerofoil NACA 64-010; fin 64-009. Airframe life 15,000 hours.

FLYING CONTROLS: Conventional and manual. Pushrod actuation for all primary surfaces. Slotted flaps electrically actuated; max deflection 60°. Servo tab and mass balance on each aileron; elevator trim tab starboard side with electric and manual actuation; rudder and elevator have mass balances, plus horn balance on rudder.

STRUCTURE: Semi-monocoque fuselage comprises a self-supporting carbon fibre-reinforced plastic shell with frame and web members. Cantilever wing of single-trapezoidal cross-section has an I-beam main spar with caps of carbon fibre rovings. Wing shell of honeycomb sandwich, except tank section of PVC foam sandwich. Interconnection of wings is via the spar stubs, bolted together with two large bolts which connect the stub spars. Each wing is attached to the fuselage by three bolts. The main spar and strong webs hold mountings for the main gear leg. An auxiliary spar closes the wing trailing-edge and carries the flaps and ailerons.

Flaps with upper and lower CFRP skins in rigid PVC foam core. Aileron structure same as flaps. Fin, integrated with fuselage, comprises main and end spar of honeycomb sandwich



Grob G 120A-I aerobatic lightplane 0530193

Grob G 120A of Allied Wings training organisation wearing a spurious, but indicative Canadian registration 1158289

design and a carbon-reinforced full laminate shell. Structural configuration of tailplane as for wings. Tailplane attached to the fuselage by four fittings. Both elevators have top and bottom CFRP shells; structure as for ailerons. Airframe is protected from moisture and ultra-violet radiation by UP gel-coat. A white filler on the outer surface of the aircraft conducts electricity, being part of lightning protection system. White two-component polyurethane lacquer covers the filler and completes the finish. Structural service life (Aerobatic) 15,000 hours.

LANDING GEAR: Tricycle type; retractable. Mainwheels 6.00-6; nosewheel 5.00-5. Nosewheel steerable ±10°.

POWER PLANT: One 194 kW (260 hp) Textron Lycoming AEIO-540-D4D5 flat-six, driving a Hartzell HC-C3YR-1RF/F7663R three-blade, constant-speed propeller. Fuel capacity 262 litres (69.2 US gallons; 57.6 Imp gallons), of which 252 litres (66.6 US gallons; 55.4 Imp gallons) are usable. Max oil capacity 11.4 litres (3.0 US gallons; 2.5 Imp gallons).

SYSTEMS: Grob 120A-5700 landing gear hydraulic system, pressure 103 bar (1,500 lb/sq in); Grob ECS 115TA-7301 air conditioning system. Electrical system 28 V DC with 80 A alternator and Concorde RG-24-20 24 V 19 Ah battery. External power socket, port side, to rear of cockpit.

AVIONICS: *Comms:* Bendix/King KMA 24H-70 audio control/intercom, KY 196A VHF, KT 76C transponder.

Flight: Bendix/King KX 165A nav/com/glideslope, KN 62 DME, KLN 94 GPS, KCS 55A compass, KR 87 ADF with KI 227 indicator.

DIMENSIONS, EXTERNAL:

Wing span	10.18 m (33 ft 4¾ in)
Wing aspect ratio	7.8
Length overall	8.11 m (26 ft 7¼ in)
Height overall	2.66 m (8 ft 8¾ in)
Tailplane span	3.80 m (12 ft 5½ in)
Wheel track	2.42 m (7 ft 11¼ in)
Wheelbase	1.87 m (6 ft 1½ in)
Propeller diameter	1.98 m (6 ft 6 in)

AREAS:

Wings, gross	13.30 m² (143.2 sq ft)
Ailerons (total)	0.915 m² (9.85 sq ft)
Trailing-edge flaps (total)	1.61 m² (17.33 sq ft)
Fin	1.71 m² (18.41 sq ft)
Rudder	0.77 m² (8.33 sq ft)
Tailplane	3.04 m² (32.72 sq ft)
Elevator	0.70 m² (7.53 sq ft)

WEIGHTS AND LOADINGS (A: Aerobatic, B: Utility):

Weight empty	1,080 kg (2,381 lb)
Baggage capacity	50 kg (110 lb)
Max T-O and landing weight: A	1,440 kg (3,174 lb)
B	1,490 kg (3,284 lb)
Max zero-fuel weight	1,315 kg (2,899 lb)
Max wing loading	112.0 kg/m² (22.95 lb/sq ft)
Max power loading	7.68 kg/kW (12.62 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	235 kt (435 km/h; 270 mph)
Max level speed	172 kt (319 km/h; 198 mph)
Manoeuvre speed	165 kt (306 km/h; 190 mph)
Cruising speed at 75% power at FL50	166 kt (307 km/h; 191 mph)
Stalling speed: A	55 kt (102 km/h; 64 mph)
B	56 kt (104 km/h; 65 mph)
Service ceiling, all	5,490 m (18,000 ft)
Max rate of climb at S/L: A	390 m (1,280 ft)/min
B	366 m (1,200 ft/min)
T-O to 15 m (50 ft): A	654 m (2,146 ft)
B	707 m (2,320 ft)
Landing from 15 m (50 ft)	562 m (1,844 ft)
Range at 45% power, 30 min reserves:	
G 120A at FL80	830 n miles (1,537 km; 955 miles)
Observer at FL60	1,360 n miles (2,518 km; 1,565 miles)
Endurance at 45% power at FL20, 30 min reserves:	
Observer	11 h 40 min
g limits: G 120A Aerobatic	+6/−4
G 120A Utility, Observer	+4.4/−1.76

GROB G 140TP

TYPE: Business turboprop.

PROGRAMME: Development started early 2001. Prototype (D-ETPG), then unflown and previously unannounced, exhibited at Paris Air Show from 16 to 24 June 2001.

Design freeze completed in 2002 following incorporation of changes based on feedback from potential customers. First flight 12 December 2002; some 190 flight test hours recorderd by late 2005, when certification programme was said to be 50 per cent complete.

CUSTOMERS: Potential market for 20 to 40 per year, for military and civilian markets. Production go-ahead dependent on large fleet order.

COSTS: Unpressurised version USD1.2 million (2005).

DESIGN FEATURES: Generally similar to G 115/120 series. By 2004, a ventral strake had been added to the rear fuselage.

FLYING CONTROLS: Conventional and manual. Trim tab on port elevator and each aileron; horn-balanced rudder. Slotted flaps. Dual controls (sticks) standard.

STRUCTURE: Entirely CFRP. Structural service life (aerobatic) 15,000 flight hours.

LANDING GEAR: Retractable tricycle type with trailing-link suspension on main units. Single wheel on each unit. Main legs retract inwards into wing root area, nosewheel rearwards. Hydraulic disc brakes.

POWER PLANT: One 336 kW (450 shp) Rolls-Royce 250-B17F turboprop driving an MT-Propeller MTV-5 five-blade, constant-speed (hydraulic) propeller. Integral fuel tanks in wings, combined usable capacity 520 litres (137.4 US gallons; 114.4 Imp gallons).

ACCOMMODATION: Four persons in individual seats. Separate upward-opening gullwing-type door for each seat, with circular 'porthole' window at rear of cabin on each side. Baggage door at rear of cabin on port side. Air-conditioning standard, pressurisation will be offered as an option.

AVIONICS: Bendix/King EFIS 40 two-screen EFIS as core system.

Comms: Dual Bendix/King KX 165 VHF com/MKR transceivers; KT 71 transponder; KMA 28 audio panel; ACK E-01 ELT.

Flight: Dual Bendix/King KX 165A nav; KR 87 ADF; KN 63 DME; KA 51B slaving control unit; KMT 112 magnetic azimuth transmitter.

Instrumentation: ED 461 EHSI; ED 462 EADI; Litef LCR 92 remote gyro unit; KEA 130 encoding altimeter.

DIMENSIONS, EXTERNAL:

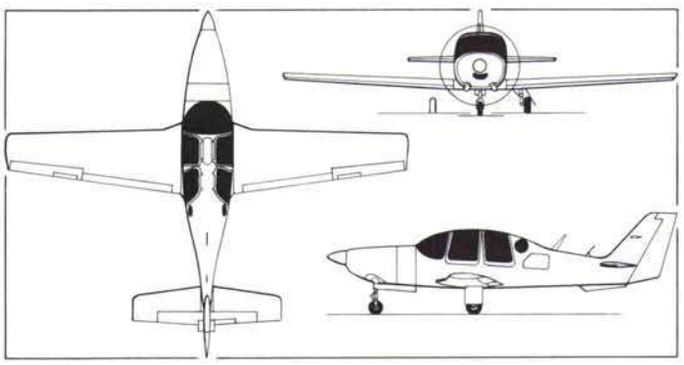
Wing span	10.60 m (34 ft 9¼ in)
Wing aspect ratio	8.5
Length overall	8.90 m (29 ft 2½ in)
Height overall	2.80 m (9 ft 2¼ in)

AREAS:

Wings, gross	13.28 m² (142.9 sq ft)

Grob G 140TP instrument panel 1043835

Prototype Grob G 140TP *(Paul Jackson)* 1043811



Grob G 140TP business turboprop *(James Goulding)* 0580557

Ailerons (total) ..... 0.94 m² (10.12 sq ft)
Fin ..... 1.02 m² (10.98 sq ft)
Rudder ..... 0.76 m² (8.18 sq ft)
Tailplane ..... 2.34 m² (25.19 sq ft)
Elevator (total, incl tab) ..... 2.34 m² (25.19 sq ft)

WEIGHTS AND LOADINGS (A: Aerobatic; B: Utility):
Weight empty ..... 1,130 kg (2,491 lb)
Max T-O and landing weight: A ..... 1,530 kg (3,373 lb)
B ..... 1,830 kg (4,034 lb)
Max wing loading ..... 137.8 kg/m² (28.22 lb/sq in)
Max power loading ..... 5.45 kg/kW (8.95 lb/shp)

PERFORMANCE :
Cruising speed at FL100:
max ..... 230 kt
long range ..... 170 kt
Stalling speed: A ..... 55 kt (102 km/h; 64 mph)
B ..... 61 kt (113 km/h; 70 mph)
Max rate of climb at S/L: A ..... 853 m (2,800 ft)/min
B ..... 652 m (2,140 ft)/min
T-O to 15 m (50 ft): A ..... 374 m (1,225 ft)
B ..... 570 m (1,870 ft)
Landing from 15 m (50 ft): A ..... 460 m (1,509 ft)
B ..... 610 m (2,001 ft)
Range at FL100, 30 min reserves:
with max payload ..... 1,000 n miles (1,852 km; 1,150 miles)
with max fuel ..... 1,100 n miles (2,037 km; 1,265 miles)
g limits: U ..... +4.4/−1.76
A ..... +6/−4

GROB G 160 RANGER

TYPE: Business turboprop.

PROGRAMME: Announced 5 May 2003; public debut of prototype (c/n 87000/D-FTGB), then unflown, at Paris Air Show 15 June 2003; first flight 29 March 2004; wing span 13.00 m (42 ft 7¾ in), area 20.48 m² (220.4 sq ft).

By late December 2004, a total of 60 flight hours had been recorded in 105 sorties that included more than 180 spins in 13 configurations, and take-offs and landings on grass and snow-covered runways. Production configuration aircraft being built in late 2005. EASA certification, originally anticipated in mid-2006, followed by FAA approval, but G 160 subsequently given lower priority in company plans.

COSTS: Approximately USD2.8 million (2004).

DESIGN FEATURES: Low-wing monoplane; winglets added by 2005; twin strakes under rear fuselage; sweptback fin; non-swept tailplane.

FLYING CONTROLS: Conventional and manual. Fowler flaps. Electric pitch trim with manual backup. Tabs in both ailerons; horn-balanced elevators with tab each side; horn-balanced rudder; inset horn on ailerons. Dual controls (yokes) standard.

STRUCTURE: CFRP/Nomex honeycomb sandwich primary structure.

LANDING GEAR: Retractable tricycle type with single wheel on each unit. Nosewheel retracts rearwards, main units retract inwards. Mainwheels 9.5×6.75–8 with hydraulic disc brakes; nosewheel 6.00–6, steerable.

Grob G 160 Ranger after addition of winglets *(Paul Jackson)* 1128910

POWER PLANT: One 634 kW (850 shp) Pratt & Whitney Canada PT6A-42A turboprop, flat rated at 41°C, driving a five-blade reversing Mühlbauer MTV-27-1-E-C-F-R (P)/CFR235-55 propeller. Usable fuel capacity 1,655 litres (437 US gallons; 364 Imp gallons).

ACCOMMODATION: Pilot and co-pilot or passenger in cockpit; four passengers in main cabin in club arrangement, with baggage area and lavatory in aft cabin separated by curtain; alternative layouts provide for one additional seat in rear cabin with reduced baggage space, or two additional seats without lavatory. Ambulance quick-change configuration provider for pilot and co-pilot or passenger in cockpit and single stretcher patient with two attendants in cabin. Cabin door on port side aft of wing split horizontally; crew emergency exit, forward, port; cabin emergency exit, starboard, above wing. Four cabin windows per side. Fold-out tables, individual reading lights and 110V/220V power supply for laptop computers standard. Refreshment centre optional. Accommodation is pressurised and air conditioned.

SYSTEMS: Hydraulic system for actuation of landing gear, maximum operating pressure 103.4 bar (1,500 lb/sq in). Electrical system comprises 28 V 300 A starter generator, 28 V 100 A alternator, and 24 V 40 Ah battery. 28 V DC external power receptacle standard. 110 V AC 60 Hz and/or 220 V AC 60 Hz converter for cabin power supply. Cabin pressurisation/heating supplied by engine bleed air; Honeywell cabin pressure control system (CPCS) standard. Pneumatic boot de-icing system for wing, tailplane and fin leading-edges; propeller, windscreen, pitot head, static ports and stall warning sensor electrically heated.

AVIONICS: Initial deliveries, *as described*, equipped with Bendix/King EFS 40 EFIS with KFC 325 flight control system. From 2007 alternative avionics fit will be Honeywell APEX integrated'glass cockpit' comprising three-tube EFIS with 15 × 20 cm (6 × 8 in) displays for PFD, MFD and EICAS functions; Mode S transponder; and EGPWS. Options will include TCAS, radio altimeter, DME, ADF, Honeywell flight information system.

Comms: Twin KX 165A nav/com, KMA 28 intercom, KT 70 Mode S transponder, ELT.

Radar: Optional RDR 2000 weather radar.

Flight: KLN 90B GPS, KN 63 DME, KR 87 ADF, KRG 332 gyro, KNI 582 RMI, Litef LCR92 AHARS. Optional KRA 405B radar altimeter, KMH 880 TAS/TAWS, second KR 87, KT 70 and KN 63.

Instrumentation: Optional KMD 850 MFD.

DIMENSIONS, EXTERNAL:
Wing span ..... 14.30 m (46 ft 11 in)
Wing aspect ratio 9.6
Length overall ..... 11.50 m (37 ft 8¾ in)
Height overall ..... 3.40 m (11 ft 1¾ in)
Tailplane span ..... 5.00 m (16 ft 4¾ in)

DIMENSIONS, INTERNAL:
Cabin: Length ..... 4.96 m (16 ft 3¼ in)
Max width ..... 1.52 m (5 ft 0 in)
Max height ..... 1.42 m (4 ft 8 in)

AREAS:
Wings, gross ..... 21.20 m² (228.2 sq ft)
Ailerons (total) ..... 190 m² (20.45 sq ft)
Fin ..... 1.61 m² (17.33 sq ft)
Rudder ..... 1.04 m² (11.19 sq ft)
Tailplane ..... 3.57 m² (38.43 sq ft)
Elevators (total) ..... 1.39 m² (38.43 sq ft)

WEIGHTS AND LOADINGS:
Weight empty ..... 2,210 kg (4,872 lb)
Max payload ..... 720 kg (1,587 lb)
Max fuel weight ..... 1,313 kg (2,895 lb)
Max T-O weight ..... 3,600 kg (7,936 lb)
Max landing weight ..... 3,300 kg (7,275 lb)
Max ramp weight ..... 3,630 kg (8,002 lb)
Max zero-fuel weight ..... 2,930 kg (6,459 lb)
Max wing loading ..... 161.1 kg/m² (33.0 lb/sq ft)
Max power loading ..... 5.21 kg/kW (8.55 lb/shp)

PERFORMANCE:
Max level speed at FL250 ..... 270 kt (500 km/h; 311 mph)
Max cruising speed ..... 240 kt (444 km/h; 276 mph)
Stalling speed ..... 61 kt (113 km/h; 71 mph)
Service ceiling ..... 2,670 m (25,000 ft)
Max rate of climb at S/L ..... 564 m (1,850 ft)/min
T-O to 15 m (50 ft) ..... 736 m (2,415 ft)
Landing from 15 m (50 ft) without propeller reversal ..... 650 m (2,133 ft)
Range, three passengers, plus pilot, cruising at FL250, 30 min reserves ..... 1,800 n miles (3,333 km; 2,071 miles)
Range with max fuel, cruising at FL250, 30 min reserves ..... 2,230 n miles (4,130 km; 2,566 miles)
g limits ..... +3.8/−1.54

GROB G 180 SP^n UTILITY JET

TYPE: Business jet; utility twin-jet.

PROGRAMME: Project launched, but not then announced, June 2004; static testing completed between November 2004 and February 2005; public launch and debut, until then still unannounced, at Paris Air Show 13 June 2005, when prototype and cabin mockup displayed. ExecuJet Aviation Group of Switzerland announced as sales, service and support partner at time of launch. First flight (D-ISPN) 20 July 2005. Following early testing, re-registered D-CSPN on 10 August 2005 for flights above 5,700 kg (12,566 lb). Demonstrated grass strip landing in July 2006.

Second prototype (D-CGSP) flew 29 September 2006, but was destroyed in an accident on 29 November 2006. Third prototype scheduled to fly in early 2007. EASA certification in CS 23 commuter category for single-pilot operation scheduled for third quarter 2007, followed by FAA FAR Pt 23 approval for day/night, IFR and known icing operations in fourth quarter 2007.

CUSTOMERS: Total of 65 orders held by October 2006.

COSTS: USD7.15 million (2006).

DESIGN FEATURES: Conventional low-wing configuration with unswept wing featuring small outward-canted winglets; swept fin and mildly swept tailplanes in cruciform configuration; dual downward-canted afterbody strakes. Pylon-mounted engines aft of cabin. Seven cabin windows on each side. Door on port side, immediately aft of cockpit. Wing sweepback 16° 50' at 25 per cent chord on inboard section, 9° 59' at 25 per cent chord on outboard section to wingtip. Dihedral 4°. Tailplane sweepback 20° 50' at 25 per cent chord. Fin sweepback 40° 10' at 25 per cent chord

Ill-fated Grob G 180 SP^n Utility Jet second prototype overflying the company's works 1040527

FLYING CONTROLS: Conventional and manual via pushrods and bellcranks. Elevators feature a bob weight and downspring system to modulate stick-free stability and control forces. Pitch trim is via two mechanically interconnected trim tabs with one electrical actuator each for redundancy; yaw and roll trim provided by electrically driven trim tabs on rudder and ailerons. Fowler flaps actuated by central electric motor via screw jacks and flexible drives. Hydraulically actuated spoiler on upper surface of wings.

STRUCTURE: Mostly carbon fibre composites with titanium wing attachment points. Minimum certified airframe service life 28,000 flight hours.

LANDING GEAR: Hydraulically retractable tricycle type with single wheel on each unit. Main units retract inwards. Reinforced legs and oversize wheels/tyres on all units to permit operation from unpaved surfaces.

POWER PLANT: Two Williams FJ44-3A turbofans, with FADEC, each rated at 12.54 kN (2,820 lb st). Fuel in integral wing tanks with independent venting, combined capacity 2,593 litres (685 US gallons; 570 Imp gallons). Honeywell RE100 APU flight operable to 9,140 m (30,000 ft). Gravity refuelling port in each wing; single-point pressure refuelling optional.

ACCOMMODATION: Cabin interior designed by Porsche Design Studio of Austria. Standard accommodation for eight passengers in double club configuration with centre aisle. 'Plug and play' modular interior has two movable bulkheads and seats and cabinetry mounted on tracks to facilitate quick change to alternative passenger seating arrangements, mixed passenger/cargo, all-cargo or air ambulance configurations, last-mentioned accommodating two stretchers and up to four seats for medical attendants. Standard self-contained lavatory, with basin, at forward end of cabin on starboard side is also removable. Standard cabin features four foldout tables (two for each double club pair); four 110 V power outlets in the cabin, plus one each in cockpit and lavatory; eight passenger-activated LED reading lights, and up/down indirect wash lights. Large plug-type door on starboard side forward of wing, with steps that lower automatically on door opening. Emergency exit each side, adjacent to wing leading-edge. Optional cargo net attaches to seat floor tracks and cabin headliner. Main baggage compartment is separate, located on port side aft of wing and accesses via a door below engine; additional baggage compartment in nose, with access via door in starboard side.

Instrument panel of Grob G 180 SP^n 1040529

SYSTEMS: Cabin pressurisation system maintains 2,440 m (8,000 ft) cabin environment at maximum operating altitude of FL410. Hydraulic system, pressure 206 bar (3,006 lb/sq in), operates landing gear, spoilers, braking system and nosewheel steering. Electrical system supplied by one 24 V 40 Ah and one 24 V 18 Ah lead-acid batteries and two Honeywell 28 V 400 A starter/generators. 28 V DC external power socket optional, and can be used for charging aircraft main battery. Oxygen system of 0.91 m^3 (32.0 cu ft) capacity includes quick-donning demand/flow masks with detachable goggles for crew and drop-down masks above every cabin seat and in lavatory for passengers. Bleed air anti-icing for wing leading-edges and engine inlets; electric heating for cockpit windscreen on captain's side, pitot/static probes, TAT and ice detection sensors and AoA probe.

AVIONICS: Honeywell APEX integrated avionics system as standard, comprising two 381 cm (15 in) PFDs and two 254 cm (10 in) across the diagonal, centrally mounted MFDs, dual ADAHRS, multimode VHF/COM/NAV/VOR/ILS digital radios, DME, radar altimeter, Mode S transponder, TCAS II with Change 7, EGPWS/TAWS Class A, tri-frequency ELT, and 76 mm (3 in) LCD standby instrument display.

DIMENSIONS, EXTERNAL:

Wing span over winglets	14.86 m (48 ft 9 in)
Wing aspect ratio	8.8
Length: overall	14.81 m (48 ft 7 in)
fuselage	14.18 m (46 ft 6¼ in)
Height overall	5.13 m (16 ft 10 in)
Tailplane span	6.48 m (21 ft 3 in)
Wheel track	3.08 m (10 ft 1¼ in)
Wheelbase	5.60 m (18 ft 4½ in)
Passenger door: Height	1.37 m (4 ft 6 in)
Width	0.84 m (2 ft 9 in)
Rear baggage door: Height	0.465 m (1 ft 6¼ in)
Width	0.725 m (2 ft 4½ in)

DIMENSIONS, INTERNAL:

Cabin: Length	5.10 m (16 ft 8¾ in)
Max width	1.52 m (5 ft 0 in)
Max height	1.64 m (5 ft 4½ in)
Volume	11.47 m^3 (405 cu ft)
Baggage compartment volume:	
rear	0.99 m^3 (35 cu ft)
nose	0.06 m^3 (2.1 cu ft)

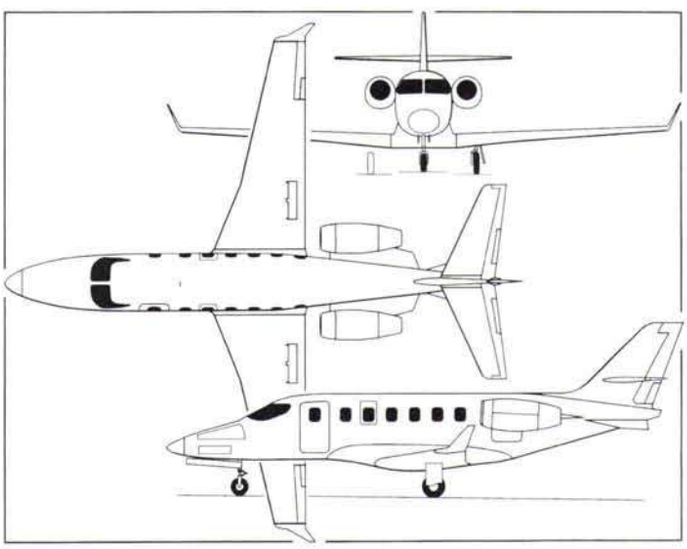
AREAS:

Wings, gross	24.99 m^2 (269.0 sq ft)
Tailplane	7.10 m^2 (76.42 sq ft)
Fin	5.00 m^2 (53.82 sq ft)

First (nearest) and second Grob G 180 SP^n prototypes 1040528

For details of the latest updates to ***Jane's All the World's Aircraft*** online and to discover the additional information available exclusively to online subscribers please visit
jawa.janes.com

Grob G 180 SP^n executive cabin layout 1040530



Grob G 180 SP^n Utility Jet ***(Paul Jackson)*** 1158967

WEIGHTS AND LOADINGS:

Weight empty	3,510 kg (7,738 lb)
Basic operating weight (single pilot)	3,601 kg (7,939 lb)
Max baggage weight	150 kg (331 lb)
Payload: max (single pilot)	1,130 kg (2,491 lb)
with max fuel	674 kg (1,486 lb)
Max fuel weight	2,075 kg (4,575 lb)
Max T-O weight	6,300 kg (13,889 lb)
Max ramp weight	6,350 kg (13,999 lb)
Max landing weight	6,100 kg (13,448 lb)
Max zero-fuel weight	4,731 kg (10,430 lb)
Max wing loading	252.1 kg/m^2 (51.63 lb/sq ft)
Max power loading	251 kg/kN (2.46 lb/lb st)

PERFORMANCE (estimated):

Max operating Mach No.	0.70
Max operating speed: S/L to FL80	260 kt (481 km/h; 299 mph) CAS
FL80 to FL298	272 kt (504 km/h; 313 mph) CAS
Max cruising speed: at FL330	407 kt (754 km/h; 468 mph)
at FL410	402 kt (744 km/h; 463 mph)
Approach speed, landing configuration	100 kt (185 km/h; 115 mph) CAS
Stalling speed, landing configuration	77 kt (143 km/h; 87 mph)
Max rate of climb at S/L	1,329 m (4,360 ft)/min
Rate of climb at S/L, OEI	414 m (1,358 ft)/min
Time to: FL330	13 min
FL390	18 min
FL410	20 min
Max operating altitude	12,495 m (41,000 ft)
T-O balanced field length at S/L	914 m (3,000 ft)
Landing from 15 m (50 ft)	814 m (2,670 ft)
Range, with NBAA IFR reserves, 100 n mile (185 km; 115 mile) alternate:	
with max fuel	1,950 n miles (3,611 km; 2,244 miles)
pilot and six passengers	1,800 n miles (3,333 km; 2,071 miles)
g limits (design load factor)	+3.1/–1.24

GROB HALE G 600 and G 600 ER

TYPE: High altitude platform.

PROGRAMME: Announced 13 June 2005 following completion of concept design studies. Estimated time from formal project launch to first flight is approximately one year, with completion of flight testing and EASA/FAA certification following 11 months later. Potential roles include border/economic zone protection and coast guard duties.

CURRENT VERSIONS: **G 600:** *As described.*

G 600 ER: Proposed extended range version, retaining same airframe as G 600 but with more powerful engines and four additional fuel tanks in rear cabin, reducing space for mission specialist to one person.

DESIGN FEATURES: Comprises forward fuselage section, pressurised cabin, engines, horizontal tail surfaces and landing gear of the G 180 SP^n Utility Jet with extended rear fuselage and taller fin and new one-piece high aspect ratio wing without winglets.

STRUCTURE: Mostly carbon fibre composites with titanium wing attachment points.

LANDING GEAR: Hydraulically retractable tricycle type with single wheel on each unit. Main units retract inwards.

POWER PLANT: G 600 has two Williams FJ44-3A turbofans, with FADEC, each rated at 12.45 kN (2,800 lb st). Fuel in integral wing tanks. G 600 ER has two unspecified Williams turbofans, each rated at 16.77 kN (3,770 lb st), with four additional fuel tanks in rear cabin, each of 1,000 litres (264 US gallons; 220 Imp gallons) capacity.

ACCOMMODATION: *G 600:* Flight crew of two, but with single-pilot capability, plus two mission specialists in cabin. Typical cabin layout would feature two workstations for screen and mission data displays with foldaway keyboards, a small bench/bunk for long endurance missions with stowage beneath, galley, lavatory and washbasin, and rack for mission equipment such as data acquisition units or computers.

G 600 ER: Flight crew of two with one mission specialist/workstation in cabin.

EQUIPMENT: Depending on the specific operation, mission equipment could include: sensors for all-weather, wide-area and spot capability including electro-optical/infrared sensors, synthetic aperture radar/moving target indicator and hyperspectral sensors for chemical and biological agent detection; line-of-sight datalink and wideband satellite datalink including satcom antenna, UHF LOS transceiver antenna, command datalink antenna and IFF transponder and antenna; self-defence systems including radar warning receiver, onboard jamming system and towed decoy launcher; unmanned systems and navigation equipment including integrated mission management computers, GPS antenna and inertial navigation system with laser gyro; and scientific payloads to measure water vapour, ozone, particles, trace-gases and radiant fluxes including milli/microjoule lidar, scatter meter inlets for gas and aerosol sampling, counter flow impactor inlet and Lyman spectrometer for condensed water, tunable diode laser for water and HNO_3, condensation nuclei counter, particle size spectrometer, integrating pyranometer, spectral radiometer, frost-point hygrometer, gas chromatograph and IR analyser for CO_2.

DIMENSIONS, EXTERNAL:

Wing span	35.60 m (116 ft 9½ in)
Wing aspect ratio	27.0
Length overall	18.65 m (61 ft 2¼ in)
Height overall	6.50 m (21 ft 4 in)

DIMENSIONS, INTERNAL (A: G 600, B: G 600 ER):

Cabin volume: A	11.6 m^3 (410 cu ft)
B	6.2 m^3 (220 cu ft)

AREAS:

Wing, gross: A, B	47.00 m^2 (505.9 sq ft)

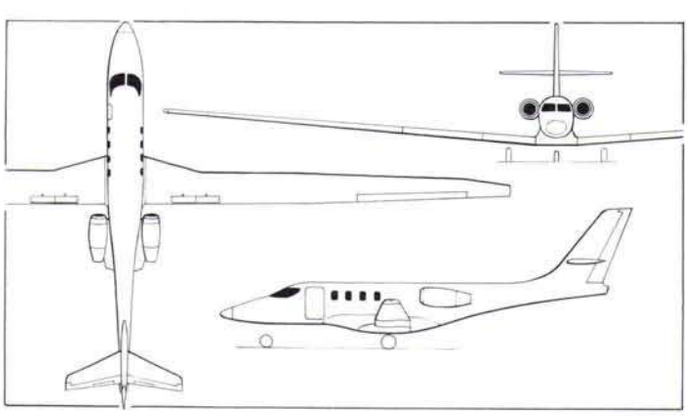
WEIGHTS AND LOADINGS:

Basic operating weight, two crew: A	4,050 kg (8,929 lb)
B	4,630 kg (10,207 lb)
Max fuel: A	2,900 kg (6,393 lb)
B	6,600 kg (14,550 lb)
Max payload: A	1,200 kg (2,645 lb)
B	800 kg (1,764 lb)
Max T-O weight: A	7,750 kg (17,085 lb)
B	12,000 kg (26,455 lb)
Max wing loading: A	164.9 kg/m^2 (33.77 lb/sq ft)
B	255.3 kg/m^2 (52.29 lb/sq ft)
Max power loading: A	311 kg/kN (3.05 lb/lb st)
B	358 kg/kN (3.51 lb/lb st)

PERFORMANCE (at max T-O weight, ISA, except where indicated):

Cruising speed: A, B	M0.61
Average Mach No.: A, B	0.60
Minimum loiter speed at FL650	M0.55
Max operating altitude: A	19,810 m (65,000 ft)
B	18,290 m (60,000 ft)
Time to climb: to FL600: A	1 h 0 min
B	14 h 0 min
to FL650: A	10 h 0 min
Max range: A	6,209 n miles (11,500 km; 7,145 miles)
B	11,339 n miles (21,000 km; 13,048 miles)
Loiter time at FL650: A	10 h 0 min
B	18 h 30 min
Endurance: A	17 h 20 min
B	33 h 0 min

Artist's impression of Grob HALE G 600 1133979



Grob HALE G 600 high-altitude platform ***(James Goulding)*** 1133952

GYROTEC

GYROTEC

Tel: (+49 7271) 92 23 34
e-mail: info@gyrotec.de
Web: www.gyrotec.de
PROPRIETOR: Michael Obermaier

Company is marketing the DF02 autogyro, a development of DF01 (F-WYGB) produced in 1980s by the late François Dedieu.

GYROTEC DF02

TYPE: Single-seat autogyro ultralight.

PROGRAMME: François Dedieu's DF01 flown at Toulouse, France, from late 1980s onwards; numerous modifications during 1990s to empennage, structure and power plant (progressively Teledyne Continental; Rotax 532; Rotax 582); Magni rotor of Italian design. Refinement complete by 2002; prototype dismantled shortly thereafter as pattern for DF02, having flown 370 hours.

Prototype DF02 (W67VN) flown 2005.

COSTS: Estimated EUR30,000 to EUR35,000 including tax (2006).

DESIGN FEATURES: Conventional enclosed autogyro with square-section metal keel mounting central fin with large rudder, plus large stabilising fins at tips of tailplane. Enclosed engine.

Sportcopter rotor turning at 270 rpm; rotor section NACA 8H12. Rotor brake. Optional baggage capsule.

FLYING CONTROLS: Conventional and manual.

STRUCTURE: Central, square-section 15CDV6 welded steel keel. Pod and empennage of glass-reinforced plastic and carbon fibre sandwich. Plexiglas canopy may be omitted for fair weather flying.

LANDING GEAR: Tricycle type; fixed. Mainwheels on spring cantilever legs. Disc brakes. Optional wheel fairings.

POWER PLANT: One 52.2 kW (70 hp) Hirth 3503E water-cooled, two-stroke piston engine. Alternatively, one 58.8 kW (78.9 hp) Rotax 912 UL air-cooled flat-four. Three-blade ground-adjustable pitch propeller; option of Duc Swirl or Kiev Prop 243. Fuel capacity 60 litres (15.8 US gallons; 13.2 Imp gallons).

Maiden flight of the Gyrotec DF02 1158657

DIMENSIONS, EXTERNAL:
Rotor diameter ..... 7.32 m (24 ft 0 in)
WEIGHTS AND LOADINGS:
Weight empty ..... 175 kg (386 lb)
Max T-O weight ..... 300 kg (661 lb)
PERFORMANCE:
Max level speed ..... 86 kt (160 km/h; 99 mph)
Normal cruising speed ..... 65 kt (120 km/h; 75 mph)
Max rate of climb at S/L at 270 kg (595 lb) ..... 300 m (984 ft)/min
T-O run ..... 50 m (165 ft)
Landing run ..... 10 m (35 ft)
Range: ..... 286 n miles (530 km; 329 miles)

HIGH PERFORMANCE

HIGH PERFORMANCE AIRCRAFT

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Web (2): www.kde-care.de/hpa
CEO: Klaus Götsch
HEAD OF DESIGN: Christian Majunke

Company founded by the late Heiko Teegen on 10 April 2002 as joint venture by professional aviation magazine *Pilot und Flugzeug* and local government of Mecklenburg-Vorpommern. Intention is to produce TT62 Alekto light twin-prop, for which full funding was in place by time of public launch at Berlin Air Show, 6 to 12 May 2002. Secondary purpose was restoration of Rostock-Laage airfield as centre of aviation development with initial creation of 41 jobs at High Performance plant. HPA filed for bankruptcy protection on 10 July 2006; receivers are Brinkmann & Partner.

HIGH PERFORMANCE TT62 ALEKTO and BALTIC

TYPE: Business twin-prop.

PROGRAMME: Promotion begun at ILA Berlin, 6 May 2002. Fifth-scale model flown 23 November 2002. Fuselage mockup at Aero, Friedrichshafen, April 2003; complete, but unflown, prototype (D-IXTT) at ILA, Berlin May 2004. Taxy trials began 29 December 2004; first flight, by D-IXTT on 22 February 2005, terminated after 15 minutes; no further flights made.

In late 2005, High Performance began complete redesign as a conventional twin named **Baltic** (announced 10 December 2005) with wing-mounted engines in tractor configuration, fuselage shortened by 1.54 m (5 ft 0½ in) with cabin accommodation for five passengers, and cruciform tail unit. Projected performance with 257 kW (345 hp) Centurion 4.0 Diesel engines included maximum cruising speed of 230 kt (426 km/h; 265 mph) at FL200 and 80 per cent power; and range with max fuel of 1,750 n miles (3,241 km; 2,103 miles). Model unveiled in May 2006, at which time certification and start of series production were expected in 2009, following first flight due in August 2007, but High Performance Aircraft filed for bankruptcy protection in July 2006.

CURRENT VERSIONS: Initial version *as described*. Projected developments include an air ambulance and aerial surveillance variant.

COSTS: EUR490,000 plus tax (2004).

DESIGN FEATURES: Design aims include speed and economy, achieved in part by internal mounting of engines for reduced frontal area and use of diesel power. Consumption 79 litres (20.9 US gallons; 17.4 Imp gallons)/h at normal cruise; 58 litres (15.3 US gallons; 12.8 Imp gallons)/h at econ cruise. Specific range, respectively, 3.84 n miles/kg and 4.80 n miles/kg.

Model of stillborn HPA TT62 Baltic 1040532

Mid-mounted wing. T tail. Two internal turbo-diesel engines connected by tubular drive-shafts to propellers mounted on upward-canted pylons at fuselage shoulders behind wing trailing-edge.

Wing section NASA LS(1)-0413 (alias GA(W)-2); dihedral 5°, incidence 1°, sweepback at leading-edge 12°. Tailplane LWK 80-120/K25, no dihedral. Fin AH 85-L-120 at root; AH 85-L-250 at tip.

FLYING CONTROLS: Conventional and manual with sidesticks. Ailerons and elevator all 30 per cent chord with aerodynamic and static balance; rudder 25 per cent chord, similar; 20 per cent chord plain flaps. Large trim tab in each aileron and in elevator; upper quarter of rudder is separate trimming rudder. Cable actuated ailerons, elevator and rudder; electrically actuated flaps; electric trim.

STRUCTURE: Carbon fibre sandwich with epoxy resin matrix throughout. Wing has two spars and four main ribs; tailplane similar; fuselage has two bulkheads and one frame; two-spar tailplane; single-spar fin.

LANDING GEAR: Retractable tricycle type, electrohydraulically actuated. Can accommodate sink rates up to 3 m; 10 ft/s. Single wheel on each trailing-link main unit; single nosewheel. Main units of aluminium 7075 and 1.4548, retracting inward into wings; nosewheel retracts forward. Mainwheels 6.50–8, nosewheel 5.0–4 (6.00–6 on prototype). Parker Cleveland brakes.

POWER PLANT: Two 228 kW (306 hp) TAE Centurion 4.0 V-8 turbocharged, FADEC-controlled Diesel engines, each driving an MT-Propeller MTV-25-1-DCF/CF175-512 five-blade constant-speed (2,300 rpm), fully feathering propeller. Cooling radiators in rear of propeller pylons. Large engine access panel each side. Fuel in wings, with gravity filler each side; total capacity 617 litres (163 US gallons; 136 Imp gallons). Baltic fuel 650 litres (175 US gallons; 146 Imp gallons).

ACCOMMODATION: Pilot and four passengers in two-one-two configuration (centre seat rearward-facing) in pressurised cabin with baggage space behind seats; differential 0.37 bar (5.5 lb/sq in); door forward of wing on port side; emergency exit for crew on lower starboard side; two cabin windows each side.

SYSTEMS: Hydraulic and electrical systems; liquid de-icing system standard. Optional air conditioning. Electrical system comprises two buses, each with separate battery. Liquid de-icing for wing, empennage and windscreen; electric propeller de-icing.

AVIONICS: Garmin G1000 suite, with two-screen EFIS. IFR standard.

DIMENSIONS, EXTERNAL:
Wing span: Alekto ..... 11.24 m (36 ft 10½ in)
Baltic ..... 12.60 m (41 ft 4 in)
Wing chord: at root ..... 1.75 m (5 ft 9 in)
at tip ..... 0.80 m (2 ft 7½ in)
Wing aspect ratio 9.0
Length overall: Alekto ..... 11.685 m (38 ft 4 in)
Baltic ..... 10.14 m (33 ft 3¼ in)
Fuselage: Length ..... 10.665 m (35 ft 0 in)
Max diameter ..... 1.55 m (5 ft 1 in)
Height without landing gear: Alekto ..... 3.435 m (11 ft 3¼ in)
Baltic ..... 3.54 m (11 ft 7¼ in)
Tailplane span ..... 4.40 m (14 ft 5¼ in)
Propeller diameter ..... 1.75 m (5 ft 9 in)
Cabin door: Max width (upper) ..... 0.90 m (2 ft 11½ in)
Min width (lower) ..... 0.68 m (2 ft 2¾ in)
DIMENSIONS, INTERNAL:
Cabin (between pressure bulkheads):
Length ..... 4.50 m (14 ft 9¼ in)
Max width (diameter) ..... 1.40 m (4 ft 7¼ in)
Baggage compartment:
Length ..... 0.70 m (2 ft 3½ in)
Width ..... 1.10 m (3 ft 7¼ in)
AREAS:
Wings, gross ..... 15.46 m² (166.4 sq ft)
Ailerons (total) ..... 0.67 m² (7.21 sq ft)
Flaps (total) ..... 2.16 m² (23.25 sq ft)
Fin ..... 2.40 m² (25.83 sq ft)

Rudder ..... 0.60 m² (6,46 sq ft)
Tailplane ..... 2,66 m² (28,63 sq ft)
Elevators (total) ..... 1,14 m² (12,27 sq ft)

WEIGHTS AND LOADINGS:
Weight empty ..... 1,780 kg (3,924 lb)
Baggage capacity ..... 75 kg (165 lb)
Payload with max fuel ..... 270 kg (595 lb)
Max fuel weight ..... 500 kg (1,102 lb)
Max T-O weight ..... 2,550 kg (5,621 lb)
Max wing loading ..... 164,9 kg/m² (33,78 lb/sq ft)
Max power loading ..... 5.59 kg/kW (9.19 lb/hp)

PERFORMANCE (estimated):
Max operating speed: Alekto, Baltic ..... 250 kt (463 km/h; 288 mph) IAS
Max cruising speed at FL200: Alekto ..... 240 kt (444 km/h; 276 mph) TAS
Baltic ..... 230 kt (426 km/h; 265 mph)
Normal cruising speed at FL200 ..... 230 kt (426 km/h; 265 mph) TAS
Long-range cruising speed: Alekto ..... 190 kt (352 km/h; 219 mph) TAS
Baltic ..... 170 kt (315 km/h; 196 mph)
Stalling speed: flaps up ..... 80 kt (149 km/h; 92 mph) IAS
flaps down ..... 74 kt (137 km/h; 86 mph) IAS
Service ceiling (theoretical), Baltic ..... 9,600 m (31,500 ft)
Max certified altitude: Alekto, Baltic ..... 7,620 m (25,000 ft)
Service ceiling, OEI: Alekto ..... 4,420 m (14,500 ft)
Baltic ..... 5,335 m (17,500 ft)
Max rate of climb at S/L: Alekto, Baltic ..... 549 m (1,800 ft)/min
Max rate of climb at S/l, OEI ..... 152 m (500 ft)/min
Time to FL200 ..... 15 min
T-O to 15 m (50 ft): Alekto ..... 670 m (2,198 ft)
Baltic ..... 540 m (1,770 ft)
Landing from 15 m (50 ft) ..... 660 m (2,165 ft)
Range, 45 min reserves:
with max payload:
normal cruising speed ..... 890 n miles (1,648 km; 1,024 miles)
long-range cruising speed ..... 1,290 n miles (2,389 km; 1,484 miles)
with max fuel:
normal cruising speed: Alekto ..... 1,440 n miles (2,666 km; 1,657 miles)
Baltic ..... 1,350 n miles (2,500 km; 1,553 miles)
long-range cruising speed: Alekto ..... 1,930 n miles (3,574 km; 2,221 miles)
Baltic ..... 1,600 n miles (2,963 km; 1,841 miles)

IKARUS

IKARUS DEUTSCHLAND (COMCO IKARUS GERATEBAU GMBH)

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Formed in 1976 to manufacture hang gliders, Ikarus undertakes sales and distribution of the C42 and Aerostyle Breezer ultralights in Europe as well as marketing completed examples of the latter. Ikarus also produces the C22 open cockpit ultralight and several hang glider designs. Over 1,500 Ikarus aircraft and 2,500 hang gliders have been sold. Ikarus operates from a 640 m² (6,889 sq ft) factory.

IKARUS C42

TYPE: Side-by-side ultralight/kitbuilt.

PROGRAMME: Designed by Hans Gygax, and simultaneously launched in Europe (Friedrichshafen Air Show) and North America (Sun 'n' Fun) in second quarter of 1997. European deliveries began immediately; in 1997 won World Championships. On 10 May 1998 an Ikarus C42 set a new ultralight world speed record over a closed circuit of 54 n miles (100 km; 62 miles) at 90,4 kt (167,5 km/h; 104,1 mph), and on 13 May 1998 established another world record over a 270 n mile (500 km; 311 mile) closed circuit at 71,78 kt (132,93 km/h; 82,60 mph). Upgraded version, introduced April 1999, offers optional winglets of GFRP and further option of GFRP ailerons, flaps, elevators and rudder.

CURRENT VERSIONS: **C42:** Production version until 2003.

C42 B: Introduced 2003. Compared to earlier version, has reprofiled nose with air intake below propeller displaced rearwards. *As described.*

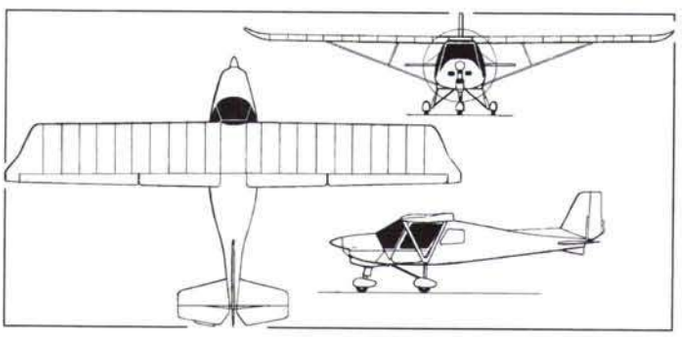
C42 Bison: Aerial towing version of C42 B launched at Aero '05 Friedrichshafen, April 2005. Rotax 914 flat-four of 84,5 kW (113,3 hp); Neuform three-blade, variable-pitch (hydraulic) propeller; ATR 500 radio and TRT 600 Mode S transponder; and internal winch; all standard and within 297 kg (654 lb) MTOW. Fuel 65 litres (17,2 US gallons; 14,3 Imp gallons). Capable of towing 750 kg (1,653 lb) sailplane in 138 m (453 ft)/min climb.

C42 Competition I/II: Kitbuilt versions with additional refinements.

CARLA-VLG: Autogyro development of C42 with wings removed and rotors added; designed by Malcolm Reid and developed by NewGen Rotorcraft of Yeovil, UK.

CUSTOMERS: First production C42 to Netherlands owner (PH-2Y5) mid-1997. Others sold in Austria, Estonia, Finland, Germany, Norway and Sweden. United Kingdom PFA type clearance, and first deliveries, early 2002. By July 2006, over 850 had been sold and production was at 80 per year; in July 2006, some 97 on British civil register.

COSTS: Ready-to-fly GBP38,479 plus VAT (2006).



Ikarus C42 B current production version *(James Goulding)* 1159383

DESIGN FEATURES: Strut-braced high-wing monoplane; strut-braced tail unit. Wings fold for storage.
NACA 2412 wing section.

FLYING CONTROLS: Conventional and manual. Ailerons and elevators pushrod-operated, rudder cable-operated. Plain flaps standard; electrically actuated flaps optional; flight adjustable trim tab on port elevator.

STRUCTURE: Glass fibre fuselage assembled around full-length aluminium boom; tubular aluminium wings and tail surfaces, covered with Mylar/polyester laminate (GT-foil). Aluminium wings optional. Glass fibre-reinforced epoxy resin fairings; stainless steel fittings; Makrolon transparencies. Optional carbon fibre winglets.

LANDING GEAR: Tricycle type; fixed. Oleo-pneumatic suspension and speed fairings on all three units; hydraulic brakes on main units. Full Lotus inflatable floats optional.

POWER PLANT: One 59,6 kW (79,9 hp) Rotax 912 UL flat-four driving a Warp Drive two-blade, carbon fibre propeller via 1:2,27 reduction gearing or 73,5 kW (98,6 hp) Rotax 912 ULS driving a GSC three-blade, ground-adjustable pitch propeller via 1:2,43 reduction gearing. Standard fuel capacity 50 litres (13,2 US gallons; 11,0 Imp gallons). Further 50 litres (13,2 US gallons; 11,0 Imp gallons) optional.

SYSTEMS: 12 V battery.

EQUIPMENT: Optional BRS 50L4 or Magnum Speed S ballistic parachute, and ELT. Spraying equipment can be fitted for agricultural operations, and a towing hook for glider- and banner-towing purposes.

DIMENSIONS, EXTERNAL:
Wing span: standard ..... 9,45 m (31 ft 0 in)
winglet option ..... 9,50 m (31 ft 2 in)
Length overall ..... 6,38 m (20 ft 11¼ in)
Height overall ..... 2,24 m (7 ft 4¼ in)

Ikarus C42 two-seat ultralight *(Paul Jackson)* 1159348

DIMENSIONS, INTERNAL:
Cabin max width ..... 1.22 m (4 ft 0 in)
AREAS:
Wings, gross ..... 12.50 m² (134.5 sq ft)
WEIGHTS AND LOADINGS:
Weight empty: Standard ..... 268 kg (591 lb)
Competition ..... 275 kg (606 lb)
Max T-O weight, all ..... 472.5 kg (1,042 lb)

PERFORMANCE (Rotax 912 UL):
Max level speed ..... 100 kt (185 km/h; 115 mph)
Cruising speed at 75% power ..... 94 kt (175 km/h; 109 mph)
Stalling speed ..... 35 kt (65 km/h; 41 mph)
Max rate of climb ..... 300 m (984 ft)/min
T-O run ..... 90 to 100 m (295 to 330 ft)
Range with standard fuel ..... 351 n miles (650 km; 403 miles)

IMPULSE

IMPULSE AIRCRAFT GMBH

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MANAGING DIRECTOR: Philipp Steinbach

Impulse was established to produce the lightplane of the same name. This exists in Ultralight and Experimental category versions.

In 2006, Impulse released the Xtreme 3000 aerobatic version, building a new factory at Cochstedt for production.

IMPULSE IMPULSE

TYPE: Two-seat lightplane; side-by-side ultralight.

PROGRAMME: Designed by Steinbach. First flight 28 July 2000. Tailwheel version first shown at Berlin in May 2002, having achieved certification on 25 April 2002. Belgian certification received 21 January 2004.

CURRENT VERSIONS: **100:** Restricted weight and power to meet 450 kg (992 lb) limit.

100TD: Tailwheel ('tail-dragger') version of 100.

130: Uprated version within US Experimental category limit. Prototype D-EKRK.

130TD: Tailwheel version introduced in 2002.

180: Higher-powered version; under development by 2002; to be certified under VLA requirements. Originally known as 360, replaced by 320.

180TD: Tailwheel version of 180; under development. D-EEZZ shown unflown at Aero '03, Friedrichshafen in April 2003; redesignated 320.

320: Higher-powered version; designation reflects engine designation.

320TD: Tailwheel version of 320.

320TDA: Aerobatic version of 320TD.

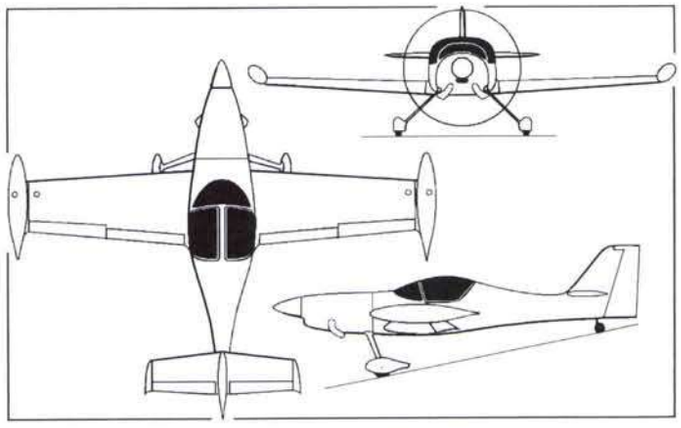
Xtreme: Turbine-powered version; prototype (D-EYKS) first flown 19 May 2005.

CUSTOMERS: Total 36 built and further six on order by May 2004, including nine in New Zealand.

COSTS: Kit: 100 EUR48,900 or 100TD EUR47,900 less engine, interior and optional factory assistance (EUR3,800 for three days; EUR14,900 for 35 days), (all 2006).

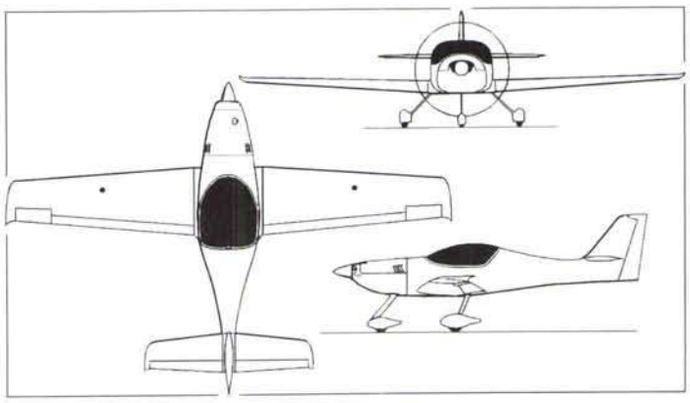
DESIGN FEATURES: Streamlined, low-wing configuration, with fuselage sharply waisted to rear of cockpit; laminar flow wing; sweptback fin with mid-mounted tailplane. Wide speed range. Available in Experimental and Ultralight weight categories. Quoted build time 450 hours; builder assistance programme available. Wings can be removed for storage and transportation.

Impulse Xtreme 3000 prototype 1159277



Impulse Xtreme general arrangement *(Paul Jackson)* 1159384

Impulse 100 fitted with Jabiru 2200 engine *(Paul Jackson)* 1159349



Impulse 100 nosewheel version *(Paul Jackson)* 1159385

FLYING CONTROLS: Conventional and manual. Horn-balanced rudder; flight-adjustable trim tab in port elevator. Actuation by pushrods (elevator and ailerons) and cables (rudder). Electrically operated three-quarter-span Fowler flaps.

STRUCTURE: Fuselage of carbon-honeycomb sandwich with 1.7734.4 chromoloy engine mount. Wings of carbon-honeycomb sandwich with single main spar passing through fuselage under occupants' knees. Tail unit also of sandwich with E-glass fin, into which radio antennas are embedded. Aluminium main landing gear legs.

LANDING GEAR: Fixed. Tricycle or tailwheeel (TD suffix) type with 5×5.00 mainwheels; tailwheel has solid 100 × 50 mm (4 × 2 in) tyre. Fuselage-mounted spring cantilever mainwheel legs with optional speed fairings. Foam cushion shock dampeners. Hydraulic brakes.

POWER PLANT: *100:* One piston engine: 59.7 kW (80 hp) Jabiru 2200 with two-blade, fixed-pitch propeller; or 73.5 kW (98.6 hp) Rotax 912 S flat-four, driving an MT 167R152-2M wooden three-blade, variable-pitch propeller; or 89 kW (120 hp) Jabiru 3300 flat-six with MT-Propeller two-blade, constant-speed propeller. Fuel in wing tanks, capacity 110 litres (29.1 US gallons; 24.2 Imp gallons). Option to fit 89.5 kW (120 hp) Jabiru 3300.

130 and 130TD: Options of 95 kW (128 hp) Limbach L2400ET flat-four and 118 kW (158 hp) LOM M332 in-line four. Fuel capacity 160 litres (42.3 US gallons; 35.2 Imp gallons).

320, 320TD and 320TDA: One 119 kW (160 hp) Lycoming IO-320 or one 134 kW (180 hp) Textron Lycoming IO-360-M1A driving an MT-Propeller MTV-12-B three-blade, variable-pitch propeller. Fuel capacity 200 litres (52.8 US gallons; 44.0 Imp gallons) in two integral wingtanks.

Xtreme: One 313 kW (420 shp) Rolls-Royce 250-B15 or -B17 driving an MT five-blade constant-speed propeller.

Fuel capacity 390 litres (103 US gallons; 85.8 Imp gallons) in two 85 litre (22.5 US gallon; 18.7 Imp gallon) wing tanks, two 85 litre (22.5 US gallon; 18.7 Imp gallon) wingtip tanks and one 50 litre (13.2 US gallon; 11.0 Imp gallon) header tank (latter fuel unusable).

Optional power plants include BMW motorcycle engine and Thielert TAE 125 turbo-diesel.

ACCOMMODATION: Two persons, side by side, beneath single-piece hood; baggage space behind seats.

SYSTEMS: 12 V starter and generator.

EQUIPMENT: BRS parachute system.

DIMENSIONS, EXTERNAL (UL: Ultralight, E: Experimental):
Wing span: all except 320TDA, Xtreme ..... 8.74 m (28 ft 8 in)
320TDA ..... 7.32 m (24 ft 0 in)
Xtreme ..... 7.42 m (24 ft 4¼ in)
Wing aspect ratio 7.8
Length overall: 100 ..... 6.30 m (20 ft 8 in)
130, 130TD ..... 6.10 m (20 ft 0¼ in)
320, 320TD, 320TDA ..... 6.20 m (20 ft 4 in)
Xtreme ..... 6.58 m (21 ft 7¼ in)
Height overall: 320 ..... 1.70 m (5 ft 7 in)
320TD, 320TDA, Xtreme ..... 1.49 m (4 ft 10¾ in)
Tailplane span: all except 320TDA, Xtreme ..... 3.29 m (10 ft 9½ in)
320TDA ..... 3.05 m (10 ft 0 in)
Xtreme ..... 2.77 m (9 ft 1 in)

Wheel track: 100, 130, 320TD, 320TDA ..... 2.10 m (6 ft 10¾ in)
320 ..... 1.46 m (4 ft 9½ in)
Xtreme ..... 2.29 m (7 ft 6 in)
Wheelbase: 320 ..... 2.20 m (7 ft 2½ in)
320TD, 320TDA ..... 4.20 m (13 ft 9½ in)
Xtreme ..... 3.94 m (12 ft 11¼ in)
DIMENSIONS, INTERNAL:
Cockpit max width ..... 1.18 m (3 ft 10½ in)
AREAS:
Wings, gross: all except 320TDA, Xtreme ..... 9.82 m² (105.7 sq ft)
320TDA, Xtreme ..... 8.56 m² (92.1 sq ft)
WEIGHTS AND LOADINGS (100 with Rotax, 130 with LOM engine):
Weight empty: 100 ..... 260 kg (573 lb)
130 ..... 320 kg (705 lb)
130TD ..... 350 kg (772 lb)
320, 320TD, 320TDA ..... 420 kg (925 lb)
Xtreme ..... 422 kg (930 lb)
Baggage capacity: 100 ..... 20 kg (44 lb)
130 ..... 50 kg (110 lb)
320, 320TD, 320TDA ..... 59 kg (130 lb)
Xtreme ..... 60 kg (132 lb)
Max T-O weight: 100 ..... 472.5 kg (1,042 lb)
130, 130TD ..... 720 kg (1,587 lb)
320, 320TD, 320TDA ..... 750 kg (1,655 lb)
Xtreme ..... 952 kg (2,100 lb)
Max wing loading:
130, 130TD ..... 73.3 kg/m² (15.01 lb/sq ft)
320TDA ..... 87.7 kg.m² (17.97 lb/sq ft)
320, 320TD ..... 76.4 kg/m² (15.66 lb/sq ft)
Xtreme ..... 111.3 kg/m² (22.80 lb/sq ft)
Max power loading:
130 ..... 6.11 kg/kW (10.04 lb/hp)
320, 320TD, 320TDA ..... 6.30 kg/kW (10.34 lb/hp)
Xtreme ..... 3.04 kg/kW (5.00 lb/shp)
PERFORMANCE (100, 130 as above):
Never-exceed speed (VNE):
100 ..... 145 kt (270 km/h; 167 mph)
130, 130TD ..... 226 kt (420 km/h; 261 mph)
Max level speed: 320, 320TD ..... 178 kt (330 km/h; 205 mph)
320TDA ..... 180 kt (333 km/h; 207 mph)
Xtreme ..... 270 kt (500 km/h; 311 mph)
Max cruising speed at 75% power:
100 ..... 130 kt (240 km/h; 149 mph)
130, 320, 320TD ..... 162 kt (300 km/h; 186 mph)
130TD ..... 170 kt (315 km/h; 196 mph)
320TDA ..... 165 kt (306 km/h; 190 mph)
Xtreme ..... 230 kt (426 km/h; 265 mph)
Stalling speed, flaps up: 100 ..... 35 kt (65 km/h; 41 mph)
130 ..... 41 kt (75 km/h; 47 mph)
130TD ..... 44 kt (82 km/h; 51 mph)
320, 320TD ..... 43 kt (80 km/h; 50 mph)
320 TDA ..... 49 kt (91 km/h; 57 mph)
Xtreme ..... 55 kt (102 km/h; 64 mph)
Max rate of climb at S/L: 320, 320TD, 320TDA ..... 732 m (2,400 ft)/min
Xtreme ..... 2,438 m (8,000 ft)/min
Service ceiling: all ..... 6,095 m (20,000 ft)
T-O run: 100 ..... 60 m (197 ft)
130, 130TD ..... 100 m (330 ft)
180 ..... 120 m (395 ft)
T-O to 15 m (50 ft): 100TD, 130 ..... 200 m (656 ft)
320, 320TD ..... 158 m (520 ft)
320TDA ..... 240 m (787 ft)
Xtreme ..... 91 m (300 ft)
Landing from 15 m (50 ft): 100, 100TD, 130 ..... 210 m (690 ft)
320, 320TD ..... 259 m (850 ft)
320TDA ..... 400 m (1,312 ft)
Xtreme ..... 122 m (400 ft)
Range: 100 ..... 647 n miles (1,200 km; 745 miles)
130, with auxiliary tank ..... 3,509 n miles (6,500 km; 4,038 miles)
320, 320TD, 320TDA ..... 900 n miles (1,666 km; 1,035 miles)
Xtreme ..... 950 n miles (1,759 km; 1,093 miles)

M+D

M+D FLUGZEUGBAU GMBH

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DIRECTOR: Tim Markwald

M+D formed in 1995 as a support organisation for sailplanes, with services including repair, overhaul, modification and sales. Company occupies a 2,200 m² (23,675 sq ft) plant close to Bohlenbergerfeld gliding airfield.

In late 2005, M+D began production of the Samburo motor glider which had previously been discontinued by Aircraft Philipp, although originating in a design by Alpha Werke of Austria.

M+D AVO 68-R SAMBURO

TYPE: Motor glider.

PROGRAMME: Original AVo 68-S built in 1970s. Named for Kenyan tribe. New AVo 68-R variant, using converted AVo 68-S D-KFGN (c/n 024) as prototype, developed by Nitsche Flugzeugbau and first flew March 1995, retaining original landing gear of single nosewheel. Second prototype converted from AVo 68-S D-KALO (029), incorporating new twin leg landing gear design. First production AVo 68-R D-KSAM, with turbocharged and intercooled Rotax 914 engine, lengthened and widened fuselage and new canopy design, exhibited unflown at Aero '99 at Friedrichshafen in April 1999; first flight shortly thereafter. Programme transferred to Aircraft Philipp in 2001, but discontinued almost immediately thereafter. Production restarted by M+D in 2005.

CURRENT VERSIONS: **AVo 68-R100:** With Rotax 912 FS engine.
AVo 68-R115: With Rotax 914 engine.

CUSTOMERS: Earlier AVo 68v and AVo 68-S production totalled 29. Eight new aircraft and at least five conversions completed up to 2001.

DESIGN FEATURES: Mid-wing configuration with wingtip fences and moderate sweepback on all leading-edges. Improvements over AVo 68-S include more powerful engine, wider cockpit, glider towing capability, conventional aeroplane landing gear and modernised avionics. Wing folding optional. Maintenance checks at 100 hour intervals.

FLYING CONTROLS: Conventional and manual. Adjustable tab on starboard elevator and plain (door-type) spoilers in upper wings. No flaps.

STRUCTURE: Steel fuselage frame covered with glass fibre. Wings of wood with glass fibre covering to two-thirds chord on inboard panels and whole of outboard fixed surface; polyester covering on remaining wing surface, ailerons and elevator and rudder.

LANDING GEAR: Non-retractable tailwheel type with composites cantilever main legs and castoring tailwheel which unlocks on application of differential hydraulic braking; speed fairings standard. Monowheel configuration with outrigger under each wing optional.

POWER PLANT: One Rotax 912 FS3/FS4 rated at 73.5 kW (98.6 hp) for take-off and 69.8 kW (93.6 hp) maximum continuous, or optional Rotax 914 F3 rated at 84.6 kW (113.4 hp) for take-off and 73.5 kW (98.6 hp) maximum continuous, both with Hoffmann HO-V352F-S2 constant-speed feathering propeller. Throttle connected to variable pitch control in one combined lever to replicate fixed-pitch propeller motor gliding handling. Fuel contained in two wing tanks plus header tank. Total capacity 80 litres (21.1 US gallons; 17.6 Imp gallons), of which 79.5 litres (21.0 US gallons; 17.5 Imp gallons) are usable.

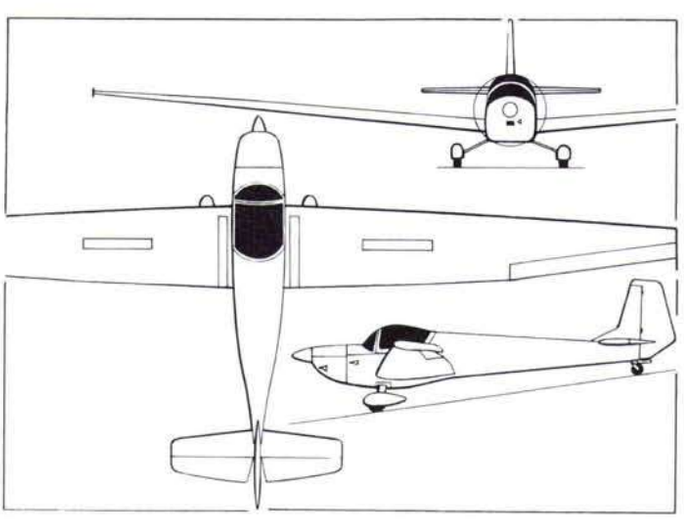
ACCOMMODATION: Two persons, side by side under rearward-sliding canopy. Baggage compartment behind seats.

AVIONICS: *Comms:* Optional equipment includes Filser ATR 720A, Becker AR 4201 or Dittel FSG 71M or FSG 90 coms; Honeywell KY 125 nav/com; Honeywell KT 76A or Becker ATC 2000 transponder; and ACK Technologies ELT.
Instrumentation: Winter 6 FMS ASI, 4 FGH 10 altimeter. 5 StV variometer, compass, ammeter, oil temperature and pressure gauges and CHT gauge all standard. Optional instruments include second altimeter. RC Allen or SEENA 703 artificial horizon, gyrocompass and Elba electronic fuel indicator.

EQUIPMENT: Standard equipment includes ergonomic seats with back supports, four-point seat harnesses, carburettor heat, cockpit heating and ventilation, rudder-mounted antenna and two-colour external paint scheme. Options include hydraulic brake for single-wheel landing gear, glider-towing kit, shift lock for airbrakes, landing and position lights and additional external generator.

DIMENSIONS, EXTERNAL:
Wing span ..... 16.68 m (54 ft 8¾ in)
Wing aspect ratio 13.4
Width, wings folded (option) ..... 10.00 m (32 ft 9¼ in)
Length overall ..... 8.05 m (26 ft 5 in)
Height overall ..... 1.86 m (6 ft 1¼ in)
Tailplane span ..... 3.44 m (11 ft 3½ in)
Wheel track ..... 1.10 m (3 ft 7¼ in)

First production AVo 68-R Samburo *(Paul Jackson)* 0110627


M+D AVo 68-R Samburo motor glider *(James Goulding)* 1159386

AREAS:
Wings, gross ..... 20.70 m² (222.81 sq ft)
WEIGHTS AND LOADINGS (A: Rotax 912 FS3/FS4; B: Rotax 914 F3):
Weight empty ..... 550 kg (1,212 lb)
Max T-O weight ..... 700 kg (1,543 lb)
Max wing loading ..... 33.8 kg/m² (6.93 lb/sq ft)
Max power loading: A ..... 9.52 kg/kW (15.65 lb/hp)
B ..... 8.27 kg/kW (13.59 lb/hp)
PERFORMANCE, POWERED:
Never-exceed speed (VNE) ..... 116 kt (215 km/h; 133 mph)
Cruising speed, 60.4 kW (81 hp) engine at 75% power ..... 97 kt (180 km/h; 112 mph)
Stalling speed ..... 30 kt (56 km/h; 35 mph)
Max rate of climb at S/L: A ..... 342 m (1,122 ft)/min
B ..... 360 m (1,181 ft)/min
T-O run: A ..... 118 m (390 ft)
B ..... 95 m (315 ft)
T-O to 15 m (50 ft): A ..... 183 m (600 ft)
B ..... 165 m (545 ft)
Max range ..... 540 n miles (1,000 km; 621 miles)
PERFORMANCE, UNPOWERED:
Best glide ratio, at 51 kt (94 km/h; 59 mph) 25
Min rate of sink ..... 1.15 m (3.77 ft)/s

MECKLENBURGER

MECKLENBURGER ULTRALEICHT (FLUGZEUGBAU CHRISTIAN ENGELEN)

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Web (1): www.meck-ul.de
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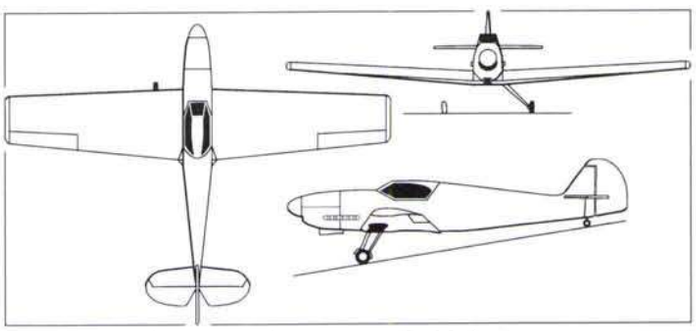
CEO: Christian Engelen

Mecklenburger was established by Herr Engelen to develop ultralight versions of significant Second World War aircraft, principally fighters. A scale Messerschmitt 109 has been produced in composites, based on an original replica devised by Tassilo Bek. In 2006, the company entered into partnership with Peak Aerospace GmbH.

MECKLENBURGER Me-109

TYPE: Single-seat ultralight kitbuilt.
PROGRAMME: Mecklenburger launched production of current version in late 2003, following construction of some eight of earlier (Bek) series, including c/n 007 with Rotax 912 UL flat-four of 59.6 kW (79.9 hp). By April 2004, the prototype of the new series was 58 per cent complete, aircraft '9' (c/n 9) exhibited incomplete at Berlin, May 2004; third aircraft (D-MYME) shown complete, but unflown, at ILA, Berlin, May 2006.
CURRENT VERSIONS: **Ultralight:** MTOW limited to 300 kg (661 lb).
Experimental: Short-span, increased weight version.
COSTS: *Ultralight:* Basic kit (minus engine and instruments) EUR24,700; flyaway EUR44,950 (with Rotax 582) (all including tax, 2006).
DESIGN FEATURES: Approximately three-quarters scale replica of Messerschmitt Bf 109. Low, tapered wing; strut-braced tailplane. Quoted build time 600 hours.
FLYING CONTROLS: Conventional and manual. Horn-balanced rudder; plain ailerons. No flaps on Ultralight version. Experimental version has three-position (0, 15, 30°) flaps. Trim tab in starboard elevator.
STRUCTURE: Predominantly of glass and carbon fibre, with fabric-covered wooden control surfaces. One-piece wing has 11 composite ribs each side and is covered with plywood (80 per cent) and fabric.

Third production Mecklenburger Me-109 *(Paul Jackson)* 1159350



Mecklenburger Me-109 general arrangement *(Paul Jackson)* 1159387

LANDING GEAR: Tailwheel type with manually retractable (outwards) mainwheels. Mainwheel doors of wood. Tailwheel 2.00–5; mainwheels 4.00–4 with cable brakes.
POWER PLANT: One piston engine. Options include 48.0 kW (64.4 hp) Rotax 582 and 59.6 kW (79.9 hp) Rotax 912 for Ultralight and 59.7 kW (80 hp) Subaru EA-71 for Experimental category; also under consideration is the 46.2 kW (62 hp) Suzuki G10 three-cylinder four-stroke engine. Fuel capacity 55 litres (14.5 US gallons; 12.1 Imp gallons) in single tank located between pilot's feet.
EQUIPMENT: Ballistic parachute option on German-registered aircraft.
DIMENSIONS, EXTERNAL (UL: Ultralight, EX: Experimental):
Wing span: UL ..... 8.10 m (26 ft 7 in)
EX ..... 6.70 m (21 ft 11¾ in)
Length overall: UL, EX ..... 6.70 m (21 ft 11¾ in)
Height: propeller turning ..... 2.10 m (6 ft 10¾ in)
to fin tip ..... 1.17 m (3 ft 10 in)
AREAS:
Wings, gross: UL ..... 10.10 m² (108.7 sq ft)
WEIGHTS AND LOADINGS:
Weight empty: UL ..... 190 kg (441 lb)
EX ..... 280 kg (617 lb)
Max T-O weight: UL ..... 322 kg (661 lb)
EX ..... 420 kg (926 lb)
PERFORMANCE (UL with Rotax 582, EX with Subaru):
Max level speed: UL ..... 119 kt (220 km/h; 137 mph)
UL, Rotax ..... 130 kt (240 km/h; 149 mph)
EX ..... 145 kt (270 km/h; 167 mph)
Cruising speed at 65% power:
UL ..... 97 kt (180 km/h; 112 mph)
EX ..... 103 kt (190 km/h; 118 mph)
Stalling speed: UL ..... 32 kt (59 km/h; 37 mph)
EX ..... 36 kt (65 km/h; 41 mph)
Service ceiling ..... 3,000 m (9,840 ft)
T-O run ..... 100 m (328 ft)
Range ..... 270 n miles (500 km; 310 miles)
g limits: UL ..... +4/-2
EX ..... +6/-4

MK

MK HELICOPTER GMBH

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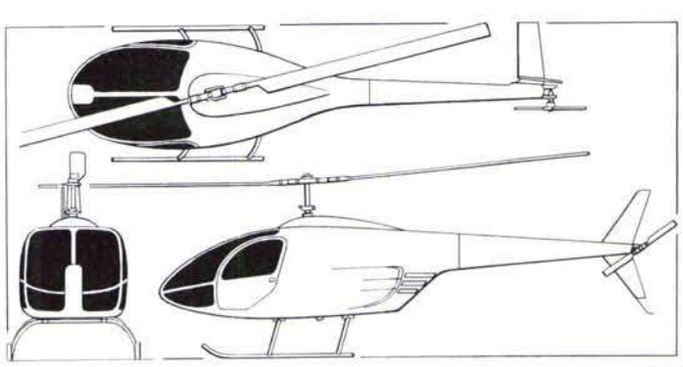
PROJECT ENGINEER: Thys Pieterse
FACTORY MANAGER: Jens Klüver

The MK II light helicopter was developed into the MK3, which received its public debut at Aero '05, Friedrichshafen, in April 2005.

MK HELICOPTER MK3

TYPE: Three-seat helicopter.
PROGRAMME: Design (initially as Ultralight Mk 2 and later MK Helicopter Mk II) started 1995. Construction of prototype scheduled to begin in December 2001; first flight expected September 2003; construction of first production helicopter anticipated in January 2003; EASA 27 certification process began in March 2001 and completion expected in June 2003. Eventually, advanced engineering mockup was exhibited at Friedrichshafen in April 2005, when MK announced plans to fly two prototypes in 2006. However, these plans delayed by lack of funding, although promotion continued at ILA, Berlin, May 2006. Production will be in USA/Canada or Asia/Pacific.
CURRENT VERSIONS: **MK30 (previously MK3-A):** Avgas-fuelled Textron Lycoming piston engine. Prototype and available to order.
MK3 (previously MK3-J): Jet A-1-fuelled Diesel engine. Envisaged main production version.
MK5: Five-seat version powered by Textron Lycoming TIO-540 (MK50) and not-yet-determined Diesel equivalent (MK5).
COSTS: Target USD280,000 (2003).
DESIGN FEATURES: Three-blade semi-articulated main rotor with hydraulically boosted cyclic control (two-blade in original design); two-blade tail rotor on port side. Main rotor blade section Eppler E361; tail rotor blade section NACA 81012. Engine drives single-stage bevel-gear 1:2.5 reduction transmission with belt drive for main rotor; 90° bevel gear drive for tail rotor. Sweptback dorsal and ventral fins.



MK3 helicopter *(James Goulding)* 1159388

MK Helicopter MK3/MK30 *(Paul Jackson)* 1159351

STRUCTURE: Tubular main frame with aluminium sheet box structure; Nomex/carbon fibre sandwich fuselage. Main blades comprise glass/carbon-reinforced plastic (GRP) skin over Rohacell foam core with lead inlay. Aluminium tail rotor.

LANDING GEAR: Skid type.

POWER PLANT: One 196 kW (260 hp) Textron Lycoming IO-540-AE1A5 flat six in MK30 prototype. Production aircraft (MK3) generally with Thielert Centurion 4.0 of 195 kW (261 hp). Fuel contained in two tanks above engine, combined capacity 180 litres (47.6 US gallons; 39.6 Imp gallons).

ACCOMMODATION: Pilot and two passengers, or pilot and one student with dual controls. Cabin heated and ventilated. Forward-hinged door each side.

SYSTEMS: 24 V battery for electrical system.

AVIONICS: 'Glass cockpit'.

DIMENSIONS, EXTERNAL:

Main rotor diameter	9.00 m (29 ft 6¼ in)
Tail rotor diameter	1.56 m (5 ft 1½ in)
Main rotor blade chord	0.24 m (9½ in)
Tail rotor blade chord	0.13 m (5 in)
Length: overall, rotors turning	10.60 m (34 ft 9 in)
Fuselage: Length	7.70 m (25 ft 3 in)
Max width	1.70 m (5 ft 7 in)
Height overall	2.92 m (9 ft 7¼ in)
Skid track	2.10 m (6 ft 10¾ in)

AREAS:

Main rotor disc	63.60 m² (684.6 sq ft)
Tail rotor disc	1.91 m² (20.56 sq ft)

WEIGHTS AND LOADINGS (MK3 and MK30, where different):

Weight empty, equipped: MK3	704 kg (1,552 lb)
MK30	680 kg (1,499 lb)
Max T-O weight	1,136 kg (2,504 lb)
Max disc loading	17.9 kg/m² (3.66 lb/sq ft)

PERFORMANCE (estimated, MK3 and MK30):

Never-exceed speed (VNE)	130 kt (241 km/h; 149 mph)
Max cruising speed at S/L	120 kt (222 km/h; 138 mph)
Max rate of climb at S/L	274 m (900 ft)/min
Service ceiling	4,570 m (15,000 ft)
Hovering ceiling: IGE	2,743 m (9,000 ft)
OGE	1,371 m (4,500 ft)
Max range	351 n miles (650 km; 403 miles)

REMOS

REMOS AIRCRAFT GMBH

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Remos company formed in 1983, and Remos Aircraft in 1990; currently markets the G-3 Mirage and announced the G-4 at Friedrichshafen in April 2001, although no further progress has been made with the latter. Non-aviation activities of the parent company involve production of automotive components, including an enclosed road trailer for the Mirage.

In 2003, Remos appointed RLS Air of Bloomfield, Indiana as its US distributor, leading to LSA approval in 2006.

REMOS G-3 MIRAGE

TYPE: Side-by-side ultralight/kitbuilt.

PROGRAMME: Prototype (D-MRAE) exhibited at Friedrichshafen Aero '97, April 1997. First flight 20 September 1997. First prize in 1998 German two-seat ultralight championships. Production version, shown in April 1999, featured rudder horn balance and minor changes to ailerons and elevator. **Mirage S**, certified 16 August 1999 with 74.6 kW (100 hp) Rotax 912 ULS, has 113 kt (210 km/h; 130 mph) cruising speed. In June 2000, D-MPCJ shown (then unflown) at ILA, Berlin, with 53.7 kW (72 hp) Swiss Auto SAB 430 turbocharged, two-cylinder, four-stroke motorcar engine, which installation weighs 30 kg (66 lb) less than Rotax. **Mirage RS**, with redesigned rudder and landing gear, plus addition of roof window and more extensive instrumentation, introduced at Aero '01, April 2001.

At Aero '03, April 2003, Remos unveiled the Mirage RS/L (*Leicht*; light), which features more than 100 weight-saving modifications totalling 10 kg (22 lb), the main change being to a Jabiru 2200A engine. Prototype D-MPLK (c/n 137) flown shortly after exhibition and all subsequent aircraft to this standard.

In 2003, Remos announced **Mirage ARF** (almost-ready-to-fly) kit. **G-3/600** development of Mirage marketed from early 2004 to take advantage of LTF-2003 increased max T-O weight limit of 472.5 kg (1,042 lb) for German (and French) ultralights; prototype displayed at Sun 'n' Fun, April 2004, and had flown by end of that month; '600' indicates tested to 6 g load at 600 kg (1,322 lb). Special LSA approval achieved March 2006.

G-3 RaLi: Version marketed by Jordan Aerospace Industries and announced at Dubai Air Show, 2004. However, by 2006 this was no longer being promoted.

Remos G-3/600 registered in US as Light Sport Aircraft *(Paul Jackson)* 1159352

CUSTOMERS: Over 175 sold by mid-2006. Exports include Argentine police and undisclosed military agency in Romania; several to US from 2002 onwards. Other sales in Netherlands, New Zealand, Poland, Switzerland and Thailand. Total of 11 sold in Germany in 2004.

COSTS: G-3/600 EUR67,999, excluding tax (2006). Upgrade to Rotax 912S extra EUR2,700.

DESIGN FEATURES: Meets FAR Pt 23. Intended for recreational and instructional use. Waisted rear fuselage, sweptback fin and braced wing with tapered outer panels. Wings fold for transportation and storage.

FLYING CONTROLS: Conventional and manual. Single-piece elevator with flight-adjustable inset tab. Horn-balanced rudder, ailerons and elevator. No rudder tab. Horn-balanced control surfaces on production version. Electrically operated flaps and trim.

STRUCTURE: Composites fuselage; wings of sandwich composites; leading edges and tips composites, remainder fabric-covered; all tail surfaces composites. Tail bumper. GFRP ailerons and flaps. Composites parts produced in Poland; metal parts in Germany.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring cantilever main gear with hydraulic drum brakes and integral speed fairings; rubber-in-compression nosewheel leg with speed fairing. Mainwheels 4.00–6; nosewheel 4.00–6.

POWER PLANT: Baseline model has one 59.6 kW (79.9 hp) Rotax 912 UL four-stroke engine, driving a GT-2/169.5 two-blade wooden propeller. Optionally, a certified 73.5 kW (98.6 hp) Rotax 912 ULS or /S2 can be fitted. Mirage RS/L has one 59.7 kW (80 hp) Jabiru 2200A flat-four driving a GT-2/166/VSR-FW101STRC two-blade, wood-and-composites, fixed-pitch propeller. Fuel capacity 70 litres (18.5 US gallons; 15.4 Imp gallons); can be increased to 80 litres (21.1 US gallons; 17.6 Imp gallons).

AVIONICS: To customer's specification.

EQUIPMENT: Junkers or BRS ballistic parachute.

DIMENSIONS, EXTERNAL:

Wing span	9.80 m (32 ft 1¾ in)
Length	6.47 m (21 ft 2¾ in)
Height overall	1.70 m (5 ft 7 in)

DIMENSIONS, INTERNAL:

Cockpit max width	1.17 m (3 ft 10 in)

AREAS:

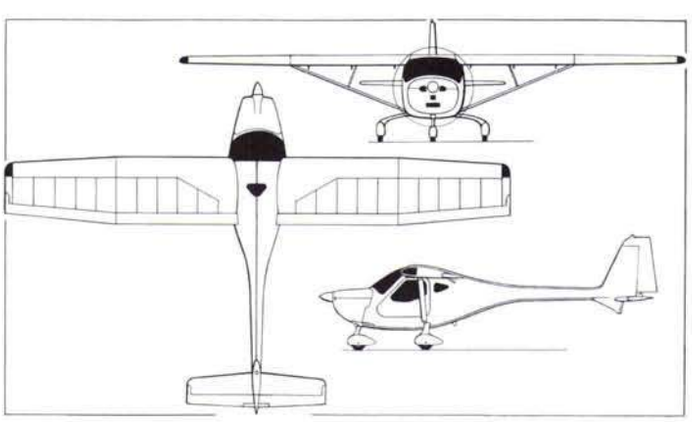
Wings, gross	12.04 m² (129.6 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	284 kg (626 lb)
Max T-O weight: BFU-95	450 kg (992 lb)
LTF-2003	472.5 kg (1,041 lb)
US LSA	558 kg (1,232 lb)

PERFORMANCE, POWERED (A: Rotax 912UL, B: Rotax 912 ULS):

Never-exceed speed (VNE)	121 kt (225 km/h; 139 mph)
Max level speed	105 kt (195 km/h; 121 mph)
Normal cruising speed: A	105 kt (195 km/h; 121 mph)
B	111 kt (205 km/h; 127 mph)



Remos G-3 Mirage *(James Goulding)* 1159389

Stalling speed ..... 34 kt (63 km/h; 40 mph)
Max rate of climb at S/L: A ..... 390 m (1,280 ft)/min
B ..... 348 m (1,141 ft)/min
T-O run ..... 60 m (197 ft)
T-O to 15 m (50 ft): A ..... 150 m (495 ft)
B ..... 180 m (590 ft)
Landing from 15 m (50 ft): both ..... 200 m (660 ft)
Range ..... more than 486 n miles (900 km; 559 miles)
Endurance ..... 6 h
g limits ..... +4/−2
PERFORMANCE, UNPOWERED:
Best glide ratio 17
Min rate of sink ..... 1.80 m (5.91 ft)/s

RMT

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MANAGING DIRECTOR: André von Schoenebeck

RMT Aviation markets the Bateleur kit, designed by its managing director, having moved to Germany from South Africa in 2001. In 2002 RMT was building a 2,500 m² (26,900 sq ft) plant in South Africa. A European facility will be located at Bremgarten aerodrome, Germany, while plans for a North American plant have been discussed; however, no evidence of production by mid-2006.

ROLAND

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PRESIDENT: Roland Hauke

Roland is German distributor of Zenith and AMD ultralights and lightplanes. The company's latest venture is a scale replica of the Messerschmitt Bf 109 Second World War fighter engineered in Czech Republic.

Roland Bf 109G-2 ultralight kitbuilt 1159278

ROLAND Bf 109G-2

TYPE: Tandem-seat sportplane/kitbuilt.
PROGRAMME: Engineered in Czech Republic by Petr and Thomas Podesva, also responsible for Trener Baby and Let-Mont series of aircraft. Partly complete prototype displayed at Aero '05, Friedrichshafen, April 2005. Maiden flight performed early 2006 by prototype (OK-KUD 02). Initial marketing in Experimental class; Ultralight to follow, with kit option.
DESIGN FEATURES: Replica of Dipl Ing Willy Messerschmitt's Bayerische Flugzeugwerke Bf 109G-2 to 82 per cent scale.
FLYING CONTROLS: Conventional and manual; horn-balanced rudder and elevators, plain ailerons. Optional split flaps.
STRUCTURE: Generally of metal. Welded steel tube cockpit with aluminium skin. Composites wingtips, spinner and engine cowling. Fabric-covered rudder and elevators.
LANDING GEAR: Tailwheel type; mainwheels, size 400×100, retract outwards. Steel tube legs with oleo shock-absorbers. Fully castoring tailwheel.
POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS flat-four driving a Kaspar ground-adjustable, three-blade propeller.
DIMENSIONS, EXTERNAL:
Wing span ..... 8.14 m (26 ft 8½ in)
Length overall ..... 7.30 m (23 ft 11½ in)
Height overall ..... 2.30 m (7 ft 6½ in)
PERFORMANCE:
Never-exceed speed (VNE) ..... 162 kt (300 km/h; 186 mph)
Normal cruising speed ..... 130 kt (240 km/h; 149 mph)

SCHEIBE

SCHEIBE AIRCRAFT GMBH

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Original Scheibe company produced or licenced almost 1,500 gliders since it was founded at Dachau on 31 October 1951 by the late Dipl Ing Egon Scheibe. Most recent motor glider production comprised the steel tube and wood SF 25C Falke and Rotax Falke. New SF 41 revealed in 2005. In November 2005 the company filed for bankruptcy; on 30 April 2006 Scheibe terminated aircraft production and transferred responsibility for support of company products to Sammet GmbH at Heubach aerodrome. A new company was immediately formed at Heubach, holding type certificates for all Scheibe types except SF 23, 34, 36 and 41.

SCHEIBE SF 25C FALKE

TYPE: Motor glider.
PROGRAMME: Bergfalke sailplane first flew 5 August 1951; motorised as SF-25A Motor Falke; D-KEDO first flew May 1963. Built in several versions, including under licence by Sportavia-Pützer (Germany) and Slingsby (UK, as T.61).
SF 25C version first flew (D-KBIK) in March 1971 and gained its type certificate in September 1972; FAA certification April 2001. Falke 1700, with 48.5 kW (65 hp) Limbach 1700 engine discontinued. Falke 2100, with Sauer SS2100 engine, tested 1988 (D-KIAC), but only two others built.
Falke production at Dachau ended in May 2006, but reformed Scheibe Aircraft transferred production to Heubach.
CURRENT VERSIONS: **Falke 2000:** Limbach L 2000 EA flat-four engine; monowheel landing gear or conventional tailwheel with two mainwheels available.
Rotax Falke: Prototype D-KIAJ flown 1989. Has essentially the same performance as Falke 2000, but is powered by a water-cooled Rotax 912 A or, from 1999, Rotax 912 S flat-four engine; nosewheel landing gear optional. Most production now of this version; some earlier Falkes have been upgraded with Rotax engines. Tricycle landing gear first tested on Falke 2000 D-KBUG in 1987; deliveries from 1990.
Superschlepper: Glider tug version; has max T-O weight of 600 kg (1,323 lb), in this mode. Rotax 912 A or 912 S. Towing trials by D-KIEK in 1998–99.
SF 41 Zwergfalke: Short-span VLA version; *described separately*.
CUSTOMERS: Total of 1,276 SF 25s of all types delivered by mid-2006, including 715 SF-25Cs by the original Scheibe firm. More than 100 Rotax Falkes used as glider tugs.
COSTS: Falke 2000 with Limbach engine and monowheel landing gear, EUR90,060; nosewheel landing gear EUR3,130 extra; Rotax Falke EUR89,440 with 912 A, EUR91,380 with 912 S (nose-gear versions respectively EUR3,150 and EUR3,110 extra (all prices 2003).
DESIGN FEATURES: Docile aerofoil with moderate aspect ratio, designed for safe and simple handling; aircraft can be easily dismantled and transported by trailer. Mid-mounted wing with taper and slight forward sweep; constant chord tailplane; sweptback fin. Various landing gear and engine options.
FLYING CONTROLS: Conventional and manual. Door-type wing spoilers at one-third span; upper wing only. Trim tab on starboard aileron; 13 mm (0.5 in) endplates on wing.
STRUCTURE: Steel tube and fabric fuselage; wooden wing and empennage; wing fabric-covered rearwards from one-third chord; fabric-covered elevators and fin.
LANDING GEAR: Fixed standard landing gear is central monowheel, outriggers under wings, and tailwheel; two-wheel, fuselage-mounted, sprung cantilever main landing gear with steerable tailwheel, and tricycle landing gear (only at 650 kg MTOW), are optional; mainwheels and nosewheel (where fitted) 5.00–4.
POWER PLANT: *Rotax Falke:* One 59.6 kW (79.9 hp) Rotax 912 A with water-cooled cylinder heads, running at 5,800 rpm and turning the propeller at 2,500 rpm; or a 73.5 kW (98.6 hp) Rotax 912 S running at 5,800 rpm and turning the propeller at 2,380 rpm.
Falke 2000: One 59.7 kW (80 hp) Limbach L 2000 EA driving the propeller at 3,450 rpm.
All engines have electric starter and alternator; propeller feathering optional. Glider tug has MTV-1-A/175-05 constant-speed (for Rotax 912 A) or MT 175R130-2A fixed-pitch (for Rotax 912 S) propeller.
Standard fuel tankage (all versions) is 55 litres (14.5 US gallons; 12.0 Imp gallons); optional fuel tankage 80 litres (21.1 US gallons; 17.6 Imp gallons).
ACCOMMODATION: Side-by-side seating under forward-hinged canopy; optional large cockpit opening. Dual controls standard; instrument panel space for radio.
SYSTEMS: 12 V electrical system.
AVIONICS: Choice of optional Bendix/King or Becker nav/com radios.
DIMENSIONS, EXTERNAL:
Wing span ..... 15.30 m (50 ft 2¼ in)
Wing aspect ratio 12.9
Length overall: except Rotax Falke ..... 7.60 m (24 ft 11¼ in)
Rotax Falke ..... 7.78 m (25 ft 6¼ in)
Height overall: tailwheel ..... 1.68 m (5 ft 6¼ in)
nosewheel ..... 2.50 m (8 ft 2½ in)
DIMENSIONS, INTERNAL:
Cockpit max width ..... 1.00 m (3 ft 3¼ in)
AREAS:
Wings, gross ..... 18.20 m² (195.9 sq ft)
WEIGHTS AND LOADINGS (Rotax 912 A):
Manufacturer's weight empty ..... 448 kg (988 lb)
Fuel weight: standard ..... 40 kg (88 lb)
optional ..... 58 kg (128 lb)
Max T-O weight ..... 650 kg (1,433 lb)

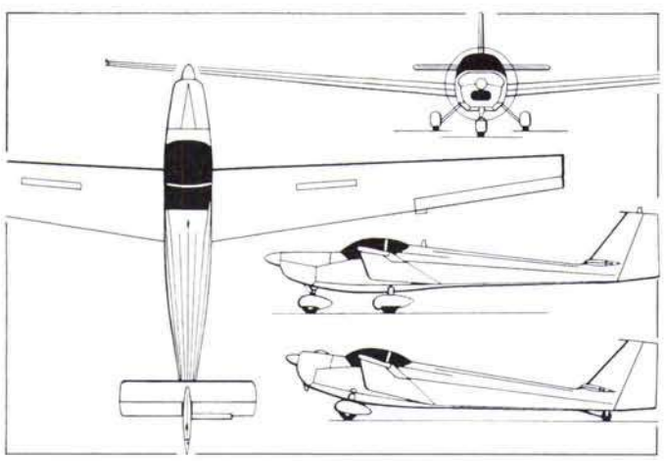
Scheibe Rotax Falke with twin mainwheels and tailwheel *(Paul Jackson)* 1128911

Max wing loading ..... 35.7 kg/m² (7.31 lb/sq ft)
Max power loading ..... 10.90 kg/kW (17.91 lb/hp)
PERFORMANCE, POWERED (L: Limbach, A: Rotax 912 A, S: Rotax 912 S, fixed-pitch (FP) or constant-speed (CS) propeller):
Max level speed (all) ..... 102 kt (190 km/h; 118 mph)
Cruising speed: L ..... 81 kt (150 km/h; 93 mph)
A ..... 92 kt (170 km/h; 106 mph)
S ..... 97 kt (180 km/h; 111 mph)
Stalling speed (all) ..... 35 kt (65 km/h; 41 mph)
Max rate of climb at S/L: L ..... 192 m (630 ft)/min
A: FP ..... 240 m (787 ft)/min
CS ..... 288 m (945 ft)/min
S: FP ..... 300 m (984 ft)/min
CS ..... 330 m (1,082 ft)/min
T-O run: L ..... 140 m (460 ft)
A ..... 100 m (330 ft)
S ..... 90 m (295 ft)
Range, standard fuel:
L, A ..... 378 n miles (700 km; 435 miles)
S ..... 324 n miles (600 km; 372 miles)
Endurance, standard fuel:
L ..... 4–5 h
A ..... 4 h 30 min
S ..... 4 h
PERFORMANCE, UNPOWERED:
Best glide ratio 23-24
Min rate of sink ..... 1.10 m (3.61 ft)/s

SCHEIBE SF 41 ZWERGFALKE

English name: Merlin

TYPE: Two-seat lightplane.



Tri-gear Scheibe SF 25C Falke powered by Rotax 912 A engine, with second side view (lower) of Falke 2000 with conventional landing gear *(Mike Keep)* 1158927

PROGRAMME: VLA lightplane version of SF 25C Rotax Falke, apparently replacing development of ultralight version following 1998 suspension of SF 40C Allround described in earlier editions of *Jane's All the World's Aircraft*. Prototype (D-EESF) shown at Aero '05, Friedrichshafen, May 2005, when maiden flight said to be due "very soon"; not reported by mid-2006, when Scheibe company was closed. Re-established Scheibe Aircraft has no plans to launch production.

SILENCE

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PARTNERS:
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Silence's first project is an ultralight kitbuilt with flying surfaces similar in shape to those of the Supermarine Spitfire. Until late 2003, the aircraft also was known as Silence, but is now designated Twister. In July 2003, a new company, Silence Flugzeugbau, was established by sailplane manufacturer DG Flugzeugbau to build and market the Twister in conjunction with designers Matthias and Thomas Strieker. Manufacture is being undertaken at Verl.

Silence has designed its own propeller for the Twister (*e-mail:* t.strieker@silencedesign.de).

SILENCE TWISTER

TYPE: Single-seat ultralight/kitbuilt.

PROGRAMME: Developed over a period of four years in a garden gazebo. Prototype (D-MTMH, incorporating partners' initials) made first flight 30 September 2000; LBA certification received May 2002; PFA VLA certification process under way in UK early 2004 and completed 26 August 2005. Kits produced by DG Flugzeugbau.

CURRENT VERSIONS: **SA155:** Original version; with Diamond engine; now discontinued.

Twister: As SA155, but with Jabiru engine. Prototype, initially known as SA180, D-MTMN (c/n 3), shown at Aero '03, Friedrichshafen, April 2003.

Twister Kit: Experimental category version under development for US market.

Diesel Twister: Proposed version with Ecofly Smart Diesel engine.

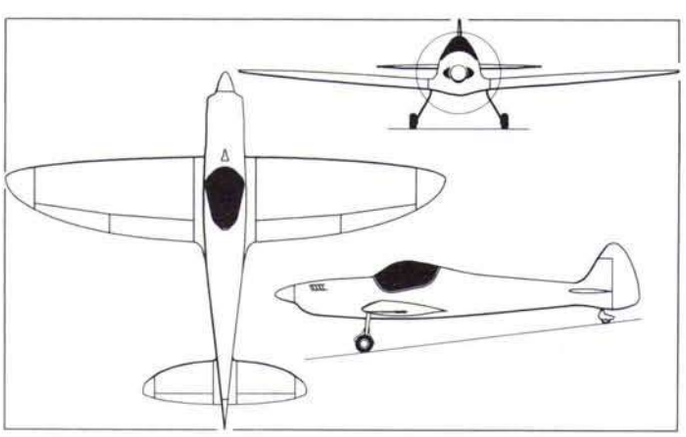
CUSTOMERS: Six flying and several more under construction. Sales include three to UK. First US-built aircraft (N787M) first flown 30 June 2004; two sold in Germany in 2004.

COSTS: Twister kit EUR29,000 including Jabiru fitting kit; flyaway EUR70,000 (2006).

DESIGN FEATURES: Compact, low-wing configuration, with elliptical wings and tailplane. Extensive use of carbon and glass fibre honeycomb construction throughout to maintain strength and minimise weight. Wings detachable in 10 minutes for transportation and storage; custom designed trailer available. Propeller spinner has three strakes and rotates freely in the airflow, thereby governing propeller angle. Quoted build time 500-800 hours.

FLYING CONTROLS: Conventional and manual. Elevator and ailerons operated by carbon fibre pushrods, cable-actuated rudder. Plain flaps. Horn-balanced rudder.

Silence Twister built in UK *(Paul Jackson)* 1159353



Silence Twister single-seat ultralight *(Paul Jackson)* 1159390

STRUCTURE: Monocoque single-piece fuselage of composites, with honeycomb core. Kevlar sandwich safety-cell centre-section, similar to Formula 1 motor-racing cars, incorporating pilot's seat and attachments for wing spar, landing gear and ballistic parachute. Single-piece wing spar. Aerofoil Stuttgart LWK180/25.

LANDING GEAR: Tailwheel type. Electric retraction; carbon fibre main legs rotate 90° and retract rearwards. Tailwheel non-retractable. Mainwheels 14×4. Hydraulic brakes.

POWER PLANT: Engines in the region of 70 kW (93.9 hp) can be fitted, to drive a three-blade, ground-adjustable pitch Helix carbon fibre propeller; prototype SA155 had 40 kW (53.6 hp) Wankel engine. Twister has 59.7 kW (80 hp) Jabiru 2200 flat-four driving a three-blade Silence carbon fibre propeller. Fuel capacity 80 litres (21.1 US gallons; 17.6 Imp gallons) of which 75 litres (19.8 US gallons; 16.5 Imp gallons) is usable.

EQUIPMENT: Junkers ProFly or BRS 1050 ballistic parachute system.

DIMENSIONS, EXTERNAL:

Wing span	7.50 m (24 ft 7¼ in)
Length overall	6.18 m (20 ft 3¼ in)
Height overall	1.44 m (4 ft 8¾ in)

AREAS:

Wings, gross	8.72 m² (93.9 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: SA155	200 kg (441 lb)
Twister	215 kg (474 lb)
Max T-O weight	340 kg (749 lb)

PERFORMANCE:

Never-exceed speed (VNE)	162 kt (300 km/h; 186 mph)
Cruising speed: SA155	108 kt (200 km/h; 124 mph)
Twister	130 kt (240 km/h; 149 mph)
Stalling speed: both	35 kt (65 km/h; 41 mph)
Max rate of climb at S/L: SA155	330 m (1,083 ft)/min
Twister	510 m (1,673 ft)/min
T-O run: Twister	90 m (295 ft)
Landing run: Twister	122 m (400 ft)
Range with max fuel: Twister	702 n miles (1,300 km; 807 miles)
g limits	+6/−4

STEMME

STEMME AG

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Founded in 1985, Stemme was originally based in Berlin but moved to nearby Strausberg airfield in 1991; current factory area is 3,000 m² (32,292 sq ft); workforce of 45 at beginning of 2003. The 100th aircraft was delivered in September 1998. Turnover was EUR4 million in 2001 and was forecast to increase to EUR20 million in 2005.

Stemme's first aircraft design, the S10 high-performance motor glider, introduced an unorthodox light aircraft concept by combining a modular airframe with the engine mounted amidships and driving a front-mounted propeller with retractable blades. Some 180 have been delivered, in three different versions. Current product range also includes the S2 (originally S7), a two-seat competition sailplane, which was expected to fly in September/October 2006.

In 2005, S10 series was to be followed by new range of two-seat aircraft (TSA programme), a modular family of side-by-side sport aircraft comprising the S2 sailplane, S6 soaring motor glider and S8 touring motor glider, of which the S6-RT was expected to fly in July 2006 and the S8 in 2007.

Research and development is undertaken by subsidiary Stemme F&D (Flugzeuge und Dienstleistungen). Subsidiary Stemme UMS (Umwelt-Messflug-Systeme) is developing the S15-8 entry-level surveillance version and the S8-Safari for semi-professional use.

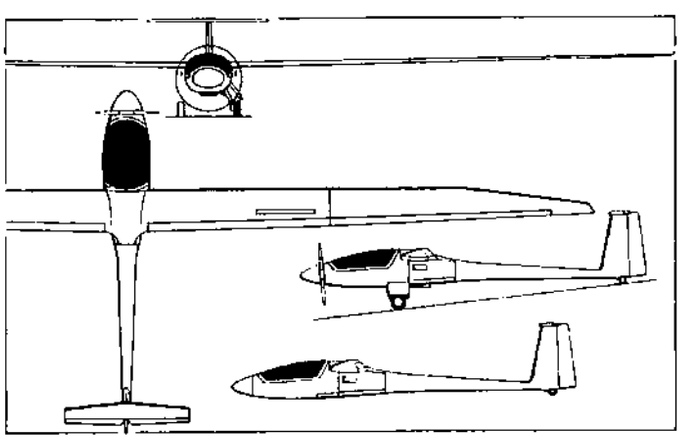
STEMME S10 and S15

US marketing name: Chrysalis
US Air Force designation: TG-11A

TYPE: Motor glider.

PROGRAMME: Prototype (D-KKST), with Glaser-Dirks DG500 wing, flown 6 July 1986; first flight of second prototype (D-KCHS) with definitive wing 2 June 1987; S10-VC surveillance and observation platform introduced in 1989; designed to JAR 22. Certified in Germany 31 December 1990, in UK 29 October 1991 and in USA, to FAR Pt 21, 8 July 1992. Production of S10 suspended March 1994; resumed late 1994 until 1997 with S10-V and since then with S10-VT.

CURRENT VERSIONS: **S10:** Original version, with 69.4 kW (93 hp) Limbach L 2400 EB1.AD flat-four engine and retractable fixed-pitch propeller; 54 produced until March 1994, including prototypes.



Stemme S10-VT showing additional side view (left) with landing gear and propeller retracted *(Mike Keep)* 1154181

S10-VC: Surveillance/observation conversion with underwing and small wingtip sensor pods for pollution control and resources investigation. One former S10 (D-KGCM/N600PL) used by Greenpeace since May 1994; one former S10-V (PH-1055) operated by Aerial Surveyance den Hollander, Netherlands, since 1995.

S10-V: Variable-pitch propeller version; power plant as for S10. Demonstrator (D-KGCX) completed mid-1994 as conversion of S10 but written off in Tanzania 10 March 1995; certified September 1994; total of 29 built between late 1994 and 1997; further five, or more, conversions from S10; production completed. (S10-V has engineering designation S14.)

S10-VT: Current production version with turbocharged Rotax 914 engine and variable-pitch propeller. Prototype (D-KGCR) built 1997; LBA certification August 1997, FAA certification September 1997 and CAA certification May 1998; total of 95 produced by mid-2005; of these, at least 39 to USA. (S10-VT has engineering designation S11.) Set world soaring record (D-KMTE) of 1,330 n miles (2,463 km; 1,530 miles) on 26 November 2000, piloted by Klaus Ohlmann.

Following description applies to S10-VT, except where indicated

S15: Launched at the 1996 Berlin Air Show; Rotax 914 engine and a 20.00 m (65 ft 7½ in) wing span; two underwing hardpoints for sensor pods in law-enforcement or scientific research roles suitable for loads up to 65 kg (143 lb) each, including FLIR, Nightsun searchlights, video cameras, and environmental monitoring equipment being developed by Berlin Technical University's Geography Institute. Prototype (D-ESTE) registered 1996, but no record of completion. S15B, light surveillance version, based on S10-VT, was then due to enter service in 2002, followed by S15A advanced surveillance model in 2004; both sponsored by Deutsche Bundesstiftung Umwelt. First S10-VT (D-KGCR) shown at Berlin, June 2000 (and again in May 2002) as POC S15. Now superseded by S15-8 (see separate entry).

Busard: Optionally piloted version (Buzzard), under development by ONERA and SAGEM as testbed for UAV sensor payloads.

Irkut-850: Optionally piloted version; similar in concept to Busard; being promoted by Irkut of Russian Federation in 2006.

Condor: Medium-altitude long-endurance (MALE) manned or unmanned version proposed jointly in 2004 by OHB System (Germany) and Elop (Israel); would use Stemme S10-VT airframe, modified to V-tail configuration and possibly turboprop- or Diesel-powered, although version considered with podded turbofan above fuselage, immediately ahead of tailfins. Sensor-carrying capabilities generally similar to those of Stemme S15-8, with Thales Optronique Agile E-O/IR turret offered as standard mission payload.

S-UAV: Unpiloted surveillance conversion. One S10-V (N600V) used as testbed by Platforms International Corporation, Mojave, California.

CUSTOMERS: Owners in Australia, Austria, Belgium, Brazil, Canada, Czech Republic, Denmark, Finland, France, Germany, Italy, Mexico, Netherlands, New Zealand, South Africa, Spain, Switzerland, UK and USA. Two delivered in 1995 to 94th Air Training Squadron, USAF Academy, Colorado Springs, Colorado. Total of 183 S10 variants (including prototypes) built by mid-2006; 100th production S10-VT (confusingly D-KILO) completed in mid-2006 for Italian customer.

COSTS: S 10-VT EUR168,000 basic (2003).

DESIGN FEATURES: Three-part shoulder-wing, T-tail motor glider with mid-mounted engine and completely retractable nose-mounted propeller. Transition time between soaring and powered flight is 5 seconds. Winglets option introduced from 1997. Outer wings can be folded by one person for ground handling and hangarage; wing sections carried in gantries inside trailer so that one person can fit centre and outer sections straight from trailer to fuselage.

Wing section Horstmann & Quast laminar flow HQ41/14.35; dihedral 1°; no twist.

FLYING CONTROLS: Conventional and manual. Full-span, six-position (−10/−5/0/+5/+10/+16°) trailing-edge flaps, outer segments of which function also as ailerons. Flap/aileron linkage for manoeuvrability and docility at low airspeeds; Schempp-Hirth airbrakes in outer ends of wing centre-section.

STRUCTURE: CFRP wings in three sections detachable from fuselage; CFRP rear fuselage and tail mounted to steel tube centre frame carrying wing, engine and landing gear; cockpit section, of CFRP structure with Kevlar safety lining, mounted at front of centre frame. Engine fully accessible and horizontal firewall separates engine from wing and flying controls. Winglets optional. Airframe made in Poland by Wytwornia Konstrukcji Kompozytowych, ulitsa Strumienska 829A, PL-43-385 Jasienica; *telephone* (+48 33) 815 33 31; *fax* (+48 33) 815 33 07; *e-mail* wkkpapiorek@pro.onet.pl

LANDING GEAR: Tailwheel type; electrically actuated, inward-retracting, narrow track mainwheels; non-retractable tailwheel, steered by rudder. Mainwheel tyres 5.00-5 or 6.00-5, with electrically actuated, mechanical standby disc brakes. Tailwheel: 210×65 tyre; fairing standard.

POWER PLANT: One 84.6 kW (113.4 hp) Rotax 914 F2/S1 turbocharged liquid/air-cooled flat-four engine mounted in the central fuselage steel tube frame aft of cockpit and driving a two-blade, variable-pitch retractable propeller via a centrifugal clutch, a CFRP extension shaft and a reduction gear. Engine cooling by adjustable ram air intake. Nosecone is moved forward and spring-folded blades emerge through peripheral slot under centrifugal force.

Fuel in two 45 litre (11.9 US gallon; 9.9 Imp gallon) fuel tanks in outer ends of centre wing; 60 litre (15.8 US gallon; 13.2 Imp gallon) tanks optional. Total capacities 90 litres (23.8 US gallons; 19.8 Imp gallons) or 120 litres (31.7 US gallons; 26.4 Imp gallons).

Stemme S10-VT equipped for surveillance with camera turret beneath port wing *(Paul Jackson)* 1128912

ACCOMMODATION: Two pilots side by side; dual controls standard; seats adjustable for position and rake; one-piece canopy hinged at forward end and held open by gas struts.

SYSTEMS: 12 V electrical system; full night lighting, landing light and solar cells optional. Solar cells can be fitted behind cockpit to provide 12 V 37.5 W.

AVIONICS: *Comms:* Intercom, VHF radio and transponder optional, as is special cut-down panel for mountain soaring.

DIMENSIONS, EXTERNAL:

Wing span, excl winglets	23.00 m (75 ft 5½ in)
Wing aspect ratio	28.3
Width, wings folded	11.40 m (37 ft 4¾ in)
Length overall	8.42 m (27 ft 7½ in)
Fuselage max width	1.18 m (3 ft 10½ in)
Height over tailplane	1.80 m (5 ft 10¾ in)
Wheel track	1.15 m (3 ft 9¼ in)
Wheelbase	5.42 m (17 ft 9½ in)
Propeller diameter	1.63 m (5 ft 4¼ in)
Fuselage ground clearance at mainwheels	0.72 m (2 ft 4¼ in)

DIMENSIONS, INTERNAL:

Cockpit: Width	1.16 m (3 ft 9½ in)
Height	0.93 m (3 ft 0½ in)

AREAS:

Wings, gross	18.70 m² (201.3 sq ft)
Vertical tail surfaces (total)	1.51 m² (16.25 sq ft)
Horizontal tail surfaces (total)	1.46 m² (15.72 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	660 kg (1,455 lb)
Max T-O and landing weight	850 kg (1,874 lb)
Max wing loading	45.5 kg/m² (9.31 lb/sq ft)
Max power loading	10.06 kg/kW (16.53 lb/hp)

PERFORMANCE, POWERED:

Never-exceed speed (VNE), smooth air	146 kt (270 km/h; 168 mph)
Manoeuvring speed	97 kt (180 km/h; 112 mph)
Max cruising speed:	
at S/L	121 kt (225 km/h; 139 mph)
at FL100	134 kt (248 km/h; 154 mph)
Stalling speed, flaps down	42 kt (78 km/h; 48 mph)
Max rate of climb at S/L	249 m (817 ft)/min
Service ceiling	9,140 m (30,000 ft)
T-O run	205 m (675 ft)
T-O to 15 m (50 ft)	447 m (1,465 ft)
Max range:	
standard fuel	696 n miles (1,290 km; 801 miles)
max optional fuel	928 n miles (1,720 km; 1,068 miles)

PERFORMANCE, UNPOWERED:

Best glide ratio at 57 kt (106 km/h; 66 mph)	50
Min rate of sink at 45 kt (83 km/h; 52 mph)	0.57 m (1.87 ft)/s
g limits	+5.3/−2.65

OPERATIONAL NOISE LEVELS:

To German light aircraft rules (LSL Chapter X)	71.3 dBA

STEMME S6, S8 and S15-8

TYPE: Motor glider.

PROGRAMME: Development nearing completion in late 2002 of modular family known as TSA (two-seat aircraft) and comprising S2 glider (two versions); S6 motor glider (five versions); and S8 motor glider (six versions). S8 announced at ILA, Berlin, May 2000; S6 at Aero '01, Friedrichshafen, April 2001. Deliveries of S6 were scheduled to begin in second quarter 2003, but revised schedule as at April 2005 forecast S6 maiden flight for August 2005. This not achieved. Structural testing under way in February, March and April 2006, with first flight (S6-RT prototype) then predicted in July 2006 and first deliveries at year-end; S2 to be next to fly, then S8 in 2007.

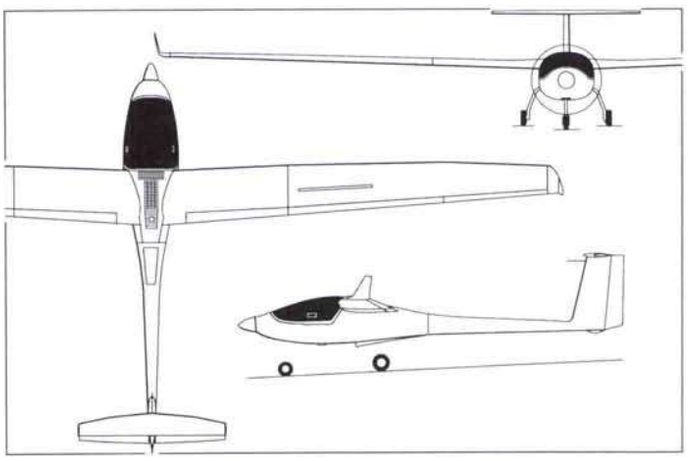
CURRENT VERSIONS: **S6:** Soaring motor glider with large one-piece canopy, fixed tricycle landing gear and naturally aspirated Rotax 912 S engine. Suitable for towing gliders of up to 750 kg (1,653 lb) MTOW.

S6-L: As S6 except for lower MTOW.

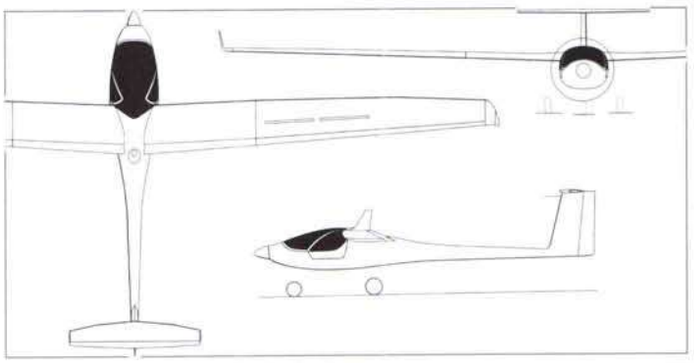
S6-T: As S6, but turbocharged Rotax 914 F engine.

S6-R: As S6, but fully retractable tricycle landing gear.

Prototype Stemme S6 displayed, semi-complete, at Berlin in May 2006 *(Paul Jackson)* 1158102



Stemme S6 general arrangement *(Paul Jackson)* 1046949



Stemme S8 motor glider *(Paul Jackson)* 0535823

S6-RT: As S6, but turbocharged Rotax 914 F and retractable tricycle landing gear.

S8: Touring motor glider with roomier cockpit and door on each side; otherwise as S6.

S8-T: As S8, but turbocharged Rotax 914 F.

S8-R: As S8, but retractable tricycle landing gear.

S8-RT: As S8, but turbocharged Rotax 914 F and retractable tricycle landing gear.

S8-Safari: Derivative of S8, S8-R, S8-T or S8-RT with hardpoints and underwing pods for semi-professional use.

S15-8: Light reconnaissance and surveillance aircraft for manned or MALE (medium-altitude, long-endurance) unmanned (UAV) missions. Derived from S8-T or S8-RT for governmental or commercial applications. Hardpoints for external loads; quick-change underwing mission equipment pods. Sensor payloads can include day/night E-O, SAR, lidar, imaging spectrometer and digital photogrammetric cameras; sensor fusion and integration with GPS/INS available.

DESIGN FEATURES: Based on platform strategy with S10 design principles, including proven propulsion system with mid-mounted engine, driveshaft and front propeller. New features include non-retractable constant-speed propeller with feathering for soaring mode, tricycle landing gear and task-adapted, low-drag aerodynamics. In area of wing/fuselage junction a geometric twist is combined with specially designed turbulent flow aerofoils, which minimise separations of boundary layer. Ease of maintenance through rapid change potential of power plant (engine, from drive flange to end of muffler, is mounted on a subframe), landing gear and propeller driveshaft group. Innovative engine installation offers upward exhaust emission for a noise level far below international limit.

FLYING CONTROLS: Primary controls (elevator, ailerons, rudder) conventional and manual; full dual controls. Secondary controls (flaps, trim, airbrakes). Electric trim. Manually actuated flaps. Advanced flap/aileron linkage for middle and outer wing control surfaces. Schempp-Hirth airbrakes in outer wings.

STRUCTURE: CFRP wings in three sections, plus winglets. Wing detachable from fuselage; CFRP tailcone and tail unit mounted to centre steel framework accommodating engine and landing gear; safety cockpit with different types of composites.

LANDING GEAR: Tricycle type, fixed; or electrically actuated fully retractable (see Current Versions). Former has speed fairings on all wheels. Mainwheels size 380×150, nosewheel 300×100.

POWER PLANT: *Except T and RT versions:* One 73.5 kW (98.6 hp) Rotax 912 S flat-four engine, mounted on subframe aft of cockpit and driving a two-blade (optionally three-blade) constant-speed propeller via a CFRP extension shaft and a reduction gear.

T and RT versions and S15-8: One 84.5 kW (113.3 hp) turbocharged Rotax 914 F flat-four; five-blade MTV-Propeller in S15-8; otherwise as described in preceding paragraph.

Standard fuel capacity (S6) 70 litres (18.5 US gallons; 15.4 Imp gallons); 140 litres (37.0 US gallons; 30.8 Imp gallons) optional for S6-T and S6-RT, standard for S8 variants. Additional option in S15-8 for 230 litre (60.8 US gallon; 50.6 Imp gallon) long-range tank and/or two 65 litre (17.2 US gallon; 14.3 Imp gallon) underwing tanks.

ACCOMMODATION: Pilot and passenger/student side by side in S6, under single-piece, forward-hinged canopy. More spacious cockpit in S8 versions, with door each side.

SYSTEMS: As described for S10.

AVIONICS: *Comms:* VHF radio and intercom.

Flight: VOR; GPS; ATC transponder.

Instrumentation: Moving map; soaring computer.

Following data are as projected in late 2002:

DIMENSIONS, EXTERNAL (all):

Wing span	18.00 m (59 ft 0¾ in)
Wing aspect ratio	18.6
Width, wings folded	7.20 m (23 ft 7½ in)
Length overall	8.52 m (27 ft 11½ in)
Height to top of tail	2.45 m (8 ft 0½ in)
Wheel track: S6	2.00 m (6 ft 6¾ in)
S8	1.80 m (5 ft 10¾ in)
Wheelbase	2.00 m (6 ft 6¾ in)

AREAS:

Wings, gross	17.40 m² (187.3 sq ft)
Vertical tail surfaces (total)	1.50 m² (16.15 sq ft)
Horizontal tail surfaces (total)	1.74 m² (18.73 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: S6	603 kg (1,329 lb)
S6-L	583 kg (1,285 lb)
S6-R	587 kg (1,295 lb)
S6-T	629 kg (1,387 lb)
S6-RT	599 kg (1,321 lb)
S8, S15-8	587 kg (1,294 lb)
S8-R	592 kg (1,305 lb)
S8-RT	630 kg (1,389 lb)
Max T-O weight: except S6-L	850 kg (1,873 lb)*
S6-L	800 kg (1,764 lb)
Max wing loading:	
except S6-L	48.8 kg/m² (10.00 lb/sq ft)
S6-L	46.0 kg/m² (9.42 lb/sq ft)
Max power loading:	
Rotax 912 S (except S6-L)	11.56 kg/kW (19.00 lb/hp)
S6-L	10.89 kg/kW (17.89 lb/hp)
Rotax 914 F	10.06 kg/kW (16.53 lb/hp)

* *S15-8 950 kg (2,094 lb) with special C of A*

PERFORMANCE, POWERED (estimated, with two-blade propeller; A: S6-RT, B: S8-RT, C: S15-8):

Max level speed at S/L:	
A, B, C	151 kt (280 km/h; 174 mph)
Max level speed at FL160: C	175 kt (324 km/h; 201 mph)
Max cruising speed at S/L:	
at 55% power: A, B	130 kt (240 km/h; 149 mph)
C	114 kt (211 km/h; 131 mph)
Max cruising speed at FL100:	
A, B	167 kt (310 km/h; 193 mph)
Max rate of climb at S/L: A	348 m (1,142 ft)/min
B	348 m (1,142 ft)/min
C	266 m (873 ft)/min
Service ceiling: A, B	8,535 m (28,000 ft)
C	7,620 m (25,000 ft)
Range at S/L, 140 litres fuel, 55% power:	
A	1,295 n miles (2,400 km; 1,491 miles)
B	1,241 n miles (2,300 km; 1,429 miles)

PERFORMANCE, UNPOWERED:

Best glide ratio:	
S6, S6-T at 61 kt (113 km/h; 70 mph)	33
S6-R, S6-RT at 64 kt (119 km/h; 74 mph)	39
S8, S8-RT at 63 kt (117 km/h; 72 mph)	32
S8-R, S8-RT at 66 kt (122 km/h; 76 mph)	38
Min rate of sink at empty weight +70 kg (154 lb):	
S6, S6-T	0.85 m (2.79 ft)/s
S6-R, S6-RT	0.73 m (2.40 ft)/s
S8, S8-T	0.86 m (2.82 ft)/s
S8-R, S8-RT	0.74 m (2.43 ft)/s

ULBI

ULTRALEICHTBAU INTERNATIONAL

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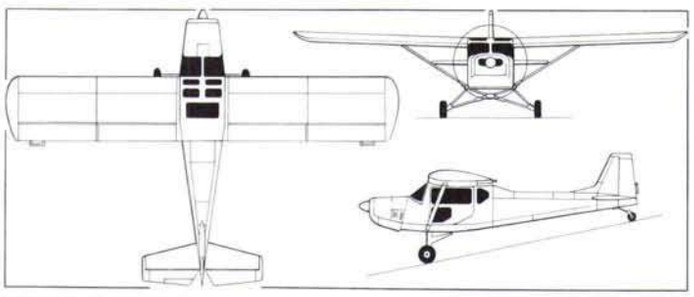
CEO: Angelika Kaiser
SALES MANAGER: Alfred Kaiser
CHIEF DESIGNER: Rainer Kurtz
CHIEF TEST PILOT: 'Biggi the Rottweiler'

The Romanian-developed Wild Thing lightplane has been marketed by Ultraleichtbau, known until 2001 as Air Light, since 1997. A nosewheel version was introduced in 1999.

In addition to the Wild Thing range, ULBI also markets the Jabiru and Corvus series of kitbuilts.



ULBI WT-01 Wild Thing *(James Goulding)* 0137227

ULBI WILD THING

TYPE: Side-by-side ultralight/kitbuilt.

PROGRAMME: Developed by Aerostar (which see) in Romania; prototype registered YR-6107. Launched at Friedrichshafen Air Show, April 1997; certification August 1997. Initial production aircraft had Jabiru 2200 engines; alternatives available from 1998. By early 2001, examples were operating in Austria, Czech Republic, France, Germany, Hungary and Netherlands.

CURRENT VERSIONS: **WT-01:** Baseline version; tailwheel.

WT-02: Nosewheel version introduced early 1999 (D-MWTA, 50th production aircraft, as demonstrator).

CUSTOMERS: Total of 90 built by 2005; five sold in Germany during 2004. Incomplete 91st airframe shown in seaplane configuration at ILA, Berlin, May 2006.

COSTS: EUR49,900 (Jabiru 2200) or EUR59,300 (Jabiru 3300); nosewheel EUR3,950 extra; all excluding tax (2006). Rotax-engined version prices on application.

DESIGN FEATURES: Bears strong outward resemblance to Canadian Murphy Rebel. Built by Aerostar in Romania for distribution out of Germany. Wings fold alongside fuselage for storage or transportation on aluminium trailer.

FLYING CONTROLS: Conventional and manual. Frise ailerons. Elevators and ailerons pushrod-operated; rudder Cable-operated. Horn-balanced tail surfaces; trim tab in port elevator; ground-adjustable tab on rudder. Flaps.

STRUCTURE: Main structure is metal monocoque, with fabric-covered ailerons and flaps.

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted. WT-01 has two faired-in side Ys plus half-axles, each with bungee cord shock-absorber, attached to compression frame. Mainwheel size 8.00-6, tailwheel size 200×50. Oversize Tundra wheels and tyres optional. Cable-operated disc brakes. WT-02 has spring cantilever mainwheel legs with attachment point further aft and nosewheel with compressed rubber shock-absorber; nosewheel size 140×6.

POWER PLANT: One 59.7 kW (80 hp) Jabiru 2200, 59.6 kW (79.9 hp) Rotax 912 UL, 78.3 kW (105 hp) Mid West Hawk, 89.5 kW (120 hp) Jabiru 3300 or 73.5 kW (98.6 hp) Rotax 912 ULS driving a two-blade Helix fixed-pitch carbon fibre ground-adjustable pitch, carbon fibre or Kremen SR 2000 XC three-blade, variable-pitch (electric) wooden propeller. Fuel in two wing tanks, combined capacity 80 litres (21.1 US gallons; 17.6 Imp gallons); can be upgraded to large tanks with combined capacity of 120 litres (31.7 US gallons; 26.4 Imp gallons).

ACCOMMODATION: Prototype had third seat in rear of cabin, hence a spacious cockpit area.

AVIONICS: Becker, Filser and Icom avionics to customer's choice.

EQUIPMENT: Junkers Magnum speed parachute emergency rescue system and gliding towing equipment both optional.

DIMENSIONS, EXTERNAL:

Wing span	9.20 m (30 ft 2¾ in)
Length overall	6.90 m (22 ft 7¾ in)
Height overall	1.92 m (6 ft 3½ in)

AREAS:

Wings, gross	13.94 m² (150.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty (typical)	290 kg (639 lb)
Max T-O weight	472.5 kg (1,041 lb)

PERFORMANCE (Jabiru 2200 engine):

Never-exceed speed (VNE)	108 kt (200 km/h; 124 mph)
Max level speed	97 kt (180 km/h; 112 mph)
Cruising speed	76 kt (140 km/h; 87 mph)
Stalling speed	32 kt (58 km/h; 36 mph)
Max rate of climb at S/L	152 m (500 ft)/min
T-O run	98 m (320 ft)
Landing run	44 m (145 ft)
Range with max fuel	432 n miles (800 km; 497 miles)

ULBI WT-01 Wild Thing *(Paul Jackson)* 1159354

WD

WD FLUGZEUGLEICHTBAU GMBH

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Web: www.uljih.cz
EXECUTIVE DIRECTOR: Jaroslav Sedláček

Formed in 1982, WD Flugzeugleichtbau marketed the Fascination D4 BK and D5 Evolution. The earlier D3 Sunwheel was also available; Final project was the Revolution competition aerobatic aircraft.

In 1999, WD opened a new production facility in the Czech Republic, where kits and complete aircraft are manufactured.

In June 2005, WD was declared insolvent and the assets of the company offered for sale; the type rights were sold to Swiss Light Aircraft AG in early 2006.

WQS

WUST QUALITY SYSTEMS

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Web: www.mark-wuest.de
FOUNDER: Wolfgang Wüst

Wüst GmbH was founded in October 2001 and in December 2001 acquired the assets of the former Mark GmbH Flugzeugbau. In 2004 the company was renamed Wüst Quality Systems GmbH (WQS). Development and production facilities are located in the Czech Republic. Test flying of the Seahawk II prototype was continuing in 2005.

WQS SEAHAWK II

TYPE: Two-seat amphibian ultralight kitbuilt.

PROGRAMME: Scale model of Seahawk I built by Mark GmbH for preliminary tests; mockup displayed at Aero 2001 at Friedrichshafen April 2001; redesign by Wüst GmbH as Seahawk II began December 2001; prototype (OK-IUU 02; later re-registered HA-XBW) completed January 2003 and first flown 29 March 2003, with test flying continuing during 2004 and 2005 at Hassfurt and Welzow, Germany, including water landings; manufacture of second prototype began September 2003.

DESIGN FEATURES: Single-step hull; parallel chord wing with turned-down wingtips forming narrow stabilising floats; sweptback fin with T tail configuration; upward-opening gullwing doors.

FLYING CONTROLS: Conventional and manual; one-piece horn-balanced elevator with trim tab; electrically actuated Fowler flaps. Dual controls standard.

STRUCTURE: Composites/honeycomb sandwich; single-spar wings.

LANDING GEAR: Retractable tricycle type; mainwheels retract upwards into sides of hull; nosewheel retracts forwards. Mainwheels on metal tube side Vs, hinged at top, with twin bracing struts mounted above and single oleo-pneumatic/helical spring (motorcar-type) shock absorber.

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS or 74.6 kW (100 hp) Textron Lycoming O-200 flat-four, pylon-mounted above wing in pusher configuration and driving a three-blade, fixed-pitch or constant-speed propeller. Fuel contained in two wing tanks, combined capacity 90 litres (23.8 US gallons; 19.8 Imp gallons).

DIMENSIONS, EXTERNAL:

Wing span	8.38 m (27 ft 6 in)
Length overall	7.35 m (24 ft 1¼ in)
Height overall	2.65 m (8 ft 8½ in)

WEIGHTS AND LOADINGS:

Weight empty	350 kg (772 lb)
Max T-O weight	549 kg (1,212 lb)
Max power loading (Rotax)	7.48 kg/kW (12.29 lb/hp)

Prototype WQS Seahawk II during water trials, with Hungarian registration

1037988

ZEPPELIN

ZEPPELIN LUFTSCHIFFTECHNIK GMBH

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HEAD OF ENGINEERING: Robert Gritzbach
SALES: Dietmar Blasius
MARKETING AND PUBLIC RELATIONS: Marion Berg
CORPORATE COMMUNICATIONS: Andrea Sinclair

ZLT Zeppelin Luftschifftechnik was formed in September 1993 for the development and production of new technology (NT) airships. Luftschiffbau Zeppelin GmbH, of which ZLT is a subsidiary, was founded by Count Ferdinand von Zeppelin in 1908 and still exists under the auspices of the Zeppelin Foundation. It had a December 2005 workforce of 84 full-time personnel.

Corporate members 2005 (percentage shareholdings in parentheses) are ZF Friedrichshafen AG (49.0), Luftschiffbau Zeppelin GmbH (51.0), Deutsche Zeppelin Reederei (DZR) formed in January 2001 as 100 per cent subsidiary of Zeppelin Luftschifftechnik; will be developed as operator, pilot training school and service centre for latter's airships; first commercial service flown 15 August 2001 and over 50,000 passengers carried by 31 December 2005. (First-generation Zeppelin undertook initial passenger service on 24 June 1910.)

On 24 August 2005, agreement was reached between Luftschiffbau Zeppelin GmbH, the CargoLifter receiver and Air Brand GmbH (the company formed to realise the assets of CargoLifter) for transfer of the intellectual property rights from the CargoLifter insolvency to Luftschiffbau Zeppelin, which plans to utilise them in support of the development of larger airships, including the NT 14.

ZEPPELIN NT

TYPE: Helium semi-rigid airship.

PROGRAMME: Study group for revival of modern semi-rigid airships formed 1989; concluded that combination of vectored thrust and new constructional approach offers best solution, resulting in NT programme; 10 m (32 ft 10 in) long, remotely controlled proof-of-concept model tested extensively in 1991. Design definition of N 07 series (originally designated N 05) completed late 1992; construction started October 1995, leading to completion in July 1997 and first flight (D-LZFN) on 18 September 1997 (69th anniversary of maiden flight (1928) of LZ 127 *Graf Zeppelin*) following public debut (April) at Friedrichshafen Air Show. Test flights undertaken from new airship base at Friedrichshafen Airport; damaged by gale in February 1999, but returned to test flying by following April; made 100th flight in August 1999; D-LZFN named *Friedrichshafen* 2 July 2000; flight test programme completed in December 2000 (more than 1,000 hours in approximately 250 flights); certified by LBA 26 April 2001. Being brought up to production standard in 2002; then to undertake mineseeking operations in Croatia; traffic monitoring duties during 2004 Olympic Games in Athens.

First production NT 07 airship (D-LZZR *Bodensee*, c/n 02) made maiden flight 19 May 2001; second (D-LZZF, c/n 03) entered construction in third quarter of 2000 and made its first flight 9 February 2003. First revenue-earning flight (by 02) 15 August 2001; had carried more than 23,000 fare-paying passengers by August 2003; sold to Japan March 2004, at which time had accumulated approximately 2,500 flying hours. On 27 October 2004 an NT 07 piloted by Steve Fossett and Hans-Paul Ströhle set a new world record of 62 kt (115 km/h; 71.5 mph) for speed over a 1 km course. NT 07 redesignated NT 07-100 in early 2005.

One NT 07 leased to De Beers Group in 2005 for R&D in southern Africa in 'Diamonds for Development' initiative.

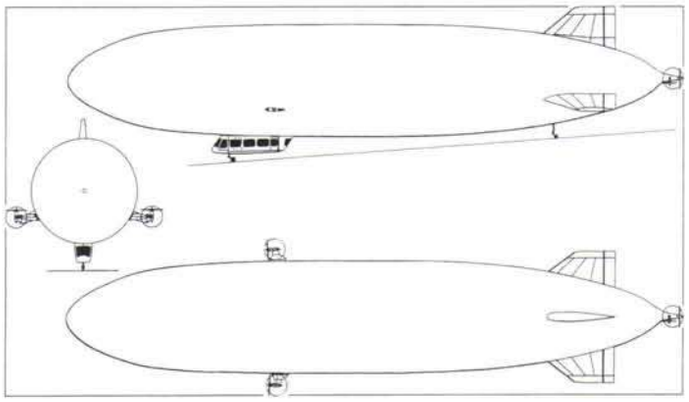
CURRENT VERSIONS: **Zeppelin NT 07-100:** *As described.*

Zeppelin NT 14: Enlarged version, for which go-ahead given on 10 February 2005, replacing earlier NT 13 proposal. Overall length 90 m (295.3 ft), maximum diameter 15.8 m (51.8 ft), overall height 21.4 m (70.2 ft), volume 13,500 m³ (476,750 cu ft), max payload 3,200 kg (7,055 lb). Commonality with NT 07-100 includes power plant, FBW system, flight deck, control surfaces, lightwing protection and ground support vehicles. Modified gondola for two pilots, 19 passengers and one flight attendant, plus galley and lavatory; envelope and landing gear strengthened.

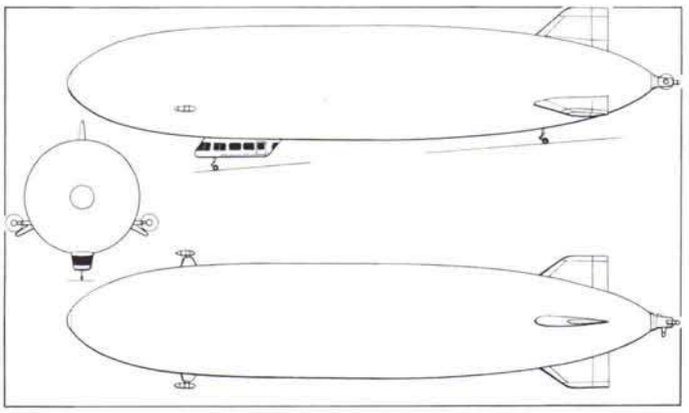
First example to fly late 2007 and be commercially operable; will be certified (as **NT 07-200**) to FAR/JAR 23; service entry third quarter 2008.

CUSTOMERS: First three NT 07-100 airships operated via DZR (Deutschen Zeppelin Reederei) subsidiary initially, to gain experience. D-LZZR purchased by Nippon Airship Corporation of Japan 2 March 2004; re-registered JA101Z and re-named *Yōkoso! Japan* (Welcome to Japan); handed over in Friedrichshafen 12 June, departing following day on demonstration/delivery flight via 10 European countries (Switzerland, France, UK,

Zeppelin NT 07-100 prototype *(Paul Jackson)* 1128913



Zeppelin NT 07-100 airship *(Paul Jackson)* 1127534



Projected Zeppelin NT 14 (NT 07-200) airship *(James Goulding)* 1127535

Belgium, Netherlands, Luxembourg, Czech Republic, Denmark, Sweden and Finland). Was then due to cross Russia, but obstacles encountered in obtaining overflight clearance; journey aborted, and returned to Friedrichshafen 10 September. Decision then taken to deliver to Japan by sea, departing 11 November 2004 for port of Gioia Tauro in southern Italy and embarking 9 December on container ship *Dock Express 10*. It arrived in Kobe on 8 January, making its first flight there on 14 January 2005.

COSTS: NT 07-100 EUR8 million, including ground infrastructure (2002); NT 14, 25 per cent higher.

DESIGN FEATURES: Revives original design principles of Count Ferdinand von Zeppelin; first airship in world since 1940 with load-bearing internal structure. Intended as precursor of product line of commercial airships for variety of applications including scientific research, environmental monitoring, TV missions and tourism. Internal 'prism' primary structure modified and optimised from Stuttgart University proposal of 1975 and British patent of 1924; single helium cell; placement of vectored thrust units near CG and also at rear enhances manoeuvrability and control at low speeds, further improving safety and reducing ground crew requirements to three persons, thereby also reducing operating costs. Tailfins in inverted Y configuration.

FLYING CONTROLS: Computer-assisted flight control, propulsion and landing. Dual fly-by-wire flight control system; no mechanical back-up. Elevator or rudder on each tail surface. Engine thrust control (see under Power Plant) in pitch and yaw.

STRUCTURE: Internal primary structure consists of three rows of aluminium tubular longerons, interconnected with triangular carbon fibre frames and cross-braced with Kevlar cables, providing internal prism-shaped structure accounting for only 12 per cent of gross weight; this frame and pressurised envelope are both load-carrying structures to enhance safety factor (airship remains fully manoeuvrable even if internal pressure drops). Envelope, attached continuously to all longerons, is a high-strength, multilayer laminate of polyester and Tedlar; this material has low gas permeability and allows airship to be moored permanently in the open. Air ballonets in lower part of envelope afford protection to cabin and airframe in the event of a hard landing.

LANDING GEAR: Twin landing/ground handling wheels in tandem under gondola and rear of envelope. Airship can be moored to a fixed or mobile mast.

POWER PLANT: Three 149 kW (200 hp) Textron Lycoming IO-360 flat-four engines: one each side of hull above gondola in vectored-thrust propulsion unit, each driving a three-blade, variable-pitch, swivelling (up to 120°) tractor propeller; engine in tailcone drives, via a belt-driven gearbox, a lateral fan (for precise yaw control during low-speed and hovering manoeuvres) and a vectored propeller used as a pusher in forward flight and for precise pitch control in landing configuration. Combination of thrust vectoring and fuel trim tanks virtually obviates need for ballast management.

ACCOMMODATION: Crew of two, on ergonomically designed flight deck; gondola main cabin accommodates up to 13 passengers on individual seats, with galley, lavatory and wardrobe provision, or equivalent cargo or other payload.

AVIONICS: *Radar:* Weather radar.

Flight: Dual digital fly-by-wire aerodynamic steering; triple thrust vector steering; modern LCD flight deck avionics, including EFIS, EICAS, radio nav and GPS.

DIMENSIONS, EXTERNAL:

Envelope: Length overall	75.00 m (246 ft 0¾ in)
Max diameter	14.16 m (46 ft 5½ in)
Fineness ratio	5.3
Max width over propeller ducts	19.50 m (63 ft 11¾ in)
Height overall	17.40 m (57 ft 1 in)

DIMENSIONS, INTERNAL:

Envelope volume	8,450 m³ (298,400 cu ft)
Ballonet volume (max)	2,200 m³ (77,700 cu ft)
Gondola: Length	10.70 m (35 ft 1¼ in)
Max width	2.25 m (7 ft 4½ in)
Volume	26.0 m³ (918.2 cu ft)

WEIGHTS AND LOADINGS:

Gondola: structural weight	440 kg (970 lb)
incl equipment and furniture	1,200 kg (2,646 lb)
Max payload	1,900 kg (4,189 lb)
Max T-O weight	10,690 kg (23,567 lb)

PERFORMANCE:

Max level speed	67 kt (125 km/h; 77 mph)
Cruising speed	62 kt (115 km/h; 71 mph)
Cruising altitude	1,000 m (3,280 ft)
Pressure ceiling	2,600 m (8,530 ft)
Range	486 n miles (900 km; 559 miles)
Endurance at 38 kt (70 km/h; 43 mph):	
with max payload	14 h
with reduced payload	24 h

Hungary

CORVUS

CORVUS AIRCRAFT KFT

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EXECUTIVE MANAGER: András Volosesuk

Corvus (Crow), formed in spring 2004, showed the first production Corvus Corone at Aero '05 in Friedrichshafen.

CORVUS CORONE

English name: Carrion Crow

TYPE: Two-seat lightplane; side-by-side ultralight.

PROGRAMME: Designed by Attila Kenéz. Prototype (35-15) first flew in November 2003; further four development aircraft. First production Corone **Mk I** shown at Aero '05 in April 2005, with 300 flying hours accumulated. Mk II mock-up shown at ILA, Berlin, May 2006.

CUSTOMERS: Three production aircraft under construction by mid-2006. US marketing began in 2006 with appearance at Oshkosh.

DESIGN FEATURES: Intended as spacious, economic, light sport aircraft (LSA/VLA) or ultralight employing high-technology composites and suitable for touring and glider towing. Readily dismantled for storage.

Low, tapered semi-monocoque wing with upturned tips; sweptback fin and low tailplane.

FLYING CONTROLS: Conventional and manual. Frise ailerons, pushrod operated; single-piece elevator, pushrod operated, with flight-adjustable trim tab. Horn-balanced rudder. Slotted flaps.

STRUCTURE: Composites monocoque. Fuselage of Kevlar honeycomb sandwich mixed with carbon fibre and glass fibre, bonded with epoxy resin. Wings assembled from upper and lower load-bearing skins.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted, spring cantilever mainwheel legs; steerable nosewheel. Wheel fairings throughout.

POWER PLANT: One Jabiru piston engine: 59.7 kW (80 hp) J2200 in ultralight; 89 kW (120 hp) J3300 in VLA. Two-blade Helix fixed-pitch propeller. Wing fuel tanks: capacity 50 litres (13.2 US gallons; 11.0 Imp gallons) in ultralight; 120 litres (31.7 US gallons; 26.4 Imp gallons) in VLA.

ACCOMMODATION: Two persons, with dual controls, beneath single-piece, forward-opening (electrical option) canopy/windscreen. Instrument panel pivots with canopy.

AVIONICS: *Instrumentation:* Analogue or 'glass cockpit' instruments mounted in the base of the opening canopy.

EQUIPMENT: Ballistic parachute standard.

DIMENSIONS, EXTERNAL:

Wing span	9.60 m (31 ft 6 in)
Length overall	6.20 m (20 ft 4 in)
Height overall	2.10 m (6 ft 10¾ in)

DIMENSIONS, INTERNAL:

Cockpit max width	1.16 m (3 ft 9½ in)

WEIGHTS AND LOADINGS:

Weight empty: ultralight	295 kg (650 lb)
VLA	320 kg (705 lb)
Max T-O weight: ultralight	475 kg (1,047 lb)
VLA	600 kg (1,322 lb)

PERFORMANCE:

Never-exceed speed (VNE): ultralight	118 kt (220 km/h; 136 mph)
VLA	143 kt (265 km/h; 164 mph)
Normal cruising speed: ultralight	86 kt (160 km/h; 99 mph)
VLA	103 kt (190 km/h; 118 mph)
Stalling speed, flaps down: ultralight	33 kt (60 km/h; 38 mph)
VLA	36 kt (65 km/h; 41 mph)
Max rate of climb at S/L: ultralight	270 m (886 ft)/min
VLA	480 m (1,575 ft)/min
T-O to 15 m (50 ft): ultralight	290 m (955 ft)
VLA	194 m (640 ft)
Landing from 15 m (50 ft): ultralight	320 m (1,050 ft)
VLA	307 m (1,010 ft)
Max range: ultralight	297 n miles (550 km; 341 miles)
VLA	648 n miles (1,200 km; 745 miles)

Corvus Corone Mk II-UL *(Paul Jackson)* 1159358

DANEX

DANEX ENGINEERING KFT

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Danex builds the EuroCub ultralight which is now marketed in the UK, having been sold in the Nordic countries for over a decade. UK launch in July 2004, but no known sales two years later.

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Tel/Fax: (+44 1666) 57 50 83
e-mail: info@eurocub.com
Web: www.eurocub.com

DANEX EUROCUB

TYPE: Side-by-side ultralight.

PROGRAMME: Derived from Al Jasman's Canadian-designed Aces High Cuby II (Cuby I being single-seat), now out of production following manufacture of some 20 kits. Swedish consortium acquired production licence in 1989; European prototype, SE-YLM with Rotax 503; others followed with Rotax 582 and Rotax 912. Sales to Denmark, Italy, Norway and Sweden with Rotax 503 and to Finland, Norway and Sweden with Rotax 912, all retaining Cuby II name.

Production transferred in 1994 to Nyiregyháza, Hungary, as Lamco (Light Aircraft Manufacturing Company KFT) EuroCub Mk I with Rotax 912 UL engine and Warp Drive IvoProp three-blade propeller, initially retaining 10.27 m (33 ft 8¼ in) wing span, although this reduced and wing endplates added. Mk I became Mk IV upon 30 per cent increase in size of tailplane, plus larger fin and rudder. Lamco became Danex Engineering KFT in 1998.

UK-based EuroCub Ltd formed to market aircraft as factory-built ultralight.

New-built Eurocub Mk IV, SE-VAY *(Paul Jackson)* 0589244

CUSTOMERS: Some 10 European Cuby IIs, two EuroCub 912 ULs, 20 Mk Is and three Mk IVs (plus conversions) produced by mid-2005. Three operated by Swedish Ultraflyers from Frolunda, Stockholm.

DESIGN FEATURES: Classic high-wing monoplane with spacious cabin and wide-track landing gear. Constant-chord wing, with endplates, attached to upper longerons and braced to lower longerons by streamlined V struts with vertical intermediate struts. Tailplane braced below with struts and to fin with wires.

Wing section Clark Y (modified).

FLYING CONTROLS: Conventional and manual. Full-span, non-drooping ailerons (no flaps). Horn-balanced rudder and elevators. Flight-adjustable tab in port elevator.

STRUCTURE: Welded 4130 steel tube fuselage covered in doped Ceconite fabric. Wings of 6061-T6 aluminium with aluminium leading-edges and endplates and Ceconite to the rear. Glass fibre engine cowling. Circular section steel wing bracing struts have streamline wooden fairings to the rear.

LANDING GEAR: Tailwheel type; fixed. Two faired-in side Vs attached to lower longerons, plus half-axles, each with bungee cord shock-absorber, attached to compression frame. Wide track, with tundra tyres. Mainwheels 6.00-6; steerable tailwheel 200×50. Hydraulic brakes. AeroComp SF 1400 floats and amphibious floats optional.

POWER PLANT: One 59.6 kW (79.9 hp) Rotax 912 UL or 73.5 kW (98.6 hp) Rotax 912 ULS flat-four piston engine, driving a Warp Drive ground-adjustable pitch propeller. Fuel capacity 80 litres (21.1 US gallons; 17.6 Imp gallons) in wing tanks; optionally 100 litres (26.4 US gallons; 22.0 Imp gallons) in fuselage tank.

DIMENSIONS, EXTERNAL:

Wing span	9.55 m (31 ft 4 in)
Length overall	6.70 m (21 ft 11¾ in)
Height overall	1.80 m (5 ft 10¾ in)

AREAS:

Wings, gross	15.13 m² (162.9 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: Ultralight	255 kg (562 lb)
Max T-O weight: Ultralight landplane	450 kg (992 lb)
floatplane	490 kg (1,080 lb)
amphibious floatplane	550 kg (1,212 lb)

PERFORMANCE (Rotax 912 ULS at 450 kg; 992 lb):

Normal cruising speed	95 kt (176 km/h; 109 mph)
Stalling speed	32 kt (60 km/h; 37 mph)
T-O run	50 m (165 ft)
Landing run	100 m (330 ft)
Endurance (absolute)	5 h 15 min
g limits	+6/−4

HALLEY

HALLEY KFT

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PRESIDENT: Zoltán Molnár

Apollo Aircraft formed at Eger in 1980 by Mr Molnár. First product (1981) was P21 hang glider. Hungarian agent for Rotax engines in 1990. Renamed Halley Kft in 1992. Also produces Jet Star, Delta Jet and Racer GT flex-wings. Had sold more than 1,000 flex-wings by 2003. Workforce 25; factory area 2,500 m² (26,900 sq ft).

HALLEY APOLLO FOX

TYPE: Side-by-side ultralight.

PROGRAMME: Derived from Apollo Classic prototype (HA-YNBA). First flight 1998. Certified in Belgium, Croatia, France, Hungary, Romania and Sweden. In 2003, an Apollo Fox flew from Hungary to Australia without the assistance of a ground support team. US agent, Tampa Bay Aerosport, pursuing SLA approval in 2006.

CUSTOMERS: More than 50 sold by 2003.

COSTS: USD43,500 with Rotax 582 engine; USD56,000 with Rotax 912 ULS; both excluding tax (2006).

DESIGN FEATURES: Built to conform to British BCAR Section S regulations. High, constant-chord wing attached to upper longerons and braced to lower longerons by streamline V struts with vertical intermediate struts. Braced tailplane and sweptback fin. Wings foldable in 10 minutes.

FLYING CONTROLS: Manual. Junkers flaperons, tailplane and rudder.

STRUCTURE: Welded steel/chrome molybdenum fuselage with Ceconite fabric covering. Wing of two aluminium spars with 14 main and 13 auxiliary ribs; Ceconite covering.

LANDING GEAR: Tricycle or tailwheel type; fixed. Two faired-in side Vs with half-axles sprung under centre fuselage. Current nosewheel option has forward inclined leg with combined intermediate brace/compressed rubber shock-absorber and fuselage-mounted spring aluminium cantilever mainwheel legs. Optional mechanical drum or hydraulic disc brakes.

POWER PLANT: One 59.6 kW (79.9 hp) Rotax 912 or 73.5 kW (98.6 hp) Rotax 912 ULS flat-four; or 48.0 kW (64.4 hp) Rotax 582 two-cylinder, liquid-cooled piston engine; or 74.6 kW (100 hp) Subaru EA81 flat four, or 59.7 kW (80 hp) Jabiru 2200. Wooden two-blade propeller or ground-adjustable pitch three- or four-blade propellers of glass fibre or carbon fibre. Fuel tanks in wings, combined capacity 70 litres (18.5 US gallons; 15.4 Imp gallons) of which 60 litres (15.9 US gallons; 13.2 Imp gallons) are usable.

Halley Apollo Fox instrument panel 1159288

DIMENSIONS, EXTERNAL:

Wing span	9.15 m (30 ft 0 in)
Length overall	5.80 m (19 ft 0¼ in)
Height overall	1.78 m (5 ft 10 in)

DIMENSIONS, INTERNAL:

Cabin max width	1.10 m (3 ft 7¼ in)

AREAS:

Wings, gross	11.40 m² (122.7 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	285 kg (628 lb)
Max T-O weight	550 kg (1,212 lb)

PERFORMANCE:

Never-exceed (VNE)	108 kt (200 km/h; 124 mph)
Cruising speed with Rotax 912	92 kt (170 km/h; 106 mph)
Stalling speed	35 kt (64 km/h; 40 mph)
Max rate of climb at S/L (solo)	1,325 m (4,347 ft)/min
T-O run	120 m (394 ft)
Landing run	200 m (656 ft)
Range	432 n miles (800 km; 497 miles)
g limits	+4/−2

Halley Apollo Fox with aluminium cantilever mainwheel legs 1159287

India

ADA

AERONAUTICAL DEVELOPMENT AGENCY

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PROJECT DIRECTOR, TECHNOLOGY DEVELOPMENT AND LCA NAVY: Dr T G Pai

The ADA, an autonomous organisation under the Defence Research and Development Organisation (DRDO) of the Indian Ministry of Defence, was created in 1984 to be responsible for design and development of the next-generation Light Combat Aircraft (LCA), which had been authorised in 1983, made its maiden flight in early 2001 and was named Tejas in May 2003; manufacturing partner is Hindustan Aeronautics Ltd (HAL). Several laboratories of the Defence Research and Development Organisation (DRDO) have also contributed to the LCA programme, initial production of which was approved in 2002. Also participating in Indo-Russian Transport Aircraft (IRTA-21), an international programme in the form of the Ilyushin/IAPO/HAL Il-214.

ADA TEJAS

English name: Radiant
TYPE: Multirole fighter.
PROGRAMME:

DEVELOPMENT MILESTONES

Feasibility study began	83
Project definition completed	late 88
Prototype construction started	mid-91
FSED Phase 1 authorised	Jun 93
Rolled out	17 Nov 95
First flight	4 Jan 01
FSED Phase 2 authorised	Nov 01
Initial production approved	Mar 02
Public debut	4 May 03
First supersonic flight	1 Aug 03

Development, as Light Combat Aircraft (LCA), approved by Indian government in 1983 as MiG-21 replacement; Indian Air Force Air Staff Requirement issued October 1985; project definition begun second quarter 1987, completed late 1988, with first flight then predicted for April 1990 and service entry in about 1995. However, due to early slippages, basic design not finalised until 1990; construction by HAL started mid-1991. FSED Phase 1 sanctioned by Indian government in June 1993; Phase-2 authorised November 2001. Aircraft named Tejas (pronounced thay' jus) by Indian Prime Minister at public debut on 4 May 2003.

Programme delays further exacerbated by May 1998 US embargo on supplies and assistance following India's refusal to sign nuclear non-proliferation treaty, necessitating all-Indian completion of development of integration of digital AFCS and some other systems (aircraft is inherently unstable and thus unable to fly without AFCS). However, sanctions lifted on 22 September 2001 and deliveries of air data and initial sensors by BAE Systems Controls (ex-Lockheed Martin) freed to resume in 2003. Development of indigenously developed radar said to be on schedule at that time. Additional USD125 million released in May 1999 to accelerate remaining development.

Phase 1 of flight test programme completed by April 2004 (100th test flight 3 March), in which envelope expanded to M1.4 speed and 11,750 m (38,550 ft) altitude during approximately 200 hours by TD1/2 and PV1; 400th test flight made on 9 May 2005; 500th on 9 March 2006 and 573 (189, 222, 133, 28 and one) flights (by five aircraft) as of 1 December 2006. All aircraft from PV2 onwards are described as being to full production standard.

IOC now expected to be declared with delivery of half a squadron in 2008; full operational clearance by December 2010.

Meanwhile, parallel programme by Gas Turbine Research Establishment (GTRE) at Bangalore to develop Kaveri turbofan as indigenous power plant has also suffered considerable slippage, resulting in early decision to power prototypes with General Electric F404-GE-F2J3, 11 of which were initially purchased and ground runs of which began 9 April 1998. Bench trials of Kaveri reportedly totalled some 1,200 hours (of 8,000 required) by early 2003, but flight trials (planned to be flown in Russia in Tu-16 testbed) not started by that date. Technological assistance reportedly offered by SNECMA and Eurojet to help achieve new flight test target date of mid-2004, but flight testing still unreported by late 2005, when Indian MoD openly appealed for international participation in completing Kaveri development. Meanwhile, cost of Kaveri programme reassessed by early 2005 at INR28 billion (USD640 million). ADA revealed in February 2006 award of contract to SNECMA for assistance in engine programme, plus plans to deliver one to Russia for flight testing from June to September 2006, now to take place on an Il-76 testbed instead of Tu-16. Test engine then to be returned for installation in PV1, requiring modification of intakes and fuselage contours. Re-engined PV1 said to begin flight testing "well into" 2007.

To offset delays in Kaveri programme, at least first eight and next 20 production aircraft now to be fitted with F404, in addition to prototypes. Further 17 F404s ordered in February 2004 (for 2006 delivery) and 40 more in 2005; former batch will be of uprated F404-GE-IN20 version and power first eight limited production aircraft and two naval prototypes.

ADA Tejas prototype TD1 1128959

CURRENT VERSIONS (specific): **TD1:** First prototype (TD: technology demonstrator); IAF serial number KH2001. Single-seat, F404-F2J3 engine. Rolled out 17 November 1995, then nine months behind already much-revised schedule. Several subsequent postponements of new (June 1996) target date for first flight, this eventually taking place 4 January 2001. Manufacturer's initial flight tests completed with 12th sortie on 2 June 2001, reaching 8,000 m (26,250 ft) altitude, 18° AoA and M0.71 speed. First supersonic flight targeted for January 2002 and eventually achieved (M1.08) on 1 August 2003; 55 flights by 6 November 2003, 115 by 4 January 2005, 172 by 10 February 2006 and 189 by 1 December 2006.

TD2: Rolled out (KH2002) 14 August 1998. Single-seat, F404-F2J3 engine. Scheduled to fly September 2001, but not achieved until 6 June 2002; 64 flights by 6 November 2003, 131 by 4 January 2005, 217 by 12 April 2006 and 222 by 1 December 2006. Marginally lighter empty weight than TD1, increased usable fuel and Indian-developed HUD.

PV1: Third development aircraft (PV: prototype vehicle). Single-seat, F404-F2J3 engine. Targeted to fly 2002, but not rolled out (KH2003) until 4 May 2003, making maiden flight 25 November 2003; 75 flights by 4 January 2005, 130 by 5 June 2006 and 133 by 1 December 2006. Reportedly some 746 kg (1,645 lb) lighter than TD1 and 2 due to greater use of composites.

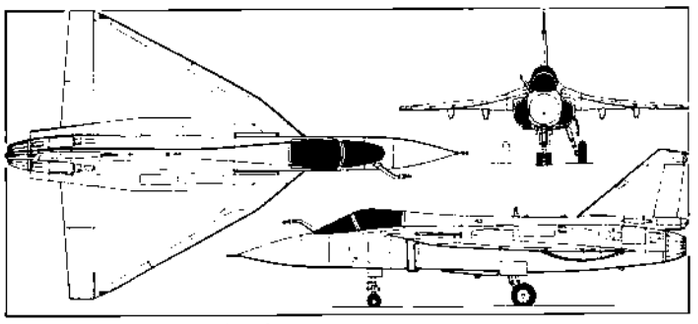
PV2: Fourth development aircraft; under construction 2003; 'nearing completion' March 2004. Maiden flight (KH2004) targeted for February 2005; achieved 1 December 2005; 13 flights by 2 June 2006 and 28 by 1 December 2006. Single-seat, F404-F2J3 engine. Scheduled as first to have indigenous radar, after this completes its flight test in a HAL HS 748 testbed.

PV3: Fifth development aircraft (KH2005). Single-seat, F404-F2J3 engine. First flight targeted for October 2005, but not achieved until 1 December 2006.

PV4: Sixth development aircraft. Single-seat, F404-F2J3 engine.

PV5: Final Indian Air Force development aircraft. Two-seat operational trainer, F404-F2J3 engine. Some commonality with naval variant.

Tejas prototype PV2, first flown 1 December 2005 1128958



ADA Tejas light combat aircraft *(Mike Keep)* 0110517

NP1: First Indian Navy prototype. Two-seat, F404-IN20 engine. Landing gear designed for sink rate of up to 7 5 m (24.6 ft)/s compared with about 3.2 m (10.5 ft)/s of land variants. First flight targeted for 2007. Max T-O weight 12,500 kg (27,557 lb); external stores load reduced to 3,000 kg (6,614 lb); max carrier landing weight 9,500 kg (20,944 lb).

NP2: Second Indian Navy prototype. Single-seat, F404-IN20 engine.

CURRENT VERSIONS (general): **Tejas:** Single-seat version for Indian Air Force. *As described.*

Tejas Trainer: Tandem two-seat operational trainer; PV-5 prototype under development. Maiden flight reportedly targeted for March 2007.

Tejas Navy: Carrierborne version; 4° drooped nose, new centre fuselage, arrester hook, long-stroke landing gear with twin nosewheels, retractable canards and movable vortex controls ('levcons') at the wingroot leading-edge. Design approved early 1999; development approved by Indian government in mid-2002; full scale engineering development started March 2003. Designed to operate from carrier deck with 14° ski-jump after 195 m (640 ft) deck run.

CUSTOMERS: Indian Air Force (requirement for 200 single-seat and 20 trainers); Indian Navy may order up to 40 single-seaters. First eight for IAF approved in MoU March 2002; production by HAL at Bangalore Initial contract for 20 anticipated in 2005, with option for further 20. These 40 expected to comprise 32 single- and eight two-seaters

COSTS: Phase 1 (TD1 and TD2) costs, including engine, estimated at approximately INR30 billion (USD675 million) by late 2000. Estimated unit cost, based on 220 production total, US$D17 million to USD20 million (2001). Revised estimate for first 20 production aircraft quoted as INR20 billion (USD444.4 million) (2005).

DESIGN FEATURES: Tail-less delta planform with relaxed static stability; shoulder-mounted delta wings with compound sweep on leading-edges; large twist from inboard to outboard leading-edges; wing-shielded, side-mounted, fixed-geometry Y-duct air intakes. Advanced materials for minimum structural weight; fly-by-wire and HOTAS controls; high agility; supersonic at all altitudes; wide range of external stores.

FLYING CONTROLS: Hydraulically actuated two-segment trailing-edge elevons and three-section leading-edge slats; vortex-shedding inboard leading-edges with inboard slats to form vortices over wingroot and fin; airbrake in top of fuselage each side of vertical fin; these and rudder also actuated hydraulically. Levcon (leading-edge vortex controller) at wingroot of naval version as secondary control surface to aid low-speed deck landing.

STRUCTURE: Advanced materials include aluminium-lithium alloy, carbon composites and titanium alloys; CFRP wings (including elevons), fin (except GFRP tip) and rudder; Kevlar radome. Wings manufactured with one-piece CFRP top and bottom skins, bolted on to wing box; majority of spars and ribs in composites. Fin, rudder, elevons, airbrakes and landing gear doors embody co-cured, co-bonded techniques. Carbon fibre composites to be increased from 30 per cent of airframe weight in TD1/2 to 42 per cent in PVs, with corresponding reduction of aluminium alloys from 57 to 43 per cent

Hindustan Aeronautics (HAL) responsible for fuselage, communications system, electrical system, mechanical system LRUs and utility systems management; Aeronautical Development Establishment (ADE) flight control system, cockpit displays and display processors; National Aerospace Laboratories (NAL) responsible for development of fin and fabrication of rudder.

LANDING GEAR: Hydraulically retractable tricycle type Single inward-retracting mainwheels; twin-wheel forward-retracting and steerable nose unit DRDL carbon disc brakes; computer-controlled brake management system. ADRDE brake-chute in fairing at base of rudder. Sink rate of naval version 7.5 m (24.6 ft)/s.

POWER PLANT: *TD1, TD2 and PV-1 to -5:* One 80.1 kN (18,000 lb st) General Electric F404-GE-F2J3 afterburning turbofan.

NP-1, NP-2 and initial production aircraft: One 83.2 kN (18,700 lb st) General Electric F404-GE-IN20 afterburning turbofan, with FADEC.

Later production aircraft: Indian GTRE GTX-35VS Kaveri turbofan (52 0 kN; 11,700 lb st dry, 80.5 kN; 18,100 lb st with afterburning), with digital engine control unit (KADECU), under development. Multi-axis thrust vectoring nozzle planned.

Internal fuel in wing and fuselage integral tanks. Fixed in-flight refuelling probe on starboard side of front fuselage. Provision for up to three 1,200 or five 800 litre (317 or 211 US gallon; 264 or 176 Imp gallon) external fuel tanks on wing inboard, mid-board and underfuselage stations.

ACCOMMODATION: Pilot only, on Martin-Baker zero/zero ejection seat. Canopy opens sideways to starboard. Development will include two-seat training version.

SYSTEMS: Hydraulic system (by HAL) for powered flying controls, brakes and landing gear; electrical system for fly-by-wire and avionics power supply; Spectrum Infotech environmental control system for cockpit, radar and fuel tanks; lox system; HAL GTSU-110 gas turbine starter unit; aircraft-mounted accessory gearbox; USMS for aircraft utilities systems management. All utility systems (fuel, hydraulic, environmental control, electrical and brake management) are controlled by microprocessors.

AVIONICS (PRODUCTION VERSION): Avionics systems have capability to monitor health of main utility systems

Comms: HAL V/UHF (with built-in ECCM) and standby UHF radios and audio management unit; HAL air-to-air/air-to-ground secure datalink; HAL IFF transponder/interrogator.

Radar: Electronics Research and Development Establishment (ERDE)/HAL multimode radar with multitarget search and track-while-scan and ground mapping functions; coherent pulse Doppler system, with look-up/look-down modes, Doppler beam-sharpening and moving target indication.

Flight: Quadruplex digital fly-by-wire AFCS. RLG-based INS; provision for GPS/INS; HAL RAM 1701A radio altimeter.

Instrumentation: NVG-compatible 'glass cockpit'; two Bharat Electronics active matrix, reconfigurable 76 × 76 mm (3 × 3 in) colour LCD MFDs; Bharat Electronics (CSIO-designed) collimated HUD; dedicated LCD 'get-you-home' panel; LCD multifunction keyboard

Mission: Three multiplexed MIL-STD-1553B digital databusses; 32-bit, Power PC/VME64-based mission computer operating in Ada, backed up by a second, equally powerful computer; IRST; laser range-finder/designator pod. Provision for reconnaissance, EW or other sensor pods Helmet-mounted display/sight.

Self-defence: EW suite, by Advanced Systems Integration and Evaluation Organisation (ASIEO), includes radar warning receiver, self-protection jammer, laser warning system, missile approach warning system, countermeasures dispensing system and chaff/flare dispenser.

ARMAMENT: GSh-23 twin-barrel 23 mm gun with 220 rounds in blister beneath starboard engine intake trunk. Eight external stores stations (three under each wing, one on fuselage centreline and one beneath port intake trunk) for wide range of short/medium-range air-to-air missiles, PGMs, air-to-surface (including anti-ship) missiles, targeting or ECM pod, unguided rockets, conventional and retarded bombs, and cluster bomb dispensers. Indigenous Astra active radar-guided ASM under development by DRDL. Underwing stations stressed for loads of 1,200 kg (2,646 lb) inboard, 800 kg (1,764 lb) centre and 150 kg (331 lb) outboard; centreline station also 1,200 kg; port intake trunk station can carry 200 kg (441 lb) pod (FLIR, IRST, laser designator or reconnaissance). All except outboard underwing stations are wet for carriage of drop tanks.

DIMENSIONS, EXTERNAL:

Wing span	8.20 m (26 ft 10¾ in)
Wing aspect ratio	1.8
Length overall	13.20 m (43 ft 3¾ in)
Height overall	4.40 m (14 ft 5¼ in)
Wheel track	2.20 m (7 ft 2½ in)
Wheelbase	4.34 m (14 ft 2¾ in)

AREAS:

Wings, gross	approx 38.40 m² (413.3 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	approx 5,500 kg (12,125 lb)
Max external stores load	more than 4,000 kg (8,818 lb)
T-O weight (clean)	approx 8,500 kg (18,740 lb)
Wing loading (clean)	approx 221.4 kg/m² (45.35 lb/sq ft)
Power loading (TD1 and 2, clean)	106 kg/kN (1.04 lb/lb st)

PERFORMANCE (estimated):

Max level speed at altitude	M1.8
Service ceiling	above 15,240 m (50,000 ft)
g limits	+9/−3.5

ADA MEDIUM COMBAT AIRCRAFT (MCA)

The DRDO is studying an advanced version of the Tejas under the above designation, as a potential replacement for Indian Air Force Jaguars and Mirage 2000s from about 2010. Conceptual design has begun, and specifications were continuing to be defined by the Indian Air Force in 2005-06 The single-seat, tail-less delta MCA is intended to embody stealth technology, be powered by two non-afterburning variants of the GTRE Kaveri turbofan with thrust vectoring, carry laser-guided weapons and have a greater range than the Tejas. Other design features are planned to include the adoption of radar-absorbent materials; twin outward-canted tailfins; and overwing external fuel tanks. Design and development costs were provisionally estimated at USD2.3 billion in 1996 dollars.

WEIGHTS AND LOADINGS(approx):

T-O weight: clean	12,000 kg (26,455 lb)
max	18,000 kg (39,685 lb)

CSIR

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HEAD OF CCADD AND SARAS PROJECT MANAGER: Dr K Yegna Narayan

Design and development of the Saras twin-turboprop business and commuter transport is nearing fruition as an Indian programme, having previously appeared in the International section under the Myasishchev/NAL heading and latterly under that of the Indian National Aerospace Laboratories (NAL). It has received Rs 1.58 billion (US$33 million) funding from various Indian government agencies and is currently under the leadership of CSIR, which has created the Centre of Civil Aircraft Design and Development (CCADD) to act as the nodal agency to monitor and manage the programme. Many Indian public and private sector industries are participating in the venture, with manufacture of production components being carried out in 35 work centres across the country. Final assembly will be by NAL.

CSIR SARAS

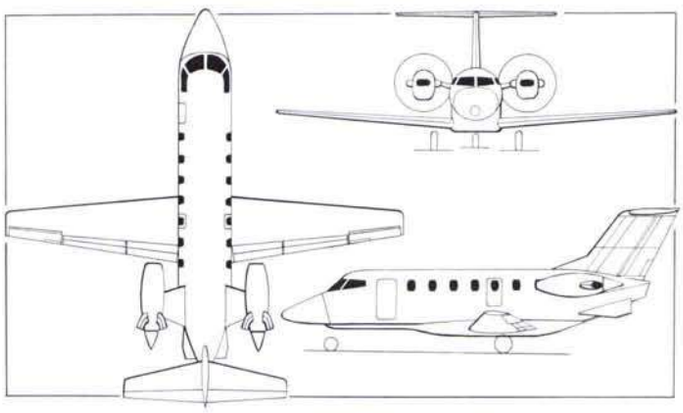
English name: Crane

TYPE: Twin-turboprop transport.

PROGRAMME: Originated as six/nine-passenger light transport shown in model form at Moscow Aerospace '90 exhibition; revised design announced by Myasishchev 1993, with name Delphin; India had comparable project; general agreement concluded 1993 to combine Myasishchev and Indian programmes, Russian version being known as M-102 Duet and Indian version as Saras (species of Indian crane). Full-scale mockup shown at 1993 and 1995 Moscow Air Shows. Prototype construction (two in Russia, one in India originally) planned to begin in September 1994, but Indian share of private venture capital not secured until early 1996. Detailed engineering began in April 1996 following finalisation of design late in previous year; however, in 1997 Myasishchev was proceeding with unilateral development of the similar M-202, yet by 2001, was again promoting M-102 version; neither has progressed to the prototype stage in Russia. In early November 2001, Russia and India signed a protocol on construction of the M-102/Saras.

India elected to continue with the Saras as a national programme, although some collaboration with the former Russian partner was not ruled out. Government secured private backing of Taneja Aerospace and Kumaran Industries, plus financial support from the Indian Technology Development Board. Hindustan Aeronautics Ltd also became a

CSIR Saras in flight *(Patrick Allen)* 1136946



CSIR Saras twin-turboprop transport *(James Goulding)* 0130859

major partner in the development programme and to build production aircraft at Nasik. Release of further government funding in mid-1999 enabled work to begin on manufacture (by HAL) of two flying prototypes and a structural test airframe. First prototype (VT-XSD) reported in February 2001 to be 80 per cent complete, with first flight then expected by end of 2001, but in following month, programme management board called for "rigorous weight control exercise". Roll-out 4 February 2003; first engine run conducted 30 October 2003; first flight 29 May 2004, followed by second flight on 7 June 2003. 'Inaugural' flight of 22 August 2004 was seventh sortie, performed for VIPs. Flew 50th sortie on 28 April 2006. Registration VT-XRM reserved for second prototype, scheduled to fly during 2005, but unreported, and to join the 500-hour flight test programme leading to FAR Pt 25 certification in 2007, and first customer deliveries in 2008.

CURRENT VERSIONS: **Saras:** Initial variant, *as described*.

Saras-S: Stretched 22- to 25-seat version, first publicly revealed in model form at Asian Aerospace 2004 in Singapore in February 2004 and expected to become standard production model. Provisional data includes: maximum T-O weight 7,900 kg (17,416 lb); maximum fuel 900 kg (1,984 lb); maximum speed at 9,140 m (30,000 ft) 249 kt (462 km/h; 287 mph); cruising speed 239 kt (442 km/h; 275 mph); T-O run 880 m (2,887 ft); service ceiling 9,140 m (30,000 ft); max rate of climb at S/L 826 m (2,170 ft)/min; range with max payload at FL300 540 n miles (1,000 km; 621 miles).

CUSTOMERS: At least 250 Indian orders forecast over 15 years. Indian Air Force has initial requirement for six, to replace Dornier 228s, by 2005; Indian Coast Guard also considering Saras as Dornier 228 replacement.

COSTS: Design and development cost quoted in February 1996 as USD40 million. Late in 1996, cost re-estimated as USD60 million, including flight test phase. Indian government approved INR1.3 billion (USD30 million) in June 1999 to enable prototype manufacture to begin. Estimated unit price USD3.75 million (2001).

DESIGN FEATURES: Suitable for operations in hot-and-high conditions (typically, airfield at 2,000 m; 6,560 ft, at up to 45°C), and from semi-prepared runways. Unconventional twin pusher propeller configuration. High aspect ratio, low-mounted wings, with straight taper; pressurised circular-section fuselage; T tailplane on sweptback fin; engines pylon-mounted each side of rear fuselage.

Wing section GA(W)-2 (modified); leading-edge sweep 5°; thickness/chord ratio 15 per cent; 4° dihedral; 2° incidence; 2° twist.

FLYING CONTROLS: Conventional and manual. Tabs in all control surfaces; electrically operated pitch, roll and yaw trim; yaw damper; spoilers and 25 per cent chord, single-slotted Fowler flaps; dual-channel three-axis autopilot. Highly swept ventral fins provide nose-down pitching moment at high AoA.

STRUCTURE: Mixed construction of aluminium alloy (fuselage, engine pylons and fixed portion of wing) and composites (nosecone, wing/body fairing, wing moving surfaces and tips); designed for 30,000 hour life; fail-safe philosophy for all primary structures and major attachments; incorporates damage tolerance features. Two-spar wing with integrally milled skin riveted to stringers; two-spar flaps with honeycomb sandwich filler; single-spar ailerons with honeycomb filler; single-piece, two-spar metal tailplane and three-spar metal fin.

LANDING GEAR: Hydraulically retractable tricycle type, with single mainwheels and single steerable (±53°) nose unit. Mainwheels retract inward into wingroot fairings, nosewheel forward. Oleo-pneumatic shock-absorbers. Mainwheels 26×8.75, pressure 5.52 bar (80 lb/sq in); nosewheel 17.5×6.3, pressure 3.79 bar (55 lb/sq in); air-cooled carbon brakes. Minimum turning radius 8.10 m (26 ft 7 in) at nosewheel.

POWER PLANT: Two 634 kW (850 shp) Pratt & Whitney Canada PT6A-66 turboprops, pylon-mounted on sides of rear fuselage; Hartzell five-blade, constant-speed pusher propellers, rotating in opposite directions. Integral fuel tank in each wing, combined capacity 1,608 litres (425 US gallons; 354 Imp gallons), of which 1,595 litres (421 US gallons; 351 Imp gallons) are usable. Gravity refuelling point in port wing upper surface; optional single-point pressure refuelling point at starboard wingroot.

ACCOMMODATION: Two-person flight deck with dual controls, but to be certified also for one-pilot operation. Alternative layouts for 14 economy class passengers in single seats at 76 cm (30 in) pitch, with centre aisle, rear lavatory and total of 1.1 m³ (39 cu ft) for baggage in forward and rear compartments; or 18 passengers in commuter layout. Typical executive interior could have eight seats, tables, wardrobe, baggage compartment, galley and lavatory. Ambulance version capable of carrying six stretchers, with seats for two medical attendants, medical supplies storage, baggage compartment and lavatory. Various passenger/cargo arrangements or special mission interiors optional in combi version. Door at front on port side, hinged downward, with integral airstairs; overwing Type III emergency exit on each side. Baggage compartment door on port side of tailcone.

SYSTEMS: Bootstrap environmental control system and pneumatic cabin pressure control system; cabin pressure differential 0.45 bar (6.5 lb/sq in). Hydraulic system (pressure 207 bar; 3,000 lb/sq in) for landing gear actuation, brakes and nosewheel steering; 4 litres (1.06 US gallons; 1.27 Imp gallons)/min electrically powered hydraulic pump; pneumatic system for emergency lowering of landing gear.

Primary electrical power is 28 V DC, supplied by two 12 kW starter/generators; 43 Ah Ni/Cd battery provides emergency power for essential loads for approximately 30 minutes, including three engine restarts. Two solid-state inverters supply 115/26/5 V AC power at 400 Hz for instrumentation; AC power for anti-icing and windscreen heating obtained via alternators. Emergency oxygen system for crew and passengers (two 1,400 litre; 49.4 cu ft bottles), plus two 122 litre (4.3 cu ft) portable bottles and masks for first aid. Engine fire and cabin smoke detection systems. Halon fire extinguishing system. De-icing boots on wing leading-edge nacelle intakes.

AVIONICS: Integrated digital system (ARINC 429 compatible).

Comms: VHF (two), optional HF, intercom/PA system, TCAS II transponder and CVR.

Radar: Weather radar.

Flight: Autopilot (dual-channel, three-axis), ADF, VOR/ILS, marker beacon receiver, DME, radar altimeter, air data sensor and computer, AHRS, flight control computer and flight director standard; GPS, satcom, Selcal and flight management system optional.

Instrumentation: Four-tube EFIS; 'return home' standby instrumentation.

DIMENSIONS, EXTERNAL:

Wing span	14.70 m (48 ft 2¾ in)
Wing chord: at c/l	2.65 m (8 ft 8¼ in)
at tip	0.85 m (2 ft 9½ in)
Wing aspect ratio	8.4
Length overall	15.02 m (49 ft 3¼ in)
Fuselage: Length	13.90 m (45 ft 7¼ in)
Max diameter	1.95 m (6 ft 4¾ in)
Height overall	5.20 m (17 ft 0¾ in)
Tailplane span	6.09 m (19 ft 11¾ in)
Wheel track	3.20 m (10 ft 6 in)
Wheelbase	6.465 m (21 ft 2½ in)
Propeller diameter	2.16 m (7 ft 1 in)
Propeller ground clearance	1.30 m (4 ft 3¼ in)
Distance between propeller centres	3.89 m (12 ft 9 in)
Passenger door (fwd, port): Height	1.48 m (4 ft 10¼ in)
Width	0.75 m (2 ft 5½ in)

DIMENSIONS, INTERNAL:

Cabin: Length	7.74 m (25 ft 4¾ in)
Max width	1.80 m (5 ft 10¾ in)
Aisle width at floor	0.54 m (1 ft 9¼ in)
Max height	1.72 m (5 ft 7¾ in)
Floor area	7.08 m² (76.2 sq ft)
Volume	21.3 m³ (752 cu ft)
Baggage hold volume: fwd, stbd	0.64 m³ (22.6 cu ft)
rear, port	0.46 m³ (16.2 cu ft)

AREAS:

Wings, gross	25.70 m² (276.6 sq ft)
Ailerons (total)	1.27 m² (13.71 sq ft)
Trailing-edge flaps (total)	3.99 m² (42.93 sq ft)
Spoilers (total)	0.65 m² (7.00 sq ft)
Fin	5.70 m² (61.40 sq ft)
Rudder, incl tab	1.81 m² (19.45 sq ft)
Tailplane	7.00 m² (75.35 sq ft)
Elevators, incl tabs	2.05 m² (22.07 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, equipped	4,116 kg (9,074 lb)
Max fuel weight	1,326 kg (2,923 lb)
Max payload	1,232 kg (2,716 lb)
Max T-O and landing weight	6,100 kg (13,448 lb)
Max zero-fuel weight	5,348 kg (11,790 lb)
Max wing loading	237.4 kg/m² (48.61 lb/sq ft)
Max power loading	4.81 kg/kW (7.91 lb/shp)

PERFORMANCE (estimated):

Never-exceed speed (VNE)	372 kt (690 km/h; 428 mph)
Max level speed at FL250	283 kt (524 km/h; 326 mph)
Econ cruising speed at FL250	216 kt (400 km/h; 249 mph)
Stalling speed at S/L, power off:	
flaps up	96 kt (178 km/h; 111 mph)
flaps down	78 kt (145 km/h; 90 mph)
Max rate of climb at S/L	700 m (2,297 ft)/min
Rate of climb at S/L, OEI	130 m (427 ft)/min
Max certified altitude	9,100 m (29,860 ft)
Service ceiling	11,000 m (36,090 ft)
Service ceiling, OEI	6,000 m (19,680 ft)
T-O run	720 m (2,362 ft)
T-O field length	1,000 m (3,280 ft)
Landing field length	1,200 m (3,937 ft)
Landing run	720 m (2,362 ft)
Runway LCN	10
Range, IFR reserves:	
with 8 passengers	756 n miles (1,400 km; 870 miles)
with 14 passengers	216 n miles (400 km; 248 miles)
self-ferry	1,038 n miles (1,924 km; 1,195 miles)
Endurance	5 h

HAL

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DIRECTOR, CORPORATE PLANNING AND MARKETING: M Fakruddin
GENERAL MANAGER, MARKETING: Air Cdre (Retd) B Banerjee
CHIEF OF MEDIA COMMUNICATIONS: Anantha Krishnan

Hindustan Aircraft (Pvt) Ltd, established at Bangalore in 1940, was taken over by the Indian Ministry of Industry and Supplies in 1945, transferring to Ministry of Defence control in 1951. In August 1963, Hindustan Aeronautics Ltd (HAL) was incorporated as a wholly government-owned entity, adopting its present existence upon merging (with no change of name) with Aeronautics India Ltd (AIL) on 1 October 1964. HAL has manufactured more than 3,500 aircraft (12 types of in-house design and 13 types by licensed manufacture) and 3,540 aero-engines. It has 14 manufacturing divisions at eight locations (seven at Bangalore, one each at Nasik, Koraput, Hyderabad, Barrackpore, Kanpur, Lucknow and Korwa), plus Design and Development Complex; nine R&D centres located with manufacturing divisions; all divisions have ISO 9000, 9001 and 9002 accreditation. Workforce 30,000 in late 2004. Hyderabad Division manufactures avionics for all aircraft produced by HAL, plus air route surveillance and precision approach radars; Lucknow Division produces instruments and other accessories under licence from manufacturers in France, Russia and the UK; Korwa manufactures inertial navigation and nav/attack systems.

Former Multirole Transport Aircraft (MTA) project now an international joint venture (IRTA-21: Indo-Russian Transport Aircraft, 21st century) with Ilyushin and IAPO of Russian Federation.

Turnover during 2004–05 totalled INR4.425 billion; net profit during this period was INR0.63 billion, representing percentage increases over 2003-04 of 16 and 5 respectively.

Major elements of HAL are:

DESIGN AND DEVELOPMENT COMPLEX *Follows this entry*
BANGALORE COMPLEX *Follows Design and Development Complex*
TRANSPORT AIRCRAFT DIVISION *Follows Bangalore Complex*
MIG COMPLEX *Follows Transport Aircraft Division*
ACCESSORIES COMPLEX
PO Box 215, Lucknow 226 016
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MANAGING DIRECTOR: K Umamaheshwar

Comprises Lucknow (Accessories), Hyderabad (Avionics) and Korwa (Avionics) Divisions.

DESIGN AND DEVELOPMENT COMPLEX

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Fateh Singh (ARDC)
N H Venkatesh (RWRDC)

HAL currently has nine Research and Design (R&D) Centres, including one each for fixed-wing aircraft (ARDC) and rotary-wing (RWRDC) programmes. Former's main programmes are LCA Tejas (managed by ADA) and HJT-36 Sitara; latter concerned mainly with Dhruv ALH. Transport Aircraft R&D Centre was responsible for developing oversize cabin door, integration of Super Marec radar, gun pod, IR/UV scanner and flight data recorder for HAL-built Dornier 228 programme. Earlier designs have included HT-2, Pushpak, Krishak, Basant, Marut, Kiran, Deepak and HTT-34. Jet trainer successor to Kiran was revealed as HJT-36 in 1998; flight testing began in 2003. Complex had workforce of 1,901 in 2003.

HAL LCH

TYPE: Multirole medium helicopter.

PROGRAMME: Derivative of Dhruv (which see); displayed in model form at Paris Air Show, June 2001 as LAH (light attack helicopter) proposal, but was restyled LCH, signifying light combat. Original slimmed-down 'gunship' fuselage now discarded and basic Dhruv airframe retained except for forward fuselage modified to tandem crew seating. Officially launched 5 February 2003 and replaces earlier LOH programme, which now to be met by foreign design. LCH scheduled to fly within two years of government go-ahead. Primary intention is to replace Indian Army Cheetah and Chetak, but now being developed for multirole applications. Prospects improved by 2004 decision to reduce planned buy of 198 foreign combat helicopters to only 35, with LCH making up shortfall. First flight believed targeted for 2007.

Artist's impression of HAL Light Combat Helicopter 0576665

COSTS: INR300 million earmarked for design and development (2003).

DESIGN FEATURES: Generally as for Dhruv except for modified nose section with tandem crew seating. Four-blade hingeless main rotor with swept blade tips. Intended for anti-tank, close air support, air-to-air combat and scout roles. All weather, high-altitude operability.

STRUCTURE: Extensive use of composites to reduce radar signature.

LANDING GEAR: Non-retractable and crashworthy tricycle type.

POWER PLANT: Two 895 kW (1,200 shp) Turbomeca/HAL TM333-2C2 Ardiden 1H turboshafts (Indian name Shakti) with FADEC, derated to 798 kW (1,070 shp). Crashworthy fuel system.

ACCOMMODATION: Crew of two in tandem; ergonomic cockpit.

SYSTEMS: Four-axis autostabilisation system; anti-resonance isolation system (ARIS). Dual-redundant electrical and hydraulic systems as for Dhruv.

AVIONICS: *Radar:* Requirement for maritime/overland surveillance radar.
Flight: Digital AFCS and nav/com as for Dhruv.
Instrumentation: Dual night attack MFDs in each cockpit.
Mission: FLIR, TV and laser range-finder/designator; helmet-mounted sights.
Self-defence: Radar and laser warning receivers; MAWS; chaff/flare dispenser.

ARMAMENT: Undernose 20 mm cannon. Stub-wing hardpoints for ASMs, ATMs, AAMs or rocket launchers.

DIMENSIONS, EXTERNAL:

Main rotor diameter	13.20 m (43 ft 3¾ in)
Length: fuselage	13.94 m (45 ft 8¾ in)
overall, rotors turning	15.86 m (52 ft 0½ in)
Height to top of rotor head	5.27 m (17 ft 3½ in)
Stub-wing span	4.43 m (14 ft 6½ in)
Wheel track	2.50 m (8 ft 2½ in)

WEIGHTS AND LOADINGS:

Max T-O weight	5,500 kg (12,125 lb) class

PERFORMANCE (estimated):

Never-exceed speed (VNE)	178 kt (330 km/h; 205 mph)
Max cruising speed	151 kt (280 km/h; 174 mph)
Service ceiling	6,500 m (21,320 ft)
Range with standard fuel	378 n miles (700 km; 435 miles)

HAL HJT-36 SITARA

English name: Star

TYPE: Basic jet trainer/light attack jet.

PROGRAMME:

DEVELOPMENT MILESTONES

Design started	97
Revealed	Feb 98
Mockup displayed	Dec 98
Development contract awarded	Jul 99
Production approval	Jan 01
First flight	7 Mar 03
Official first flight	21 Mar 03

Revealed at Singapore Air Show, February 1998; design started 1997. Conceived as IJT (Intermediate Jet Trainer) successor to IAF HJT-16 Kiran second-stage pilot trainer. Mockup, with Thales (Sextant) avionics suite, exhibited at Air India Show in December 1998, differed considerably in appearance from general arrangement released at Singapore. Indian government contract valued at USD42 million awarded in July 1999, covering completion, flight test (4,500 hours) and certification of prototypes; avionics contract placed June 2001. First metal cut July 2001; structural assembly began January 2002; systems integration started December 2002; roll-out 26 December 2002; first taxi tests February 2003. Maiden flight of first prototype (S3466) 7 March 2003; 'inaugural' (official) first flight 21 March 2003 was seventh sortie; about 50 flights by 1 February 2004; second prototype (S3474), with full 'glass cockpit' and digital avionics, flew on 26 March 2004; about 150 flights by first two prototypes by June 2005. Second prototype shown at Aero India, February 2005; international debut at Paris, June 2005.

Surprise announcement by HAL in second quarter 2004 indicated that Larzac power plant to be replaced for production aircraft by still-in-development Saturn AL-55 turbofan, produced by Ufa Engine Building Association (UMPO). Sitara production start will be correspondingly delayed (from late 2004/early 2005), since delivery of first batch of Russian engines not expected before 2006 at the earliest. Indo-Russian agreement for licensed manufacture of AL-55I signed 16 August 2005; initially, HAL will build 250 engines, with options for up to 750 more. Will also power HJT-39 if that programme goes ahead.

CUSTOMERS: Indian Air Force and Navy as replacement for existing fleet of approximately 170 Kirans from about 2005. Government provisional approval for 211 awarded in January 2001, 187 for Indian Air Force and 24 for Indian Navy; total production expected to be between 210 and 250. Announced 6 February 2003 that initial order would be 16 for IAF; these to be preceded by LSP (limited series production) batch of 12.

COSTS: Development cost INR4.67 billion (2005).

DESIGN FEATURES: Capable of high-speed training, but with simple handling at low speeds; cockpit layout compatible with current combat aircraft; some 25 per cent of LRUs are common with ADA Tejas. Conventional, low-wing CAD/CAM design (HAL's first) with moderate (18°) wing leading-edge sweepback and 2° dihedral. NACA 64-series aerofoil (t/c ratio 15 per cent at root, 12 per cent at tip).

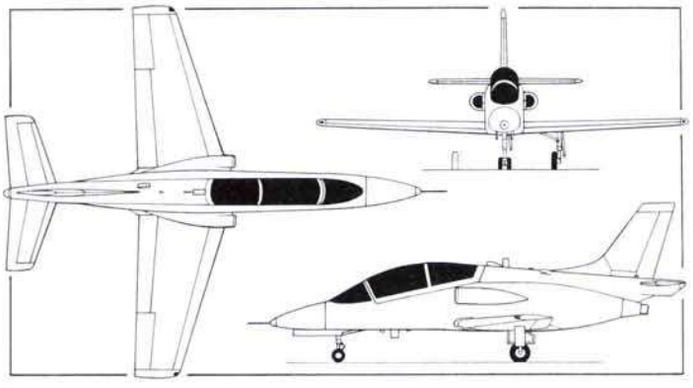
FLYING CONTROLS: Conventional. Manually operated ailerons and rudder with electric trim; electrically actuated, horn-balanced elevators. Flaps. Large perforated airbrake under rear fuselage.

STRUCTURE: Light alloy and composites. Intended fatigue life of more than 7,500 hours, extendable to 10,000 hours.

LANDING GEAR: Hydraulically retractable tricycle type. Inward-retracting main units, forward-retracting twin nosewheels.

POWER PLANT: Prototypes powered by one 14.12 kN (3,175 lb st) SNECMA Larzac 04-H20 non-afterburning turbofan in rear fuselage, fed by bifurcated air intake. Saturn/UMPO 21.6 kN (4,850 lb st) AL-55I non-afterburning turbofan selected in April 2004 for production aircraft; to be manufactured under licence by HAL. Fuel tanks in fuselage and wings. Usable fuel capacity 1,150 litres (304 US gallons; 253 Imp gallons).

HAL HJT-36 Sitara second prototype *(Paul Jackson)* 1158006



Provisional general arrangement of the HAL HJT-36 jet trainer *(Michael Badrocke)* 0572160

ACCOMMODATION: Crew of two in tandem, on Zvezda K-36LT lightweight zero/zero ejection seats; rear (instructor's) seat raised. One-piece canopy opens sideways to starboard. Forward vision over nose −8°.

SYSTEMS: Hydraulic system for landing gear actuation and wheel brakes. Electrical system powered by 9 kW engine-driven starter/generator and two 43 Ah Ni/Cd batteries. Gaseous oxygen system.

AVIONICS: Smiths Aerospace integrated system, with units supplied by French, German and Indian manufacturers, comprising dual V/UHF comms, open systems architecture mission computer, HUD (Elop), HUD repeater, GPS, AHRS, active matrix LCDs (Thales), air data computers and rear cockpit data entry panel.

ARMAMENT: One underfuselage and four underwing weapons pylons for bombs, rocket pods and gun pods.

DIMENSIONS, EXTERNAL:

Wing span	9.80 m (32 ft 1¾ in)
Wing aspect ratio	5.5
Length overall	10.91 m (35 ft 9½ in)
Height overall	4.13 m (13 ft 6½ in)
Wheel track	2.51 m (8 ft 2¾ in)
Wheelbase	4.525 m (14 ft 10¼ in)

AREAS:

Wings, gross	approx 17.5 m² (188.4 sq ft)

WEIGHTS AND LOADINGS (approx):

Max external stores load	1,000 kg (2,204 lb)
Max fuel weight (usable)	917 kg (2,022 lb)
T-O weight: clean	3,500 kg (7,716 lb)
max	4,500 kg (9,920 lb)

PERFORMANCE (estimated):

Max operating Mach No.	0.8
Max permissible diving speed	445 kt (824 km/h; 512 mph)
Max level speed at S/L	378 kt (700 km/h; 435 mph)
Service ceiling	12,000 m (39,370 ft)
Range (standard fuel)	540 n miles (1,000 km; 621 miles)
Endurance	3 h
g limits	+7.0/−2.5

HAL HJT-39

TYPE: Advanced jet trainer/light attack.

PROGRAMME: Announced at Aero India, February 2005, as Combat Attack Trainer (CAT) 'initiative to develop' for Indian Air Force AJT (Advanced Jet Trainer) requirement, specifications for which being in final stages by IAF at the time; would compete for this with any additional orders for BAE Hawk. Mockup of front fuselage and cockpit shown. Projected to fly within three and a half years of go-ahead; airframe commonality with HJT-36 Sitara, avionics comparable with those of HJT-36 and Tejas. As of second quarter 2006, no go-ahead had been given.

CUSTOMERS: Potential Indian Air Force requirement for about 100; possibility of export sales.

Following details all provisional.

DESIGN FEATURES: Substantially a twin-engined derivative of HJT-36.

FLYING CONTROLS: Digital fly-by-wire.

POWER PLANT: Proposed with two 21.6 kN (4,850 lb st) Saturn/UMPO AL-55I non-afterburning turbofans.

ACCOMMODATION: Tandem seating, with elevated rear seat.

SYSTEMS: Optional OBOGS.

AVIONICS: To include CSIR/Bharat Electronics HUD and up-front control panel (UFCP) and HAL mission computer.

WEIGHTS AND LOADINGS:

External stores load	2,000 kg (4,409 lb)
Max T-O weight	7 tonne (15,430 lb) class

PERFORMANCE:

Max level speed	Transonic

BANGALORE COMPLEX

Post Bag 1785, Bangalore 560 017
Tel: (+91 80) 522 82 30
Fax: (+91 80) 522 95 64
MANAGING DIRECTOR: A K Saxena

Bangalore Complex comprises Aircraft Division, Helicopter Division, Aerospace Division, Engine Division, Overhaul Division, Foundry and Forge Division, Industrial and Marine Gas Turbines Division, and Airport Services Centre. Programmes include subcontract work for leading aerospace companies such as BAE Systems, EADS, Airbus France, Boeing and Latécoère. Aircraft Division will complete 50 of 66 BAE Hawk Mk 132s ordered on 26 March 2004 for the Indian Air Force (eight from CKD kits, 42 by local manufacture, after delivery of 16 UK-built aircraft from BAE); first UK deliveries due in 2007.

Aerospace Division manufactures light alloy structures and assemblies for satellites and launch vehicles. Engine Division manufactures, overhauls and repairs Adour Mk 811, Artouste IIIB and TPE331-5 engines; it also overhauls and repairs Adour Mk 804E, Dart, Gnome, Orpheus and Avon engines. Overhaul of Jaguar, Kiran, Mirage and An-32 aircraft, Cheetah helicopters and Pratt & Whitney and Textron Lycoming piston engines is undertaken by Overhaul Division.

AIRCRAFT DIVISION:
Post Bag 1788, Bangalore 560 017
Tel: (+91 80) 522 89 69
Fax: (+91 80) 522 51 88
GENERAL MANAGER: G Parasuramireddy

Main programmes Jaguar International production and upgrade; composites and metal drop tanks; Dornier 228 landing gears; sheet metal items; forward passenger doors for Airbus A320 family (600 shipsets initially; contract renewed and expanded to 1,000 sets in July 2004; about 500 sets delivered at that time); overwing emergency exits and other parts for Boeing 737, 757, 767 and 777. Floor area 125,100 m² (1,346,565 sq ft); workforce 2,102 in January 2003.

HELICOPTER DIVISION:
Post Bag 1790, Bangalore 560 017
Tel: (+91 80) 523 86 02
Fax: (+91 80) 523 47 17
GENERAL MANAGER: S M Kapoor

Manufacture and overhaul of Cheetah, Chetak, Lancer and Dhruv light helicopters. MoU in February 2004 for local production of rotor blades for Bell 206. Agreement with Eurocopter in 2005 to manufacture components for AS 350/550.

HAL (SEPECAT) JAGUAR INTERNATIONAL

Indian Air Force name: Shamsher (Assault Sword)

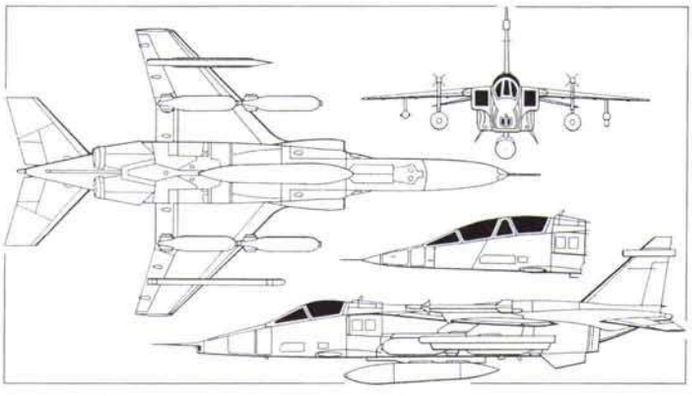
TYPE: Attack fighter.

Comprehensive details in Jane's Aircraft Upgrades; *following refers to Indian versions.*

PROGRAMME: Forty (including five two-seat) Jaguar Internationals with Adour Mk 804 engines delivered from UK, beginning March 1981; 45 more with Adour Mk 811s and new DARIN nav/attack system assembled in India, making first flight (JS136) 31 March 1982; IOC achieved 1984 and FOC 1985. Further 31 manufactured under licence in India (first delivery early 1988); deliveries of further 15, ordered 1993, were completed by March 1999 with delivery of last three of this batch. Indian government ordered additional batch of 17 two-seaters in March 1999. These being equipped with upgraded DARIN II nav/attack system and employed in a night attack role with laser-guided weapons; eight delivered to Indian Air Force by September 2004; further nine on 15 July 2005. Letter of intent for further 20 single-seaters has been received, which would extend Jaguar production until 2007; these also would have upgraded DARIN II nav/attack system and new LRMTS.

CURRENT VERSIONS: **Jaguar B(I)**: Two-seat trainer version; 15 delivered; further 15 on order with DARIN II nav/attack system, laser designator pod and modified fin; first eight of these due for delivery by end March 2004.

SEPECAT Jaguars in Indian service *(IAF)* 1042741



Jaguar single-seat tactical support aircraft and scrap view of two-seat operational trainer *(Mike Keep)* 1158036

Jaguar S(I): Standard single-seat strike version; 106 delivered; further 20 scheduled to follow.

Jaguar Maritime: Jaguars of IAF No. 6 Squadron, assigned to anti-shipping role, have Agave radar, interfaced with DARIN nav/attack system and Sea Eagle anti-shipping missiles; first modified aircraft delivered January 1986; 12 ordered, of which all delivered by end of 1999. To be upgraded by substitution of Elta EL/M-2032 for Agave, with which flight trials were under way in 2002. In 2001, deliveries began of a further two Jaguar M.

CUSTOMERS: Indian Air Force received 132, comprising 117 single-seat (including 12 Maritime) and 15 two-seat combat-capable trainers. Further 15 Jaguar Bs and two Ms (ordered 1999) in production for delivery from 2003; additional 20 single-seaters expected to follow. Basic strike version equips Nos. 5 ('Tuskers') and 14 ('Bulls') Squadrons at Ambala and Nos. 16 ('Cobras') and 27 ('Flaming Arrows') Squadrons at Gorakhpur; anti-shipping version equips 'A' Flight of No. 6 ('Dragons') Squadron at Pune.

DESIGN FEATURES: Purpose-designed attack aircraft. Shoulder-wing monoplane. Anhedral 3°. Sweepback 40° at quarter-chord. Outer leading-edges fitted with slat which also gives effect of extended chord. Tail unit sweepback at quarter-chord 40° on horizontal, 43° on vertical surfaces; tailplane anhedral 10°. Ventral fins beneath rear fuselage.

FLYING CONTROLS: Fairey Hydraulics powered flying controls. No ailerons; control by two-section spoilers, forward of outer flap on each wing, in association (at low speeds) with differential tailplane. Hydraulically operated (by screwjack) full-span double-slotted trailing-edge flaps. Leading-edge slats can be used in combat. All-moving slab-type tailplane, the two halves of which can operate differentially to supplement the spoilers.

STRUCTURE: Wing is an all-metal two-spar torsion box structure; skin machined from solid aluminium alloy, with integral stiffeners. Main portion built as single unit, with three-point attachment to each side of fuselage. Fuselage all-metal, mainly aluminium, built in three main units and making use of panels and, around the cockpit(s), honeycomb panels. Local use of titanium alloy in engine bay area. Two door-type airbrakes under rear fuselage, immediately aft of each mainwheel well. Structure and systems aft of cockpit(s), identical for single-seat and two-seat versions. The tail unit is a cantilever all-metal structure, covered with aluminium alloy sandwich panels. Rudder and outer panels and trailing-edge of tailplane have honeycomb core.

LANDING GEAR: Messier-Hispano-Bugatti retractable tricycle type, all units having Dunlop wheels and low-pressure tyres for rough field operation. Hydraulic retraction, with oleo-pneumatic shock-absorbers. Forward-retracting main units each have twin wheels, tyre size 615×225-10, pressure 5.8 bar (84 lb/sq in). Wheels pivot during retraction to stow horizontally in bottom of fuselage. Single rearward-retracting nosewheel, with tyre size 550×250-6 and pressure 3.9 bar (57 lb/sq in). Twin landing/taxying lights in nosewheel door. Dunlop hydraulic brakes. Anti-skid units and arrester hook standard. Irvin brake parachute of 5.5 m (18 ft 0 in) diameter in fuselage tailcone.

POWER PLANT: Two HAL-built Rolls-Royce Turbomeca Adour Mk 811 turbofans (Phase 3 aircraft onwards), each rated at 25.0 kN (5,620 lb st) dry and 37.4 kN (8,400 lb st) with afterburning. Fixed-geometry air intake on each side of fuselage aft of cockpit. Fuel in six tanks, one in each wing and four in fuselage. Total internal fuel capacity 4,200 litres (1,110 US gallons; 924 Imp gallons). Armour protection for critical fuel system components. Provision for carrying three auxiliary drop tanks, each of 1,200 litres (317 US gallons; 264 Imp gallons) capacity, on fuselage and inboard wing pylons. Provision for in-flight refuelling, with retractable probe forward of cockpit on starboard side.

ACCOMMODATION: Jaguar S(I) has enclosed cockpit for pilot, with rearward-hinged canopy and Martin-Baker Mk 9B zero/zero ejection seat. Jaguar B(I), crew of two in tandem on Martin-Baker Mk 9B Srs II zero/zero ejection seats. Individual rearward-hinged canopies. Rear seat 38 cm (15 in) higher than front seat. Windscreen bulletproof against 7.5 mm rifle fire.

SYSTEMS: Air conditioning and pressurisation systems for cockpit(s) also control temperature in certain equipment bays. Two independent hydraulic systems, powered by two engine-driven pumps. Hydraulic pressure 207 bar (3,000 lb/sq in). First system (port engine) supplies one channel of each actuator for flying controls, hydraulic motors which actuate flaps and slats, landing gear retraction and extension, brakes and anti-skid units. Second system supplies other half of each flying control actuator, two further hydraulic motors actuating slats and flaps, airbrake and landing gear emergency extension jacks, nosewheel steering and wheel brakes. In addition, there is a hydraulic power transfer unit and an emergency electrohydraulic pump.

Electrical power provided by two 15 kVA AC generators, either of which can sustain functional and operational equipment without load shedding. DC power provided by two 4 kW transformer-rectifiers. Emergency power for essential instruments provided by 40 Ah battery and static inverter. De-icing, rain clearance and demisting standard. Liquid oxygen system, which also pressurises pilot's anti-*g* trousers.

Jaguar is fully power-controlled in all three axes and is automatically stabilised as a weapons platform by gyros which sense disturbances and feed appropriate correcting data through a computer to the power control assemblies, in addition to human pilot manoeuvre demands. Power controls are all of duplex tandem arrangement, with mechanical and electrical servo-valves of Fairey platen design. Air-to-air combat capability can be enhanced by inclusion of roll/yaw dampers, to increase lateral stability, and by increasing slat and flap angles.

AVIONICS: HAL-manufactured DARIN (display attack and ranging inertial navigation) nav/attack system initially, incorporating INS, HUDWAC, COMED, interconnected MIL-STD-1553B dual-redundant databus and interfaced with LRMTS. The 17 new two-seaters and (when ordered) additional 20 strike versions will be fitted with DARIN II system incorporating new RLG/INS with GPS, new HUD and smart MFDs (see below); HOTAS upgrade postponed.

Comms: Main (20-channel) V/UHF; standby UHF and HAL COM 326A HF transceivers (being replaced by Incom integrated com system); IFF-400 AM transponder (single-seaters only).

Radar: Thales Avionics Agave originally in Maritime version, interfaced with DARIN system; planned to be replaced by Elta EL/M-2032.

Flight: SAGEM ULISS 82 INS (to be replaced by RLG/INGPS); HAL ADF and radar altimeter. Indian autopilot under development.

Instrumentation: Smiths HUDWAC (head-up display and weapon aiming computer) (to be replaced by Elbit HUD and dual HAL-developed mission computers); BAE Systems COMED 2045 (combined map and electronic display) to be replaced by Thales (Sextant) digital autopilot and 152 × 152 mm (6 × 6 in) smart multifunction display (SMFD), ordered November 1999.

Mission: Laser ranger and marked target seeker (LRMTS). Provisional selection of Rafael Litening laser designation pod announced February 1996.

Self-defence: Marconi RWR (replaced by Indian unit in DARIN II); active and passive ECM. Chaff dispenser added in DARIN II.

ARMAMENT: Two 30 mm Aden guns in lower fuselage aft of cockpit in single-seater, with 150 rds/gun; single Aden on port side in two-seater (to be removed to accommodate self-protection jammer). One stores attachment on fuselage centreline and two under each wing. Centreline and inboard wing points can each carry up to 1,134 kg (2,500 lb) of weapons, outboard underwing points up to 567 kg (1,250 lb) each. Typical alternative loads include one air-to-surface missile and two 1,200 litre (317 US gallon; 264 Imp gallon) drop tanks; eight 1,000 lb bombs; various combinations of free-fall, laser-guided, retarded or cluster bombs; overwing R.550 Magic missiles; air-to-surface rockets; or a reconnaissance camera pack. Maritime Jaguars equipped with one or two Sea Eagle anti-shipping missiles.

DIMENSIONS, EXTERNAL:

Wing span	8.72 m (28 ft 7¼ in)
Wing aspect ratio	3.1
Length overall, incl probe:	
single-seat	16.955 m (55 ft 7½ in)
two-seat	17.52 m (57 ft 6 in)
Height overall	4.89 m (16 ft 0½ in)
Wheel track	2.40 m (7 ft 10½ in)
Wheelbase	5.69 m (18 ft 8 in)

INDIAN AIR FORCE JAGUARS

Mark/Variant	Serial Nos.	Assembled[1]	Remarks	Qty
GR. Mk 1	JI003 to 018	BAe	Loaned by/returned to RAF[2]	(16)
S(I)	JS101 to 135	BAe	Phase 2; Adour 804, NAVWASS	35
	JS136 to 170	HAL	Phase 3; Adour 811, DARIN	35
	JS171 to 194	HAL	Phase 4; Adour 811, DARIN	24[3]
	JS195 to 205	HAL	Phase 5; Adour 811, DARIN	11
Maritime	JM251 to 258	HAL	Phase 4; Adour 811, DARIN, Agave	8[3]
	JM259 to 262	HAL	Phase 5; Adour 811, DARIN, Agave	4
	JM263 to 264	HAL	Phase 6	2
T. Mk 2	JI001 to 002	BAe	Loaned by/returned to RAF[2]	(2)
B(I)	JT051 to 055	BAe	Phase 2; Adour 804, NAVWASS	5
	JT056 to 065	HAL	Phase 3; Adour 811, DARIN	10
	JT066 to ?	HAL	Phase 6; night attack, Adour 811, DARIN II	17
Total				**151 (18)**

[1] All co-built by (SEPECAT) BAe and Dassault

[2] Adour 804 engines and NAVWASS nav/attack avionics; two single-seat lost in Indian service

[3] Phase 4 originally planned as 56 aircraft of entirely local manufacture; amended to 32 kits

AREAS:
Wings, gross ..... 24.03 m² (258.7 sq ft)
WEIGHTS AND LOADINGS:
Typical weight empty ..... 7,000 kg (15,432 lb)
Max external stores load (incl overwing) ..... 4,763 kg (10,500 lb)
Normal T-O weight (single-seater, with full internal fuel and ammunition for built-in cannon) ..... 10,954 kg (24,149 lb)
Max T-O weight with external stores ..... 15,700 kg (34,612 lb)
Max wing loading ..... 653.3 kg/m² (133.79 lb/sq ft)
Max power loading ..... 210 kg/kN (2.06 lb/lb st)
PERFORMANCE:
Max level speed at S/L ..... M0.98 (648 kt; 1,200 km/h; 745 mph)
Max level speed above 6,000 m (19,680 ft) ..... M1.5 (907 kt; 1,680 km/h; 1,044 mph)
Touchdown speed ..... 115 kt (213 km/h; 132 mph)
Service ceiling ..... 13,715 m (45,000 ft)
T-O run, clean: ..... 565 m (1,855 ft)
with four 1,000 lb bombs ..... 880 m (2,890 ft)
with eight 1,000 lb bombs ..... 1,250 m (4,100 ft)
T-O to 15 m (50 ft) with typical tactical load ..... 940 m (3,085 ft)
Landing from 15 m (50 ft) with typical tactical load ..... 785 m (2,575 ft)
Landing run:
normal weight, with brake-chute ..... 470 m (1,540 ft)
normal weight, without brake-chute ..... 680 m (2,230 ft)
overload weight, with brake-chute ..... 670 m (2,200 ft)
Typical attack radius, internal fuel only:
hi-lo-hi ..... 460 n miles (852 km; 530 miles)
lo-lo-lo ..... 290 n miles (537 km; 334 miles)
Typical attack radius with external fuel:
hi-lo-hi ..... 760 n miles (1,408 km; 875 miles)
lo-lo-lo ..... 495 n miles (917 km; 570 miles)
Range with max external fuel ..... 1,400 n miles (2,593 km; 1,611 miles)
g limits ..... +8.6 (+12 ultimate)/−3

HAL DHRUV

English name: Polaris

TYPE: Light utility helicopter.

PROGRAMME:

DEVELOPMENT MILESTONES

Agreement with MBB	Jul 84
Design started	Nov 84
Rolled out	29 Jun 92
First flight	20 Aug 92
First flight (military)	28 May 94
First flight (naval)	23 Dec 95
First flight (civil)	6 Mar 02
First delivery (Coast Guard)	18 Mar 02
First civil order (Azal)	5 Feb 03
Certification (civil)	Oct 03

Agreement signed with MBB (Germany) July 1984 to support design, development and production of Advanced Light Helicopter (ALH); design started November 1984; ground test vehicle runs began April 1991; five flying prototypes (two basic, one air force/army, one naval and one civil); PT1 first prototype (Z3182) rolled out 29 June 1992, first flight 20 August and 'official' first flight 30 August 1992; PT2 second prototype (Z3183) made its first flight 18 April 1993; PT-A (army/air force prototype Z3268) on 28 May 1994; PT-N (naval prototype), with CTS 800 engines, flew for first time (IN901) on 23 December 1995. Total hours flown, including 'hot-and-high' trials in environments of 45°C (113°F) and more than 6,000 m (19,680 ft), were about 1,500. Military certification of air force/army, naval and coast guard versions completed in March 2002.

Naval trials by PT-N conducted in March 1998 aboard aircraft carrier INS *Viraat* and smaller decks of other Indian Navy vessels. May 1998 US trade embargo, imposed following India's refusal to sign nuclear test ban treaty, blocked import of CTS 800 engines (30 ordered) and delayed planned first flight of PTC-2 civil fifth prototype (VT-XLH) with this engine until 6 March 2002. Instead, all current variants now powered by TM 333, including retrofit of PT-N prototype; contract announced 7 February 2003 for HAL to co-develop and co-produce Turbomeca Ardiden 1H (Indian name Shakti) for future, higher-powered Army and Air Force versions of Dhruv. Weight reduction programme initiated in mid-1998; RFPs issued later same year for cockpit display system. By the end of 1998, manufacture was well advanced of three preproduction aircraft (PPN-1, PPA-2 and PPA-3; one for each of the three armed services).

Deliveries (four each to Indian Air Force and Army, two each to Navy and Coast Guard) were due to begin in late 1999 but programme slipped; new schedule provided for first two (to Army) instead becoming due for delivery by end of 2001, to be followed by two each to Coast Guard, Navy and Air Force by the end of March 2002. Seven deliveries actually achieved by this date: Army two (IA-1101 and -1103) starting 20 March 2002, Air Force two (J-4041/4042 on 20 March), Navy two (IN-701/702 on 28 March) and Coast Guard (CG-851 on 18 March) one. However, Army's IA-1102 had been delivered for trials use earlier, on 4 January 2002. Indian Navy user trials conducted on board INS *Godavari* in November 2002. Eight more scheduled for delivery by 31 March 2003, of which Indian Navy received two on 24 March; total deliveries had increased to 18 by June 2003 (Army eight, Air Force four, Navy and Coast Guard three each). Initial batch of 30 TM 333-2B2 ordered in mid-1999 to power first 12 (including two civil) production Dhruvs; all then intended for delivery by 2002. Further 52 TM 333s ordered mid-2000 to power next 20; deliveries of these almost completed by February 2003. Additional contract at that time for over 300 TM 333s (some of which to re-engine Cheetahs) and Ardidens, former type for delivery from early 2004.

Development and marketing agreement between HAL and Israel Aircraft Industries announced in late 2002; involves both Dhruv and LCH derivative; IAI (Lahav) to concentrate on integrated avionics package and other internal systems. Second prototype (PT2) equipped in 2003 as demonstrator, with suite including 'glass cockpit', MAWS and NVGs.

Indian Air Force Sarang (Peacock) display team formed 2003; made public debut at Aero India and Asian Aerospace air show, Singapore, February 2004. Four Dhruvs in extensive demonstration to Chilean armed forces in mid-2004.

CURRENT VERSIONS: **Air force/army:** Skid gear, crashworthy fuel tanks, bulletproof supply tanks, IR and flame suppression; night attack capability; roles to include attack and SAR.

Naval: Retractable tricycle gear, SV-2000 surveillance radar, harpoon decklock, pressure refuelling; fairings on fuselage sides to house mainwheels, flotation gear and batteries.

Civil: Roles to include passenger and utility transport, commuter/offshore executive, rescue/emergency medical service and law enforcement. Wheel landing gear. Prototype targeted to fly in 2001, but this not achieved until 6 March 2002; DGCA certification received October 2003. Entered production in 2003. Launch customer Azal India Helicopter (one ordered 5 February 2003, for delivery later that year). Two civil Dhruvs ordered early 2005 by provincial government of Jharkand; first of three, ordered June 2005 by Indian Oil and Natural Gas Corporation, was handed over 11 August 2005.

Coast Guard: High commonality with naval version; nose-mounted surveillance radar; roof-mounted FLIR; starboard side, cabin-mounted 7.62 mm machine gun; radar console and operator's seat; liferaft, loudhailer.

LCH: Light attack development: *described separately*.

CUSTOMERS: Indian government requirement for armed forces and Coast Guard, to replace Chetaks/Cheetahs; letter of intent for 300 (Army 110, Air Force 150, Navy/Coast Guard 40) followed by contract for 100 in late 1996, but allocation revised by 2001 as Army 120, Navy 120, Air Force 60 and Coast Guard seven; all to be delivered by 2015. Initial Indian Army aircraft to 201 Squadron. Second production lot contains 20. HAL predicts total military/civil domestic orders for about 650.

According to Jane's sources, approx 45 delivered by January 2006 to Indian armed forces (Army 18 to 20, Air Force/Navy about 16); remainder to Coast Guard and various state governments. Two delivered to Royal Nepal Army 13 June 2004. HAL registered (VT-HAR) 77th aircraft as a demonstrator in March 2006.

COSTS: Unit price of basic aircraft approximately INR250 million (USD5.2 million) (2002). Total programme costs USD170 million by 1997 (latest information provided).

DESIGN FEATURES: First modern helicopter of local design and construction. Conventional layout, including high-mounted tailboom to accommodate rear-loading doors. Four-blade hingeless main rotor with advanced aerofoils and sweptback tips; Eurocopter FEL (fibre elastomer) rotor head, with blades held between pair of cruciform CFRP starplates; manual blade folding and rotor brake standard; integrated drive system transmission; four-blade bearingless crossbeam tail rotor on starboard side of fin; fixed tailplane; sweptback endplate fins offset to port; vibration damping by Lord AVCS (active vibration control system), comprising four isolator elements between main gearbox and fuselage.

Main rotor blade section DMH 4 (DMH 3 outboard); tail rotor blade section S 102C (S 102E at tip). Rotor speeds 314 rpm (main), 1,564 rpm (tail).

FLYING CONTROLS: Integrated dynamic management by four-axis AFCS (actuators have manual as well as AFCS input); constant-speed rpm control, assisted by collective anticipator (part of FADEC and stability augmentation system acting through AFCS).

Indian Army HAL Dhruv 1037984

Naval version of the Dhruv Advanced Light Helicopter, with additional side view (centre) of air force/army variant *(Mike Keep)* 0507145

HAL Dhruv PT2 during demonstrations in Chile 1037983

STRUCTURE: Composites account for some 67 per cent of airframe. Main and tail rotor blades and rotor hub glass fibre/carbon fibre with Rohacell foam core and nickel or stainless steel leading-edge strips; Kevlar nosecone, crew/passenger doors, cowling, upper rear tailboom and most of tail unit; carbon fibre lower rear tailboom and fin centre panels; Kevlar/carbon fibre cockpit section; aluminium alloy sandwich centre cabin and remainder of tailboom.

LANDING GEAR: Non-retractable metal skid gear standard for air force/army version. Hydraulically retractable tricycle gear on naval and civil versions, with twin nosewheels and single mainwheels, latter retracting into fairings on fuselage sides which also (on naval version) house flotation gear and batteries; rearward-retracting nose unit; naval version has harpoon decklock system. Spring skid under rear of tailboom on all versions, to protect tail rotor. FPT Industries (UK) Kevlar inflatable flotation bags for prototypes, usable with both skid and wheel gear.

POWER PLANT: First three, and fifth, prototypes each powered by two Turbomeca TM 333-2B2 or -2C turboshafts, with FADEC, rated at 740 kW (993 shp) for T-O, 783 kW (1,050 shp) maximum contingency and 666 kW (893 shp) maximum continuous. LHTEC CTS 800-4H (998 kW; 1,338 shp) selected late 1994 and test-flown in fourth prototype, but subsequently embargoed; all now to have TM 333-2B2 until availability of 895 kW (1,200 shp) class Ardiden 1H (Shakti). Latter engine will be confined to army and air force Dhruvs, to enhance operation in 'hot and high' conditions. Engine flight testing due to start in mid-2006.

Transmission ratings (two engines) 1,280 kW (1,716 shp) for 30 minutes for T-O and 1,156 kW (1,550 shp) maximum continuous; OEI ratings 800 kW (1,073 shp) for 30 seconds (super contingency), 700 kW (939 shp) for 2½ minutes. Transmission input from both engines combined through spiral bevel gears to collector gear on stub-shaft. AVCS system (see Design Features) gives 6° of freedom damping. Power take-off from main and auxiliary gearboxes for transmission-driven accessories.

Total usable fuel, in self-sealing crashworthy underfloor tanks (three main and two supply), 1,400 litres (370 US gallons; 308 Imp gallons). Pressure refuelling in naval version. Crossfeed and fuel dump systems in all military versions. Provision for carrying additional fuel tanks in cabin.

ACCOMMODATION: Flight crew of two, on crashworthy seats in military/naval versions. Main cabin seats 12 persons as standard, 14 in high-density configuration. EMS interior (first flown by PT2/Z3183 in January 2001) can accommodate two stretchers and four medical attendants, or four stretchers and two medical personnel. Crew door and rearward-sliding door (military) or hinged door (civil) on each side; clamshell cargo doors at rear of passenger cabin.

SYSTEMS: DC electrical power from two independent subsystems, each with a 6 kW starter/generator, with battery back-up for 15 minutes of emergency operation; AC power, also from two independent subsystems, each with a 5/10 kVA alternator. Three hydraulic systems (pressure 207 bar; 3,000 lb/sq in, maximum flow rate 25 litres; 6.6 US gallons; 5.5 Imp gallons)/min: systems 1 and 2 for main and tail rotor flight control actuators, system 3 for landing gear, wheel brakes, decklock harpoon, rescue hoist (naval variant) and optional equipment. Oxygen system.

AVIONICS (early aircraft): *Comms:* V/UHF, HF/SSB and standby UHF com radio, IFF and intercom.

Radar: Weather radar optional. LRDE SuperVision-2000 360° I-band surveillance radar in Navy/Coast Guard version.

Flight: SFIM four-axis AFCS, Doppler navigation system, TAS system, ADF, radio altimeter, heading reference standard. GPS nav system in civil version, with additional VOR/ILS, DME and marker beacon.

Mission: Roof-mounted FLIR in Coast Guard version. EMS version equipped with navaids, patient monitoring, data recording systems, and datalink to transmit medical information to ground-based hospitals.

AVIONICS (IAI upgrade package): Integrated, modular 'glass cockpit' suite includes comprehensive self-defence equipment (radar and laser warning receivers, MAWS and 30-cartridge chaff/flare dispenser each side); day and night observation capability (TV, FLIR and laser rangefinder); targeting system; flexible weapon-carrying capability; four 152 × 203 mm (6 × 8 in) LCDs; INS/GPS navigation (Doppler GPS optional); and standby horizon, ASI and altimeter.

EQUIPMENT: Depending on mission, can include two to four stretchers, external rescue hoist, liferaft and 1,500 kg (3,307 lb) capacity cargo sling.

ARMAMENT: Cabin-side pylons for two torpedoes/depth charges or four anti-ship missiles on naval variant; on army/air force variant, stub-wings which can be fitted with eight anti-tank guided missiles, four pods of 68 mm or 70 mm rockets or two pairs of air-to-air missiles. Army/air force variant can also be equipped with ventral 20 mm gun turret or sling for carriage of land mines. Cabin-mounted 7.62 mm machine gun in Coast Guard version, firing from starboard side doorway.

DIMENSIONS, EXTERNAL:

Main rotor diameter	13.20 m (43 ft 3¾ in)
Main rotor blade chord: inboard	0.50 m (1 ft 7¾ in)
at tip	0.165 m (6½ in)
Tail rotor diameter	2.55 m (8 ft 4½ in)
Length:	
overall, both rotors turning	15.87 m (52 ft 0¾ in)
fuselage (except Coast Guard version)	13.43 m (44 ft 0¾ in)
Height: overall, tail rotor turning:	
army/air force version	4.98 m (16 ft 4 in)
naval version	4.91 m (16 ft 1¼ in)
to top of main rotor head:	
army/air force version	3.93 m (12 ft 10¾ in)
naval version	3.76 m (12 ft 4 in)
Fuselage max width	2.00 m (6 ft 6¾ in)
Width over mainwheel sponsons (naval version)	3.15 m (10 ft 4 in)
Tail unit span (over fins)	3.19 m (10 ft 5½ in)
Wheel track (naval version)	2.80 m (9 ft 2¼ in)
Wheelbase (naval version)	4.37 m (14 ft 4 in)
Skid track (army/air force version)	2.60 m (8 ft 6¼ in)
Tail rotor ground clearance	2.34 m (7 ft 8¼ in)

DIMENSIONS, INTERNAL:

Cabin, excl flight deck: Max width	1.97 m (6 ft 5½ in)
Max height	1.42 m (4 ft 8 in)
Volume	7.33 m³ (259 cu ft)
Cargo compartment volume	2.16 m³ (76.3 cu ft)

AREAS:

Main rotor disc	136.85 m² (1,473.0 sq ft)
Tail rotor disc	5.11 m² (55.0 sq ft)
Main fin	2.126 m² (22.88 sq ft)
Endplate fins (total)	1.45 m² (15.61 sq ft)
Tailplane	2.40 m² (25.83 sq ft)

WEIGHTS AND LOADINGS (A: army/air force standard, B: naval version):

Weight empty, equipped: A	2,550 kg (5,622 lb)
B	2,685 kg (5,919 lb)
Max fuel weight: A	1,075 kg (2,370 lb)
B	1,140 kg (2,513 lb)
Max sling load: A	1,000 kg (2,205 lb)
B	1,500 kg (3,307 lb)
Max T-O weight: A	4,500 kg (9,920 lb)
B	5,500 kg (12,125 lb)
Max disc loading: A	32.9 kg/m² (6.74 lb/sq ft)
B	40.2 kg/m² (8.23 lb/sq ft)
Transmission loading at max T-O weight and power:	
A	3.04 kg/kW (4.99 lb/shp)
B	3.72 kg/kW (6.10 lb/shp)

PERFORMANCE (A and B as above, at MTOW at S/L, ISA + 15°C):

Never-exceed speed (VNE):	
A	178 kt (330 km/h; 205 mph)
B	162 kt (300 km/h; 186 mph)
Max cruising speed: A	143 kt (265 km/h; 165 mph)
B	135 kt (250 km/h; 155 mph)
Econ cruising speed: A	121 kt (225 km/h; 140 mph)
B	119 kt (220 km/h; 137 mph)
Max rate of climb at S/L: A	780 m (2,559 ft)/min
B	600 m (1,968 ft)/min
Service ceiling: A	6,500 m (21,320 ft)
B	4,580 m (15,020 ft)
Hovering ceiling:	
IGE: A	4,400 m (14,435 ft)
B	1,900 m (6,235 ft)
OGE: A	3,800 m (12,470 ft)
B	1,200 m (3,940 ft)
Radius with 2 crew and 10 passengers	120 n miles (222 km; 138 miles)
Range with max fuel, 20 min reserves:	
A	378 n miles (700 km; 435 miles)
B	351 n miles (650 km; 403 miles)
Endurance, conditions as above:	
A	4 h 20 min
B	4 h 0 min

HAL CHEETAH and CHEETAL

TYPE: Light utility helicopter.

PROGRAMME: **Cheetah** is licence-built Aerospatiale SA 315B Lama. Production by HAL for Indian armed forces started 1972. In early 2000, HAL received further orders for production for several years and has taken up employment of 746 kW (1,000 shp) Turbomeca TM 333-2B2 turboshaft to enhance performance. With this engine, aircraft is renamed **Cheetal**. On 2 November 2004, an Indian Air Force Cheetal set a new world record of 7,666 m (25,150 ft) for the highest density altitude landing by a helicopter (equivalent pressure altitude 7,077 m; 23,220 ft).

CUSTOMERS: HAL had delivered 260 (including 20 supplied by France) by mid-2002, at which time manufacture of a batch of 10 for the Indian Air Force was under way, and order for further five anticipated. Re-engining with TM 333-2B2 engines in programme to enhance performance; prototype (Z3455) flew for first time on 1 February 2003; prospect of entire (Indian) fleet retrofit of up to 230 aircraft. Upgrade also includes integrated helmet, countermeasures dispensing system and oxygen system.

Prototype HAL Cheetal (Turbomeca TM 333 turboshaft) ***(Paul Jackson)***

1127714

HAL LANCER

TYPE: Armed observation helicopter.

PROGRAMME: Upgraded, counter-insurgency version of Cheetah. Prototype, rebuilt from late production aircraft Z2867, unveiled late 1998; cabin has lightweight composites armour protection for pilot, control linkages and fuel tank; bulletproof flat-plate transparencies; twin gun/rocket pods. Can be rebuild or new production.

CUSTOMERS: Indian Army order for 12 (converted from Cheetah), of which five delivered March 2002; remainder due to follow during 2003. Ten ordered in November 2001 by Nepal for newly established Armed Police Force. No further orders known by mid-2006.

ACCOMMODATION: Crew of two, side by side; cleared for single-pilot operation.

HAL Lancer prototype, an armed and armoured version of the Cheetah

0099550

ARMAMENT: Tubular metal outrigger each side of cabin, outboard of landing skids, each supporting jettisonable pod containing one 12.7 mm machine gun and three 70 mm unguided air-to-surface rockets. Pilot's gunsight.

WEIGHTS AND LOADINGS:

Basic weight empty: Cheetah	1,090 kg (2,403 lb)
Lancer, incl weapon pods	1,350 kg (2,976 lb)
Fuel weight	393 kg (866 lb)
Ammunition (500 rds) and six rockets	130 kg (287 lb)
Max T-O weight	1,950 kg (4,299 lb)

PERFORMANCE:

Never-exceed speed (VNE)	113 kt (210 km/h; 130 mph)
Cruising speed at S/L, ISA + 20°C	95 kt (176 km/h; 109 mph)
Max rate of climb at S/L	330 m (1,083 ft)/min
Service ceiling	5,400 m (17,720 ft)
Operational radius, incl 30 min over target and 20 min fuel reserves, ISA + 20°C	78 n miles (145 km; 90 miles)
Endurance	2 h 30 min

HAL CHETAK and CHETAN

TYPE: Light utility helicopter.

PROGRAMME: **Chetak** is licence-built Aerospatiale SA 316B Alouette III; remains in production only in India. HAL output had totalled at least 359 (of which 35 built from French kits) by mid-2002. Further orders, to prolong production for several years, received in early 2001. With original Artouste IIIB piston engine replaced by Turbomeca TM 333-2M2 (started January 2005), aircraft is renamed **Chetan**; increases service ceiling to 6,492 m (21,300 ft). First flight in this form took place 1 February 2005.

The TM 333-powered Chetan, which made its maiden flight on 1 February 2005 *(Jane's/Patrick Allen)* 1136588

TRANSPORT AIRCRAFT DIVISION

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GENERAL MANAGER: D K Mahajan

This Division established in 1960 to manufacture Hawker Siddeley (Avro) 748; is currently responsible for manufacture of the Dornier 228, and for overhaul, maintenance and repair of the Dornier 228, HS 748, HAL HPT-32 and civil aircraft. Co-operation agreement with Israel Aircraft Industries 21 February 2002 involves HAL in IAI (Bedek) Boeing 737 freighter conversion programme. Division assisted in design and development, and manufacturing prototypes, of the CSIR Saras (which see); series production at Kanpur is planned. Also plans co-production of ATR 42/72, for which launch order still awaited in early 2005. Co-design and development of Il-214 with Ilyushin and IAPO to fulfill IRTA-21 (Indo-Russian Transport Aircraft, 21st century) requirement.

Division holds ISO 9001 and ISO 14001 accreditation and is equipped with Transport Aircraft Research and Design Centre (TARDC) specialising in role modifications, sensor integration, aircraft upgrades and repair technology.

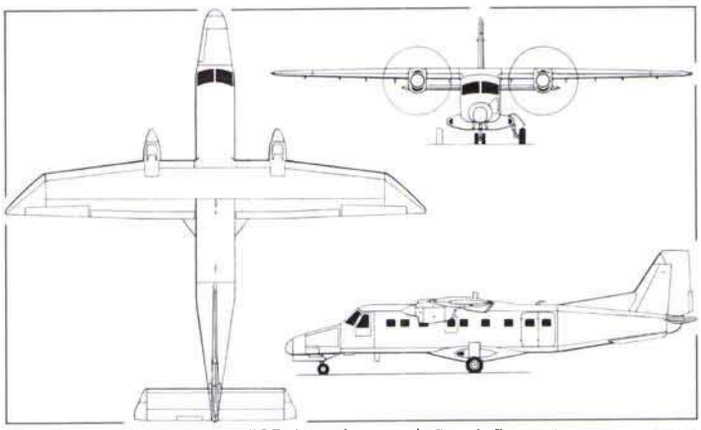
HAL (DORNIER) 228

TYPE: Twin-turboprop transport.

PROGRAMME: First flight of Dornier 228-100 prototype (D-IFNS) in Germany 28 March 1981; first flight 228-200 prototype (D-ICDO) 9 May 1981; British CAA certification 17 April 1984, FAR Pt 23 and Appendix A Pt 135 11 May 1984, Australian 11 October 1985. European production (including 11 for India), is not described here.

Contract for licensed manufacture of up to 150 Dornier 228s in India signed 29 November 1983; one pattern aircraft supplied complete from Germany; production planned in four phases (six, 10, 10 and 43 aircraft respectively), fourth phase representing full local manufacture after production from locally assembled kits; first Phase 1 Kanpur-assembled aircraft (VT-EJN, c/n 1002) handed over to Vayudoot on 1 November 1985 and made maiden flight on 31 January 1986. Full local manufacture from 18th onwards (CG758, first flight 7 March 1991). Indian production programme dormant from

Indian Navy Dornier 228-201 0566569



HAL (Dornier) 228-201 (two TPE331 turboprops) *(Dennis Punnett)* 0507143

first quarter of 1997, but was continuing with production (early 2003) of three for Indian Air Force. Additional 11 aircraft for Indian Navy and Coast Guard were sanctioned by Indian Cabinet Committee on Security on 29 March 2005.

Following discontinuation of German production, worldwide sales and marketing rights held by HAL since November 1998; HAL pursuing export market and anticipates future orders to maintain production for further eight to 10 years. Power plant, landing gear and some avionics also manufactured by HAL to preserve self-sufficiency.

CURRENT VERSIONS: **Regional Airliner:** Ten **228-201**s (five each by Dornier and HAL) delivered to Vayudoot.

Maritime Surveillance: Thirty-six ordered for Indian Coast Guard (including three from Germany, delivered from July 1986); CG754 first flight 18 February 1988; first 18 from Indian production are **228-101**s and were delivered by March 1997. Go-ahead for next batch (seven **228-201**s) received in September 1999; these ordered under USD72 million contract in early 2000, of which all delivered in basic configuration by early 2003, with sensor integration then under way. One to Mauritius Coast Guard in 1990; second delivered in 2004.

In service with Coast Guard Air Squadrons at Daman and Chennai for coastal, environmental and anti-smuggling patrol; 360° Marec 2 search radar under fuselage (replaced in 15 aircraft by Super Marec and last seven to have 360° Elta EL/M-2022A(V)3 radar); Matra infra-red/ultraviolet linescanner for pollution detection. Latest production batch also have IAI Tamam AMOSP and datalinks (see Anti-ship paragraph below). Search and rescue liferafts, searchlight, hand-held aerial camera, bubble windows, side-mounted loudhailer, marine markers, and provision for two Micronair underwing spraypods to combat oil spills; in-flight-openable roller door for parajumping/paradropping. Normal crew two pilots, radar operator and observer. Optional armament includes two underwing 7.62 mm twin-gun pods.

Anti-ship: Indian Navy acquired 25 specially equipped Dornier **228-201**s (ordered in batches of five, 10 and 10). Deliveries began (IN221) on 24 August 1991 for service with INAS 310 ('Cobras') at Dabolim; last batch of 10 completed in 2000. First two batches have Super Marec 360° radar; Elta EL/M-2022A search radar in second batch of 10 (integration of eight completed by early 2003). Apart from radar (360° scan, near-SAR/MTI and track-while-scan) under forward fuselage, current aircraft have IAI Tamam Airborne Multimission Optronic Stabilised Payload (AMOSP) (TV/FLIR/laser range-finder) ball turret in starboard main gear fairing; air/ground data downlink; and cabin consoles for four systems operators with MFDs and moving map display.

Utility transport: Indian Air Force received 25 **228-201**s; deliveries started (HM667 and HM668) 15 December 1987 to Nos. 41 'Otters' and 59 'Hornbills' Squadrons; can carry 21 field-equipped troops on inward-facing composites folding seats; large HAL-developed cargo double door, to meet IAF requirement, at rear, port side. Expectation of IAF follow-on order for further 18, but only three extra aircraft included in batch due for delivery by March 2003; no further orders by April 2006.

Executive/Air taxi: Various configurations including six- or 10-seat executive or 15-passenger air taxi, with customised interior, cabin attendant, work table and galley/wardrobe/lavatory; built-in APU for air conditioning and lighting in flight or on ground. One (VT-EIX) for Indian Oil and Natural Gas Corporation.

CUSTOMERS: HAL deliveries are given in the accompanying table. The company anticipates building a further 56 aircraft beyond the 72 currently produced.

COSTS: USD166 million approved for acquisition of 11 aircraft (2005).

DESIGN FEATURES: Optimised for efficient cruising flight. High wing for propeller clearance, despite minimised fuselage ground clearance and pannier-mounted landing gear. Variable sweep wing leading-edge; unswept tailplane; sweptback fin with dorsal fillet.

Special Dornier wing with Do A-5 supercritical aerofoil; 8° leading-edge sweep on outer wing panels; raked tips; no dihedral or anhedral.

FLYING CONTROLS: Conventional and manual. Variable incidence tailplane with actuator switch on aileron wheel; horn-balanced elevators; rudder trim tab; single-slotted Fowler flaps augmented by drooping ailerons; two strakes under rear fuselage for low-speed stability.

STRUCTURE: Two-spar wing box; mainly light alloy structure, but with CFRP wingtips and tips of tailplane and elevators; GFRP nosecone, tips of rudder and fin; Kevlar landing gear fairings and in part of wing ribs; hybrid composites in fin leading-edge; fuselage unpressurised, built in five sections.

LANDING GEAR: Retractable tricycle type, with single mainwheels and twin-wheel nose unit; main units retract inward into fuselage fairings; hydraulically steerable nosewheels retract forward; Goodyear wheels and tyres, 25.5×8.75-10 (650×220-10) (10/12 ply) or 8.50-10 (10 ply) on mainwheels, 6.00-6 (8 ply), on nosewheels.

POWER PLANT: HAL-built Dornier 228-201s have two HAL-built Honeywell TPE331-5-252D turboprops, each flat rated at 533 kW (715 hp) to ISA +18°C and driving a Hartzell four-blade fully feathering propeller with reverse pitch. Post-2000 production aircraft have HAL-built TPE331-10 series engines; performance improvements of −5 engines through turbine blade enhancements also planned.

Primary wing box forms integral fuel tank with standard usable capacity 2,386 litres (630 US gallons; 525 Imp gallons); can be increased to 2,850 litres (753 US gallons; 627 Imp gallons). Oil capacity per engine 5.9 litres (1.56 US gallons; 1.30 Imp gallons).

ACCOMMODATION: Crew of one or two; pilots' seats adjustable fore and aft; two-abreast seating with central aisle; maximum capacity 19 (more in military versions); commander, AMOSP operator and two radar specialists in Coast Guard version. Flight deck door on port side; combined two-section passenger and freight door, with integral steps, on port side of cabin at rear; one emergency exit on port side of cabin, two on starboard side; baggage

GERMAN/INDIAN DORNIER 228 DELIVERIES
(to January 2005)

Country	Operator	Series	Dornier	HAL/CKD	HAL	Total
India	Air Force	201		5	23	28
	Airports Authority	201	1	1		2
	Coast Guard	101	3	4	11	18
		201			7	7
	Navy	201	1		14	15
	Oil and Natural Gas Corporation	101	1			1
	UB Air	101		1		1
	Vayudoot	201	5	5		10
Mauritius	Coast Guard	101			2	2
Totals			**11**	**16**	**57**	**84**

compartment at rear of cabin, accessible externally and from cabin; capacity 210 kg (463 lb). Enlarged baggage door optional; additional baggage space in fuselage nose, with separate access; capacity 120 kg (265 lb); modular units using seat rails for rapid changes of role.

SYSTEMS: Entire accommodation heated (by engine bleed air) and ventilated. Hydraulic system, pressure 207 bar (3,000 lb/sq in), for landing gear, brakes and nosewheel steering; hand pump for emergency landing gear extension. Primary 28 V DC electrical system, supplied by two 28 V 250 A engine-driven starter/generators and two 24 V 25 Ah Ni/Cd batteries; two 350 VA inverters supply 115/26 V 400 Hz AC system. Air intake anti-icing standard; de-icing system optional for wing and tail unit leading-edges, fuselage, windscreen and propellers.

AVIONICS: *Comms:* Standard avionics include Rockwell Collins dual VHF-22A and single HF-230 com; Becker audio selector and intercom; Motorola Selcal; H R Smith ELT-503.

Radar: HAL-built Primus 500 weather radar; Elta EL/M-2022A(V)3 or Super Marec 360° search radars.

Flight: Dual Rockwell Collins VIR-32A VOR/ILS; dual or single Rockwell Collins ADF-62A; dual or single Bendix/King KNI 582 RMI indicators; dual or single Rockwell Collins DME-42. Bendix/King KFC 250 autopilot optional to permit single-pilot IFR operation.

Instrumentation: IFR instrumentation standard, comprising dual Honeywell GH14B gyro horizons; dual ADIs; dual VSIs.

EQUIPMENT: Standard equipment includes complete internal and external lighting, hand fire extinguisher, first aid kit, gust control locks and tiedown kit. Stores attachment points beneath each wing outboard of engine nacelle. Indian Navy aircraft reported to have provision for up to four anti-ship missiles.

ARMAMENT: Provision for gun pod, other weapons or mission pod under each wing.

DIMENSIONS, EXTERNAL:

Wing span	16.97 m (55 ft 8 in)
Wing aspect ratio	9.0
Length overall	16.56 m (54 ft 4 in)
Height overall	4.86 m (15 ft 11½ in)
Tailplane span	6.45 m (21 ft 2 in)
Wheel track	3.30 m (10 ft 10 in)
Wheelbase	6.29 m (20 ft 7½ in)
Propeller diameter	2.69 m (8 ft 10 in)
Propeller ground clearance	1,08 m (3 ft 6½ in)
Passenger door (port, rear): Height	1.35 m (4 ft 5 in)
Width	0.64 m (2 ft 1¼ in)
Height to sill	0.91 m (2 ft 11¾ in)
Freight door (port, rear): Height	1.35 m (4 ft 5 in)
Width, incl passenger door	1.28 m (4 ft 2½ in)
Emergency exits (each): Height	0.66 m (2 ft 2 in)
Width	0.48 m (1 ft 7 in)
Baggage door (nose): Height	0.50 m (1 ft 7½ in)
Width	1.20 m (3 ft 11¼ in)
Standard baggage door (rear):	
Height	0.90 m (2 ft 11½ in)
Width	0.53 m (1 ft 9 in)

DIMENSIONS, INTERNAL:

Cabin, excl flight deck and rear baggage compartment:	
Length	7.08 m (23 ft 2¾ in)
Max width	1.346 m (4 ft 5 in)
Max height	1.55 m (5 ft 1 in)
Floor area	9.6 m^2 (103 sq ft)
Volume	14.7 m^3 (519.1 cu ft)
Rear baggage compartment volume	2.6 m^3 (92 cu ft)
Nose baggage compartment volume	0.89 m^3 (31.4 cu ft)

AREAS:

Wings, gross	32.00 m^2 (344.3 sq ft)
Ailerons (total)	2.71 m^2 (29.17 sq ft)
Trailing-edge flaps (total)	5.87 m^2 (63.18 sq ft)
Fin, incl dorsal fin	4.50 m^2 (48.44 sq ft)
Rudder, incl tab	1.50 m^2 (16.15 sq ft)
Horizontal tail surfaces (total)	8.33 m^2 (89.66 sq ft)

WEIGHTS AND LOADINGS (Indian-built 228-201):

Operating weight empty	3,687 kg (8,128 lb)
Max T-O weight: civil	6,200 kg (13,668 lb)
military	6,400 kg (14,110 lb)
Max ramp weight: civil	6,230 kg (13,734 lb)
military	6,430 kg (14,175 lb)
Max landing weight	6,100 kg (13,448 lb)
Max zero-fuel weight	5,590 kg (12,324 lb)
Max wing loading: civil	193.8 kg/m^2 (39.68 lb/sq ft)
military	200.0 kg/m^2 (40.96 lb/sq ft)
Max power loading: civil	5.82 kg/kW (9.56 lb/shp)
military	6.00 kg/kW (9.87 lb/shp)

PERFORMANCE (228-201):

Never-exceed speed (VNE)	255 kt (472 km/h; 293 mph) IAS
Max operating speed (VMO)	223 kt (413 km/h; 256 mph) IAS
Max cruising speed: at S/L	222 kt (411 km/h; 255 mph)
FL 100	231 kt (428 km/h; 266 mph)
Stalling speed: flaps up	79 kt (147 km/h; 91 mph) IAS
flaps down	63 kt (117 km/h; 73 mph) IAS
Max rate of climb at S/L	582 m (1,909 ft)/min
Service ceiling, 30.5 m (100 ft)/min rate of climb	8,535 m (28,000 ft)
Service ceiling, OEI, 15 m (50 ft)/min rate of climb	3,870 m (12,700 ft)
T-O run	442 m (1,450 ft)
T-O to 15 m (50 ft)	580 m (1,905 ft)
Accelerate/stop distance, with anti-skid	762 m (2,500 ft)
Landing from 15 m (50 ft) at MLW	457 m (1,500 ft)
Range at FL 100 with 19 passengers, reserves for 50 n mile (93 km; 57 mile) diversion, 45 min hold and 5% fuel remaining:	
at max cruising speed	560 n miles (1,038 km; 645 miles)
at max range speed	630 n miles (1,167 km; 725 miles)
Range with 775 kg (1,708 lb) payload, conditions as above:	
at max cruising speed	1,160 n miles (2,148 km; 1,335 miles)
at max range speed	1,320 n miles (2,445 km; 1,519 miles)

MiG COMPLEX

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M Fakruddin (Su-30, Nasik)
J R Mehta (Koraput Engine Division)
D N Vyas (Su-30 Engine Division, Koraput)

This complex comprises the Nasik Aircraft and Koraput Engine Divisions of HAL. Activities include MiG-21/27 upgrade, overhaul and repair, which continue at original Nasik facility.

Licensed manufacture of Sukhoi Su-30MKI is also responsibility of this complex, taking place at new facility located at Koraput. Agreement signed at Nasik 28 December 2000 for licensed local manufacture of up to 140 following earlier order for initial batch of 50 Russian-built Su-30Ks (deliveries from 1997 and completed in December 2004); contract valued at USD3.7 billion; HAL investment in programme reportedly valued at USD650 million.

HAL manufacture started in 2004 (first two sets of components received on 7 June) and being undertaken in four stages. Stage 1, involving 26 aircraft in three batches, concerns HAL assembly from Russian-built CKD kits. The first in this batch (SB 102) was rolled out on 28 November 2004, and the first pair handed over to the Indian Air Force on 21 March 2005. The remaining 114 were to have been completed in Phase 2 (equipping of major assemblies), Phase 3 (local manufacture of entire airframe except fuselage) and Phase 4 (all airframe and engine components manufactured locally), with completion in 2017 or 2018. However, programme accelerated in 2006 at Indian request, moving Phase 3 and 4 deliveries into Phase 2 and 3 time frame to enable completion in about 2012. As of May 2006, a delivery contract for 18 HAL-built aircraft had been signed. Agreement also provides for HAL-built canards, fins and tailplanes to be supplied for Russian production line. HAL divisions at Hyderabad (radio and radar), Korwa (avionics and EO equipment) and Lucknow (hydraulics/pneumatics) also involved in Su-30MKI programme. Various systems upgrades are expected to be introduced during the manufacturing period.

IITB

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The Programme on Airship Design and Development (PADD) was launched at IITB in 2001, with team members drawn from various national aerospace organisations and private sector companies in India. PADD aims at developing airship technology in India for various scientific and commercial applications. The first phase of PADD, a study project sponsored by a department of the Ministry of Science and Technology, was completed in 2003. In this, conceptual design studies were carried out of airships for transportation of goods and passengers over mountainous terrain under 'hot and high' conditions.

Development of two types of airship is proposed in future phases: the PADD Demo and the PADD PaxCargo. Funding for these future phases was awaited in 2006. At that time, the PADD team was developing an unmanned airship with payload capacity of approximately 35 kg (77 lb) for several scientific applications such as aerial photography and surveillance. Studies were also under way in the areas of design and development of stratospheric airships; shape optimisation of aerostat and airship envelopes; development of robust control systems for unmanned airships; and feasibility of airships for transportation of heavy cargo. An indoor remotely controlled airship with a lenticular envelope has also been developed.

IITB PADD AIRSHIPS

TYPE: Helium non-rigid airships.

PROGRAMME: PADD programme launched 2001 and Phase 1 completed 2003; funding awaited in 2005 for Phase 2 and beyond. No subsequent information.

CURRENT VERSIONS: **PADD Micro:** Phase 1 remotely controlled, unmanned prototype for PADD Demo; developed and test-flown January 2002.

PADD Mini: Phase 1 remotely controlled, unmanned prototype for PADD PaxCargo; developed and demonstrated during 90th Indian Science Congress, January 2003.

IITB/PADD Micro airship 1178278

IITB/PADD Mini airship 1159032

IITB Indoor: Remotely controlled, with lenticular envelope shape, developed and demonstrated during IUCAA Science Fair, 2004.

PADD Demo: Phase 2 manned airship with 100 kg (220 lb) payload capacity.

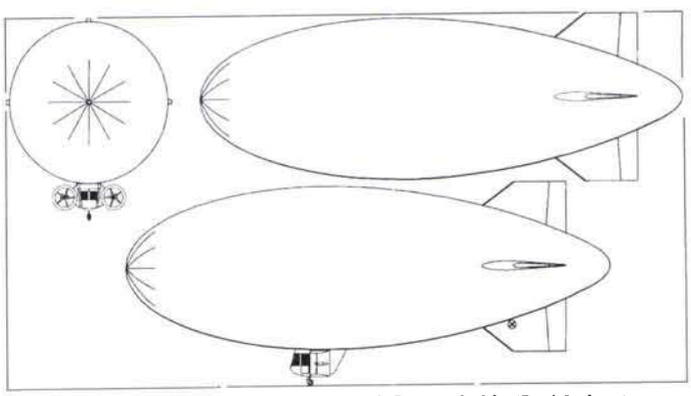
PADD PaxCargo: Phase 2 follow-on manned design, with payload capacity for 15 passengers or 1,500 kg (3,307 lb) of cargo.

DIMENSIONS, EXTERNAL:

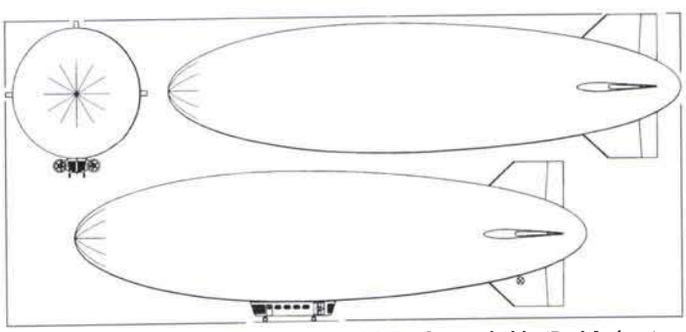
Length overall: Micro	5.00 m (16 ft 4¾ in)
Mini	6.70 m (21 ft 11¾ in)
Demo	26.78 m (87 ft 10¼ in)
PaxCargo	70.00 m (229 ft 8 in)
Max diameter: Demo	8.78 m (28 ft 9¾ in)
PaxCargo	17.50 m (57 ft 5 in)
Height overall: Demo	11.00 m (36 ft 1 in)
PaxCargo	21.15 m (69 ft 4¾ in)
Span over tailfins: Demo	9.10 m (29 ft 10¼ in)
PaxCargo	19.40 m (63 ft 7¾ in)

DIMENSIONS, INTERNAL:

Envelop volume: Micro	6.80 m³ (240 cu ft)
Mini	8.60 m³ (304 cu ft)



General arrangement of the proposed PADD Demo airship *(Paul Jackson)* 1158276



General arrangement of the proposed PADD PaxCargo airship *(Paul Jackson)* 1042483

NAL

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The NAL's current major civil aircraft programmes are the CSIR Saras twin-turboprop transport (which see), now undergoing certification flight test, and the Hansa-3 two-seat trainer and sportplane, in low-rate series production.

NAL HANSA-3

English name: Swan

TYPE: Primary prop trainer/sportplane.

PROGRAMME: Developed under agreement with Indian National Aerospace Laboratories and originally known as NALLA: NAL Light Aircraft. Design started May 1989; construction of Hansa-2 prototype began December 1991, and this aircraft (VT-XIW) made first flight 23 November 1993. Prototype received Indian DGCA Experimental category type certificate; re-engined 1995 as Hansa-2RE with more powerful IO-240 replacing original 74.6 kW (100 hp) O-200 flat-four. Retired to HAL's museum after 128 hours of flying. Deliveries of initial five production Hansa-3s by NAL began on 20 March 2001. Hansa manufacturing techniques transferred to external agencies, beginning 28 August 2002 when Reinforced Plastics Industries, Bangalore, initiated manufacture of first two composites fuselage shells.

Letter of intent from DGCA for further eight Hansa-3s issued in 2004. Beyond these, any substantial orders are intended to be manufactured by Taneja Aerospace and Aviation Ltd (TAAL) which flew its initial aircraft (VT-HOA) on 3 June 2006. Australian certification also being sought, to assist international marketing. For this, planned modifications by RMIT University's Sir Lawrance Wackett Centre for Aerospace Design Technology will replace existing landing gear by all-composites units, expected to reduce empty weight by about 15 kg (33 lb).

CURRENT VERSIONS: **Hansa-2:** Prototype in original configuration.

Hansa-2RE: Prototype (VT-XIW) re-engined with 93 kW (125 hp) IO-240B; span increased and flaps added; first flight 26 January 1996.

Hansa-3: Production-standard version of Hansa-2RE, first flown (VT-XAL; designated Hansa-3I) on 25 November 1996. First flight with Rotax 914 F3 engine, 9 May 1998, made by second (and lighter) prototype VT-XBL (designated Hansa-3II); provisional JAR-VLA certification awarded to 'XBL in December 1998 in day VFR category; re-registered VT-HBL later. Current version (c/n 001 prototype VT-HNS) has lightning protection for night operations; made first flight 14 May 1999 and received DGCA certification on 1 February 2000 under FAR Pt 23, Amendment 23-42 (JAR-VLA night operation requirements). VT-XBL and first five production aircraft had flown more than 1,920 hours by June 2004.

Following description applies to this version.

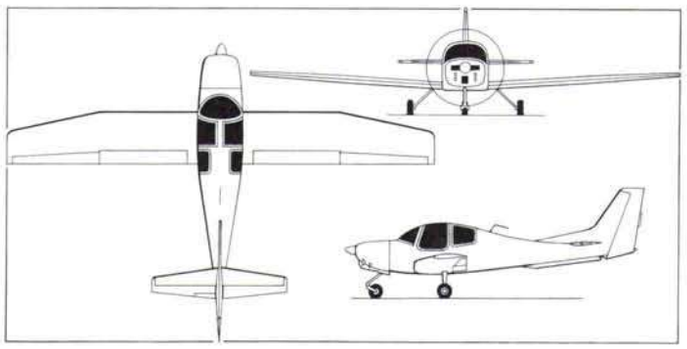
Hansa-S: Four-seat version with raised rear decking and winglets; previously known as Hansa-4, powered by 123 kW (165 hp) SMA SR305-230 or Thielert diesel; project initiated 2002 and model shown at Asian Aerospace, Singapore, February 2004. Changes include winglets and enlarged horizontal tail. NAL hoping to begin prototype in second half of 2005, but not reported by mid-2006.

CUSTOMERS: Four prototypes, including Hansa-2 VT-XIW, of which VT-HNS handed over on 22 March 2002 for use by Department of Aerospace Engineering, IIT Kanpur, although not delivered to Kanpur until 18 April 2003; has non-standard engine cowling and although marked as "Hansa 3" is referred to as Hansa IIT-K.

Three Hansa-3s ordered by DGCA for Indian flying clubs (c/n 002, 003 and 004: VH-HNT, 'HNU and 'HNV), of which first (maiden flight 10 March 2001) handed over to DGCA on 20 March 2001, then presented to Andhra Pradesh Aviation Academy on 12 April 2001 and delivered to Hyderabad on 8 May 2001. Second and third to DGCA on 22 March 2002, of which 'NU (first flight 15 January 2002) to Kerala Aviation Training Centre at Trivandrum and 'NV (first flight 8 March 2002) to Madhya Pradesh Flying Club at Indore on 12 June 2002. Fourth Hansa-3 (c/n 005: VH-HNW) flown 30 March 2003; to DGCA 14 July 2003 for Kerala Aviation Training Centre at Trivandrum. Fifth aircraft (c/n 006: VH-HNX) registered to National Aerospace Laboratory at Bangalore 11 May 2003; delivered to Haryana Institute of Civil Aviation at Karnal 27 October 2004. Further two (VT-HNY and 'HNZ) formally presented on 30 June 2006 to Bangalore Flying School and Andhra Pradesh Aviation Academy, respectively. Additional three (VT-HOA to 'HOC) registered by March 2006, comprising one for Madras Flying Club (VT-HOC) and two ('HOA and 'HOB) initial production machines from TAAL assembly line.

COSTS: Programme development USD40 million (1997); standard aircraft INR4.5 million (2001).

Hansa 'IIT-K' of Indian Institute of Technology's Flight Laboratory at Kanpur, marked as a Hansa-3 1159033



NAL Hansa-3 *(Mike Keep)* 0121113

DESIGN FEATURES: Docile handling qualities for *ab initio* training; robust construction and low acquisition/operating cost. Low-wing monoplane with circular-section waisted fuselage; outer wings tapered on leading-edges, with unswept trailing-edge; sweptback fin and rudder; shallow ventral strake; conventional unswept, straight-tapered horizontal tail surfaces.

Laminar-flow wing, with NASA LS(1)-0415 aerofoil section on constant-chord inboard portion, linearly tapered to LS(1)-0413 from there to tip; sweepback 12° 18' 36" on outer leading-edges; dihedral 4° from roots; incidence 0°; twist 0° between root and kink; washout −2° between kink and tip.

FLYING CONTROLS: Conventional and manual. Frise ailerons (100 per cent internal mass balance); horn-balanced plain elevators and large rudder, all actuated by pushrods; pitch trim by electrically operated tab in port elevator. Single-slotted Fowler flaps, deflection 20°.

STRUCTURE: Built primarily of composites (GFRP reinforced epoxy except for carbon fibre main spar) with hand-laid, vacuum-bagged, room temperature-cured sandwich shells; components are post-cured before assembly. Conventional rib and three-spar wings, with moulded sandwich shell and PVC foam core; two-spar tail surfaces similar. Fuselage is also a moulded sandwich shell with PVC foam core.

LANDING GEAR: Non-retractable tricycle type, with wing-mounted cantilever spring steel mainwheel legs and steerable (±33°) trailing-link nosewheel. Cleveland wheels and McCreary tyres (main 6.00–6, nose 5.00–5), pressure 2.07 bar (30 lb/sq in) on all units. Cleveland hydraulic disc brakes. Minimum ground turning radius 2.64 m (8 ft 8 in).

POWER PLANT: One 84.6 kW (113.4 hp at 5,800 rpm) Rotax 914 F3 turbocharged flat-four engine; Hoffmann NOV 352FQ+8 two-blade constant-speed propeller. Single composites fuel tank aft of cockpit, usable capacity 85 litres (22.5 US gallons; 18.7 Imp gallons). Single gravity refuelling point on top of fuselage, port side. Oil capacity 3 litres (0.8 US gallon; 0.7 Imp gallon).

ACCOMMODATION: Two seats side by side; dual controls standard. Upward-opening gullwing doors. Baggage compartment aft of pilot's seat.

SYSTEMS: Manual (toe-operated) hydraulic mainwheel brakes. Electrical (DC) system powered by 14 V, 40 A generator and 12 V, 18 Ah Gill G25M lead-acid battery.

AVIONICS: *Comms:* Bendix/King KLX 125 combined VHF/VOR com/nav unit with concealed foil antennas; ACK Technologies E-01 ELT; Clark intercom.

Flight: Optional GPS.

Instrumentation: Conventional VFR (IFR version planned). For day operations: ASI, VSI, altimeter, magnetic compass, slip/skid indicator and OAT gauge. For night operations: artificial horizon, directional gyro, turn co-ordinator, navigation lights, landing lights, anti-collision lights, panel and map lights.

DIMENSIONS, EXTERNAL:

Wing span	10.47 m (34 ft 4¼ in)
Wing chord: at root	1.30 m (4 ft 3¼ in)
at tip	0.80 m (2 ft 7½ in)
Wing aspect ratio	8.8
Length overall	7.66 m (25 ft 1½ in)
Fuselage max width	1.13 m (3 ft 8½ in)
Height overall	2.615 m (8 ft 7 in)
Tailplane span	3.60 m (11 ft 9¾ in)
Wheel track	2.20 m (7 ft 2½ in)
Wheelbase	1.95 m (6 ft 4¾ in)
Propeller diameter	1.70 m (5 ft 7 in)
Propeller ground clearance	0.33 m (1 ft 1 in)

DIMENSIONS, INTERNAL:

Cockpit: Length	2.15 m (7 ft 0¾ in)
Max width	1.07 m (3 ft 6¼ in)
Max height	1.00 m (3 ft 3¼ in)
Floor area	0.96 m² (10.3 sq ft)
Volume	1.4 m³ (49.9 cu ft)
Baggage compartment volume	0.24 m³ (8.5 cu ft)

AREAS:

Wings, gross	12.47 m² (134.2 sq ft)
Ailerons (total)	0.97 m² (10.44 sq ft)
Flaps (total)	1.515 m² (16.31 sq ft)
Fin	0.75 m² (8.07 sq ft)
Rudder	0.70 m² (7.53 sq ft)
Tailplane	1.19 m² (12.81 sq ft)
Elevators (total, incl tab)	0.85 m² (9.15 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: normal	485 kg (1,069 lb)
night operations	545 kg (1,202 lb)
Max fuel weight	65 kg (143 lb)
Max T-O and landing weight	750 kg (1,653 lb)
Max wing loading	60.1 kg/m² (12.32 lb/sq ft)
Max power loading	8.87 kg/kW (14.57 lb/hp)

PERFORMANCE:

Max cruising speed at FL100	115 kt (213 km/h; 132 mph)
Stalling speed, flaps down	48 kt (89 km/h; 56 mph) IAS
Max rate of climb at S/L	198 m (650 ft)/min
T-O run	413 m (1,355 ft)
T-O to 15 m (50 ft)	450 m (1,480 ft)
Landing from 15 m (50 ft)	600 m (1,970 ft)
Landing run	540 m (1,775 ft)
Range with max fuel	455 n miles (842 km; 523 miles)
Endurance	4 h

RAJ HAMSA

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Fax: (+33 2) 40 64 15 22
e-mail: contact@randkar.fr
Web: www.randkar.fr Company was founded at Pondicherry in 1980, initially building hang gliders; powered hang gliders introduced 1983 and X-Air range 10 years later. Currently also markets Mosquito, Javelin and Racer hang gliders and Clipper and Voyager powered hang gliders. Company has built over 1,000 aircraft.

RAJ HAMSA X-AIR

TYPE: Side-by-side ultralight kitbuilt.

PROGRAMME: Launched 1993 as development of US Weedhopper; has BCAR Section S certification.

CURRENT VERSIONS: **X-Air:** Baseline version; wing span 9.80 m (32 ft 1¾ in); area 16.00 m² (172.2 sq ft). Available as **X-Air 502T** (Rotax 503 engine '50 horsepower, two-stroke'), **X-Air 602T** (Rotax 582 '60 horsepower, two-stroke'); **X-Air 604T** (44.7 kW; 60 hp HKS 700E); and **X-Air Jabiru** (59.7 kW; 80 hp Jabiru 2200 engine).

X-Air F Gumnam: Has more efficient wing, of higher aspect ratio (6.4 instead of 6.0) and fitted with flaps; deeper rear fuselage, providing space for 20 kg (44 lb) of baggage aft of seats; optional auxiliary fuel tank in wing; wire-braced tailplane. Known simply as X-Air F for European and US marketing; or in UK as **Falcon**, latter with Rotax 912 flat-four.

Raj Hamsa X-Air in open cockpit form *(Paul Jackson)* 1159075

Available as **X-Air F 502T**, **602T**, or **804TJ** with Jabiru engine.

CUSTOMERS: More than 900 kits produced by January 2004.

Description applies to X-Air F, *except where indicated.*

COSTS: In India, flyaway, INR1,415,900 for X-Air with Rotax 582; INR1,497,000 for Gumnam (Rotax 582) and INR1,767,900 for Gumnam (Jabiru). In Europe, basic X-Air F airframe kit EUR10,676 (or EUR11,261 optimised for Jabiru), plus EUR323 for engine instruments (EUR416 for Jabiru), EUR727 for flight instruments and either EUR3,980 (Rotax 503), EUR5,546 (Rotax 582), EUR7,191 (Rotax 582 with silencers and electric starter) or EUR10,534 (Jabiru 2200) for engine (all plus tax, 2006).

Original X-Air remains available, with airframe kits at EUR9,300 (502T, 602T), EUR9,604 (604T/HKS) and EUR9,885 (Jabiru), plus add-ons as for X-Air F (all excluding tax, 2006).

DESIGN FEATURES: High-wing monoplane with sweptback leading-edges and wing-mounted engine. Quick-build kit (quoted build time only 40 hours). Potential applications include basic training, crop-spraying, aerial observation and surveillance.

Wing section NACA 4412. Sweepback 8°; dihedral 1° 12'; washout 4°.

FLYING CONTROLS: Conventional and manual. Differential ailerons; fixed tab on port elevator. All control surfaces non-balanced. Flaps; maximum deflection 25°.

STRUCTURE: Aluminium alloy subframe, with composites nose module; rear fuselage, wings and tail surfaces fabric-covered. Braced wings (V struts); tailplane strut-braced on X-Air, wire-braced on X-Air F/Gumnam. Lexan doors optional.

LANDING GEAR: Tricycle type, fixed; two side Vs hinged to lower longerons, plus half-axles; shock-absorbers on all three units. Mainwheel drum brakes; nosewheel steerable by rudder pedals. All tyres 350×80. Optional mainwheel speed fairings (standard on Gumnam) and nosewheel guard. Small tailskid at base of fin. Can be equipped with Puddlejumper floats.

POWER PLANT: *X-Air F 502T:* One 37.0 kW (49.6 hp) Rotax 503 UL-2V air-cooled two-stroke driving a two-blade, wooden propeller.

X-Air F 602T: One 47.8 kW (64.1 hp) Rotax 582 UL water-cooled two-stroke driving a two-blade wooden, or three-blade composites, propeller.

X-Air F 804TJ: One 59.7 kW (80 hp) Jabiru 2200 air-cooled four-stroke driving a two-blade, composites propeller.

Fuel in two tanks aft of seats, combined capacity 50 litres (13.2 US gallons; 11.0 Imp gallons); auxiliary wing tank optional.

EQUIPMENT: Ballistic recovery parachute optional.

DIMENSIONS, EXTERNAL:

Wing span	9.40 m (30 ft 10 in)
Length overall	5.65 m (18 ft 6½ in)
Height overall	2.55 m (8 ft 4½ in)

DIMENSIONS, INTERNAL:

Cabin max width	1.16 m (3 ft 9¾ in)

AREAS:

Wings, gross	14.32 m² (154.1 sq ft)

WEIGHTS AND LOADINGS:

Basic weight empty: 502T	230 kg (507 lb)
602T	237 kg (522 lb)
804TJ	262 kg (578 lb)
Max T-O weight	450 kg (992 lb)

PERFORMANCE, POWERED (804TJ):

Never-exceed speed (VNE)	83 kt (155 km/h; 96 mph)
Max level speed at S/L	78 kt (145 km/h; 90 mph)
Econ cruising speed at S/L	59 kt (110 km/h; 68 mph)
Stalling speed: flaps up	27 kt (50 km/h; 32 mph)
25° flap	24 kt (43 km/h; 27 mph)
Max rate of climb at S/L	288 m (945 ft)/min
Service ceiling	4,000 m (13,120 ft)
T-O run	80 m (265 ft)
T-O to 15 m (50 ft)	220 m (725 ft)
Landing from 15 m (50 ft)	110 m (360 ft)
Landing run	70 m (230 ft)
Endurance at cruising speed, standard fuel	more than 3 h
g limits	+6/−3

PERFORMANCE, UNPOWERED (804TJ):

Best glide ratio at 35 kt (64 km/h; 40 mph)	7
Min sinking speed	2.50 m (8.20 ft)/s

RAJ HAMSA HANUMAN

US marketing name: X-Air H

TYPE: Side-by-side ultralight/kitbuilt.

PROGRAMME: Prototype (82.0 kW; 110 hp Hirth F30 engine and full-span flaperons) complete by July 2001 and immediately shipped to France for test flying by Rand Kar. Debut at Blois Air Show, September 2001. Launched at Paris, 15-22 June 2003, when second of planned six development and demonstrator aircraft was shown. Deliveries from first quarter 2004.

CURRENT VERSIONS: **X-Air H Hanuman 602T:** '60 horsepower, two-stroke' version with Rotax 582 engine.

X-Air H Hanuman 804TJ: Jabiru 2200 engine.

X-Air H Hanuman 912: Rotax 912 engine.

COSTS: In India, INR1,906,700 flyaway, with Jabiru 2200. In Europe, basic kit EUR13,047 (Rotax 582 and Jabiru) or EUR13,237 (Rotax 912); engine and instruments EUR7,950 extra for Rotax 582, EUR15,961 for Rotax 912 or EUR11,760 for Jabiru; flyaway price EUR25,196 (Rotax 582), EUR35,037 (Rotax 912) or EUR29,768 (Jabiru) (all 2006, plus tax).

DESIGN FEATURES: Further development of X-Air/Gumnam, redesigned for even faster kit assembly. High wing with V strut bracing; upward-swept rear fuselage and sweptback fin.

FLYING CONTROLS: Conventional and manual. Plain, three-position flaps, maximum deflection 45°. Ailerons and flaps actuated by pushrods; rudder and elevators by cables. Flight adjustable trim tab on starboard elevator. No aerodynamic balances.

STRUCTURE: Aluminium tube fuselage and wings with Dacron covering, except composites forward fuselage. Wire-braced empennage.

LANDING GEAR: Tricycle type; fixed. Mainwheels and steerable nosewheel all 3.50-8. Bungee cord levered suspension. Cable-actuated mainwheel brakes. Mainwheel speed fairings standard.

POWER PLANT: One 48.0 kW (64.4 hp) water-cooled Rotax 582 two-stroke driving an Arplast EcoProp three-blade, ground-adjustable pitch, composites propeller; or one 59.7 kW (80 hp) air-cooled Jabiru 2200 four-stroke with two-blade composites propeller; or 59.6 kW (79.9 hp) Rotax 912 S air/water-cooled four-stroke with two-blade wooden propeller. Fuel capacity 80 litres (21.1 US gallons; 17.6 Imp gallons).

EQUIPMENT: BRS1050 ballistic recovery parachute optional.

DIMENSIONS, EXTERNAL:

Wing span	10.05 m (32 ft 11¾ in)
Length overall	6.09 m (19 ft 11¾ in)
Height overall	2.30 m (7 ft 6½ in)

DIMENSIONS, INTERNAL:

Cockpit max width	1.14 m (3 ft 9 in)

AREAS:

Wings, gross	13.92 m² (149.8 sq ft)

WEIGHTS AND LOADINGS:

Basic weight empty, equipped:	
602T	263 kg (580 lb)
804TJ	276 kg (608 lb)
Max T-O weight	450 kg (992 lb)

PERFORMANCE (804TJ):

Never-exceed speed (VNE)	105 kt (195 km/h; 121 mph)
Max level speed	89 kt (165 km/h; 102 mph)
Econ cruising speed	70 kt (130 km/h; 81 mph)
Stalling speed, power off:	
flaps up	34 kt (63 km/h; 40 mph)
25° flap	32 kt (58 km/h; 36 mph)
45° flap	29 kt (53 km/h; 33 mph)
Max rate of climb at S/L	288 m (945 ft)/min
Service ceiling	4,000 m (13,120 ft)
T-O run	80 m (265 ft)
T-O to 15 m (50 ft)	220 m (725 ft)
Landing from 15 m (50 ft)	110 m (360 ft)
Landing run	70 m (230 ft)
g limits	+6/−3

PERFORMANCE, UNPOWERED (804TJ):

Best glide ratio at 49 kt (90 km/h; 56 mph)	9
Min sinking speed	2.50 m (8.20 ft)/s

Raj Hamsa Hanuman, or X-Air H *(Paul Jackson)* 1159076

TAAL

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TAAL is part of Indian Seamless Metal Tubes Group; has modern plant on 89 ha (220 acre) site at Hosur, near Bangalore, with 1,300 m (4,265 ft) captive runway (being extended to 2,286 m; 7,500 ft in 2006), hangars, laboratories, paint shops and other facilities for aircraft manufacture and overhaul. Entered into technical agreement second quarter 1992 with Partenavia of Italy to produce P.68C/TC, P.68 Observer and AP.68TP-600 Viator light twins in India. Second Viator delivered to South African customer in March 2003, but no other recent evidence of any output. More recently, TAAL received kits of about 10 Sport E lightplanes (current incarnation of former Thorp T-211) from IndUS Aviation of Dallas, Texas, and had begun assembly of first two by end of 2003, with first delivery then scheduled for March 2004. Indian parts manufacture was expected to begin three months later.

TAAL is also active in air taxi operations with fleet of 11 P.68Cs; manufactures Nishant UAVs for Aeronautical Development Establishment and structural parts for space launchers; and plans to enter MRO business area, with new narrow-body hangar due to open in May 2006.

Indonesia

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Originally formed by Indonesian government as PT (Perusahaan Terbatas Industri Pesawat Terbang Nurtanio (Nurtanio Aircraft Industry Ltd) 23 August 1976 to centralise all aerospace facilities in one company; renamed PT Industri Pesawat Terbang Nusantara (IPTN) 11 October 1985. Company restructured in January 2000, with PT Bahana Pengelola Industri Strategis as major shareholder, becoming limited liability company (PT Persero) with nine strategic business units, six (now four) profit centres, four resource centres and six subsidiaries/corporate functions

New name PT Dirgantara Indonesia (internationally, Indonesian Aerospace, or IAe) inaugurated 24 August 2000 (start of company's 25th year of existence) Site area is 87 ha (215 acres) including 600,000 m^2 (6,458,350 sq ft) covered area. Workforce in July 2003 was 9,600, including 2,500 engineers and 5,000 technicians and operators, compared with some 9,500 in early 2002; reduced to 3,720 by 2004. Former 18 business units now consolidated into five, as follows:

Aircraft co-manufactures Airtech CN-235 Series 200/220, produces NC-212 Series 200 under licence from EADS CASA of Spain, and NAS-332 Super Puma under licence from Eurocopter. One NC-212-200 delivered to Indonesian Army 3 January 2005 and one (in maritime patrol configuration) to Indonesian Marine Corps on 12 May 2005. As at February 2006, backlog of these two types was reported to be three NC-212-200s for the Indonesian Navy and the final seven of 16 NAS-332s for the Indonesian Army. Earlier programmes included manufacture of NBO-105 helicopters under Eurocopter licence, and NBell-412 under licence from Bell.

Two CN-235s delivered to South Korea in December 2001 and six more by end of 2002. Pakistan Air Force ordered four and Royal Malaysian Air Force two; those for PAF handed over in 2004 (28 January, September and 3 December) and 2005 (6 June); those for RMAF 9 August 2005 and 14 February 2006. Ten ordered by Thailand in December 2005 (six for Air Force and four for Ministry of Agriculture). Agreement 19 June 1991 with BAe (now BAE Systems) to collaborate on production and assembly of Hawks for Indonesian Air Force, although all were assembled in UK with Indonesia receiving offset work. In January 2006, EADS CASA agreed to extend manufacturing licence to include Series 400 C-212. Earlier, Dirgantara had received a seven-year, USD45 million contract from EADS CASA to supply nose, centre and rear fuselage components for the Spanish C-295 production line

New five-year business plan for Dirgantara in late 2003 envisaged development, possibly as joint ventures with other Southeast Asian partners, of a 19-passenger transport (N-219) and a new light helicopter. Feasibility of former under discussion with CTRM (Malaysia) in early 2004, as well as a larger (up to 50 passengers) turboprop twin. At that time, licensed assembly of Polish SW-4 being examined as possible future helicopter venture. No further news of N-219 by early 2005; however, contract announced at that time for international development of NMX-1 six-passenger jet with AeroNimbus of Malaysia.

Aircraft Services undertakes maintenance, repair, overhaul and modification.

Aerostructures subcontract work includes production of components for Boeing (737/777), Bombardier (Global Express and Global 5000) and Airbus (A320/321/330/340/380); first A380 deliveries 28 April 2003. Company's 1,400 m^2 (15,070 sq ft) gas-turbine maintenance centre can maintain, overhaul and repair Rolls-Royce 250, P&W JT8D, P&WC PT6T-3/3B, R-R Dart RDa.7, Honeywell LTS101 and TPE331 and General Electric CT7 engines, plus some components of Allison T56 and R-R Tay.

Engineering Services is responsible for communication and simulation technologies, information technology solutions and design centre.

Defence is concerned principally with naval and other non-aviation work.

International

AGUSTAWESTLAND

(A FINMECCANICA COMPANY)

Web: www.agustawestland.com
CHAIRMAN: Kevin Smith
CEO: Amedeo Caporaletti
MANAGING DIRECTOR: Richard Case
COOS:
A Gustapane (Italy)
A Johnson (UK)
MARKETING MANAGER: G Orsi
PUBLIC RELATIONS MANAGERS:
Gianluca Grimaldi (Italy)
David Bath (UK)

MoU covering joint merger of helicopter divisions signed by Finmeccanica of Italy and GKN of UK on 16 April 1998; heads of agreement 18 March 1999; details finalised (subject to regulatory approval) and name AgustaWestland announced 26 July 2000; company declared fully operational 12 February 2000.

Westland also contributed its 50 per cent share in EH101, GKN's aerospace transmissions business and 50 per cent share in Aviation Training International (joint venture with Boeing to support British Army WAH-64 Apaches). Agusta also contributed half of EH 101, transmissions and aerostructures business and own shares in NH90 (32 per cent) and Bell/Agusta (45 per cent). Workforce in 2005 was 8,968

Fundamental change announced 26 May 2004 upon GKN's agreement to sell its 50 per cent share to Finmeccanica for £1,065 million, with AgustaWestland becoming wholly Italian-owned. In December 2005, AgustaWestland acquired the AB 139 helicopter formerly developed jointly with Bell; 45 per cent share of Bell/Agusta to be retained through increase of investment in BA609 tiltrotor. AB 139 became AW 139 in February 2005, this designation prefix to be used for all new projects.

Together, the two companies have built over 7,100 helicopters for customers in more than 80 countries. Turnover in 2004 was EUR2,542 million and 2005 backlog valued at EUR5,238 million. Delivered 66 commercial and 26 military helicopters in 2004.

AgustaWestland owns 100 per cent of both Agusta SpA and Westland Holdings Ltd, latter comprising Westland Helicopters Ltd and Westland Transmissions Ltd. Subsidiaries are as follows:

Agusta SpA
AgustaWestland Inc (USA) (50 per cent)
Agusta Aerospace Corporation (USA)
Agusta Aerospace Services BV (Belgium)
AgustaWestland International Ltd (50 per cent)
Bell/Agusta Aerospace Company (USA) (50 per cent)
NHI sarl (32 per cent)
other subsidiaries and holdings

Westland Helicopters Ltd
AgustaWestland Inc (USA) (50 per cent)
AgustaWestland International Ltd (50 per cent)
Aviation Training International Ltd (50 per cent)
other subsidiaries and holdings

On 31 October 2001, AgustaWestland initiated a joint marketing effort with Lockheed Martin, under which the latter promotes a US market version of the EHI EH101, known as the US101 In January 2005 this was purchased for US Presidential use as VH-71 Kestrel.

Agusta and Westland products are marketed under the AgustaWestland name, but helicopter type certificate ownership (and thus civil register entries) remains unaltered. The Bell/Agusta partnership does not involve Westland.

Agusta
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CHAIRMAN AND CEO: Amedeo Caporaletti
VICE-PRESIDENT, EXTERNAL RELATIONS AND COMMUNICATIONS: Gian Luigi Ghez
GENERAL MANAGER: Giuseppe Orsi

Original Agusta company established 1907 by Giovanni Agusta; acquired licence for Bell 47 in 1952; first flight of first Agusta example 22 May 1954; later produced Bell 204, 205, 206 and 212; Bell AB 412 still in low-volume production; also produced various versions of Sikorsky S-61 under licence; participates in NH90 programme. Own designs include A 109 multirole helicopter, A 119 Koala, A 129 anti-tank helicopter, AW 139 and military AW 149 utility helicopters.

Agusta group completely reorganised from 1 January 1981 under new holding company Agusta; became part of Italian public holding company EFIM, but integrated into Finmeccanica on 20 December 1996.

Manufacturing plants in Italy comprise Cascina Costa (HQ and transmissions), Vergiate (final assembly), Anagni/Frosinone (composites and rotor heads), Benevento (castings) and Brindisi (aerostructures).

In November 1998 Agusta and Bell Helicopter Textron signed an agreement to form Bell/Agusta Aerospace Company, to share development, manufacture and marketing of the Bell/Agusta BA609 civil tiltrotor and AB139 utility helicopter, the latter being removed from the agreement in 2005 and becoming an AgustaWestland programme as AW 139.

On 14 January 2002, Agusta and Denel Group of South Africa signed an agreement for licensed production of the A 109 and A 119 in South Africa. Under the terms of the agreement Denel is manufacturing the helicopters at its Kempton Park facility for marketing in Africa, the Middle East, South America and Southeast Asia. Denel building 25 of the 30 A 109s ordered by the South African Air Force.

Westland

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CEO: Richard Case

Westland Aircraft Ltd (later expanded to Westland Group plc) formed July 1935, taking over aircraft branch of Petters Ltd (known previously as Westland Aircraft Works) that had designed/built aircraft since 1915; entered helicopter industry having acquired licence to build US Sikorsky S-51 as Dragonfly 1947.

GKN shareholding in Westland Group progressively increased until overall control achieved on 18 April 1994.

Westland Helicopters Ltd included GKN Westland Industrial Products Ltd and had 50 per cent interest in Aerosystems International Ltd at Yeovil (aerospace software; partnership with BAE Systems) and EH Industries Ltd.

Under June 1989 agreement with former McDonnell Douglas, Westland obtained co-production rights for Boeing AH-64 Apache; this selected for British Army Air Corps, July 1995; Westland is prime contractor to UK MoD. Production undertaken in newly built 5,200 m² (56,000 sq ft) assembly hall at Yeovil, opened 14 January 1999. Deliveries completed in 2004.

Aviation Training International (ATI) joint venture company formed with Boeing on 3 August 1998 to provide air, ground and maintenance crews for British Army Apaches under £650 million, 30 year contract; began operations 29 July 1999 at Sherborne HQ; has branches at Middle Wallop, Dishforth and Wattisham flying bases, plus engineering school at Arborfield.

AgustaWestland International Ltd (AWIL)

EH Industries (European Helicopter Industries) formed June 1980 by Westland Helicopters and Agusta (50 per cent each), to undertake joint development of new anti-submarine warfare helicopter for Royal Navy and Italian Navy. Programme handled on behalf of both governments by UK Ministry of Defence; Westland allocated design leadership for commercial version, Agusta for rear-loading military/utility version; naval version developed jointly for UK and Italian navies and export. IBM Federal Systems (now Lockheed Martin Aerospace Systems Integration Corporation) selected to manage Royal Navy programme in 1991, overseeing and taking responsibility for RN-specific development activity, systems integration and aircraft production and delivery.

Kawasaki of Japan, in conjunction with trading company Okura, signed an agreement in June 1995 for joint marketing and support of the EH101 as KHI-01, this to include local assembly.

On 19 March 2004, EHI Ltd was renamed AgustaWestland International Ltd upon official opening of new headquarters at Farnborough, UK.

AGUSTAWESTLAND LYNX

TYPE: Light utility helicopter.

PROGRAMME: Developed within Anglo-French helicopter agreement confirmed 2 April 1968; Westland given design leadership; first flight of first of 13 prototypes (XW835) 21 March 1971; first flight of fourth prototype (XW838) 9 March 1972, featuring production-type monobloc rotor head; first flights of British Army Lynx prototype (XX153) 12 April 1972, French Navy prototype (XX904) 6 July 1973, production Lynx (RN HAS. Mk 2 XZ229) 20 February 1976; first RN operational unit (No. 702 Squadron) formed on completion of intensive flight trials December 1977; AH. Mk 5 first flew (ZE375) 23 February 1985; other development details and records in 1975–76 and subsequent *Jane's*. Production shared 70 per cent Westland, 30 per cent Aerospatiale.

Second phase of development was Super Lynx (naval) and Battlefield Lynx, to which standards later UK military Lynx (Mks 8 and 9) were built; also exported. Battlefield Lynx mockup displayed at 1988 Farnborough Air Show (converted demonstrator G-LYNX), featuring wheeled landing gear, exhaust diffusers and provision for anti-helicopter missiles each side of fuselage; first flight of wheeled prototype (converted trials AH. Mk 7 XZ170) 29 November 1989; first flight of South Korean Super Lynx (90–0701, temporarily ZH219) 16 November 1989 (also first Lynx with Seaspray Mk 3 radar); first flight of Portuguese Super Lynx (9201, temporarily ZH580, ex-RN ZF559) 27 March 1992.

In September 1996, GKN Westland formally launched versions of Lynx powered by CTS800 turboshafts, with or without a Six-screen EFIS. Current production versions were simultaneously redesignated, those now on offer being Srs 100, 200 or 300. Fuselages built from 1999 have potential for MTOW extension to 5,443 kg (12,000 lb) and beyond. First Super Lynx 300 (ZT800) flew 27 January 1999, although maiden flight with CTS800 engine was on 12 June 2001.

Potential life extension for Lynx possible following 30 January 2002 award to Westland of £20+ million, 18-month study contract expected to lead to upgrade of 80 British Army Mk 7 and Mk 9 Lynxes under Future Lynx Battlefield Light Utility Helicopter programme at total cost of £1 billion. This followed, on 22 July 2002, by announcement of assessment phase for Future Lynx to meet Royal Navy's Surface Combatant Maritime Rotorcraft requirement, requiring upgrade of 40 Lynx to enter service from 2008.

UK MoD decision to proceed with Future Lynx announced 24 March 2005, £1,000 million programme involving both army and navy versions. Agreement also includes exploration of potential partnership between AgustaWestland and MoD for both support of existing military helicopter fleet and future requirements.

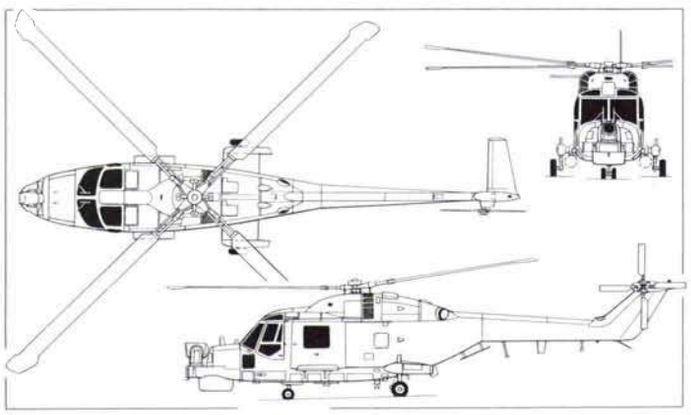
CURRENT VERSIONS: Early versions of Lynx for UK armed forces were last described in the 2002-03 *Jane's All the World's Aircraft*. Those for overseas operators appeared in the 1990-01 and earlier editions.

Super Lynx Series 100: Introduced September 1996; export version of HMA. Mk 8; conventional cockpit instrumentation, Rolls-Royce Gem 42-1 turboshafts and 360° radar. Applies retrospectively to aircraft sold to Brazil (Mk 21A), Portugal (Mk 95) and South Korea (Mk 99) as well as to seven Mk 88As sold to Germany, also in September 1996.

Artist's impression of Future Lynx in maritime form for Royal Navy 1151714

AgustaWestland Lynx Srs 300 Mk 110 of Thai Navy 1151712

Future Lynx in British Army form, shown in an artist's impression 1151713



AgustaWestland Lynx HMA. Mk 8, based on the Super Lynx advanced export version *(Dennis Punnett)* 0507240

Super Lynx Series 200: Conventional cockpit, but electronic power system displays and two LHTEC CTS800-4N turboshafts with FADEC. Original Lynx demonstrator G-LYNX fitted with two 1,007 kW (1,350 shp) T800 turboshafts as **Battlefield Lynx 800** private venture (LHTEC funding power plants and gearboxes, Westland provided airframe for full flight demonstration programme); first flight 25 September 1991; programme terminated early 1992 after 17 hours. CTS800 is derived from the T800 (as in the Boeing Sikorsky RAH-66 Comanche) and offers an additional 30 per cent of power to operators using the Lynx in hot climates. Version for production Lynx is CTS800-4N

Super Lynx Series 300: Prototype first flown (ZT800) 27 January 1999, initially with Gem 42 engines; flew with CTS800-4N engines 12 June 2001. Six-screen EFIS cockpit (including four 158 mm; 6¼ in square integrated display units); dual redundant MIL-STD-1553B and ARINC 429 databusses; new navigation system and AHRS; revised communications suite; CTS800 engines. Ordered by Malaysia (with Sea Skua anti-ship missiles); Thailand confirmed contract for two in 2001; Oman announced intention to purchase on 17 March 2001 and signed contract for 16 on 19 January 2002; aircraft equipment includes Avitronics EW suite.

South Africa, announced intention to purchase on 18 November 1998, but later deferred expected contract for four to unspecified date; authorisation to proceed given February 2003; contract confirmation announced 14 August 2003; South African Srs 300s will be designated Mk 64 and equipped with Telephonics AN/APS-143(V)-3 radar, Sysdel Sea Raven 118 ESM, Kentron Cumulus LEO Mk 2 sensor turret with video datalink, Grintek GUS-1000 communications system (two Reutech ACR-500 V/UHF and one Grintek AT-2820 HF) and Tellumat PT-200 IFF.

Future Lynx: Development of Series 300; offered to UK armed forces as retrofit meeting Army's Battlefield Light Utility Helicopter and Navy's Surface Combatant Maritime Rotorcraft requirements. Growth potential to MTOW of 6,250 kg (13,778 lb). By early 2005, Future Lynx design refined to incorporate flat-sided tailboom with horizontal stabiliser having fins at tip.

CUSTOMERS: Refer to table. Contracts for later versions include Super Lynx ordered by South Korea 1988 (12 **Mk 99** with Racal Avionics Doppler 71/TANS N nav system, Seaspray Mk 3 360° radar, AN/AQS-18 dipping sonar and Sea Skua), handed over between 26 July 1990 and May 1991 for 'Sumner' and 'Gearing' class destroyers; further 13 delivered 1999–2000 as Mk 99As to order confirmed in June 1997. Mk 99A has composites tailplane; first aircraft flown 3 July 1999 and departed Yeovil for surface delivery 1 September 1999. Portugal ordered five (first two ex-Royal Navy modified airframes) Super Lynx **Mk 95** 1990 (plus three options) with Racal RNS252 GPS-aided INS and Doppler 91 navigation systems and some US equipment including AN/AQS-18 sonar and Honeywell RDR 1500 radar; first two handed over 29 July 1993 for 'Vasco da Gama' class (MEKO 200) frigates; final two delivered 16 November 1993. Brazil ordered nine **Mk 21As** (plus five conversions from Mk 21). First for upgrade, N3027 delivered to Yeovil on 1 February 1995 and reflown as Mk 21A (N4010) on 22 December 1995; last two redelivered in late April 1998. First new-build helicopter (N4001) flew 12 June 1996; last delivered in August 1997. Mk 21A avionics include 360° Seaspray 3000 radar, RNS252 INS and Doppler 71 (but no FLIR or CTS); armament includes Sea Skua missiles. Mk 21A introduced 5,330 kg (11,750 lb) MTOW.

German Navy ordered seven Super Lynx **Mk 88As** in September 1996 and simultaneously took an option (confirmed on 25 June 1998) on upgrading (with new-build airframes) of its existing 17 (subsequently reduced by attrition to 15); new deliveries began with roll-out on 14 July 1999 (post first flight) of initial aircraft. Westland converted initial upgraded helicopter (8303), first flown 28 February 2001. First of 14 upgrades by Eurocopter at Donauwörth (of 8309) was redelivered on 7 March 2002. Mk 88A is a Srs 100 aircraft with 360° Seaspray Mk 3000 radar, FLIR turret (or nose fairing when not fitted), Rockwell Collins GPS and Racal Doppler 91 and RNS252; Sea Skua ASM armament.

Eight Danish aircraft upgraded to **Mk 90B** by 2004 with new airframes under contract announced 20 January 1998; all except one undertaken locally; initial conversion (S-191) by Westland and redelivered to Denmark on 1 November 2000; eighth entered re-work in June 2004. Super Lynx also offered to Australia and New Zealand (both unsuccessfully) and Malaysia, last-mentioned announcing order for six Mk 100s on 7 September 1999; deliveries began mid-2003; first flight in Malaysia was on 21 July 2003; final aircraft (No. 3) delayed in UK until mid-2004 for Sea Skua anti-ship missile trials and formally handed-over at Farnborough International on 19 July 2004.

Oman's first Lynx **Mk 120** flew 25 October 2003; first three delivered on 24 June 2004, although formal acceptance (sixth aircraft) not effected until 19 July 2004 in ceremony at Farnborough International. Are first Lynx with new-generation HUMS and related maintenance data transfer device. Manufacture complete by mid-2005.

COSTS: £100 million for seven Mk 88As (Germany), 1996. Proposed four Srs 300s for South Africa estimated to cost total of £80 million (1998). Two Thai Lynx 300s, plus logistic support and services, £25 million (2001). Six Malaysian Lynx 300s valued at RM700 million (US$184 million) (1999).

DESIGN FEATURES: Compact design suited to hunter-killer ASW and missile-armed anti-ship naval roles from frigates or larger ships (superseding ship-guided helicopters), armed/unarmed land roles with cabin large enough for squad, or other tasks; manually folding tail pylon on most (but not all) naval versions; single four-blade semi-rigid main rotor (foldable), each blade attached to main rotor hub by titanium root plates and flexible arm; rotor drives taken from front of engines into main gearbox mounted above cabin ahead of engines; in flight, accessory gears (at front of main gearbox) driven by one of two through shafts from first stage reduction gears; four-blade tail rotor, drive taken from main ring gear; single large window in each main cabin sliding door; provision for internally mounted armament, and for exterior universal flange mounting each side for other weapons/stores. Super Lynx has all-weather day/night capability; extended payload/range; advanced technology swept-tip (BERP) composites main rotor blades offering improved speed and aerodynamic efficiency and reduced vibration; and reversed direction tail rotor for improved control.

FLYING CONTROLS: Rotor head controls actuated by three identical tandem servojacks and powered by two independent hydraulic systems; control system incorporates simple stability augmentation system; each engine embodies independent control system providing full-authority rotor speed governing, pilot control being limited to selection of desired rotor speed range; in event of one engine failure, system restores power up to single-engine maximum contingency rating; main rotor can provide negative thrust to increase stability on deck after touchdown on naval versions; hydraulically operated rotor brake mounted on main gearbox; sweptback fin/tail rotor pylon, with starboard half-tailplane.

STRUCTURE: Conventional semi-monocoque pod and boom, mainly light alloy; glass fibre access panels, doors, fairings, pylon leading/trailing-edges, and bullet fairing over tail rotor gearbox; composites main rotor blades; main rotor hub and inboard flexible arm portions built as complete unit, as titanium monobloc forging; tail rotor blades have light alloy spar, stainless steel leading-edge sheath and rear section as for main blades.

LANDING GEAR (general purpose military version): non-retractable tubular skid type. Provision for a pair of adjustable ground handling wheels on each skid. Flotation gear optional. Battlefield Lynx and AH. Mk 9 equivalent have non-retractable tricycle gear with twin nosewheels.

LANDING GEAR (naval versions): non-retractable oleo-pneumatic tricycle type. Single-wheel main units, carried on sponsons, fixed at 27° toe-out for deck landing; can be manually turned into line and locked fore and aft for movement of aircraft into and out of ship's hangar. Twin-wheel nose unit steered hydraulically through 90° by the pilot to facilitate independent take-off into wind. Sprag brakes (wheel locks) fitted to each wheel prevent rotation on landing or inadvertent deck roll. These locks disengaged hydraulically and re-engage automatically in event of hydraulic failure. Maximum vertical descent 1.83 m (6 ft)/s; with lateral drift 0.91 m (3 ft)/s for deck landing. Flotation gear, and deck securing system, optional. Latter include RDM Deadlock, Trigon 3, Trigon 5, Assist and PRISM, to customer's requirements.

POWER PLANT: Current option of two Rolls-Royce Gem 42-1 turboshafts, each rated at 746 kW (1,000 shp) for T-O or 664 kW (890 shp) max continuous; or two LHTEC CTS800-4Ns, each of 1,016 kW (1,362 shp) and 945 kW (1,267 shp), respectively. Additionally, CTS800 can supply 1,123 kW (1,506 shp) for 2 minutes max contingency or 1,208 kW (1,620 shp) for 30 seconds emergency rating. Transmission rating 1,372 kW (1,840 shp). Exhaust diffusers for IR suppression optional on Battlefield Lynx.

Fuel in five internal tanks; usable capacity 957 litres (253 US gallons; 210 Imp gallons) when gravity-refuelled; 985 litres (260 US gallons; 217 Imp gallons) when pressure-refuelled. Optional internal tank, replacing bench seat at rear of cabin, capacity 345 litres (91.0 US gallons; 75.9 Imp gallons). For ferrying, two tanks each of 441 litres (116 US gallons; 97.0 Imp gallons) in cabin, replacing bench tank. Maximum usable fuel 1,867 litres (493 US gallons; 411 Imp gallons). Engine oil tank capacity 6.8 litres (1.8 US gallons; 1.5 Imp gallons). Main rotor gearbox oil capacity 28 litres (7.4 US gallons; 6.2 Imp gallons).

ACCOMMODATION: Pilot and co-pilot or observer on side-by-side seats. Dual controls optional. Individual forward-hinged cockpit door and large rearward-sliding cabin door on each side; cockpit doors jettisonable; windows of cabin doors also jettisonable. Cockpit accessible from cabin area. Maximum high-density layout (military version) for one pilot and 10 armed troops or paratroops, on lightweight bench seats in soundproofed cabin. Alternative VIP layouts for four to seven passengers, with additional cabin soundproofing. Seats can be removed quickly to permit carriage of up to 907 kg (2,000 lb) of freight internally. Tiedown rings provided. In casualty evacuation role, with a crew of two, Lynx can accommodate up to six Alphin stretchers and a medical attendant. Both basic versions have secondary capability for search and rescue (up to nine survivors) and other roles.

SYSTEMS: Two independent hydraulic systems, pressure 141 bar (2,050 lb/sq in). Third hydraulic system provided in naval version when sonar equipment installed. No pneumatic system. 28 V DC electrical power supplied by two 6.3 kW engine-driven starter/generators and an alternator. External power sockets. 24 V 23 Ah (optionally 40 Ah) Ni/Cd battery fitted for essential services and emergency engine starting. 200 V three-phase AC power available at 400 Hz from two 25 kVA transmission-driven alternators. Cabin heating and ventilation system. Optional supplementary cockpit air conditioning system. Electric anti-icing and demisting of windscreen, and electrically operated windscreen wipers, standard; windscreen washing system.

AVIONICS: *Comms:* Typically Rockwell Collins VOR/ILS; DME; Rockwell Collins AN/ARN-118 Tacan; I-band transponder (naval version only); BAE PTR446, Rockwell Collins APX-72, DaimlerChrysler STR 700/375 or Italtel APX-77 IFF.

Flight: BAE duplex three-axis automatic stabilisation equipment; BAE GM9 Gyrosyn compass system; Racal tactical air navigation system (TANS); Racal 71 Doppler, E2C standby compass. BAE Mk 34 AFCS. Additional units fitted in naval version, when sonar is installed, to provide automatic transition to hover and automatic Doppler hold in hover.

Latest versions have Racal Doppler 91 and RNS 252 navigation; Honeywell/Smiths AN/APN-198 radar altimeter; Rockwell Collins 206A ADF; Rockwell Collins VIR 31A VOR/ILS.

Radar: Optional Seaspray Mk 3000 or Honeywell RDR 1500 360° scan radar in chin fairing. BAE Sea Owl thermal imaging equipment optional above nose.

Mission: Optional Honeywell AN/AQS-18 or Thomson HS-312 sonars in naval variants. Detection of submarines by dipping sonar or magnetic anomaly detector. Dipping sonar operated by hydraulically powered winch and cable hover mode facilities within the AFCS.

LYNX PRODUCTION

Variant	Customer	Qty	First aircraft	First flights	Operators
AH. Mk 1	Army Air Corps	113[13]	XZ170	11 Feb 1977-24 Jan 1984	
HAS. Mk 2	Fleet Air Arm	60	XZ227	20 Feb 1976-26 May 1981	Converted to Mk 3
HAS. Mk 2(FN)	French Navy	26	260	4 May 1977-5 Sep 1979	31F, 34F, ERCE
HAS. Mk 3	Fleet Air Arm	31	ZD249	4 Jan 1982-21 Oct 1988	815, 702 Sqdns
HAS. Mk 4(FN)	French Navy	14	801	1 Apr 1982-26 Aug 1983	31F, 34F, ERCE
Mk 5	MoD(PE)	3[13]	ZD285	21 Nov 1984-23 Feb 1985	DERA
AH. Mk 6	Royal Marines	-	-	None built	-
AH. Mk 7	Army Air Corps	11[13]	ZE376	23 Apr 1985-5 Jun 1987	
HMA. Mk 8	Fleet Air Arm	-		Conversions	815, 702 Sqdns
AH. Mk 9	Army Air Corps	16[13,14]	ZG884	20 Jul 1990-21 Jun 1992	653, 659 Sqdns
Mk 21	Brazilian Navy	9	N3020	30 Sep 1977-14 Apr 1978	Five upgraded to 21A
Mk 21A	Brazilian Navy	9[14]	N4001	12 Jun 1996-24 Apr 1997	1° EHEAA
Mk 22	Egyptian Navy	-	-	None built	-
Mk 23	Argentine Navy	2	0734	17 May 1978-23 Jun 1978	Withdrawn from service
Mk 24	Iraqi Army	-	-	None built	-
Mk 25[1]	Netherlands Navy	6	260	23 Aug 1976-16 Sep 1977	7/860 Sqdns
Mk 26	Iraqi Army (armed)	-	-	None built	
Mk 27[2]	Netherlands Navy	10	266	6 Oct 1978-12 Nov 1979	7/860 Sqdns
Mk 28	Qatari Police	3[13]	QP-31	2 Dec 1977-12 Apr 1978	Withdrawn from service[7]
Mk 64	South African Navy[10]	4[14]	-	-	22 Squadron
Mk 80[12]	Danish Navy	8[11]	S-134	3 Feb 1980-15 Sep 1981	See Mk 90
Mk 81[3]	Netherlands Navy	8	276	9 Jul 1980-24 Mar 1981	7/860 Sqdns
Mk 82	Egyptian Army	-	-	None built	
Mk 83	Saudi Army	-	-	None built	
Mk 84	Qatari Army	-	-	None built	
Mk 85	UAE Army	-	-	None built	
Mk 86	Norwegian Coast Guard	6	207	23 Jan 1981-11 Sep 1981	Skv 337
Mk 87	Argentine Navy	-	-	Embargoed	-
Mk 88	German Navy	19[9]	8301	26 May 1981-10 Dec 1988	3/MFG 3
Mk 88A	German Navy	7[14]	8320	30 Apr 1999 — Mar 2000	3/MFG 3
Mk 89	Nigerian Navy	3	01-F89	29 Sep 1983-14 Mar 1984	101 Sqdn
Mk 90[12]	Danish Navy	1[4]	S-256	19 Apr 1988[6]	Søværnets Flyvetjeneste
Mk 95	Portuguese Navy	3[14,5]	9203	9 Jul 1993–1993	EHM[8]
Mk 99	South Korean Navy	12[14]	90–0701	16 Nov 1989-14 May 1991	627 Sqdn
Mk 99A	South Korean Navy	13[14]	99–0721	3 Jul 1999-Aug 2000	629 Sqdn
Srs 300/Mk 100	Malaysian Navy	6[14]	M501-1	28 Mar 2002	501 Sqdn
Srs 300	Thai Navy	2[14]	2313	26 Jul 04	203 Sqdn
Srs 300/Mk 120	Oman Air Force	16[14]	757	25 Oct 2003	3 Sqdn
Subtotal		**417**			
Lynx 3		1	ZE477	14 Jun 1984	
Demonstrators		3	G-LYNX	18 May 1979-27 Jan 1999	
Prototypes		13	XW835	21 Mar 1971-5 Mar 1975	
Total		**434**			

Notes: Note A: Army Air Corps 651, 652, 654, 655, 656, 657, 659, 661, 662, 663, 664, 665, 667, 669 and 671 Squadrons; 847 Squadron (Royal Marine Commando)

[1] Netherlands designation UH-14A; all to SH-14D
[2] Netherlands designation SH-14B; all to SH-14D
[3] Netherlands designation SH-14C; all to SH-14D
[4] Plus one conversion from demonstrator; these two upgraded to Super Lynx Mk 90B with new airframes
[5] Plus two conversions from Mk 3
[6] Completion and first flight at Vaerløse, Denmark
[7] Sold to Royal Navy for spares recovery and use as ground instructional airframes
[8] Esquadrilha de Helicopteros de Marinha
[9] Surviving 15 upgraded to Super Lynx with new airframes in 2001–2003
[10] Programme delay announced in 1999; go-ahead given February 2003
[11] Surviving six converted to Super Lynx Mk 90B with new airframes
[12] Converted during 1990s to Mk 80A/90A with Gem 42-1 engines
[13] Army version
[14] Super/Battlefield Lynx

EQUIPMENT: All versions equipped as standard with navigation, cabin and cockpit lights; adjustable landing light under nose; and anti-collision beacon. For search and rescue, with three crew, both versions can have a waterproof floor and a 272 kg (600 lb) capacity clip-on hydraulic or electric hoist on starboard side of cabin; cable length 30 m (98 ft).

ARMAMENT: For armed escort, anti-tank or air-to-surface strike missions, army version can be equipped with two 20 mm cannon mounted externally so as to permit fitment of pintle-mounted 7.62 mm machine gun inside cabin. External pylon can be fitted on each side of cabin for variety of stores, including two Minigun or other self-contained gun pods; two rocket pods; or up to eight HOT, Hellfire, TOW, or similar air-to-surface missiles. Additional six or eight reload missiles carried in cabin. For ASW role, armament includes two Mk 44, Mk 46, A244S or Sting Ray homing torpedoes, one each on an external pylon on each side of fuselage, and six marine markers; or two Mk 11 depth charges. Alternatively, up to four Sea Skua semi-active homing missiles; on French Navy Lynx, four AS.12 or similar wire-guided missiles.

Following data refer to Super Lynx.

DIMENSIONS, EXTERNAL:
- Main rotor diameter ... 12.80 m (42 ft 0 in)
- Tail rotor diameter ... 2.36 m (7 ft 9 in)
- Distance between rotor centres ... 7.66 m (25 ft 1½ in)
- Length of fuselage, tail rotor turning ... 13.34 m (43 ft 9¼ in)
- Length overall:
  - both rotors turning ... 15.24 m (50 ft 0 in)
  - main rotor blades and tail folded ... 10.85 m (35 ft 7¼ in)
- Width overall, main rotor blades folded ... 2.94 m (9 ft 7¾ in)
- **Height overall: tail rotor turning ... 3.67 m (12 ft 0½ in)**
- **main rotor blades and tail folded ... 3.25 m (10 ft 8 in)**
- Tailplane half-span ... 1.32 m (4 ft 4 in)
- Wheel track ... 2.94 m (9 ft 7¾ in)
- Wheelbase ... 3.02 m (9 ft 11 in)

DIMENSIONS, INTERNAL:
- Cabin, from back of pilots' seats:
  - Min length ... 2.055 m (6 ft 9 in)
  - Max width ... 1.78 m (5 ft 10 in)
  - Max height ... 1.42 m (4 ft 8 in)
  - Floor area ... 3.45 m² (37.1 sq ft)
  - Volume ... 4.9 m³ (173 cu ft)
- Cabin doorway: Width ... 1.37 m (4 ft 6 in)
  - Height ... 1.19 m (3 ft 11 in)

AREAS:
- Main rotor disc ... 128.71 m² (1,385.4 sq ft)
- Tail rotor disc ... 4.37 m² (47.04 sq ft)

WEIGHTS AND LOADINGS:
- Manufacturer's basic weight ... 3,291 kg (7,255 lb)
- Operating weight empty (including crew and appropriate armament):
  - ASW (two torpedoes) ... 4,618 kg (10,181 lb)
  - ASW (four Sea Skuas) ... 4,373 kg (9,641 lb)
  - **surveillance and targeting ... 3,708 kg (8,174 lb)**
  - **search and rescue ... 3,778 kg (8,329 lb)**
- **Max underslung load ... 1,361 kg (3,000 lb)**
- **Max fuel weight: normal ... 787 kg (1,735 lb)**
  - **bench seat ... 275 kg (606 lb)**
  - ferry tanks, total two ... 696 kg (1,534 lb)
- Max T-O weight ... 5,330 kg (11,750 lb)
- Max disc loading ... 41.4 kg/m² (8.48 lb/sq ft)
- Transmission loading at max T-O weight and power ... 3.89 kg/kW (6.39 lb/shp)

PERFORMANCE (CTS800 engines):
- Max continuous cruising speed ... 132 kt (244 km/h; 152 mph)
- Hovering ceiling IGE, ISA +20°C ... 2,105 m (6,900 ft)
- Hovering ceiling OGE, ISA +20°C ... 1,445 m (4,740 ft)
- Radius of action:
  - range with auxiliary fuel ... 540 n miles (1,000 km; 621 miles)
  - anti-submarine, 2 h on station, dipping sonar and one torpedo ... 20 n miles (37 km; 23 miles)
  - **point attack with four Sea Skuas ... 125 n miles (232 km; 143 miles)**
  - **surveillance, 3 h 50 min on station ... 75 n miles (139 km; 86 miles)**
- Max endurance with auxiliary fuel ... 5 h 20 min

AGUSTAWESTLAND A 109

US Coast Guard designation: MH-68A Stingray
Swedish armed forces designation: Hkp 15

TYPE: Light utility helicopter.

Royal Air Force AgustaWestland A 109E Power used for VIP transport

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Swedish armed forces AgustaWestland Hkp 15A

1037994

PROGRAMME: First flight of original A 109 4 August 1971; deliveries of A 109A started early 1976; single-pilot IFR certification 20 January 1977; deliveries of uprated A 109 Mk II began September 1981; A 109C certified 1989; first deliveries February 1989; A 109 Max was medevac version; A 109CM and A 109EOA for military use.

First flight of A 109K April 1983; first flight of production representative second aircraft March 1984. A 109K2s of REGA air ambulance fitted with Sextant AFDS 95-1 AFCS, granted FAA single-pilot IFR certification late in 1996.

A 109 Power programme begun in 1993, intending to unify A 109C and A 109K2; initially known as A 109 Unified; launched November 1993; unique A 109D development aircraft with FADEC-equipped Allison 250-C22R9s flew 1 October 1994; prototype A 109E (I-EPWS) flew 8 February 1995. A 109D became second A 109E prototype.

CURRENT VERSIONS: **A 109KM:** Military version of A 109K2; roles include anti-tank/scout, escort, command and control, utility, ECM and SAR/medevac; fixed landing gear; sliding side doors.

A 109KN: Shipboard version with equivalent roles to A 109KM, including anti-ship, over-the-horizon surveillance and targeting and vertical replenishment.

A 109K2: Special civil rescue version first sold to Swiss REGA non-profit rescue service; REGA equipment includes Spectrolab SX-16 searchlight, 1,000 kg (2,204 lb) cargo hook, GPS, Elbit moving map display and single-pilot IFR instrumentation; NVG compatible. Equipped with Thales AFDS 95-1 AFCS from 1996.

A 109K2 Law Enforcement: Dedicated police version; optional equipment includes 907 kg (2,000 lb) cargo hook, 204 kg (450 lb) capacity variable speed rescue hoist with 50 m (164 ft) of cable, rappeling kit, wire-strike protection, SX-16 searchlight, MA3 retractable light, external loudspeakers, emergency floats, GPS, FM tactical communications, weather radar, LLTV and FLIR.

A 109 Power: Revealed at 1995 Paris Air Show, by which time prototype had accumulated more than 60 hours of flight testing. Engineering designation is **A 109E**. Based on A 109K2 airframe with new, A 129-derived lightweight, low-maintenance titanium main rotor head connected to composites material grips via single elastomeric bearing on each blade; Pratt & Whitney Canada PW206C or Turbomeca Arrius 2K1 engines; new heavy-duty high-clearance landing gear in revised position below fuselage; cabin as for A 109K2, retaining quick-change facility from passenger to EMS operation. First production aircraft (I-PWER) completed late 1995; RAI IFR certification 31 May 1996; FAA IFR certification 26 August 1996. Aircraft with Rogerson IIDS (integrated instrument display system) cockpit (I-EAPW; first production) displayed at 1997 Paris Air Show. First 120 or so Powers had P&W engines; Turbomeca variant phased in with delivery of N7YL to Erie Lifestar in early September 2001. PZL-Świdnik of Poland contracted to build fuselages for A 109E between 1996 and 2002 as alternative production source.

US Coast Guard MH-68A (see Customers, below) is equipped with night vision device (NVD) cockpit, FLIR, weather radar and machine gun. Following trials aboard the USCG *Gallatin* (WHEC 721) in early 2001, the MH-68A has been cleared for deployment aboard all helicopter-capable cutters in the USCG fleet. MH-68A fleet had logged 10,667 hours by 28 April 2004.

A 109 Power Elite: Special edition of A 109E; improved interior and soundproofing; limited to 50 aircraft, c/ns 11151 to 11200, of which first (I-RAIB) exhibited at Paris in June 2001; initial export, fourth Elite, was delivered to Air Harrods in UK, May 2002; some 26 built by end of 2004, including first for Italian Carabinieri; none further by 2006.

MH-68A: US Coast Guard version of A 109E (P & W version). Provision for MG240 machine gun in port doorway and rescue hoist over starboard door. Night vision compatible cockpit; encrypted radios.

A 109LUH: Formerly A109M. Military version of A 109E with PW207C or Arrius 2K2 engine. Swedish armed forces ordered 20, under designation Hkp 15, on 20 June 2001; two leased helicopters handed over 10 September 2002. First production Hkp 15 handed over to Swedish Defence Material Agency (FMV) 2 February 2006 prior to service entry on 28 March; used for crew training, utility, ASW, SAR and Medevac missions; versions are **Hkp 15A** (12) for land operations; and **Hkp 15B** (eight) equipped to operate from 'Visby' class corvettes.

Requirement for 40 A 109LUHs announced by South African Air Force in November 1998 of which 30 ordered, with 10 options; these likely to be equipped with IST Dynamics turret mounting a Vektor multiple-calibre gun; first five manufactured in Italy, remainder by the Denel Group in South Africa. Initial Agusta-built aircraft rolled out 6 September 2002; Turbomeca engines. First Denel-built aircraft (4006) entered final assembly in February 2003 and made its public debut at the Africa Aerospace and Defence 2004 exhibition on 22 September 2004.

A 109LOH: Light observation helicopter variant. Selected by Malaysian Army Aviation in September 2003, with order for 11, plus initial support and training package, valued at USD70 million. First delivery (M81-01) December 2005.

A 109S Grand: Described separately.

CUSTOMERS: Some 817 of A 109 family built by January 2006 as detailed in adjacent table.

AGUSTAWESTLAND A 109 PRODUCTION
(at January 2006)

Variant	Qty	Remarks
A 109	4	Prototypes and pre-series
A 109A/II/EOA	343	
A 109	(2)	Static test airframes
A 109BA	46	Belgian Army
A 109C Max	82	
A 109D	1	Prototype
A 109E	256	
A 109E Elite	26	
A 109K	12	Peruvian Army
A 109K2	39	
A 109LUH	7	South Africa. Total 30
A 109LUH/Hkp 15	-	Sweden. Total 20
A 109LOH	1	Malaysia. Total 11
Total	**817**	

Customers include the US Coast Guard, which ordered four A 109Es (with four options, all taken up and delivered by late 2001, and two further options announced in February 2003) in interdiction configuration in April 2000 to equip Helicopter Interdiction Tactical Squadron 10 (HITRON TEN) based at Jacksonville, Florida, for armed anti-drug missions; Italy's Carabinieri, which took delivery of two A 109Es in 2000; Duke Life Flight of Durham, North Carolina, which took delivery of two A 109Es in EMS configuration in December 2001 and January 2002; the Italian government, which ordered one A 109E in

First A 109LOH for Malaysian Army Aviation, handed over on 8 December 2005

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VIP configuration for the Prime Minister's use; car manufacturer and Formula One racing team Ferrari, one A 109E; Air Harrods of the UK, one A 109E; Careflite, of Dallas-Fort Worth, Texas, which ordered four A 109Es in EMS configuration, the last of which was delivered on 30 December 2002, plus one ordered in February 2003, plus three options; Shenzhen Police of China, which ordered one A109E, plus two options, in January 2003; and the Slovenian Ministry of Defence, which ordered one, plus two options, in January 2003 for border patrol, civil protection, SAR and EMS duties. Greek government ordered five A 109Es in EMS configuration in 1999, and Dyfed/Powys Police Authority in the UK took delivery of an A 109E in late 1999, and ordered a replacement in March 2003.

Nigerian Navy ordered four Turbomeca-engined A 109 Powers for anti-smuggling duties in the Niger delta, first two delivered mid-2002, followed by remaining two in September 2004. Deer Jet of China ordered two A 109E Powers for harbour pilot shuttle services. Japanese National Police Agency ordered three A 109Es in June 2003, for delivery by end of year, for operation in Hiroshima, Fukushima and Niigata. UK operator Euro SkyLink took delivery of an A 109E Power in May 2004. Phoenix Police Department Air Patrol Unit and the Government of Rajasthan each ordered one A109 Power in July 2004; Airlift Northwest of Seattle ordered two A 109 Powers in October 2004; LifeFlight of Maine took delivery of two A 109 Powers in EMS configuration in December 2004.

More recent customers included Aerolineas Ejecutivas SA of Mexico, which ordered two A 109 Powers in February 2005; Saudi Aranco, which has ordered seven A 109 Powers, of which the first two were delivered in November 2005; and Libyan Italian Advanced Technology Company (LIATEC), which has ordered 10 A 109 Powers by delivery commencing in late 2006/early 2007 to be used for border patrol; the Royal Air Force, which took delivery of the first of three A 109 Powers on 22 March for operation by No 32 (The Royal) Squadron at RAF Northolt on a five-year contract that commenced on 1 April 2006; Latvia's Ministry of the Interior, which has ordered two A 109 Powers for border and law enforcement; Medair of Turkey, Power which took delivery of an A 109 in June 2006; the Japanese National Police Agency, which ordered four A 109 Powers in June 2006; and the Beijing Municipality Public Security Bureau, which ordered three A 109 Powers in June 2006.

COSTS: A 109E USD3.2 million to USD3.5 million (2002). A 109K2 USD3.5 million (2001). A 109E direct operating cost USD380 per hour (2000). US Coast Guard contract for four A 109Es valued at USD18.6 million (2000). Swedish armed forces order for 20 A 109Ms valued at €130 million (2001).

DESIGN FEATURES: Fully articulated four-blade metal main rotor hub with tension/torsion blade attachment and elastomeric bearings; delta-hinged two-blade stainless steel tail rotor; manual blade folding and rotor brake optional. Main blade section NACA 23011 with drooped leading-edge; thickness/chord ratios 11.3 per cent at root, 6 per cent at tip. Tail rotor with Wortmann aerofoil and stainless steel skins; optional rotor brake. Compared with earlier models, A 109K has lengthened cabin to hold two stretchers fore and aft; modified fuel system; and smaller instrument panel.

FLYING CONTROLS: Fully powered hydraulic; IFR system with autopilot available. A 109KM has three-axis stability augmentation/attitude hold system; dual redundant IFR system and four-axis AFCS with flight path computer optional.

LANDING GEAR: A 109K series has non-retractable tricycle type, giving increased clearance between fuselage and ground. A 109E Power has tricycle type, with oleo-pneumatic shock-absorber in each unit. Single mainwheels and self-centring nosewheel castoring ±45°. Hydraulic retraction, nosewheel forward, mainwheels upward into fuselage. Hydraulic emergency extension and locking. Magnaghi disc brakes on mainwheels. All tyres are tubeless, of same size (360×135–6 or 380×135–6 or 14.5×5 5–6, 12/14 ply tubeless) and pressure (5.90 bar; 85 lb/sq in). Tailskid under ventral fin. Emergency pop-out flotation gear and fixed snow skis optional on all models.

POWER PLANT: *A 109K:* Two Turbomeca Arriel 1K1 turboshafts, each rated at 575 kW (771 shp) for 2½ minutes, 550 kW (737 shp) for take-off (30 minutes) and 471 kW (632 shp) maximum continuous power. Engine particle separator optional. Main transmission uprated to 671 kW (900 shp) for take-off and maximum continuous twin-engined operation; single-engine rating is 477 kW (640 shp) for 2½ minutes and 418 kW (560 shp) maximum continuous. Main rotor rpm 384, tail rotor 2,085. Standard usable fuel capacity 750 litres (198 US gallons; 165 Imp gallons), with optional 150 litre (39.6 US gallon; 33.0 Imp gallon) auxiliary tank for EMS operations, or 200 litre (52.8 US gallon; 44.0 Imp gallon) auxiliary tank in the A 109KM. Self-sealing fuel tanks optional. Independent fuel and oil system for each engine.

A 109E: Two Pratt & Whitney Canada PW206C engines, each rated at 477 kW (640 shp) for T-O, 423 kW (567 shp) for twin-engine operation, 546 kW (732 shp) for 2½ minutes' OEI contingency rating and 500 kW (670 shp) maximum continuous OEI; or two Turbomeca Arrius 2K1, each rated at 500 kW (670 shp) for T-O, 425 kW (570 shp) for twin-engine operation, 559 kW (750 shp) for 2½ minutes' OEI contingencies and 500 kW (670 shp) maximum continuous OEI; transmission rating 671 kW (900 shp) for T-O and maximum continuous for twin-engine operation, 418 kW (560 shp) maximum continuous and 477 kW (640 shp) for 2½ minutes' OEI; FADEC and liquid crystal multifunction displays for engine management. Standard fuel capacity (three cells) 605 litres (160 US gallons; 133 Imp gallons); optional capacity 710 litres (187 US gallons; 156 Imp gallons) with one extra cell or 870 litres (230 US gallons; 191 Imp gallons) with two extra cells.

SYSTEMS: Military versions have electrical system supplied by two 160 A 28 V DC self-cooled starter/generators and 27 Ah 28 V Ni/Cd battery. Optional AC electrical system comprises two 250 VA or two high-load 600 VA 115/26 V AC 400 Hz static inverters. Optional high-load AC system comprises one 6 kVA alternator and one standby 250 VA solid-state inverter. Dual independent hydraulic systems for flight controls, each capable of operating main actuators in the event of failure of the other system; utility hydraulic system with normal and emergency accumulators for operation of rotor brake, wheel brakes and nosewheel centring.

AVIONICS: A109E has Rockwell Collins Pro Line II or Bendix/King Silver Crown as core system. Military versions have ergonomic, NVG-compatible flight deck with provision for IFR instrumentation and role/mission dedicated displays.

Comms: VHF/AM, VHF/FM, UHF, HF, three-station intercom, IFF and ELT.

Radar: Colour weather radar optional.

Flight: ADF, VOR/GS/ILS, DME, GPS and VLF-Omega. Optional Rockwell Collins CMS80 cockpit management system with one or more centrally mounted CDUs and automatic target hand-off system compatibility.

Mission: FLIR.

Self-defence: Radar/laser warning receivers and chaff/flare/smoke dispensers.

EQUIPMENT: Optional equipment for military use includes windscreen wipers, rear view mirror, bleed air heater, particle separator, engine fire extinguisher, oxygen system, environmental control unit, one- or two-stretcher installation, air ambulance kit, external loudspeaker system, high-intensity searchlight, cargo platform, external cargo hook with maximum capacity 1,000 kg (2,205 lb), rescue hoist maximum capacity 270 kg (595 lb), snow skis and emergency floats.

ARMAMENT (optional): Internal armament comprises pintle-mounted 7.62 mm machine gun and 12.7 mm machine gun in doorway. Provision for carriage of four or eight TOW, TOW 1, TOW 2 or TOW 2A missiles on external lateral pylons, each of 300 kg (661 lb) maximum capacity, with roof-mounted HeliTOW sight or APX M 334 or Helios gyrostabilised sights. Alternatively, pylons can accommodate seven- or 12-tube pods for 2.75 in or 81 mm rockets; rocket/machine gun (RPM) pods each with three 70 mm rockets and a 12.7 mm machine gun with 200 rounds; or machine gun (MG) pods with 12.7 mm gun (and 250 rounds) or 7.62 mm gun. A 109M has 12.7 mm or 20 mm nose-mounted turret gun.

DIMENSIONS, EXTERNAL:

Main rotor diameter	11.00 m (36 ft 1 in)
Tail rotor diameter	2.00 m (6 ft 6¾ in)
Length overall, rotors turning	13.04 m (42 ft 9 in)
Fuselage length	11.44 m (37 ft 6 in)
Height over tailfin	3.50 m (11 ft 5¾ in)
Tailplane span	2.88 m (9 ft 5½ in)
Width overall, rotor in 'X'	7.78 m (25 ft 6¼ in)
Width over mainwheels	2.45 m (8 ft 0½ in)
Wheelbase	3.535 m (11 ft 7¼ in)
Main rotor tip ground clearance	2.45 m (8 ft 0½ in)
Fuselage ground clearance	0.40 m (1 ft 3¾ in)
Passenger doors (each): Height	1.06 m (3 ft 5¾ in)
Width	1.15 m (3 ft 9¼ in)
Height to sill	0.65 m (2 ft 1½ in)
Baggage door (port, rear): Height	0.51 m (1 ft 8 in)
Width	1.00 m (3 ft 3¼ in)

DIMENSIONS, INTERNAL:

Cabin: Length	2.10 m (6 ft 10¾ in)
Max width: KM, K2	1.59 m (5 ft 2½ in)
E	1.61 m (5 ft 3½ in)
Max height	1.28 m (4 ft 2½ in)
Volume, incl flight deck: K2	4.9 m³ (173 cu ft)
E	5.1 m³ (180 cu ft)
Baggage compartment volume: K2	0.85 m³ (30.0 cu ft)
E	0.95 m³ (33.6 cu ft)

AREAS:

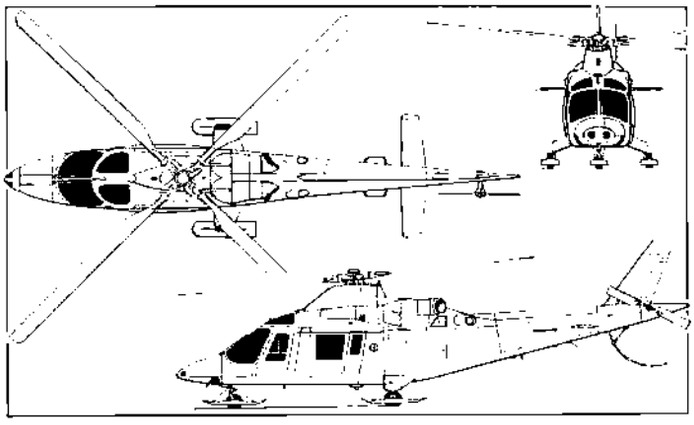
Main rotor disc	95.03 m² (1,022.9 sq ft)
Tail rotor disc	3.14 m² (33.82 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: KM	1,660 kg (3,660 lb)
K2	1,650 kg (3,638 lb)
E	1,585 kg (3,494 lb)
LUH	1,639 kg (3,614 lb)
Max slung load	1,000 kg (2,204 lb)
Max T-O weight: all	2,850 kg (6,283 lb)
Max T-O weight with slung load: all	3,000 kg (6,613 lb)
Max disc loading:	
KM, K2, E	30.0 kg/m² (6.14 lb/sq ft)
Transmission loading at max T-O weight and power:	
all	4.24 kg/kW (6.97 lb/shp)

PERFORMANCE:

Never-exceed speed (VNE):	
KM, K2	152 kt (281 km/h; 174 mph)
E, LUH	168 kt (311 km/h; 193 mph)
Max cruising speed at S/L, clean:	
KM, K2	143 kt (264 km/h; 164 mph)
E	154 kt (285 km/h; 177 mph)
LUH	151 kt (280 km/h; 174 mph)
Max rate of climb at S/L: KM, K2	594 m (1,950 ft)/min
E, LUH	588 m (1,930 ft)/min
Rate of climb at S/L, OEI:	
KM, K2, LUH	274 m (900 ft)/min
Service ceiling: KM, K2	6,100 m (20,000 ft)
E	5,974 m (19,600 ft)
LUH	5,029 m (16,500 ft)
Service ceiling, OEI: KM, K2	3,660 m (12,000 ft)
E, LUH	3,990 m (13,100 ft)
Hovering ceiling IGE: KM, K2	5,305 m (17,400 ft)
E	5,060 m (16,600 ft)
LUH	4,328 m (14,200 ft)
Hovering ceiling OGE: KM, K2	3,900 m (12,800 ft)
E	3,597 m (11,800 ft)
LUH	2,957 m (9,700 ft)
Max range, best height and speed, max optional (five cells) fuel:	
KM, K2	434 n miles (805 km; 500 miles)
E	521 n miles (964 km; 599 miles)
LUH	447 n miles (827 km; 514 miles)
Endurance: KM, K2	4 h 0 min
E	5 h 5 min
LUH	4 h 29 min



AgustaWestland A 109K2 civil rescue and utility helicopter (two Turbomeca Arriel 1K1 turboshafts) *(Dennis Punnett)* 0507372

AGUSTAWESTLAND A 109S GRAND

TYPE: Light utility helicopter.

PROGRAMME: Version of A 109 with enlarged cabin, unveiled in mockup form at Farnborough International, 20 July 2004. However, first of two prototypes (c/n 22001 and 22002) flown in 2002 and 2003, respectively (unannounced) and by July 2004 had accumulated combined 200 hours. First production Grand (I-RAID, c/n 22003) made public debut at Paris Air Show, where EASA certification formally presented on 15 June 2005.

CUSTOMERS: Approximately 10 sold by time of unveiling, mid-2004. Deliveries planned from 2005 onwards, with 15 to be supplied to customers by end of 2006. Announced customers include US launch customer Seacor Holdings Inc, parent company of offshore operator Tex-Air Helicopters, which ordered three in September 2004; Aerolineas Ejecutivas of Mexico, which ordered two in February 2005; Airlift Northwest (USA), four; Heli Dubai, two; and Baxter Air (South Africa), one. First production Grand was re-registered G-CGRI in August 2005 and delivered to C G Roach in UK; second also for UK operator, Errigal Helicopters, in October 2005. Total two delivered by end of 2005.

COSTS: USD4.0 million to USD4.7 million (2004). Variable operating cost USD677 per hour (2005).

Data generally as for A 109, except that following

DESIGN FEATURES: A 109 fuselage stretched by 0.21 m (8¼ in), allowing second window in cabin door. Quieter, scimitar-shape tail rotor. Certified to FAR/JAR 27, but with capabilities approaching FAR/JAR 29 standards

POWER PLANT: Two Pratt & Whitney Canada PW207C turboshafts with FADEC, each rated at 548 kW (735 shp) for T-O; 466 kW (625 shp) max continuous; 608 kW (815 shp) OEI max contingency for 2 min 30 s; and 548 kW (735 shp) OEI max continuous. Transmission rating 716 kW (960 shp) for T-O; 671 kW (900 shp) max continuous; 545 kW (730 shp) OEI max contingency; and 448 kW (600 shp) OEI max continuous. Fuel capacity (all minus 10 litres; 2.6 US gallons; 2.2 Imp gallons unusable): 576 litres (152 US gallons; 127 Imp gallons) with three-cell system; 674 litres (178 US gallons; 148 Imp gallons) with four-cell system; or 818 litres (216 US gallons; 180 Imp gallons) with five-cell system.

ACCOMMODATION: Eight persons, including one or two crew. Corporate/VIP configuration with five or six seats in club configuration. Baggage compartment, with external door, in tailboom.

AVIONICS: *Instrumentation:* Four flight/navigation LCDs, plus two data monitoring LCDs.

DIMENSIONS, EXTERNAL:

Main rotor diameter	10.83 m (35 ft 6½ in)
Tail rotor diameter	1.94 m (6 ft 4½ in)
Length overall: rotors turning	12.96 m (42 ft 6¼ in)
Fuselage: Length	11.65 m (38 ft 2½ in)
Max width	1.64 m (5 ft 4½ in)
Height over tailfin	3.44 m (11 ft 3½ in)
Tailplane span	2.88 m (9 ft 5½ in)
Wheel track	2.15 m (7 ft 0½ in)
Wheelbase	3.74 m (12 ft 3¼ in)
Ground clearance: fuselage	0.40 m (1 ft 3¾ in)
tail rotor	1.00 m (3 ft 3¼ in)
Passenger doors (each): Width	1.40 m (4 ft 7 in)

DIMENSIONS, INTERNAL:

Cockpit volume	1.7 m^3 (58 cu ft)
Cabin (excl cockpit):	
Length: at floor	2.30 m (7 ft 6½ in)
at roof	1.90 m (6 ft 2¾ in)
Max height	1.28 m (4 ft 2½ in)
Volume	3.9 m^2 (138 sq ft)
Baggage compartment: Length	2.30 m (7 ft 6½ in)
Max height	0.71 m (2 ft 4 in)
Volume	0.95 m^3 (33.5 cu ft)

AREAS:

Main rotor disc	92.12 m^2 (991.6 sq ft)
Tail rotor disc	2.96 m^2 (31.82 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	1,655 kg (3,649 lb)
Max fuel weight: three cells	460 kg (1,014 lb)
four cells	535 kg (1,179 lb)
five cells	644 kg (1,420 lb)
Max T-O weight: internal load	3,175 kg (7,000 lb)
underslung load	3,200 kg (7,054 lb)
Max disc loading: internal load	34.5 kg/m^2 (7.06 lb/sq ft)
underslung load	34.7 kg/m^2 (7.11 lb/sq ft)
Transmission loading at max T-O weight and power:	
internal load	4.44 kg/kW (7.29 lb/shp)
external load	4.77 kg/kW (7.84 lb/shp)

PERFORMANCE:

Never-exceed speed (VNE)	168 kt (311 km/h; 193 mph)
Max cruising speed at S/L	155 kt (287 km/h; 178 mph)
Max rate of climb at S/L	558 m (1,830 ft)/min
Max rate of climb at S/L, OEI	326 m (1,070 ft)/min
Hovering ceiling: IGE	4,572 m (15,000 ft)
OGE	3,048 m (10,000 ft)
Service ceiling	4,938 m (16,200 ft)
Service ceiling, OEI	2,896 m (9,500 ft)
Range with five fuel cells at FL50	480 n miles (889 km; 552 miles)
Endurance with five fuel cells at FL50	4 h 28 min

OPERATIONAL NOISE LEVELS:

T-O	90.5 EPNdB
Approach	91.2 EPNdB
Overflight	88.4 EPNdB

First production AgustaWestland A 109S Grand after delivery to Mr C G Roach in UK ***(Paul Jackson)*** 1037931

AgustaWestland A 109 Grand eight-seat utility helicopter ***(Paul Jackson)*** 0589208

AGUSTAWESTLAND A 119 KOALA

TYPE: Light utility helicopter.

PROGRAMME: First flight (I-KNEW, second airframe) early 1995; public debut by static test first airframe (I-KOAL) at Paris Air Show June 1995; both initially with 597 kW (800 shp) Turbomeca Arriel 1 turboshaft; rebuilt with PT6B turboshafts early in 1997 as I-KOAL c/n 14003 and I-KNEW c/n 14004; demonstrator and first production aircraft (I-KNOW) added in 1999 and US demonstrator in 2000; FAA certification 28 April 2000; initial delivery (VH-FOX) to Linfox Holdings, Melbourne, Australia, 25 September 2000.

As part of South African purchase of 40 military A 109s, Denel (which see) is assembling and marketing the Koala in Africa and providing components for the Italian production line.

In February 2004, Agusta announced that assembly of the Koala would be transferred to Agusta Aerospace Corporation's Philadelphia, Pennsylvania facility during 2004. This duly begun, with N31HH (c/n 14050) being first flown 13 June 2005, although US production certificate not awarded until 24 August 2006, applying to c/n 14517 (74th production) and subsequent aircraft; previous machines assembled in US received Italian export certification. A new 3,716 m^2 (40,000 sq ft) assembly plant has an initial capacity of 15 to 20 A 119s per year.

CURRENT VERSIONS: **A 119:** *as described.*

A 119 Military: Multirole military variant.

CUSTOMERS: Total of 76 production helicopters (78 overall) completed by December 2006; produced in Italy by late 2004 (including prototypes, but not two rebuilds). Assembly now in US.

Six ordered by Omniflight Helicopters in February 1996; orders and options totalled more than 45 by January 2003 from customers in Europe, North and South America and the Far East. Southeast Mississippi Air Ambulance District of Hattiesburg, Mississippi, took delivery of one in EMS configuration in February 2002. Interest shown by Carabinieri (Italian military police) as replacement for AB 206 and Guardia di Finanza (customs) as NH 500 replacement. Recent customers include the Pennsylvania State Police Department, which ordered two in January 2003, New York City Police's Department of Aviation, which ordered four in February 2003, of which the first was delivered in July 2004, Tex-Air Helicopters, which ordered 10 in June 2003, of which the first three were scheduled for delivery in late 2003, for offshore operations in the Gulf of Mexico, Zhengzhou Police of China, which has ordered one, J V Gokal & Co of India, which has ordered two, Phoenix Police Air Support Unit, which has ordered three, of which the first was delivered on 26 February 2006, the Mexican Government, which ordered five in July 2006, Skyline Helicopters of British Columbia, Canada, which ordered one in February 2006, Aerolineas Ejecutivas SA of Mexico which ordered one in August 2006, Kaan Air of Turkey, which took delivery of one in June 2006 and will receive another in 2007, Libyan Red Crescent, which ordered five in December 2006 for EMS duties, and SEACOR Holdings/ERA Helicopters, which took delivery of one on 15th December 2006.

COSTS: USD1.85 million (2000).

DESIGN FEATURES: Fully articulated four-blade composites main rotor with titanium hub, composites material grips and elastomeric bearings; two-blade tail rotor; large underfin.

STRUCTURE: Aluminium alloy fuselage.

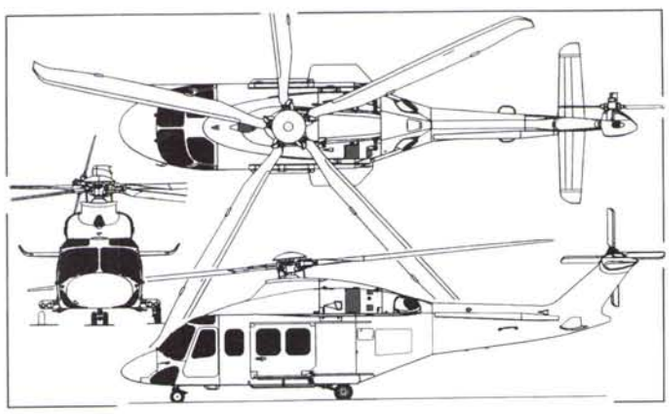
LANDING GEAR: Fixed skids.

POWER PLANT: One Pratt & Whitney Canada PT6B-37A turboshaft rated at 747 kW (1,002 shp) for T-O, and 650 kW (872 shp) maximum continuous. Transmission rating 671 kW (900 shp) for take-off and maximum continuous. Standard three-cell fuel system, combined capacity 606 litres (160 US gallons; 133 Imp gallons); optional four- and five-cell fuel tanks, combined capacities respectively 721 litres (188 US gallons; 156.5 Imp gallons) and 871 litres (230 US gallons; 191.5 Imp gallons).

ACCOMMODATION: Pilot and passenger in front; six passengers in main cabin in three-abreast club configuration; flight-accessible baggage compartment in cabin; main baggage compartment in rear fuselage with optional extensions; in EMS configuration can

AgustaWestland A 119 Koala 1040534

AgustaWestland AW139 supplied to Irish Air Corps in 2006 1040540



General arrangement of the AgustaWestland AW139 *(Paul Jackson)* 1158935

be configured for four, five, six or seven seats in club configuration. Alternatively, six stretchers and four attendants in medevac configuration. Plug-type sliding door on each side of cabin, with separate crew doors.

SYSTEMS: Systems duplicated and separated. Main and tail rotor ice protection optional. Smiths Aerospace HUMS. Eaton Corporation Smart Zapper chip detection system for main transmission, intermediate and tail rotor gearboxes.

AVIONICS: Honeywell Primus Epic as core system. Provision for up to four 203 × 254 mm (8 × 10 in) high definition colour active matrix liquid crystal displays for MFD, PFD and FLIR/video functions, and four-axis modular digital autopilot with flight director for hands off operation and SAR modes.

Optional avionics include search/weather radar, multiband radio, EGPWS, TCAS, CVR/FDR, FLIR, and auto-deployable ELT.

EQUIPMENT: Optional equipment includes auxiliary fuel tank, four bag flotation system, two 17-man externally mounted life rafts, external cargo hoist and hook, Nightsun SX-16 searchlight, NVG compatible cockpit, wire strike protection, and removable cabin windows for weapon mounts.

DIMENSIONS, EXTERNAL:

Main rotor diameter	13.80 m (45 ft 3¼ in)
Tail rotor diameter	2.69 m (8 ft 10 in)
Length overall, rotors turning	16.66 m (54 ft 8 in)
Fuselage: Length	13.53 m (44 ft 4¾ in)
Max width: across cabin	2.26 m (7 ft 5 in)
across sponsons	3.20 m (10 ft 6 in)
Height, rotors turning	4.95 m (16 ft 3 in)
Distance between rotor centres	8.41 m (27 ft 7 in)
Tail rotor ground clearance	2.34 m (7 ft 8 in)
Wheel track	3.05 m (10 ft 0 in)
Wheelbase	4.34 m (14 ft 3 in)
Cabin doors (two, each): Height	1.35 m (4 ft 5 in)
Width	1.68 m (5 ft 6 in)

DIMENSIONS, INTERNAL:

Cabin: Length	2.70 m (8 ft 10¾ in)
Max width	2.00 m (6 ft 6¾ in)
Max height	1.42 m (4 ft 8 in)
Volume	8.0 m³ (283 cu ft)
Baggage compartment volume	3.4 m³ (120 cu ft)

AREAS:

Main rotor disc	149.57 m² (1,610.0 sq ft)
Tail rotor disc	5.52 m² (59.37 sq ft)

WEIGHTS AND LOADINGS:

Typical equipped weight:	
Law enforcement	3,946 kg (8,700 lb)
Executive transport	3,950 kg (8,708 lb)
Offshore, SAR, maritime security	4,037 kg (8,900 lb)
Typical payload:	
Law enforcement	2,454 kg (5,410 lb)
Executive transport	2,450 kg (5,401 lb)
Offshore, SAR, maritime security	2,363 kg (5,210 lb)
Useful load	2,500 kg (5,512 lb)
Max external load	2,700 kg (5,952 lb)
Max T-O weight	6,400 kg (14,110 lb)
Max disc loading	42.79 kg/m² (8.76 lb/sq ft)

PERFORMANCE (estimated):

Never-exceed speed (VNE)	167 kt (309 km/h; 192 mph)
Max cruising speed	157 kt (291 km/h; 181 mph)
Max rate of climb at S/L	610 m (2,000 ft)/min
Service ceiling	6,095 m (20,000 ft)
Service ceiling, OEI	3,595 m (11,800 ft)
Hovering ceiling OGE	1,675 m (5,500 ft)
Max range, no reserves	550 n miles (1,018 km; 632 miles)
Endurance	5 h
Typical SAR mission, with auxiliary fuel, at 50 n miles (93 km; 58 mile) distance to search area, 30 min reserves:	
Time to reach search area	18 min
Time on station	3 h 36 min
Rescue of six survivors	20 min
Time to return to base, best range speed	22 min

AGUSTAWESTLAND AW149

TYPE: Multirole medium helicopter.

PROGRAMME: In October 2003, Agusta revealed preliminary plans for a 6.8 tonne multirole helicopter which it planned to offer to Australia as part of the AgustaWestland/BAE Systems combined bid for the Air 9000 requirement complementing, and in the long term possibly replacing, Sikorsky S-70A Black Hawks. The helicopter appeared to be a reactivation of the A129 Utility project, which Agusta allowed to lapse in the mid-1990s. Australia was offered participation in design of the cabin and tailboom, but the helicopter was not selected for the RAAF.

In November 2005, AgustaWestland released further — but still incomplete — details of the A149, following this with a formal AW149 launch at Farnborough on 22 June 2006. First flight due 2009; civil IFR one/two pilot certification in 2011. Industrial partners being sought in 2006.

DESIGN FEATURES: Affordable multipurpose medium helicopter for military and para-public roles, operable throughout the world. Incorporates new components, structure and systems.

LANDING GEAR: Tricycle type; retractable.

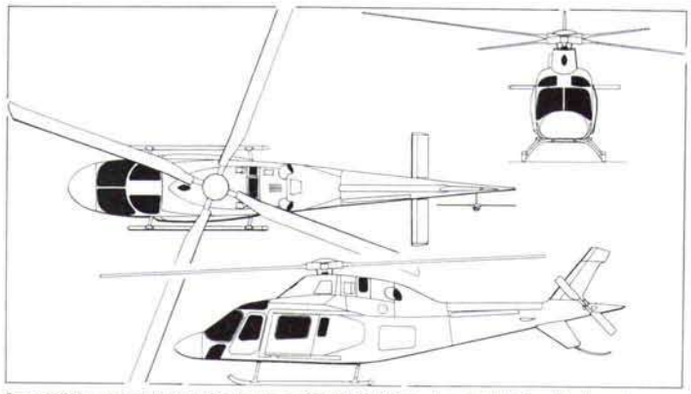
POWER PLANT: Two turboshafts, each in 1,491 kW (2,000 shp) class. Transmission rating 1,252 kW (1,679 shp) for T-O. Engine air particle separator standard. Closed circuit refuelling system. Crashworthy, self-sealing fuel tanks.

ACCOMMODATION: Two crew and up to 15 passengers or 12 fully equipped troops. Sliding door each side of cabin; crew door each side, forward-hinged.

SYSTEMS: Four-axis autopilot. Air conditioning. Optional de/anti-icing. Health and usage monitoring system.

AVIONICS: *Comms:* Cockpit voice recorder. Emergency locator system.

Artist's impression of AgustaWestland AW149 1159306



AgustaWestland A 119 Koala (one P&WC PT6B turboshaft) *(Paul Jackson)*
0137339

accommodate two stretchers and three medical attendants. Large sliding doors on each side of main cabin; forward-hinged door to cockpit on both sides. Cabin is heated, air conditioned and soundproofed.

AVIONICS: Bendix/King Silver Crown suite and integrated instrument display system (IIDS) standard.

Comms: Silver Crown com/nav and ELT standard.

Flight: Three-axis autopilot with duplex SAS and altitude hold mode standard; radar altimeter, Garmin GNS 430/530 GPS and moving map display optional.

Instrumentation: Third generation NVG compatibility optional.

EQUIPMENT: Optional equipment includes 500 kg (1,102 lb) or 1,000 kg (2,205 lb) fixed cargo hook; 450 kg (992 lb) rescue hoist; Simplex 323 fire attack system with 1,200 litre (317 US gallon; 263.9 Imp gallon) capacity; snow skids, external emergency floats, particle separator, Spectrolab SX-5 searchlight and FLIR/LLTV camera.

DIMENSIONS, EXTERNAL:

Main rotor diameter	10.83 m (35 ft 6½ in)
Tail rotor diameter	2.00 m (6 ft 6¾ in)
Length overall, rotors turning	13.01 m (42 ft 8¼ in)
Height overall	3.77 m (12 ft 4½ in)
Fuselage: max width	1.67 m (5 ft 5¾ in)
Width overall, rotor in 'X'	7.66 m (25 ft 1½ in)
Main rotor tip ground clearance	2.54 m (8 ft 4 in)
Tail rotor tip ground clearance	1.29 m (4 ft 2¾ in)
Fuselage ground clearance	0.54 m (1 ft 9¼ in)

DIMENSIONS, INTERNAL:

Cabin: Length	2.10 m (6 ft 10¾ in)
Max width	1.67 m (5 ft 5¾ in)
Max height	1.28 m (4 ft 2½ in)
Floor area	2.60 m² (28.0 sq ft)
Volume, incl flight deck	4.96 m³ (175.2 cu ft)
Baggage compartment: Length	2.30 m (7 ft 6½ in)
Volume	0.95 m³ (33.5 cu ft)

AREAS:

Main rotor disc	92.12 m² (991.6 sq ft)
Tail rotor disc	3.14 m² (33.82 sq ft)

WEIGHTS AND LOADINGS:

Basic weight empty	1,430 kg (3,153 lb)
Max T-O weight: internal load	2,720 kg (5,996 lb)
external load	3,150 kg (6,944 lb)
Max disc loading:	
internal load	29.53 kg/m² (6.05 lb/sq ft)
external load	34.19 kg/m² (7.00 lb/sq ft)
Transmission loading at max T-O weight and power:	
internal load	4.05 kg/kW (6.65 lb/shp)
external load	4.69 kg/kW (7.71 lb/shp)

PERFORMANCE (max internal load):

Never-exceed speed (VNE)	152 kt (281 km/h; 174 mph)
Max level speed	139 kt (257 km/h; 160 mph)
Hovering ceiling: IGE	4,450 m (14,600 ft)
OGE	3,261 m (10,700 ft)
Service ceiling	6,100 m (20,000 ft)
Range with max auxiliary fuel, at 1,525 m (5,000 ft), no reserves	560 n miles (1,037 km; 644 miles)
Endurance	5 h 45 min

AGUSTAWESTLAND AW139

TYPE: Multirole medium helicopter.

PROGRAMME:

DEVELOPMENT MILESTONES

Announced	8 Sep 98
Mockup unveiled	12 Jun 99
First flight	3 Feb 01
Assembly of production aircraft began	Nov 01
Certification	20 Jun 03

Announced at Farnborough Air Show, 8 September 1998, as joint venture under Bell/Agusta partnership; designated AB139; to complement, rather than replace, Bell 412. Full-scale mockup unveiled at Paris Air Show 12 June 1999. AgustaWestland responsible for development, certification to JAR/FAR 29 and transition to production, with participation by Bell on a 75:25 per cent work-share basis; final assembly by

Spectacularly decorated AgustaWestland AW139 owned by a South African businessman
1040541

AgustaWestland at Vergiate, and by Bell (possibly at Mirabel, Canada) for American and Pacific Rim customers. In December 2005, this agreement cancelled and AgustaWestland announced plans to acquire Bell's share of the programme and make its own provision for a US production line in Philadelphia.

No designated "prototype"; first preproduction aircraft (01, later I-ACOI) undertook maiden flight on 3 February 2001 followed by second aircraft (02, later I-ATWO) on 4 June 2001 and third (03, later I-EPIC) on 22 October 2001; Assembly of first production aircraft began in late November 2001; this (I-ANEW) demonstrated at Farnborough in July 2002. Three preproduction aircraft and one tie-down helicopter (TDH) undertook flight test programme leading to Italian certification on 20 June 2003, following 1,600 hour ground and flight test programme (including those flown by first preproduction aircraft which was lost in crash on 22 April 2002) and 750 hours completed on the TDH. FAA certification achieved 20 December 2004. Change of designation to AW139 revealed 23 February 2006 with purchase of 12 by Japanese dealer, Mitsui Bussan. First AW139 assembled by North American subsidiary in Philadelphia was N915DH c/n 31057, handed-over to SEACOR Holdings/ERA Helicopters on 15 December 2006.

Risk-sharing collaborators include GKN Westland (tail rotor drive train), Honeywell (avionics), Kawasaki (transmission input module), Liebherr Germany (landing gear and air conditioning system), Pratt& Whitney Canada (power plant) and PZL Świdnik (airframe components).

CUSTOMERS: More than 150 ordered by more than 40 customers by November 2005. Launch customer Bristow Helicopters of UK announced order for two on 26 September 2000 for delivery in 2003. Hawker Pacific ordered four on 12 February 2001 for corporate, utility and offshore operations in the Arabian Gulf. Customers include the government of Namibia, which ordered two for VIP and multimission duties, of which the first was delivered on 16 September 2004; the Aga Khan Development Network (AKDN), which has ordered four for operations in South and Central Asia in connection with construction of three University of Central Asia campuses; Evergreen International, which ordered two in June 2003; ChevronTexaco, three for offshore operations, the first of which was delivered on 6 February 2005 during the HAI Convention in Anaheim, California; Evergreen Helicopters, the first of which was also delivered on 6 February 2005; Seacor Holdings Inc, which ordered 20 on 7 February 2005 for its Era Helicopters subsidiary for offshore operations; the United Arab Emirates Air Force, eight, six of which will be in SAR configuration and two assigned to VIP transport; Abu Dhabi Aviation, which took delivery of one in VIP configuration during the Dubai Airshow in November 2005 and Estonian Border Guard, one ordered November 2005.

Selected for US Coast Guard 'Deepwater' programme vertical take-off/landing recovery and surveillance (VRS) requirement, with first delivery expected in 2012. Selection by Irish Department of Defence announced 3 December 2004 for Irish Air Corps utility helicopter requirement; firm order for four; initial Irish delivery on 11 August 2006 in Italy as first to a military customer; entered service in Ireland (two aircraft) 28 November 2006. Anticipated market for 900 over 20 years, some 55 per cent for military use; 34 per cent of sales projected in Europe, 23 per cent in Middle East, 18 per cent in Far East, 13 per cent in South America and 12 per cent in North America.

COSTS: Commercial version USD7 million (2002). Estimated direct operating cost based on North American operation, USD757.30 per hour (2003).

DESIGN FEATURES: Design goals include high manoeuvrability and agility, low pilot workload, night/all-weather operation, low acoustic and infra-red emissions and mission flexibility for commercial and military operators. Intended for offshore support, medevac, corporate/VIP transport, SAR and military operations. Able to operate at maximum T-O weight from Class A helipads at 945 m (3,100 ft) at ISA + 20°C. Five-blade, fully articulated, ballistic tolerant main rotor and four-blade tail rotor. Some transmission and rotor elements based on AgustaWestland A129 Mangusta. Upturned tips added to horizontal stabilisers of production aircraft.

FLYING CONTROLS: Four-axis, digital AFCS.

LANDING GEAR: Heavy-duty, retractable tricycle type with twin wheels on nose unit; single wheels on main units, which retract into side sponsons.

POWER PLANT: Two Pratt & Whitney Canada PT6C-67C turboshafts, with FADEC, each rated at 1,252 kW (1,679 shp) for T-O and 1,142 kW (1,531 shp) maximum continuous; OEI ratings 1,396 kW (1,872 shp) for 2.5 minutes and 1,252 kW (1,679 shp) maximum continuous. Fuel tanks behind main cabin. Main transmission can run for up to 30 minutes without oil.

ACCOMMODATION: Up to 15 passengers on crashworthy seats in three rows of five, two forward facing, one rearward facing, in unobstructed cabin with flat floor; flight-accessible baggage compartment at rear of cabin (base of tailboom). In executive configuration the cabin can

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Radar: Optional weather radar in chin pod.

Flight: Flight data recorder.

Instrumentation: Fully integrated avionics system based on MIL-STD-1553B databus with four 152 × 203 mm (6 × 8 in) active colour matrix LCDs.

Mission: FLIR; NVG compatible lighting.

Self-defence: Defensive aid subsystems.

EQUIPMENT: Emergency flotation system. External electrical hoist kit of 272 kg (600 lb) capacity, with utility hoist light. Wire strike protection. Optional, modular ballistic protection kits.

ARMAMENT: Outrigger pylons attached to lower, rear cabin sides; braced to top of cabin. Options include seven-, 12- and 19-tube rocket launchers for 70 mm and 81 mm weapons; window-mounted 7.62 mm machine gun; external pods for 12.7 mm and 20 mm machine guns; air-to-ground and air-to-air missiles.

DIMENSIONS, EXTERNAL:

Main rotor diameter	14.00 m (45 ft 11¼ in)
Length overall, rotors turning	16.91 m (55 ft 5¾ in)
Height overall	5.05 m (16 ft 6¾ in)

DIMENSIONS, INTERNAL:

Cabin: Length	3.00 m (9 ft 10 in)
Max width	2.26 m (7 ft 5 in)
Max height	1.45 m (4 ft 9 in)
Volume	10.0 m³ (353 cu ft)
Baggage hold volume	4.0 m³ (141 cu ft)

AREAS:

Main rotor disc	153.9 m² (1,657.0 sq ft)

WEIGHTS AND LOADINGS:

Max underslung load	3,000 kg (6,614 lb)
Max T-O weight	7,000-8,000 kg (15,432-17,637 lb)

PERFORMANCE:

Max cruising speed	160 kt (296 km/h; 184 mph)
Hovering ceiling, OGE at 35°C (95°F)	1,830 m (6,000 ft)
Range with 12 troops	more than 500 n miles (926 km; 575 miles)

AGUSTA-BELL 412 and GRIFFON

Swedish military designation: Hkp 11

TYPE: Multirole medium helicopter.

PROGRAMME: First flight of Bell 412SP (in USA) August 1979; deliveries started January 1981; Agusta licensed production of civil version started 1981; first flight of military Griffon August 1982; deliveries began January 1983; Bell 412HP certified 29 June 1990; Bell 412EP is a civilian version currently manufactured under licence by AgustaWestland.

CURRENT VERSIONS: **Griffon:** Military derivative developed for direct fire support, scouting, assault transport, equipment transport, SAR and maritime surveillance.

Creso: Battlefield surveillance version; trial installation for Italian Army in AB 412 MM81196 as an element (with Mirach 26 UAVs and other sensors) of the CATRIN C³I system. FIAR Creso E-band MTI radar in a circular radome below the nose, plus Elettronica emitter locators at the nose and on the tailboom. Galileo FLIR turret above pilot's seat. Maximum operational altitude of 1,500 m (4,920 ft) gives radar range of 39 to 49 n miles (72 to 91 km; 45 to 56 miles). First flight of operational system mid-1996; Creso is Italy's contender in the NATO Alliance Ground Surveillance programme.

CUSTOMERS: Some 294 produced by early 2006. Those in Italy include Army (24), Carabinieri (37), Coast Guard (10), national fire service (23), national forest service (12) and Guardia di Finanza (22). Exports to Zimbabwe Air Force (10), Ugandan Army (six), Finnish Coast Guard (four); Royal Netherlands Air Force (three); Dubai Air Force (three or more); Ghana Air Force (two, in EMS configuration); Royal Saudi Air Force (in parallel with Bell-built 412SAs); Swedish Army (five); and Dubai Police (two). Eritrean Air Force (four). Lesotho Defence Force (two). Abu Dhabi Air Force (three). Eventual 14 ordered for SAR by Turkish Coast Guard, beginning in late 1999.

COSTS: Five Turkish Coast Guard, total cost USD52 million (1999).

DESIGN FEATURES: Griffon has reinforced impact-absorbing landing gear, selective armour protection and differences noted below.

POWER PLANT: One Pratt & Whitney Canada PT6T-3D Twin-Pac rated at 1,342 kW (1,800 shp) for T-O and 1,194 kW (1,600 shp) maximum continuous (single-engine ratings 850 kW; 1,140 shp for 2½ minutes and 723 kW; 970 shp continuous). Transmission rating 1,181 kW (1,584 shp) for 5 minutes, 846 kW (1,135 shp) maximum continuous and 850 kW (1,140 shp) single engine. IR emission reduction devices optional. Fuel capacity 1,249 litres (330 US gallons; 275 Imp gallons). Two 75.7 or 341 litre (20.0 or 90.0 US gallon; 16.7 or 74.9 Imp gallon) auxiliary fuel tanks optional; single-point refuelling.

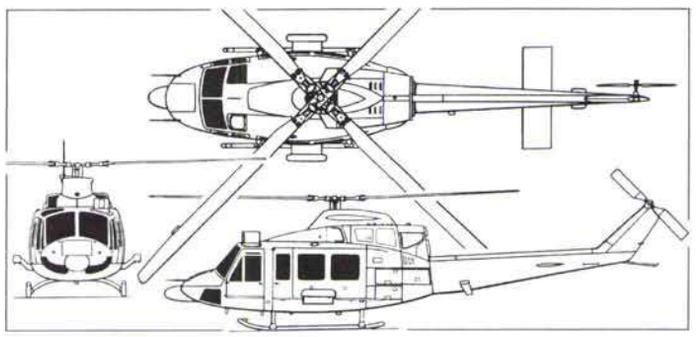
ACCOMMODATION: One or two pilots on flight deck, on energy-absorbing, armour-protected seats. Fourteen crash-attenuating troop seats in main cabin in personnel transport roles, six patients and two medical attendants in ambulance version, or up to 1,814 kg (4,000 lb) of cargo or other equipment. Space for 181 kg (400 lb) of baggage in tailboom. Total of 51 fittings in cabin floor for attachment of seats, stretchers, internal hoist or other special equipment.

SYSTEMS: Generally as for Bell 212/412.

AVIONICS: Optional four-screen EFIS.

EQUIPMENT: SAR and coastal surveillance versions equipped with 360° panoramic search radar integrated with FLIR and TV; video and still camera systems; datalink; dual digital four-axis AFCS with auto approach to hover, mark on target and search pattern; dual GPS; EFIS-LCD IFR cockpit instrumentation; operator's console in passenger compartment; gyrostabilised binoculars; searchlight and rescue light; electric rescue hoist; liferafts and lightweight emergency floats. BAE Systems MST-S multisensor turret system supplied for undisclosed AB 412EP customer in 1996, to operate in conjunction with Honeywell RDR-1500 maritime surveillance radar.

Agusta-Bell 412HP of Italian Customs service *(Paul Jackson)* 1037927



Agusta-Bell 412 Griffon military helicopter *(Dennis Punnett)* 1158281

ARMAMENT: Wide variety of external weapon options for Griffon include swivelling turret for 12.7 mm gun, two 25 mm Oerlikon cannon, four or eight TOW anti-tank missiles, two launchers each with nineteen 2.75 in SNORA or twelve 81 mm rockets, 12.7 mm machine guns (in pods or door-mounted), four air-to-air or air defence suppression missiles, or, for attacking surface vessels, four Sea Skua or similar air-to-surface missiles.

DIMENSIONS: As for Bell 212/412

WEIGHTS AND LOADINGS:

Weight empty, equipped (standard configuration)	2,914 kg (6,425 lb)
Max T-O weight	5,398 kg (11,900 lb)
Transmission loading at max T-O weight and power	4.57 kg/kW (7.51 lb/shp)

PERFORMANCE:

Never-exceed speed (VNE) at S/L	140 kt (259 km/h; 161 mph)
Cruising speed: at S/L	122 kt (226 km/h; 140 mph)
at FL15	125 kt (232 km/h; 144 mph)
at FL30	123 kt (228 km/h; 142 mph)
Max rate of climb at S/L	542 m (1,780 ft)/min
Rate of climb at S/L, OEI	168 m (551 ft)/min
Service ceiling, 30.5 m (100 ft)/min climb rate	5,395 m (17,700 ft)
Service ceiling, OEI, 30.5 m (100 ft)/min climb rate	2,320 m (7,620 ft)
Hovering ceiling: IGE	3,110 m (10,200 ft)
OGE	1,585 m (5,200 ft)
Range with max standard fuel at appropriate cruising speed (see above), no reserves:	
at S/L	354 n miles (656 km; 407 miles)
at FL15	402 n miles (745 km; 463 miles)
at FL30	434 n miles (804 km; 500 miles)
Max endurance: at S/L	3 h 36 min
at FL15	4 h 12 min

AGUSTAWESTLAND EH101

Royal Navy designation: Merlin HM. Mks 1 and 2

RAF designation: Merlin HC. Mk 3

Canadian Forces designation: CH-149 Cormorant

United States Navy designation: VH-71A

TYPE: Multirole medium helicopter.

PROGRAMME:

DEVELOPMENT MILESTONES

Requirement issued	80
Official go-ahead	25 Jan 84
First order (Royal Navy)	9 Oct 91
First flight	9 Oct 87
Certification	24 Nov 94
First flight production	6 Dec 95
First delivery (Royal Navy)	12 Nov 98
Entered service (Royal Navy)	2 Jun 00

Stems from Westland WG 34; selected in mid-1978 by UK MoD to meet SR(S) 6646 for a Sea King replacement; broadly similar requirement by Italian Navy led to 1980 joint venture with Agusta; subsequent market research confirmed compatibility of basic design with commercial payload/range and tactical transport/logistics requirements, resulting in decision to develop naval, civil and military variants based on common airframe.

Nine month project definition phase approved by UK/Italian governments 12 June 1981; full programme go-ahead announced 25 January 1984; design and development contract signed 7 March 1984; selected by Canadian government August 1987; Italian-built iron bird ground test airframe followed by nine preproduction aircraft (PP1-9; see Current Versions); RTM 322 engines selected for RN Merlin June 1990; T700-GE-T6A engines selected for Italian Navy version September 1990; fourth UK/Italian government MoU signed 30 September 1991 (starting industrialisation phase); UK MoD commitment to 44 Merlins 9 October 1991; Canadian order for 50 (35 CH-148 and 15 CH-149) announced 24 July 1992; UK and Italian civil certification of Srs 300 and 500 planned for late 1993, but eventually achieved on 24 November 1994; US FAA approval gained on following day.

Flight testing halted following January 1993 loss of PP2; resumed 24 June 1993. USD1 million study completed for US Marine Corps, 1993, assessing EH101 as 30-troop or cargo transport as fallback in event of Bell/Boeing MV-22 cancellation. First flight with RTM 322 engines, 6 July 1993; two aircraft flew total of 260 hours for development. Canadian requirement cut to 43 by deletion of seven CH-148s in August 1993 as cost-saving measure, but incoming government cancelled entire programme on 4 November 1993, despite award of substantial offsets to Canadian firms. UK government confirmed EH101 as next RAF tactical transport helicopter on 1 December 1993; formal announcement of order for 22 made 9 March 1995; Italian order confirmed October 1995 for 16, plus eight options. First production aircraft, RN01/ZH821 for Royal Navy, first flew 6 December 1995 and officially rolled out on 6 March 1996, although lacking mission avionics. Military Aircraft Release trials began in May 1998, using RN02/ZH822 (first flight 14 January 1997) and the first iteration of the Release was issued in the last quarter of 1998, allowing the start of Intensive Flight Trials with the commissioning of No. 700M Squadron (the Merlin IFTU) at RNAS Culdrose on 1 December 1998, and of RN aircrew training. First Merlin transferred to RN charge was RN05/ZH825 on 12 November 1998; first to civil customer, March 1999; first production EH101 for Italian Navy flew 6 December 1999; first squadron (824 NAS, Royal Navy) commissioned 2 June 2000 at RNAS Culdrose.

Canada and UK suspended flight operations on 5 April 2004, following destruction of Royal Navy Merlin at Culdrose on 30 March, almost cetainly caused by tail rotor assembly

Italian EH101 (MM81495) arriving at Patuxent River as test vehivle for VH-71 variant *(US Navy)* 1040483

failure. Subsequent modification of tail rotor half hub assembly cleared way for gradual return to flight status in early June, but Canadian aircraft still encountering problems with cracks in early part of 2006, with these impacting negatively on aircraft availability and capability.

Hand-over of 101st EH101 (fourth for Portugal) effected 15 April 2005 and ferried to Portugal on 21 April.

CURRENT VERSIONS: **Srs 100/Naval**: Primary roles ASW, ASV, anti-ship surveillance/tracking, amphibious operations and SAR; others include AEW, vertrep and ECM (deception, jamming and missile seduction); designed for autonomous all weather operation from land bases, large and small vessels (including merchant ships) and oil rigs and, specifically, from a 3,500-tonne frigate, with dimensions tailored to frigate hangar size. Capabilities include Type 23 frigate launch and recovery in conditions up to Sea State 6 with ship on any heading and windspeed (from any direction) up to 50 kt (93 km/h; 57 mph); endurance and carrying capacity includes ability to operate for up to 5 hours with state-of-the-art equipment and weapons.

Italian Navy ASW/ASVW/Mk 110: Operates from shore bases and aircraft or helicopter carriers against surface and underwater targets with HELRAS dipping sonar; armed with two Marte Mk. 2/S ASMs. First of eight (MM81480 '2-01') flew on 4 October 1999; first two delivered December 2000 for service trials; four more handed over by end of 2001.

Italian Navy AEW/Mk 112: Requirement revealed in 1994 for AEW helicopter. Four ordered in 1995, with first for delivery in 2003–04. Also known as **ASVW/E** (Anti-Submarine and Vessel Warfare, Enhanced). MM/APS-784 based Eliradar HEW-784 air and surface surveillance radar; radome almost doubled in size (from 1.80 m; 5 ft 10¾ in) to accommodate 3.00 m (9 ft 10 in) antenna, but other avionics similar to Italian Navy Mk 110. Initial aircraft, MM81488 '2-09', shown at Paris, 15–22 June 2003.

Merlin HM, Mk 1/Mk 111: Royal Navy ASW version for Staff Requirement (Sea) 6646; Lockheed Martin (formerly Loral) ASIC is prime contractor for systems integration; operates from Type 23 frigates, 'Invincible' class aircraft carriers, RFAs and other ships, and land bases. Initial production aircraft, RN01/ZH821, first flew 6 December 1995; second, RN02/ZH822, first with mission avionics, flew 14 January 1997. Of first seven production Merlins, RN01 and RN02 initially assigned to operational performance acceptance procedure (OPAP) trials at the fully instrumented Atlantic Underwater Test and Evaluation Center (AUTEC) in Bahamas, 1998–99, and to assistance in sea trials; RN03 to DTEO, Boscombe Down, in September 1997 for military aircraft release trials; joined by RN02 for pre-IFTU stage of release, achieved November 1998. The fully instrumented RN04 followed in late 1997; RN05-RN08 formed Intensive Flight Trials Unit (No. 700M Squadron) on 1 December 1998; PP5, RN02 and RN03 underwent operational tests at AUTEC from February 1999 (Operation Pearly King). Subsequent deep water trials were undertaken from Benbecula in 1999. In April 2000, RN12 from Boscombe Down and RN17 from Culdrose undertook extended Ship Helicopter Operational Limit trials aboard RFA *Argus*, experiencing winds of up to 50 kt (93 km/h; 58 mph) and up to Sea State 10. Snow and icing trials accomplished by RN aircraft in Canada in first half of 2001.

RN02, RN03 and RN14 undertook ASuW trials from Benbecula from late June 2000, following 30-day series of ASW tests off Bahamas, during Operation 'Trial Wizard' in March-April 2000. These included dropping eight Sting Ray torpedoes and 800 sonobuoys.

By the end of 1998, the Royal Navy had seven Merlins including two with No. 700M Squadron, which received its third on 21 April 1999. 700M evolved from IFTU to OEU on 1 September 2001. Training role to No. 824 Squadron at Culdrose on 2 June 2000, with No. 814 Squadron forming as the first front line squadron on 5 October 2001 for deployment aboard HMS *Ark Royal*. Embarked operational capability achieved in second quarter of 2002 with four helicopters, although complement will rise to six in late 2006. The aircraft also equips a small-ships squadron (No. 829, reformed 21 October 2004 with six Merlins) and a second carrier squadron, No. 820, which officially reformed at Culdrose on 5 December 2003. The Royal Navy received its 25th Merlin in August 2000 and 35 had been delivered by September 2001, with the 44th and last example handed over in December 2002.

Operational debut made in 'Telic' (UK contribution to Iraq conflict of 2003), when four helicopters of 814 Squadron deployed to Gulf aboard RFA *Fort Victoria;* primarily engaged in anti-surface warfare mission, but also undertook vertical replenishment, troop transport and Long-range delivery taskings; lack of ASW requirement permitted removal of dipping sonar, making more space available in cabin. Over 800 hours accumulated in combat conditions, with just one sortie lost because of unserviceability.

In June 2003, Lockheed Martin UK Ltd selected to undertake two-year study programme and awarded GBP18 million contract for assessment phase of Merlin Capability Sustainment Plus (MCSP) project intended to address obsolescence issues and weapon system upgrades, including operational aspects arising from combat experience in the Gulf. Cost savings to figure prominently, with increased use of COTS (commercial off-the-shelf) equipment and open system computer architecture. In January 2006, it was announced that Lockheed Martin UK Ltd had been awarded a GBP750 million contract covering upgrade of 30 Merlins with options for up to eight more. In addition to upgrading avionics equipment, this programme also entails introduction of HEAT (Helicopter Electro Actuation Technology), this being a third-generation fly-by-wire system which makes use of electrical rather than hydraulic units in controlling Merlin rotor systems. Enhancement of acoustic processing systems likely to be undertaken by Thales UK, which selected by prime contractor Lockheed Martin in mid-2006 and awarded initial GBP27 million contract. Upgraded helicopters, which could be designated **Merlin HM, Mk 2**, anticipated to enter service in 2013.

Merlin AEW: UK MoD-funded study, submitted August 1998, of possible Sea King AEW, Mk 7 replacement to meet Royal Navy's FOAEW requirement. Ventral radome and stub-wings; latter would permit speeds up to 250 kt (463 km/h; 288 mph).

Heliliner (Srs 300): Commercial variant intended to offer 360 n mile (666 km; 414 mile) range, with full IFR reserves, carrying 30 passengers and baggage; flight crew of two, provision for cabin attendant, stand-up headroom, airline-style seating, overhead baggage stowage, full environmental control, passenger entertainment, and provision for lavatory and galley. Category A VTO performance, capable of offshore/oil rig operations or scheduled flights into city centres at high all-up weights under more rigorous future civil operating rules; rear-loading ramp optional.

Military Utility (Srs 400): Tactical or logistic transport variant with rear-loading ramp; able to airlift 6 tons or up to 30 combat-equipped troops. See Italian Navy and Merlin headings below. Naval equivalent **(Srs 200)** lacks ramp. Tail- and rotor-folding Utility version under consideration, with role options including mine countermeasures, towing EDO Mk 106 sled.

Advanced technology testbed EH101 G-17-510 displays its BERP IV rotor blades during maiden flight in this configuration on 26 September 2006 1040461

Manufactured image of minesweeping gear being deployed from AgustaWestland EH101 AMCM version 1040463

Italian Navy Utility/Mk 410: Based on rear-ramp Srs 400, but with Galileo Avionica GaliFlir FLIR (also specified for other Italian versions), cargo hook, basic avionics and Elettronica ESM/ECM and Self Defence suite similar to Italian ASW version. Weather radar. Four ordered in 1995. Serves in the commando support role with Nucleo Elicotteristico per la Lotta Anfibia at Grottaglie. First aircraft, MM81492 '2-13', made public debut at Farnborough International, July 2004. Italian Air Force also has requirement for EH101s to replace two AS-61A-4 VIP helicopters.

Italian Navy Amphibious Support/Mk 413: Four ordered at beginning of 2002 for support of amphibious assault operations and special forces missions. Features include upgraded avionics for night missions (including NVG compatible cockpit) as well as weather radar, self-protection systems, personnel locator systems and armour and machine guns, plus internal cargo handling system; plumbing for in-flight refuelling equipment will be installed, although it is not intended to fit refuelling probes at present. First two handed over to Italian Navy in mid-2006, with remaining two to follow by end of 2006.

Merlin HC. Mk 3/Mk 411: Bid for RAF contract entered May 1994; revised cockpit layout for low level operations; provision for pintle-mounted machine guns in side doors. Order for 22 announced 9 March 1995, in satisfaction of Staff Requirement (Air) 440. Each has provision for rapid installation of chin-mounted FLIR turret and (non-telescopic) refuelling probe beneath the nose, offset to starboard (though neither routinely fitted). Uprated engines. Other features include integrated defensive aids system (with Nemesis directional IR countermeasures, AN/AVR-2A(V) laser warning and Sky Guardian 200 RWR), NVG compatibility, crash attenuating seats for all occupants (two pilots; loadmaster; optional fourth crewman; and 24 troops), active noise-reduction headsets for all passengers, non-folding main rotor blades and tailboom, improved navigation suite (compared with RN version), variable-speed cargo winch and roller conveyor for cargo handling, SAR hoist to starboard and cargo hook for external loads (installation in floor resulting in slightly reduced fuel capacity). Capable of carrying long wheelbase Land Rover; an overload of 30 troops can board and strap-in within 2 minutes, and deplane within 40 seconds. Critical design review completed July 1997. Assembly of first (RAF01/ZH17) began November 1997; rolled out 25 November 1998; first flew 24 December 1998. First aircraft delivered to DERA (now QinetiQ) at Boscombe Down 19 January 2000. Sixth aircraft handed over to Defence Procurement Agency on 27 June 2000, this date thereby becoming official acceptance into RAF inventory; formal release to service signed on 11 January 2001. Fifth and sixth aircraft used for conversion of first RAF instructors at Yeovil in June 2000.

Deliveries due between September 1999 (first to Boscombe Down for DTEO trials) and October 2001, but latter date not met (13 received by November 2001). Initial units, from April 2000, were Rotary Wing Operational Evaluation and Training Unit (originally at Boscombe Down) and the Operational Conversion Flight (actually an element of No. 28 Squadron at Benson) with a limited Release-to-Service for day training. Delivery of the first aircraft, due on 6 November 2000, was delayed by a worldwide EH101 grounding, following the loss of an HM. Mk 1, ZJ122 to Benson for technical familiarisation 11 December 2000; formal handover of five aircraft to RAF on 7 March 2001; by mid-June 2001, RAF had six Merlins at Benson, while further seven on flight trials with QinetiQ.

No. 28 Squadron officially re-formed 17 July 2001; is only RAF Merlin squadron and undertook first field deployment during 17–21 September 2001, when participated in exercise 'Pegasus Trial', which included operations from RAF Honington and first practice tactical troop-lift. A new Medium Support Helicopter Aircrew Training Facility, with two Merlin simulators, opened at Benson on 17 July 2000. Final aircraft handed over at Yeovil on 19 November 2002. Full operational capability attained by No. 28 Squadron in first quarter of 2003, with some Merlins deployed to Bosnia later that year. More demanding exposure to operational usage came in 2005, with deployment of No. 1419 Flight and four Merlins to Basra, Iraq; first two helicopters left Benson on 25 February and ferried to Iraq via Cyprus, Jordan and Kuwait, arriving in theatre on 1 March and being joined later by second pair which departed Benson on 7 March. Merlin operating in multirole configuration, with missions undertaken including special forces support, combat search-and-rescue, medical evacuation and airborne command post; in first 800 hours of flight time recorded on deployment, Merlin achieved 89 per cent serviceability record.

RAF expected to increase size of Merlin fleet by six, with delivery of these being accelerated through diversion of final six Danish examples that were due to be handed over in late 2006 and early 2007.

SAR/Utility (Srs 500): For commercial and paramilitary operators requiring rear-loading facility. First production **Mk 510** (I-AGWH) built for certification as a 'white tail'; rolled out in Italy 28 May 1997, and flew 17 June. Subsequently used for cold weather trials, from Fairbanks, Alaska, at temperatures from −5 to−32°C (23 to −26°F) until April 2000, and then for hot-and high trials in USA. First order in November 1996 for a Mk 510 for Tokyo Metropolitan Police Agency; first flew September 1997; delivered from Italian production in January 1998 as first to civil customer; fitting-out at Kawasaki Heavy Industries was delayed by bankruptcy of original financiers; handed over at Gifu on 25 March 1999.

SAR aircraft for Canada (described separately), Denmark and Portugal among others, are Series 500s. Initial Danish Mk 512 first flew 12 December 2003 with conventional nose, but by public debut at Farnborough International in July 2004, had gained complex radome incorporating radar antenna and, below, fixed EGPWS window, plus chin FLIR turret and side-mounted ESM.

Danish helicopters have RTM322 02/8 turboshafts and dual-processor ASMC (aircraft system management computer) for higher level of systems integration. Avionics include Inmarsat Constellation secure voice satcom, Finding/Personnel Location System (F/PLS, with both global maritime distress safety system and COSPAS/SARSAT), TCAS, EGPWS and wireless intercom. Equipment includes dual electrical hoists, operating table and associated medical apparatus. For alternative troop transport role. Danish EH101s have 16 seats, DIRCM and customer specific EW suite. Danish variant named **Merlin Joint Supporter** in ceremony, at Yeovil on 25 October 2004; first delivery to Denmark made 10 January 2006.

Portuguese EH101s fitted with ASMC, RTM322-02/8 engines, F/PLS and two hoists, plus ventral radar. SAR-specific equipment includes Nitesun searchlight, SAR Tech seats, provision for six stretchers and 11 troop seats. Additional CSAR equipment comprises EW suite, airborne interrogator and guidance system, folding main and tail rotors and machine gun attachment points at side door and on ramp. Fishery protection (SIFICAP) variant has data management console with recording capability, plus external loudspeaker. First flight of first Portuguese EH101 12 December 2003; following extensive test and training programme, this handed-over at Vergiate on 22 December 2004.

'CH-X': Offered to USMC; chin gun turret; not adopted.

CH-148 Petrel and CH-149 Chimo: Intended Canadian ASW and SAR versions; cancelled after payment of US$353 million in compensation.

CH-149 Cormorant/Mk 511: Adaptation of civil EH101 (with ramp) offered to Canada in early 1995 as a CH-113 replacement (in place of the CH-149 Chimo) for SAR missions; selected late 1997. Deck landing capability; reduced cost achieved by reliance on mainly

Royal Air Force AgustaWestland Merlin HC. Mk 2 1040462

Royal Navy AgustaWestland Merlin HM. Mk 1s 1040464

commercial avionics and by original proposed use of twin hoists in single door, rather than one per side. Hoist arrangement subsequently revised, with a primary winch in the starboard door and a secondary in the forward port door. Features Honeywell RDR-1400 radar, Litton LN-100G embedded laser INS/GPS, FLIR, Spectrolab SX-16 searchlight, crashworthy fuel tanks, Breeze-Eastern primary and secondary hoists and an underslung load hook. Planned to include provision for internal extended range tanks (ERTs) and hover in-flight refuelling from ships under way and wire-strike protection.

Total of 15 ordered from Italian production to replace CH-113 Labrador, with deliveries originally to begin in October 2000 and be complete by end of 2002; however, delays in certification and qualification resulted in deliveries being deferred. First Cormorant (149901) flew at Vergiate on 7 March 2000, with an official first flight on 31 May 2000. Assigned to 442 Squadron (19 Wing) at Comox, 413 Squadron (14 Wing) at Greenwood, 424 Squadron (8 Wing) at Trenton and 103 Squadron (9 Wing) at Gander; first two helicopters (149904 and '905) handed over in Italy on 29 September 2001 and arrived Comox on 11 October 2001. Formal acceptance at Comox on 29 October 2001; CH-149 subsequently certified for operational duty on 15 July 2002, with SAR standby alert duty from 25 July; first operational mission involving successful SAR accomplished 30 July. 413 Squadron received its first CH-149 on 24 August 2002. Deliveries completed in mid-2003.

Estimated to cost 40 per cent less than original CH-149 with 108 per cent offsets ('industrial regional benefits') totalling CAD629 million. Associated industrial team includes Bombardier, Bristol Aerospace, Spar Aerospace and CAE, with Canadian Helicopters to provide a leasing and follow-on maintenance option. EHI demonstrated a 15,500 kg (34,171 lb) MTOW (900 kg; 1,984 lb overweight) which would give a 1,080 n mile (2,000 km; 1,242 mile) SAR radius.

Problems encountered with cracks developing in tail rotor half hubs have necessitated imposition of speed and climb limitations on CH-149, as well as rigorous inspection programme. Cause of cracks still to be established and these still appearing at unpredictable frequency (as low as 15 hours and as high as 800 hours of flight time) despite replacement by newly manufactured assemblies in 2005; it was suspected that vibration was to blame and AgustaWestland was working on redesign of tail rotor in early 2006, but this could require up to four years to complete.

Cormorant MHP: Tentative designation for unsuccessful EH101 subvariant offered by EHI-led 'Team Cormorant' to meet remaining Canadian requirement (Maritime Helicopter Program) for a shipborne ASW Sea King replacement. Sikorsky S-92 selected in July 2004.

KHI-01: Designation allocated by manufacturer to version of EH101 being assembled by Kawasaki Heavy Industries at Gifu, Japan, for service with Maritime Self-Defence Force (MSDF) in mine countermeasures role as MCM101 and Antarctic support role as CH101. Japan committed in June 2003 to purchase initial quantity of 14, but could ultimately acquire about 80. First helicopter produced by AgustaWestland in UK (8651) made initial flight at Yeovil (as G-17-518/ZK112) on 15 February 2005; this shipped to Japan in June 2005 for fitment of radios, defensive aids and other specialised equipment before being delivered to MSDF on 3 March 2006. Remaining 13 helicopters being produced as kits in UK, for final assembly in Japan; first kit delivered to KHI in final quarter of 2005 with second following in first quarter of 2006; delivery of first locally-assembled MCH101 helicopter due in first quarter of 2007, to be followed by first CH101 in second quarter of same year. Service entry planned for 2007, with 11 MCH101 helicopters earmarked to replace MH-53EJ Sea Dragon, while three CH101s assume responsibility for Antarctic support from S-61A.

US101: Versions optimised for US market, following announcement on 31 October 2001 of agreement between AgustaWestland and Lockheed Martin under which latter will promote the EH101 in the USA as the US101; Bell Helicopter Textron subsequently added to team in May 2003. Initial target was US Navy VXX requirement for total of 23 helicopters to replace VH-3D Sea King and VH-60N in presidential transport role; bids from Lockheed Martin and Sikorsky submitted 2 February 2004, with contract award expected in May 2004, but twice postponed. On 28 January 2005, US101 selected and USD1.79 billion system development and demonstration contract awarded to Lockheed Martin Systems Integration at Owego, New York; VH-71A designation subsequently assigned on 7 July 2005. First five production aircraft will be to so-called Increment 1 standard, with CT7-8E engines and only 250 n mile (463 km; 287 mile) range; initial delivery and IOC set for FY09. Remaining 18 production aircraft to Increment 2 standard, with 2,237 kW (3,000 shp) engines, more sophisticated mission systems and 350 n mile (648 km; 402 mile) range. First seven aircraft at least to come from UK production, with majority for assembly by Bell at Amarillo, Texas; final delivery to Marine squadron HMX-1 at Quantico, Virginia, expected in 2014. US101 was unsuccessful candidate to satisfy USAF Personnel Recovery Vehicle (PRV) combat SAR requirement won by Boeing with HH-47 Chinook. In October 2003, Lockheed Martin took delivery of ninth development EH101 at Owego, New York, for use as a demonstrator. First flight with CT7-8E engines rated at 1,864 kW (2,500 shp) and five 254 × 203 mm (10 × 8 in) LCDs announced 6 October 2004 (UK 'B Conditions' registration G-17-510). Engine integration and performance trials under way at Victorville, California, in latter half of 2005. Italian Navy utility variant (MM81495) delivered to Lockheed Martin at Owego in June 2005 on lease; subsequently to Naval Air Test Center at Patuxent River, Maryland, as TV1 (Test Vehicle 1); used to evaluate location of antennae for communications systems and as training aid for aircrew and maintenance specialists in preparation for arrival of three definitive test vehicles in early 2007, at which time TV1 to be returned to Italy.

EH101 BERP testbed: First flight of high-performance variant (conversion of US101 demonstrator G-17-510) at Yeovil on 26 September 2006. Embodies technology of next-stage EH101 improvements, including British Experimental Rotor Programme (BERP) IV main rotor blades, more powerful CT7-8E engines and a new integrated cockpit display system. BERP IV Technology Demonstration Programme (TDP), jointly funded by MoD and AgustaWestland, has objectives comprising reduced first cost, reduced life cycle costs, reduced rotor vibration at high and low speeds, improved hover and forward flight performance, improved damage tolerance, increased erosion resistance and reduced signatures. Uprated CT7-8E engines, 1,884 kW (2,527 shp) each for take-off, provide 12 per cent more power, increasing payload by at least 907 kg (2,000 lb) hot-and-high. Fully integrated flight and mission cockpit display system utilises five 254×203 mm (10×8 in) LCD main displays, giving 70 per cent more display area, and is earmarked for Royal Navy's EH101 Merlin MCSP and UK MoD Future Lynx fleet.

CUSTOMERS: Orders totalled 165 (including 23 VH-71A) in April 2005; see table.

Total 66 for UK, comprising 44 Royal Navy Merlins and 22 RAF Merlins. Italian Navy ordered 16 (reduced from 36, and then from 24), comprising eight ASW (and ASV) versions, four AEW versions and four marines tactical transports with blade- and Tail-folding; option on four of further eight converted to firm order at start of 2002. Westland produced one Merlin in 1995, three in 1997, six in 1998, 13 in 1999 and 12 in 2000; Agusta built two civil EH101s in 1997 and delivered first in 1998, the other being retained for trials and demonstration purposes. Long-range utility version for logistic and tactical support role also under consideration by Italy and proposed unsuccessfully to US Marine Corps, with RAF Merlin HC. Mk 3 used for month-long demonstration tour of USA in May 2001. VVIP version offered to Saudi Arabia in 1995. EH101 selected in 2001 by Portugal for SAR, combat SAR and fisheries protection and by Denmark for SAR/Utility tasks. Portuguese EH101s built at Vergiate; those for Denmark at Yeovil; first Danish (M-501) and Portuguese (19601) helicopters both flew on 12 December 2003. Total of eight had been delivered to Portugal by 3 February 2006, when EH101 officially commissioned into service with 751 Squadron at Montijo. Danish deliveries began on 10 January 2006, with total of eight accepted by late 2006, when it was revealed that final six likely to be diverted to RAF and replaced by later production examples. Most recent customer is Japan, which committed in June 2003 to initial quantity of 14 for naval air arm; to be assembled in Japan.

EH101 was offered to Australia for Air 9000 requirement in August 2003, but subsequently eliminated from contest in December on grounds of size. Other potential customers include Malaysia (utility/CSAR) and Poland (VIP).

Prototypes assigned a 3,750 hour flight development programme, but had flown 5,000 hours by mid-1999. Additional 5,600 hours flown by PP8 and PP9 from Brindisi (Italy) and, from September 1998, Aberdeen (Scotland) in trial between March 1996 and June 2000, to improve reliability and prove extended (2,000 hour) overhaul intervals.

COSTS: Royal Navy GBP1.5 billion (1991) for 44 Merlin; RAF GBP500 million for 22 Merlin HC. Mk 3s; Canada CAD4.4 billion (1992) for 50 CH-148/149, reduced to CAD579 million for 15 CH-149 (AW320). Production investment phase (design, tooling, maturity and

Portuguese AgustaWestland EH101 1040465

EH101 ORDERS
(at February 2007)

Country	Service	Quantity	Commitment	Mk/Version	First aircraft
Canada	Armed Forces	15	5 Jan 98	511 (SAR)	149901
Denmark	Air Force	14	7 Dec 01[1]	512 (SAR/Utility)	M-501
Italy	Navy	8	Oct 95	110 (ASW/ASVW)	MM81480
	Navy	4	Oct 95	112 (AEW)	MM81488
	Navy	4	Oct 95	410 (Utility)	MM81492
	Navy	4	Jan 02	413 (Amphib Support)	
Japan	Tokyo Police	1	Nov 96	510 (SAR)	JA01MP
	Navy	14	Jun 03	KHI-01 (MCM/Support)	8651
Portugal	Air Force	6	30 Nov 01	514 (SAR)	19601
	Air Force	2	30 Nov 01	515 (Fisheries Protection)	
	Air Force	4	30 Nov 01	516 (CSAR)	
UK	Navy	44	9 Oct 91	111/HM. Mk 1	ZH821
	RAF	22	9 Mar 95	411/HC. Mk 3	ZJ117
USA	Marine Corps	23	28 Jan 05	US101/VXXVH-71A	

[1] Contract signature

product support) valued at GBP200 million (1993). First Italian batch (16) valued at Lit1,250 billion (USD775 million), 1995, of which Westland's share is GBP150 million. UK official audit of early 1996 reported Merlin HM. Mk 1 as GBP351 million (36.1 per cent) over budget and 60 months late. Danish order for 14 reportedly worth USD343.3 million. Development and procurement of VXX by US Navy expected to cost USD6.1 billion (2005)

DESIGN FEATURES: Three-engine power margin with long-endurance 120 kt (222 km/h; 138 mph) cruise possible on two engines and good twin-engined hover performance. Fail-safe/damage-tolerant airframe and rotating components, high system redundancy, onboard monitoring of engines/transmission/avionics/utility systems; airframe/power plant/rotor and transmission systems/flight controls/utility systems common to all variants; five-blade main rotor with multiple load path hub and elastomeric bearings; blades of advanced aerofoil section with BERP-derived high-speed tips; four-blade teetering tail rotor; transmission has minimum 30 minutes (60 minutes demonstrated) run-dry capacity; fuselage in four main modules (front and centre ones common to all variants, modified rear fuselage and slimmer tailboom on military utility variant to accommodate rear-loading ramp); automatic power folding of main rotor blades and tail rotor pylon on naval variant, with emergency manual back-up (tail section folds forward/downward, stowing starboard half of tailplane beneath rear fuselage). Folding version of utility (rear ramp) EH101 has been designed. New active vibration cancelling system ACSR (active control of structural response) reduces vibration by 80 per cent at blade passing frequency.

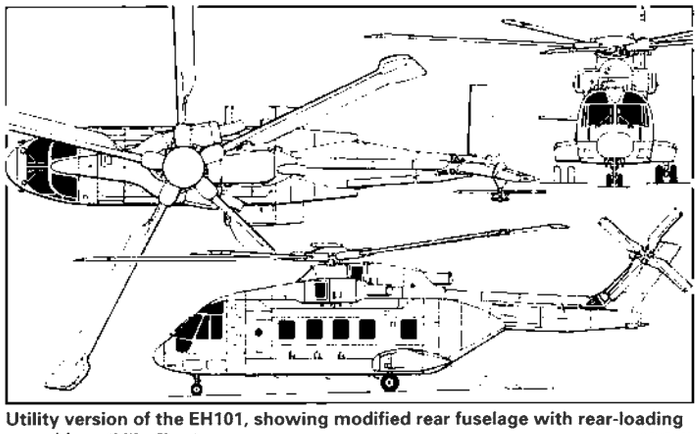
Airframe overhaul interval 1,000 hours on service entry; eventual target 3,000 hours. Intended service life of 40,000 hours

FLYING CONTROLS: Conventional cyclic, collective and yaw pedals for pilot and co-pilot. Dual digital AFCS with four-axis autopilot incorporating coupled flight director, SAR and ASW modes.

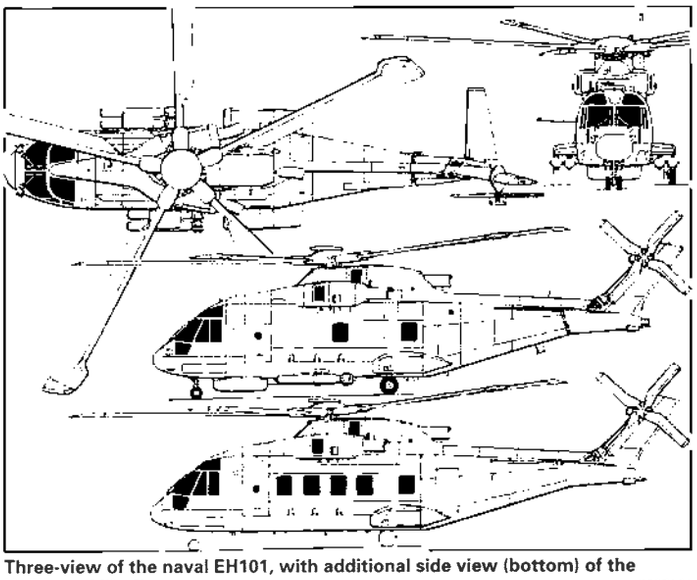
STRUCTURE: Rotor head of composites surrounding a metal core; composites blades; fuselage mainly aluminium alloy, with bonded honeycomb main panels; composites for such complex shapes as forward fuselage, upper cowling panels, tailfin, tailplane and windscreen. Engine air intakes of Kevlar reinforced with aero-web honeycomb. Tail unit of carbon epoxy and Kevlar epoxy skinned sandwich panels over central skeleton of metal- or foam-cored composites ribs and longerons; Kevlar-Nomex-Kevlar sandwich for leading-edge of tailfin. Single-sourced series production, with final assembly lines in Italy and UK. Composites materials to be replaced by aluminium on VH-71A in order to comply with US Navy crashworthiness requirements.

LANDING GEAR: Hydraulically retractable tricycle type, with single mainwheels and steerable twin-wheel nose unit, designed and manufactured by AP Precision Hydraulics in association with Officine Meccaniche Aeronautiche. Main units retract into fairings on sides of fuselage. Goodrich wheels, tyres and brakes: main units have size 8.50–10 wheels with 24×7.7 tyres, unladen pressure 6.96 bar (101 lb/sq in); nosewheels have size 19.5×6.75 tyres, unladen pressure 8.83 bar (128 lb/sq in). Twin-mainwheel gear optional for all variants; adopted for all Italian Navy helicopters and RAF Merlin. FPT Industries emergency flotation bags.

POWER PLANT: Three Rolls-Royce Turbomeca RTM 322-01/8 turboshafts in Royal Navy Merlin (maximum contingency rating 1,724 kW; 2,312 shp, T-O rating 1,566 kW; 2,100 shp and maximum continuous rating 1,394 kW; 1,870 shp); RTM 322-02/8 in RAF version, T-O rating 1,670 kW (2,240 shp); RTM 322 Mk 250 specified for Japanese helicopters; RTM 322-02/8 version of this engine chosen by Denmark and Portugal. General Electric T700-GE-T6A turboshafts in Italian naval variant, and T6A1 in Cormorant, rated at 1,521 kW (2,040 shp) for T-O and 1,327 kW (1,780 shp) maximum continuous. Engines for Italian naval variant assembled by Alfa Romeo Avio and Fiat; Cormorant engines assembled in Canada. Commercial and utility variants powered by three General Electric CT7-6 turboshafts (CT7-6A in PP3) with ratings of 1,491 kW (2,000 shp) for take-off and OEI and 1,282 kW (1,718 shp) maximum continuous; CT7-8E selected for VH-71A Increment 1 aircraft. Rolls-Royce Turbomeca RTM 322-04/8 turboshaft evaluated on RAF Merlin from latter half of 2004; additional power offers enhanced hot-and-high performance and increases MTOW to 15,600 kg (34,392 lb).



Utility version of the EH101, showing modified rear fuselage with rear-loading ramp/door *(Mike Keep)* 0507157



Three-view of the naval EH101, with additional side view (bottom) of the Heliliner *(Mike Keep)* 0507156

Transmission rated at 4,161 kW (5,580 shp) for T-O, 3,715 kW (4,982 shp) maximum continuous and 2,769 kW (3,713 shp) OEI maximum continuous.

Standard fuel in three tanks, each of 1,074 litres (276 US gallons; 230 Imp gallons) capacity; total 3,222 litres (851 US gallons; 709 Imp gallons). Each tank feeds separate engine, except on selection of emergency cross-feed; self-sealing optional. Additional fourth or fifth tanks (all same size) optional; maximum fuel capacity 5,370 litres (1,417 US gallons; 1,181 Imp gallons). Merlin HC. Mk 3 capacity approximately 4,075 litres (1,077 US gallons; 896 Imp gallons), augmented by optional tank in cargo hold. Computerised fuel management system. Pressure refuelling point on starboard side; maximum transfer rate 682 litres (180 US gallons; 150 Imp gallons)/min; individual gravity refuelling positions on port side. Provision for detachable refuelling probe on RAF Merlins.

ACCOMMODATION: One or two pilots on flight deck (naval version capable of single-pilot operation, if required, and RN operates with pilot, observer and crewman; commercial variant certified for two-pilot operation). ASW version normally also carries observer and acoustic systems operator. Italian Navy ASW crew members are designated pilot/mission commander, co-pilot/tactical co-ordinator, and two sensor operators.

CH-149 Cormorant operates with pilot, co-pilot/navigator, flight engineer and two crewmen. Martin-Baker crew seats in naval version, able to withstand 10.7 m (35 ft)/s impact. Socea or Ipeco crew seats in commercial variant. Commercial version able to accommodate 30 passengers four-abreast at approximate seat pitch of 76 cm (30 in), plus cabin attendant, with lavatory, galley and baggage facilities (including overhead bins). Offshore variant offers 'club 4' grouped seating to facilitate rapid egress through windows in event of ditching. Military variant can accommodate up to 30 (seated) or 45 (non-seated) combat-equipped troops, 16 stretchers plus a medical team, palletised internal loads, or can carry externally slung loads of up to 5,443 kg (12,000 lb). SAR version can seat 28 survivors; or four seated patients, four stretchers and six medics; or 20 fully equipped Arctic rescuers with skis. It has also demonstrated an emergency evacuation capability with 55 in the cabin.

Main passenger door/emergency exit at front on port side with additional emergency exits on starboard side and on each side of cabin at rear, above main landing gear sponson. Large sliding door at mid-cabin position on starboard side, with inset emergency exit. Commercial variant has baggage bay aft of cabin, with external access via door on port side. Cargo loading ramp/door at rear of cabin on military and utility versions. Cabin floor loading 976 kg/m^2 (200 lb/sq ft) on PP1.

SYSTEMS: Hamilton Sundstrand/Microtecnica environmental control system, dual-redundant integrated hydraulic system, pressurised by three Vickers pumps each supplying fluid at 207 bar (3,000 lb/sq in) nominal working pressure, with flow rates of 55, 59 and 60 litres (14.5, 15.6 and 15.9 US gallons; 12.1, 13.0 and 13.2 Imp gallons)/min respectively. Hydraulic system reservoirs are of the piston load pressurised type, with a nominal pressure of 0.97 bar (14 lb/sq in)

Primary electrical system is 115/200 V three-phase AC, powered by two Lucas brushless, oilspray-cooled 45 kVA generators (90 kVA if Lucas Spraymat blade ice protection system fitted), with one driven by main gearbox and the other by accessory gearbox, plus a third, separately driven standby alternator. Sundstrand T-62 APU for main engine air-starting, and to provide electrical power, plus air for ECS, without running main engines or using external power supplies. Lucas Spraymat electric de-icing of main/tail blades standard on naval variant, optional on others; in February 2003, Smiths Aerospace received contract to supply main and tail rotor blade ice protection system with effect from July 2003, this

incorporating electro-thermal heater mats on leading-edges of blades. Dunlop electric anti-icing of engine air intakes. Fire detection and suppression systems by Graviner and Walter Kidde respectively.

AVIONICS (military): Integrated systems based on two MIL-STD-1553B multiplex databusses that link basic aircraft management, avionics and mission systems.

Comms: Royal Navy version has BAE Systems communications subsystem including internal voice intercommunication to six positions, plus secure voice transmission via two AD3400 V/UHF radios, UHF and HF, plus M/A-COM Ltd ARI 5983 I-band transponder and Link 11. Racal RA 800 Light secure communications control system for RAF Merlin. Italian Navy equipment, by Elmer, includes three SRT-651 V/UHF, two SRT-170L HF, TD8503 Link 11, SP-1450 intercom and Italtel Mk 12 IFF; Mk 413 has Selex Communications satcom suite, UHF/VHF radios, and enhanced IFF. RAF Merlins have ADELT (automatically deployed emergency loader transmitter) containing FDR and CVR and locator beacon, scabbed on to starboard rear fuselage. Telephonics Corporation SDI (secure digital intercommunications) system to be installed on EH101s for Denmark and Portugal. VH-71A configuration will include sophisticated communications suite.

Radar: ASW version fitted with 360° search radar (pulse-compressed, frequency-agile BAE Systems Blue Kestrel 5000 in UK's Merlin; Eliradar MM/APS-784 in Italian helicopters). AEW version has Eliradar HEW-784 coherent pulse Doppler, 360° scan radar. Italian Navy utility helicopters have second-hand (from Agusta-Bell 212ASW) Officine Galileo MM/APS-705B search and weather radar which is removable, if demanded by certain missions. Telephonics Corporation RDR-1600 SAR Weather Avoidance Radar system used by Danish EH101s. Portuguese EH101 fitted with Galileo APS-717 radar.

Flight: Smiths Industries OMI SEP 20 dual-redundant digital AFCS is standard, providing fail-operational autostabilisation and four-axis autopilot modes (auto hover, auto transitions to/from hover standard on naval variants, optional on commercial and military variants). AFCS sensors on naval variant include BAE Systems LINS 300 ring laser gyro inertial reference unit (IRU) and Litton Italia LISA-4000 strapdown AHRS; IRU also provides self-contained navigation, with Racal Doppler 91E velocity sensor (Elmer system for Italy); Cossor Electronics GPS receiver selected for Royal Navy variant, Elmer GPS for Italian Navy aircraft. Other avionics on naval variants include Thomson-CSF AHV 16 radar altimeters (two) (Elettronica J-band units for Italian Navy), BAE Systems low-airspeed sensing and air data system, and Alenia/BAE Systems aircraft management computer. DRS Technologies subcontracted by Smiths Industries to provide flight control computer systems for Danish EH101s and any future sales.

Instrumentation: Litton EFIS with six 160 × 160 mm (6 × 6 in) Smiths multifunction screens. In mid-2003, consideration reportedly being given to introduction of three 330 × 200 mm (13 × 8 in) screens, utilising split images to present information that is currently displayed on two or more MFDs.

Mission: On naval variant, main processing element of management system is a dual-redundant aircraft management computer which carries out navigation, control and display management, performance computation and health and usage monitoring of principal systems (engines, drive systems, avionics and utilities); it also controls basic bus. Alenia/Racal cabin mission display unit. Surveillance radar (see above). Underwater detection in Royal Navy Merlin is by active/passive sonobuoys and Thales AQS-950 ADS (active dipping sonar) system, incorporating same company's AQS-903A acoustic processor for LOFAR, DIFAR, VLAD, Barra, DICAS and CAMBS buoys and Thomson Sintra folding lightweight acoustic system for helicopters (FLASH) expandable array, which has 750 m (2,460 ft) of cable and is manoeuvred by a high-speed winch. Merlin has Racal Lightweight Common Control Unit as interface between crew and tactical navigation and communications systems. The HM. Mk 1 has four units (one each for pilot, co-pilot and two operators); HC. Mk 3 has one in the cabin primarily for maintenance management. Royal Navy Merlin also has Racal Orange Reaper ESM, Normalair-Garrett mission recorder and sonobuoy/flare dispenser, Chelton sonobuoy homing system and Ultra processor for Link 11 datalink. The TMS 118 sonar was upgraded from 2001 with new, commercial, off-the-shelf processors, adding to speed and capacity. Honeywell HELRAS Mod 2 dipping sonar, Alenia AYK-204 processors (four) and Alenia SL/ALR-735 ESM in Italian ASW version, which also includes two operators' consoles with 350 mm (14 in) displays. ASST (anti-ship surveillance and tracking) version carries equipment for tactical surveillance and OTH (over the horizon) targeting, to locate and relay to a co-operating frigate the position of a target vessel, and for mid-course guidance of frigate's missiles. On missions involving patrol of an exclusive economic zone it can also, with suitable radar, monitor every hour all surface contacts within area of 77,700 km² (30,000 sq miles); can patrol an EEZ 400 × 200 n miles (740 × 370 km; 460 × 230 miles) twice in one sortie; and can effect boarding and inspection of surface vessels during fisheries protection and anti-smuggling missions. FLIR specified for all Italian Navy versions; BAE Systems MST-S FLIR turret, including magnifying mode, can be rapidly installed on RAF Merlins.

Self-Defence: RAF Merlins have integrated defensive aids including Raytheon laser detection, BAE Systems Sky Guardian 2000 RWR, Doppler-based MAWS, Northrop Grumman AN/AAQ-24 Nemesis DIRCM and BAE Systems North America AN/ALE-47 chaff/flare dispensers. Chaff and flare dispensers on all Italian versions, co-ordinated by Elettronica ELT/156X(V2) RWR and BAE Systems RALM/1 laser warner; Mk 413 has ELT/156X(V4) and RALM/1(V2) plus Selex/EADS AAR-60 MILDS II missile warning system and MES ECDS-2 chaff/flare dispensers.

AVIONICS (civil): Integrated avionics system of commercial variant based on ARINC 429 data transfer bus.

Comms: Racal intercom system; Rockwell Collins or Honeywell communications system

Radar: Honeywell weather radar.

Flight: BAE Systems Canada CMA-900 flight management system for fuel flow, fuel quantity and specific range computations; tuning of nav/com radios; interfaces with electronic instrument systems; two-dimensional multisensor navigation; and built-in navigational database with update service. AFCS sensors on commercial variant include two Litton Italia LISA-4000 strapdown AHRS. Standard avionics include Penny and Giles air data system.

Instrumentation: Smiths Industries/OMI electronic instrument system (EIS) providing colour flight instrument, navigation and power systems displays. CMA-900 includes colour CRT display with graphics and alphanumeric capability.

EQUIPMENT: ASW variants have two sonobuoy dispensers, external rescue hoist and Fairey Hydraulics (Merlin) decklock. BAJ Ltd four-float emergency flotation gear. Fast-roping equipment on Italian Navy Mk 413 amphibious support helicopter. AgustaWestland currently developing suite of equipment for AMCM (airborne mine countermeasures) mission; package will comprise operator's console; winch assembly; carriage, deployment and recovery system; and towed submersible unit. On-station duration, at 50 n miles (93 km; 58 mile) radius of action, will be 2.5 hours.

ARMAMENT (naval and military utility versions): Naval version able to carry up to four homing torpedoes (BAE Systems Sting Ray on Merlin; Mk 46 or Eurotorp MU90 on Italian version) or other weapons, including Mk 11 Mod 3 depth charges. ASV version designed to carry two air-to-surface missiles (Marte Mk 2/S for Italian Navy) and other weapons, for use as appropriate, from strikes against major units using sea-skimming anti-ship missiles to small arms deterrence of smugglers. Armament optional on military utility versions; options include pintle-mounted machine guns in doorway/rear ramp, chin turret for 12.7 mm machine gun and stub-wings for rocket pods.

DIMENSIONS, EXTERNAL (A: naval variant, B: Heliliner, C: military/utility variant):

Main rotor diameter	18.59 m (61 ft 0 in)
Tail rotor diameter	4.01 m (13 ft 2 in)
Length:	
overall, both rotors turning	22.80 m (74 ft 9¾ in)
fuselage	19.53 m (64 ft 1 in)
main rotor and tail pylon folded:	
A	15.75 m (51 ft 8 in)
C	16.00 m (52 ft 6 in)
Width: cabin	2.80 m (9 ft 2¼ in)
fuselage overall (port sponson to starboard tailplane)	5.09 m (16 ft 8¼ in)
over sponsons	4.61 m (15 ft 1½ in)
main rotor and tail pylon folded:	
A	5.20 m (17 ft 0¾ in)
C	5.60 m (18 ft 4½ in)
crew door open	5.32 m (17 ft 5½ in)
Height: overall, both rotors turning	6.62 m (21 ft 8¾ in)
main rotor and tail pylon folded:	
A	5.20 m (17 ft 0¾ in)
C	5.30 m (17 ft 4¾ in)
Tailplane half-span	2.78 m (9 ft 1½ in)
Wheel track	4.55 m (14 ft 11¼ in)
Wheelbase	6.98 m (22 ft 11 in)
Passenger door (fwd, port): Height	1.70 m (5 ft 7 in)
Width	0.91 m (3 ft 0 in)
Sliding cargo door (mid-cabin, stbd):	
Height	1.55 m (5 ft 1 in)
Width	1.83 m (6 ft 0 in)
Baggage compartment door (rear, port, B):	
Height	1.38 m (4 ft 6 in)
Width	0.55 m (1 ft 10 in)
Rear-loading ramp/door (rear, military/utility variant):	
Height	1.95 m (6 ft 4¾ in)
Width	2.26 m (7 ft 5 in)
Main rotor ground clearance (turning)	4.70 m (15 ft 5 in)

DIMENSIONS, INTERNAL:

Cabin:	
Length: A	7.09 m (23 ft 3 in)
C	6.50 m (21 ft 4 in)
Max width	2.49 m (8 ft 2 in)
Width at floor	2.26 m (7 ft 5 in)
Max height: B	1.90 m (6 ft 2¾ in)
Volume: A	29.0 m³ (1,024 cu ft)
B	27.5 m³ (970 cu ft)
Baggage compartment volume (B)	3.8 m³ (135 cu ft)
Rear ramp (C): Length	2.10 m (6 ft 10¾ in)
Width	1.80 m (5 ft 10¾ in)

AREAS:

Main rotor disc	271.51 m² (2,922.5 sq ft)
Tail rotor disc	12.65 m² (136.2 sq ft)

WEIGHTS AND LOADINGS (A, B, C, as above):

Operating weight empty (estimated):	
A	10,500 kg (23,149 lb)
B (IFR, offshore equipped)	9,300 kg (20,503 lb)
C	9,350 kg (20,613 lb)
Merlin HC. Mk 3	10,250 kg (22,597 lb)
Max fuel weight (four internal tanks, total):	
A (JP-1)	3,406 kg (7,509 lb)
B, C (JP-4)	3,360 kg (7,408 lb)
Merlin HC. Mk 3	3,200 kg (7,055 lb)
Max fuel weight (five internal tanks, total):	
B, C (JP-4)	4,200 kg (9,259 lb)
Disposable load/payload:	
A (four torpedoes)	960 kg (2,116 lb)
B (30 passengers plus baggage)	2,850 kg (6,283 lb)
C (24 combat-equipped troops)	3,120 kg (6,878 lb)
Max underslung load	5,443 kg (12,000 lb)
Max T-O weight: A, B, C: normal	14,600 kg (32,188 lb)
overload	15,600 kg (34,392 lb)
Max normal disc loading: A, B, C	53.8 kg/m² (11.01 lb/sq ft)
Transmission loading at normal max T-O weight and power	
A, B, C	3.51 kg/kW (5.76 lb/shp)

PERFORMANCE:

Never-exceed speed (VNE) at S/L, ISA	167 kt (309 km/h; 192 mph) IAS
Average cruising speed	150 kt (278 km/h; 173 mph)
Best range cruising speed	125 kt (232 km/h; 144 mph)
Best endurance speed	80 kt (148 km/h; 92 mph)
Service ceiling	4,575 m (15,000 ft)
Hovering ceiling: C: IGE	2,972 m (9,750 ft)
C: OGE	1,402 m (4,600 ft)
Range (B):	
four tanks, offshore IFR equipped, with reserves	610 n miles (1,129 km; 702 miles)
five tanks, offshore IFR equipped, with reserves	750 n miles (1,389 km; 863 miles)
Ferry range: C (four tanks plus internal auxiliary tank)	1,130 n miles (2,093 km; 1,300 miles)
SAR radius for 26 survivors, with two minute hover per survivor	350 n miles (648 km, 403 miles)
Endurance	5 h
g limit	+3

AIRBUS

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Airbus Industrie set up 18 December 1970 as Groupement d'Intéret Economique (GIE: a company which makes no profits or losses in its own right) and has been profitable since 1990, producing an operating surplus that is shared among its partners. Its first task was to manage development, manufacture, marketing and support of A300; this management subsequently extended to A300-600, A310, A318, A319/ACJ, A320, A321, A330, A340, A350 and A380. Sales reached the 1,000 mark in 1989; 2,000 in 1996; 3,000 in 1998; 4,000 in 2000; and 5,000 in August 2004. Turnover in 2005 was approximately EUR22.3 billion; backlog value EUR220.3 billion. Large Airliner Division created in March 1996 to oversee A3XX (later A380) project. Airbus delivered its 3,500th aircraft, an A318 for Air France, on 2 April 2004; the 2,500th member of the A320 family on 26 July 2005; and its 4,000th aircraft, an A330-300 for Lufthansa, on 9 September 2005. It is currently developing the A350 XWB, as a competitor to the Boeing 787. Offers business jet versions of A318 and A320 as part of A319 ACJ family.

A new single-aisle internal flight deck door, complying with pre-existing and new FAA anti-intrusion regulations, received JAA design approval on 21 May 2002 and is in production; it was certified for the A330/A340 family on 26 June 2002, and subsequently for all Airbus aircraft. In March 2003, Airbus selected Thales as its preferred supplier of HUDs for its entire range of FBW airliners, expected to appear first in the A320 family.

Plans for establishment of a single corporate entity (SCE) overtaken and modified by formation of European Aeronautic, Defense and Space Company (EADS, which see). Planned restructuring of the consortium into Airbus Integrated Company (AIC) was revealed in March 2000 and approved by the EC in late 2000; official starting date was 1 January 2001, although completion of formalities was delayed. EADS held 80 per cent and BAE Systems 20 per cent of AIC, which was incorporated in France on 11 July 2001 as an SAS (Société par Actions Simplifiées) following a formal decision on 23 June 2000. In 2006, BAE Systems indicated its wish to dispose of its holding in Airbus SAS, beginning discussions in April and committing to this course on 7 June. Airbus valuation of BAE share revealed as EUR2.75 billion (USD3.5 billion) on 2 July 2006, subject to shareholders' approval. BAE stake acquired 13 October 2006, making EADS sole owner of Airbus SAS.

Airbus is responsible for all work by partner companies and has more than 61,000 employees in Europe (France 21,400, Germany 23,650, Spain 3,100 and UK 13,000), as well as workers at its US, Chinese and Japanese subsidiaries. Stork (formerly Fokker) is an associate in A300 and A310 and Belairbus (Belgian consortium) in A310, A320, A330 and A340. Alenia manufactures front fuselage plug for A321. An engineering centre was established in Moscow in a joint venture (registered in December 2002) with the Kaskol group, which has shares in Sokol, Hydromash, Rostvertol and other Russian aerospace companies; this was opened, with a workforce of 25, in late March 2003, to develop and co-produce components for the A380 and other Airbus types; General Director is Vladimir Raschupkin. Subject to formal approval by the Chinese government, a final assembly line for the A320 family is to be set up in Tianjin under a framework agreement with AVIC signed on 26 October 2006; Chinese assembly is planned to begin in 2009.

Subsidiaries include Airbus North America, Airbus Finance Company (AFC), formed in 1994, Airbus Japan and Airbus China. Airbus's training centre in Toulouse, previously a subsidiary known as Aeroformation, and the main spares centre, Airbus Materiel Support, formerly Airspares Hamburg, are integrated within the consortium's Customer Services Directorate; a new, purpose-built mockup centre was added to the Toulouse facilities during 1999 and was fully operational by end 2000. In July 1996, Airbus Training and Support Centre in Beijing was opened, becoming operational in October 1997. A Training Centre was opened in Miami, Florida, in October 1999.

Final assembly of A380s at Toulouse 1158605

AIRBUS A300-600

TYPE: Wide-bodied airliner.
PROGRAMME:

DEVELOPMENT MILESTONES

A300B	
Launched	29 May 69
First flight (B1)	28 Oct 72
Certification	15 Mar 74
Entered service (B2) (Air France)	30 May 74
Subsequent versions	
A300-600	
Go-ahead	16 Dec 80
First flight	8 Jul 83
Certification	9 Mar 84
First delivery (Saudi Arabian Airlines)	26 Mar 84
A300-600R	
First flight	9 Dec 87
Certification	10 Mar 88
First delivery (American Airlines)	20 Apr 88
A300-600F	
First flight	2 Dec 93
Certification	27 Apr 94
First delivery (Federal Express)	27 Apr 94

Launched 29 May 1969; initial variants were A300B1 (first flight 28 October 1972, service entry November 1974, A300B2 (first flight June 1973, service entry 30 May 1974) and A300B4 (first flight December 1974, service entry June 1975; 248 built. A300-600 go-ahead 16 December 1980; first flight (F-WZLR) 8 July 1983; certified (with JT9D-7R4H1 engines) 9 March 1984; first delivery (to Saudia) 26 March 1984.

Improved version with CF6-80C2 engines and other changes (see Current Versions) made first flight 20 March 1985; French certification for Cat. IIIb take-offs and landings 26 March 1985; first delivery of improved version (to Thai Airways) 26 September 1985. Extended-range A300-600R (then known as -600ER) made first flight 9 December 1987, receiving European and FAA certification 10 and 28 March 1988 respectively, deliveries (to American Airlines) beginning 20 April 1988; A300-600 powered by GE CF6-80C2A5 with FADEC granted 180-minute ETOPS April 1994. CIS certification granted May 1996. Bulk of production backlog are A300F4-600R Freighters for Federal Express and United Parcel Service. Final delivery is due to be made in July 2007.

CURRENT VERSIONS: **A300-600**: Advanced version of A300B4-200; major A300 version since early 1984. Passenger and freight capacity increased by fitting rear fuselage of A310 with pressure bulkhead moved aft; wings have simple Fowler flaps and increased trailing-edge

TOTALS OF AIRBUS AIRLINERS
(at 1 July 2006)

	A300	A310	A318	A319	A320	A321	A330	A340	A350	A380	Totals
Firm orders	561	260	90	1,400	2,591	651	595	386	100	159	6,793
Delivered	554	255	31	911	1,601	364	437	330	0	0	4,483
Operating	417	226	31	910	1,580	363	434	327	0	0	4,288

AIRBUS ORDERS and DELIVERIES 2005

Net orders	0	0	-7	19	40	26	3	3	33	0	117
Delivered	7	0	2	73	81	14	35	7	0	0	219
Backlog	8	5	60	392	918	190	154	69	100	159	2,055

Airbus A300-600 operated by Thai Airways International *(Paul Jackson)* 1158579

camber; forward-facing two-person flight deck with EFIS; new digital avionics; new braking control system; new APU; simplified systems; weight saving by use of composites for some secondary structural components; payload/range performance and fuel economy improved by comprehensive drag clean-up. Further improvements introduced in 1985 included CF6-80C2 or PW4000 as engine options, carbon brakes, wingtip fences and 'New World' flight deck; basic equipment of aircraft delivered from late 1991 further improved by incorporating standard options.

Cargo conversions of A300-600 and earlier A300B4 are offered; see *Jane's Aircraft Upgrades* for details.

Detailed description applies to current production A300-600/600R except where indicated.

A300-600R: Extended-range version of A300-600, differing mainly in having fuel trim tank in tailplane and higher maximum T-O weight.

A300-600 Convertible: Convertible passenger/cargo version, described separately.

A300-600 Freighter: Non-passenger version, described separately.

Airbus Super Transporter: A300-600R conversion as Super Guppy replacement.

AIRBUS A300 MARKS AND VARIANTS

Series	Mark	Power Plant	FAA Certification
B1	—	CF6-50A	not certified
B2	1A	CF6-50A	30 May 74
B2	1C	CF6-50C	19 Jun 75
B2K	3C	CF6-50C	30 Jun 76
B2	203	CF6-50C2	1 Oct 80
B4	2C	CF6-50C	30 Jun 76
B4	103	CF6-50C2	4 Oct 79
B4	203	CF6-50C2	2 Oct 81
B4	601	CF6-80C2A1	28 Mar 88
B4	603	CF6-80C2A3	19 Sep 88
B4	605R	CF6-80C2A5	28 Mar 88
B4	620	JT9D-7R4H1	19 Sep 88
B4	622R	PW4158	1 Aug 91
C4	605 (F)	CF6-80C2A5	21 Jun 02
F4	605R	CF6-80C2A5	27 Apr 94
F4	622R	PW4158	14 Jul 00

Series	Variant	MTOW (kg)
B2-1A	00	137,000
B2-1C	00	137,000
B2-1C	02	142,000
B2K-3C	00	142,000
B2-203	00	142,000
B4-2C	00	150,000
B4-2C	02,03,14	157,500
B4-103	00	150,000
B4-103	02,03,14	157,500
B4-203	00, 07	165,000
B4-601/03/20	00	165,000
B4-605R/22R	00	170,500
B4-605R/22R	01, 02	171,700
B4-605R/22R	03	167,800
C4-605R	00	170,500
F4-600R/22R	00	170,500
F4-600R/22R	06	165,100
F4-600R/22R	09	168,000

Notes: Variant parameters may include differences in data other than max T-O weight. Except as constrained by Series, Variants are applicable to several engine options

CUSTOMERS: Total of 561 of all A300 versions ordered, of which 554 delivered, by 1 November 2006. Outstanding contracts at 1 November 2006 comprised six Freighters for Federal Express and one for Sagawa Express.

AIRBUS A300 ORDERS
(at 1 November 2006)

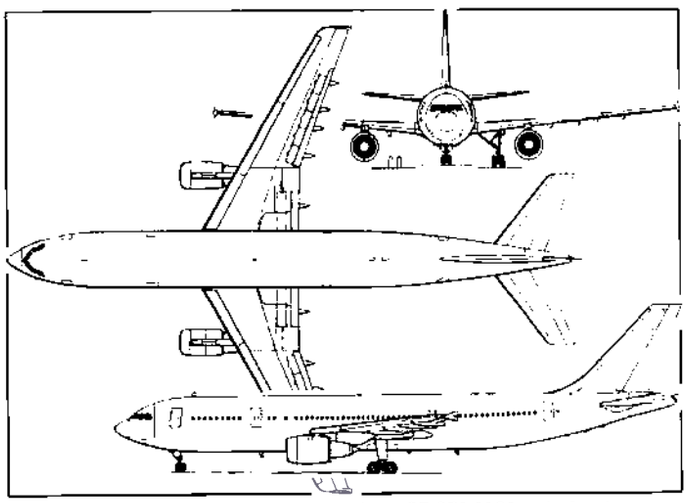
Customer	Qty
Air Afrique	3
Air France	23
Air Hong Kong	8
Air India	3
Air Inter Europe	8
Alitalia	8
American Airlines	35
Amiri Flight	2
Ansett	8
Australian Airlines	5
China Airlines	15
China Eastern Airlines	7
China Eastern Xibei	3
China Northern Airlines	6
CityBird	2
Continental Airlines	3
Cruzeiro	2
Eastern Airlines	34
Egyptair	17
Emirates	5
Federal Express	42
Finnair	2
Galaxy Airlines	1
Garuda	9
Hapag Lloyd	7
Iberia	6
Indian Airlines	10
ILFC	9
Iran Air	8
Japan Airlines	32
Japan Fleet Service	2
Korean Air	32
Kuwait Airways	8
Laker	3
LaTur	2
Lufthansa	23
Malaysia Airlines	4
Monarch	4
Olympic	10
Pakistan International Airlines	4
Pan Am	12
Philippine Airlines	5
Polaris Aircraft Leasing	5
Saudi Arabian Airlines	11
SAS	4
Singapore Airlines	8
SOGERMA SOCEA	1
South African Airways	7
Thai Airways	33
Trans European Airways	1
Tunis Air	1
United Parcel Service	53
Varig	2
VASP	3
Total	**561**

COSTS: USD109.9 million (2001).

DESIGN FEATURES: Mid-mounted wings with 10.5 per cent thickness/chord ratio, 28° sweepback at quarter-chord, and (since 1985) tip fences; circular-section pressurised fuselage; all-swept tail unit.

FLYING CONTROLS: Power-assisted. Each wing has three-segment, two-position (T-O/landing) leading-edge slats (no cutout over engine pylon), small Krueger flap at leading-edge wingroot, three cambered tabless flaps on trailing-edge, all-speed aileron between inboard flap and outer pair, and seven spoilers forward of flaps on each wing; flaps occupy 84 per cent of trailing-edge, increasing wing chord by 25 per cent when fully extended; ailerons deflect 9° 2' downward automatically when flaps are deployed; all 14 spoilers used as lift dumpers: outboard 10 for roll control and inboard 10 as airbrakes; variable incidence tailplane. Ailerons/elevators/rudder fully powered by hydraulic servos (three per surface), controlled mechanically; secondary surfaces (spoilers/flaps/slats) fully powered hydraulically with electrical control, tailplane by two independent hydraulic motors electrically controlled with additional mechanical input; preselection of spoiler/lift dump lever permits automatic extension of lift dumpers on touchdown; flaps and slats have similar drive mechanisms, each powered by twin motors driving ball screwjacks on each surface with built-in protection against asymmetric operation.

STRUCTURE: Two-spar main wing box, integral with fuselage and incorporating fail-safe principles; third spar across inboard sections; semi-monocoque fuselage (frames and open Z-section stringers), with integrally machined skin panels in high-stress areas; primary structure is of high-strength, damage-tolerant aluminium alloy, with steel or titanium for some critical fuselage components, honeycomb panels or selected glass fibre laminates for secondary structures; metal slats, flaps and ailerons. CFRP fins replaced aluminium alloy unit from 1988; secondary structure composites include AFRP for flap track fairings, rear wing/body fairings, cooling air inlet fairings and radome; GFRP for wing upper surface panels above mainwheel bays, fin leading/trailing-edges, fintip, fin/fuselage fairings, tailplane trailing-edges, elevator leading-edges, tailplane and elevator tips and elevator actuator access panel; carbon-reinforced GFRP for elevators and rudder; CFRP for spoilers, outer flap deflector doors and fin box; all CFRP moving surfaces have aluminium or titanium trailing-edges. Nosewheel doors and mainwheel leg fairing doors also of CFRP.



Airbus A300-600R wide-bodied transport (two GE CF6-80C2 turbofans)
(Dennis Punnett) 1158560

Nose gear is structurally identical to that of B2/B4/A310; main gear is generally reinforced, with a new hinge arm and a new pitch damper hydraulic and electrical installation. Nacelles have CFRP cowling panels and are subcontracted to Rohr (California); pylon fairings are of AFRP.

Airbus France builds nose (including flight deck), lower centre-fuselage, four inboard spoilers, wing/body fairings and engine pylons; Airbus Deutschland builds forward fuselage (flight deck to wing box), upper centre-fuselage, rear fuselage (including tailcone), vertical tail, 10 outboard spoilers and some cabin doors; it also equips wings and installs interiors and seats; Airbus UK (formerly BAe) designed wings and builds wing box; Airbus España manufactures horizontal tail, port and starboard forward passenger doors and mainwheel/nosewheel doors; Stork Aerospace produces wingtips, ailerons, flaps, slats and main gear leg fairings. Large, fully equipped and inspected airframe sections airlifted by Beluga to Airbus France at Toulouse for assembly and painting, aircraft then being flown to Hamburg for outfitting and returned to Toulouse for customer acceptance.

LANDING GEAR: Hydraulically retractable tricycle type, of Messier-Bugatti design, with Messier-Bugatti/Liebherr/Dowty shock-absorbers and wheels standard; twin-wheel nose unit retracts forward, main units inward into fuselage; free-fall extension; has four-wheel main bogies interchangeable left with right. Standard bogie size is 927 × 1,397 mm (36½ × 55 in); wider bogie of 978 × 1,524 mm (38½ × 60 in) is optional. Mainwheel tyres size 49×17–20 or 49×17.0R20 (30 ply) (standard) or 49×19–20 (30 ply) (wide bogie), with respective pressures of 12.41 and 11.10 bar (180 and 161 lb/sq in). Nosewheel tyres size 40×14 or 40×14.0R16 (22 ply), pressure 9.38 bar (136 lb/sq in). Steering angles 65°/95°. Messier-Bugatti/Liebherr/Dowty hydraulic disc brakes standard on all mainwheels. Normal braking powered by 'green' hydraulic system, controlled electrically through two master valves and monitored by a brake system control box to provide anti-skid protection. Standby braking (powered automatically by 'yellow' hydraulic system if normal 'green' system supply fails) controlled through a dual metering valve; anti-skid protection is ensured through same box as normal system, with emergency pressure supplied to brakes by accumulators charged from 'yellow' system. Automatic braking system optional. Bendix or Goodrich wheels and brakes available optionally. Minimum ground turning radius (effective, aft CG) 22.00 m (72 ft 2¼ in) about nosewheel, 34.75 m (114 ft 0 in) about wingtips.

POWER PLANT: Two turbofans in underwing pods. A300-600 was launched with 249 kN (56,000 lb st) Pratt & Whitney JT9D-7R4H1 and currently available with 249 kN (56,000 lb st) Pratt & Whitney PW4156 or 262 kN (59,000 lb st) General Electric CF6-80C2A1. A300-600R is offered with 274 kN (61,500 lb st) CF6-80C2A5 or 258 kN (58,000 lb st) PW4158. CF6-80C2A5 and PW4158 also available as options on A300-600.

Fuel in two integral tanks in each wing, and fifth integral tank in wing centre-section, giving standard usable capacity of 62,000 litres (16,379 US gallons; 13,638 Imp gallons). Additional 6,150 litre (1,625 US gallon; 1,353 Imp gallon) fuel/trim tank in tailplane (-600R only) increases this total to 68,150 litres (18,004 US gallons; 14,991 Imp gallons). Optional extra fuel cell in aft cargo hold can increase total to 73,000 litres (19,285 US gallons; 16,058 Imp gallons) in -600R. Two standard refuelling points beneath starboard wing; similar pair optional under port wing.

ACCOMMODATION: Crew of two on flight deck, plus two observers' seats. Passenger seating in main cabin in six-, seven-, eight- or nine-abreast layout with two aisles; typical mixed class layout has 266 seats (26 first class and 240 economy), six/eight-abreast at 96/86 cm (40/32 in) seat pitch with two galleys and one lavatory forward, one galley and two lavatories at Door 2 position, and one galley and four lavatories at rear; typical economy class layout for 285 passengers eight-abreast at 86 cm (34 in) pitch. Maximum capacity (subject to certification) 361 passengers. Closed overhead baggage lockers on each side (total capacity 10.5 m^3; 370 cu ft) and in double-sided central 'super-bin' installation (total capacity 14.5 m^3; 512 cu ft), giving 0.03 to 0.09 m^3 (1.2 to 3.2 cu ft) per passenger in typical economy layout.

Two outward parallel-opening Type A plug-type passenger doors ahead of wing on each side, and one on each side at rear. Type I emergency exit on each side aft of wing. Underfloor baggage/cargo holds fore and aft of wings, with doors on starboard side; forward hold can accommodate 12 LD3 containers, or four 2.24 × 3.17 m (88 × 125 in) pallets or, optionally, 2.43 × 3.17 m (96 × 125 in) pallets, or engine modules; rear hold can accommodate 10 LD3 containers; additional bulk loading of freight provided for in an extreme rear compartment with usable volume of 17.3 m^3 (611 cu ft); alternatively, rear hold can carry 11 LD3 containers, with bulk cargo capacity reduced to 9.0 m^3 (318 cu ft); bulk cargo compartment can be used to transport livestock. Entire accommodation is pressurised, including freight, baggage and avionics compartments.

SYSTEMS: Air supply for air conditioning system taken from engine bleed and/or APU via two high-pressure points; conditioned air can also be supplied direct to cabin by two low-pressure ground connections; ram air inlet for fresh air ventilation when packs not in use. Pressure control system (maximum differential 0.574 bar; 8.32 lb/sq in) consists of two identical, independent, automatic systems (one active, one standby); automatic switchover from one to other after each flight and in case of active system failure; in each system, pressure controlled by two electric outflow valves, function depending on preprogrammed cabin pressure altitude and rate of change of cabin pressure, aircraft altitude, and preselected landing airfield elevation. Automatic prepressurisation of cabin before take-off, to prevent noticeable pressure fluctuation during take-off. Modular box system provides passenger oxygen to all installation areas.

Hydraulic system comprises three fully independent circuits, operating simultaneously; each system includes reservoir of direct air/fluid contact type, pressurised at 3.52 bar (51 lb/sq in); fire-resistant phosphate ester-type fluid; nominal output flow 136 litres (35.9 US gallons; 30 Imp gallons)/min delivered at 207 bar (3,000 lb/sq in) pressure; 'blue' and 'yellow' systems have one pump each, 'green' system has two pumps. The three circuits provide triplex power for primary flying controls; if any circuit fails, full control of aircraft is retained without any necessity for action by crew. All three circuits supply ailerons, rudder and elevators; 'blue' circuit additionally supplies spoiler 7, spoiler/airbrake 4, airbrake 1, yaw damper and slats; 'green' circuit additionally supplies spoiler 6, flaps, Krueger flaps, slats, landing gear, wheel brakes, steering, tailplane trim, artificial feel, and roll/pitch/yaw autopilot; 'yellow' circuit additionally supplies spoiler 5, spoiler/airbrake 3, airbrake 2, flaps, wheel brakes, cargo doors, artificial feel, yaw damper, tailplane trim, and roll/pitch/yaw autopilot. Ram air turbine pump provides standby hydraulic power should both engines become inoperative.

Main electrical power supplied under normal flight conditions by two integrated drive generators, one on each engine; third (auxiliary) generator, driven by APU, can replace either of main generators, having same electromagnetic components but not constant-speed drive; each generator rated at 90 kVA, with overload ratings of 112.5 kVA for 5 minutes and 150 kVA for 5 seconds; APU generator driven at constant speed through gearbox. Three unregulated transformer-rectifier units (TRUs) supply 28 V DC power. Three 25 Ah Ni/Cd batteries used for emergency supply and APU starting; emergency electrical power taken from main aircraft batteries and emergency static inverter, providing single-phase 115 V 400 Hz output for flight instruments, navigation, communications and lighting when power not available from normal sources.

Hot air anti-icing of engines, engine air intakes, and outer segments of leading-edge slats; electrical heating for anti-icing flight deck front windscreens, demisting flight deck side windows, and for sensors, pitot probes and static ports, and waste water drain masts.

Honeywell 331-250F APU in tailcone, exhausting upward; installation incorporates APU noise attenuation. Self-contained fire protection system, and firewall panels protect main structure from an APU fire. APU provides bleed air to pneumatic system, and drives auxiliary AC generator during ground and in-flight operation; APU drives 90 kVA oilspray-cooled generator, and supplies bleed air for main engine start or air conditioning system. For current deliveries of A300-600, APU has improved relight capability, and can be started throughout flight envelope.

For new A300-600s and -600Rs, two optional modifications offered for compliance with full extended-range twin-engined operations (ETOPS) requirements: hydraulically driven fourth generator and increased cargo hold fire suppression capability. ETOPS kit qualified for aircraft with CF6-80C2 and JT9D-7R series engines and, since mid-1988, for those with PW4000 series.

AVIONICS: *Comms:* Standard communications radios include two VHF, with provision for a third, two HF, two transponders, one Selcal, interphone and passenger address systems, ground crew call system and cockpit voice recorder. Provision for Mode S transponders.

Radar: Weather radar standard, with provision for second.

Flight: Radio navigation avionics include two VOR, two ILS, two DME, one ADF, two marker beacon receivers and two radio altimeters; TCAS and GPWS. Most other avionics are to customer requirements, only those relating to the instrument landing system (Honeywell or Rockwell Collins ILS and Rockwell Collins or TRT radio altimeter) being selected and supplied by the manufacturer. Two Honeywell digital air data computers standard; basic digital AFCS has dual flight control computers (FCCs) for flight director and autopilot functions (for Cat. III automatic landings), single thrust control computer (TCC) for speed and thrust control, and two flight augmentation computers (FACs) to provide yaw damping, electric pitch trim, and flight envelope monitoring and protection. Options include second FCC (for Cat. III automatic landing); second TCC; two flight management computers (FMCs) and two control display units for full flight management system. Basic aircraft also fitted with ARINC 717 data recording system with digital flight data acquisition unit, digital flight data recorder and three-axis linear accelerometer; optional additional level of windshear protection is available. Honeywell Enhanced GPWS available from March 1997.

Instrumentation: Six identical and interchangeable CRT electronic displays (four electronic flight instrument system and two electronic centralised aircraft monitor), plus digitised electromechanical instruments with liquid crystal displays.

DIMENSIONS, EXTERNAL:

Wing span	44.84 m (147 ft 1 in)
Wing chord at root	9.40 m (30 ft 10 in)
Wing aspect ratio	7.7
Length overall	54.08 m (177 ft 5 in)
Fuselage: Length	53.30 m (174 ft 10½ in)
Max diameter	5.64 m (18 ft 6 in)
Height overall	16.51 m (54 ft 2 in)
Tailplane span	16.26 m (53 ft 4 in)
Wheel track	9.60 m (31 ft 6 in)
Wheelbase (c/l of shock-absorbers)	18.62 m (61 ft 1 in)
Passenger doors (each): Height	1.93 m (6 ft 4 in)
Width	1.07 m (3 ft 6 in)
Height to sill: forward	4.60 m (15 ft 1 in)
centre	4.80 m (15 ft 9 in)
rear	5.50 m (18 ft 0½ in)
Emergency exits (each): Height	1.60 m (5 ft 3 in)
Width	0.61 m (2 ft 0 in)
Height to sill	4.87 m (15 ft 10 in)
Underfloor cargo door (forward):	
Height	1.71 m (5 ft 7¼ in)
Width	2.69 m (8 ft 10 in)
Height to sill	3.07 m (10 ft 1 in)
Underfloor cargo door (rear):	
Height	1.71 m (5 ft 7¼ in)
Width	1.81 m (5 ft 11¼ in)
Height to sill	3.41 m (11 ft 2¼ in)
Underfloor cargo door (extreme rear):	
Height (projected)	0.95 m (3 ft 1 in)
Width	0.95 m (3 ft 1 in)
Height to sill	3.56 m (11 ft 8 in)

DIMENSIONS, INTERNAL:

Cabin, excl flight deck: Length	40.70 m (133 ft 6¼ in)
Max width	5.28 m (17 ft 4 in)
Max height	2.54 m (8 ft 4 in)
Underfloor cargo hold:	
Length: forward	10.60 m (34 ft 9¼ in)

rear ..... 7.95 m (26 ft 1 in)
extreme rear ..... 3.40 m (11 ft 2 in)
Max height ..... 1.76 m (5 ft 9 in)
Max width ..... 4.20 m (13 ft 9¼ in)
Underfloor cargo hold volume:
forward ..... 75.1 m³ (2,652 cu ft)
rear ..... 55.0 m³ (1,942 cu ft)
extreme rear ..... 17.3 m³ (611 cu ft)

AREAS:
Wings, gross ..... 260.00 m² (2,798.6 sq ft)
All-speed ailerons (total) ..... 7.06 m² (75.99 sq ft)
Trailing-edge flaps (total) ..... 47.30 m² (509.13 sq ft)
Leading-edge slats (total) ..... 30.30 m² (326.15 sq ft)
Krueger flaps (total) ..... 1.115 m² (12.00 sq ft)
Spoilers (total) ..... 5.40 m² (58.13 sq ft)
Airbrakes (total) ..... 12.59 m² (135.52 sq ft)
Fin ..... 45.20 m² (486.53 sq ft)
Rudder ..... 13.57 m² (146.07 sq ft)
Tailplane ..... 44.80 m² (482.22 sq ft)
Elevators (total) ..... 19.20 m² (206.67 sq ft)

WEIGHTS AND LOADINGS (A: CF6-80C2A1/A5 engines, B: PW4156/4158 engines, both in 266-seat configuration)[1]:
Manufacturer's weight empty:
A (600) ..... 79,210 kg (174,630 lb)
A (600R) ..... 80,070 kg (176,525 lb)
B (600) ..... 79,151 kg (174,500 lb)
B (600R) ..... 79,320 kg (174,870 lb)
Operating weight empty:
A (600) ..... 90,115 kg (198,665 lb)
A (600R) ..... 91,040 kg (200,700 lb)
B (600) ..... 90,065 kg (198,565 lb)
B (600R) ..... 90,965 kg (200,550 lb)
Max payload (structural): A (600) ..... 39,885 kg (87,931 lb)
A (600R) ..... 38,962 kg (85,896 lb)
B (600) ..... 39,993 kg (88,169 lb)
B (600R) ..... 39,037 kg (86,061 lb)
Max usable fuel:
600: standard ..... 49,786 kg (109,760 lb)
600R: standard ..... 54,721 kg (120,640 lb)
with optional cargo hold tank ..... 58,618 kg (129,230 lb)
Max T-O weight (A and B):
600 ..... 165,000 kg (363,765 lb)
600R (basic) ..... 170,500 kg (375,885 lb)
600R (option) ..... 171,700 kg (378,530 lb)
Max ramp weight (A and B):
600 ..... 165,900 kg (365,745 lb)
600R (basic) ..... 171,400 kg (377,870 lb)
600R (option) ..... 172,600 kg (380,520 lb)
Max landing weight (A and B):
600 ..... 138,000 kg (304,240 lb)
600R (basic) ..... 140,000 kg (308,645 lb)
Max zero-fuel weight (A and B):
600, 600R (basic) ..... 130,000 kg (286,600 lb)
Max wing loading: 600 ..... 634.6 kg/m² (129.98 lb/sq ft)
600R (basic) ..... 655.8 kg/m² (134.32 lb/sq ft)

[1] *Production aircraft from late 1996 onward. See 1989–90 and previous editions for original versions; 1996–97 and six previous editions for intermediate versions*

PERFORMANCE (A and B as for Weights and Loadings):
Max operating speed (VMO) from S/L to FL267 ..... 335 kt (621 km/h; 386 mph) CAS
Max operating Mach No. (MMO) above FL267 ..... 0.82
Max cruising speed:
at FL250 ..... 480 kt (890 km/h; 553 mph)
at FL300 ..... M0.82 (484 kt; 897 km/h; 557 mph)
Typical long-range cruising speed at FL310 ..... M0.80 (472 kt; 875 km/h; 543 mph)
Approach speed: 600 ..... 135 kt (249 km/h; 155 mph)
600R ..... 136 kt (251 km/h; 156 mph)
Max operating altitude ..... 12,200 m (40,000 ft)
Runway ACN for flexible runway, category B:
standard bogie and tyres: 600 56
600R 59
600R (option) 60
optional bogie and tyres: 600 52
600R 55
600R (option) 56
T-O field length at S/L, ISA + 15°C:
600: A ..... 2,378 m (7,800 ft)
B ..... 2,270 m (7,450 ft)
600R: A (C2A5 engines) ..... 2,408 m (7,900 ft)
B (PW4158 engines) ..... 2,362 m (7,750 ft)
Landing field length: 600 ..... 1,536 m (5,040 ft)
600R ..... 1,555 m (5,100 ft)
Range (1996 and subsequent deliveries) at typical airline OWE with 266 passengers and baggage, reserves for 200 n miles (370 km; 230 miles):
600, GE/PW engines ..... 3,700 n miles (6,852 km; 4,257 miles)
600R, GE/PW engines, standard fuel ..... 4,050 n miles (7,500 km; 4,660 miles)
600R, GE/PW engines, optional fuel ..... 4,157 n miles (7,700 km; 4,784 miles)

OPERATIONAL NOISE LEVELS (A300-600R, ICAO Annex 16, Chapter 3):
T-O: A ..... 91.1 EPNdB (96.3 limit)
B ..... 92.2 EPNdB (96.3 limit)
Sideline: A ..... 98.6 EPNdB (99.9 limit)
B ..... 97.7 EPNdB (99.9 limit)
Approach: A ..... 99.8 EPNdB (103.3 limit)
B ..... 101.7 EPNdB (103.3 limit)

AIRBUS A300-600 CONVERTIBLE and A300-600 FREIGHTER

TYPE: Twin-jet freighter.

PROGRAMME: Specialised versions of A300-600. First flight of A300-600F 2 December 1993; certified early April 1994, delivered to Federal Express 27 April and entered service in same month; A300-600F powered by GE CF6-80C2A5 with FADEC was first A300-600 version to operate with 180-minute ETOPS in May 1994.

CURRENT VERSIONS: **Convertible:** For all-passenger or all-cargo configuration. Typical options include accommodation (in mainly eight-abreast seating) for maximum 375 passengers (subject to certification) on the main deck; or up to twenty 2.24 × 3.17 m (88 × 125 in) pallets; or five 88 × 125 in plus nine 2.44 × 3.17 m (96 × 125 in) pallets. Three built by October 2004, including one each for Air France and Air Hong Kong.

Freighter: For freighting only; no passenger systems provided; various systems options give airlines ability to adapt basic aircraft to specific freight requirements; Airbus offers conversion with port-side forward freight door, or as new-production **A300F4-600R**, with payload capacity of 54,000 kg (119,050 lb). Freighter conversions, offered by Airbus UK and EADS EFW, are detailed in *Jane's Aircraft Upgrades*; over 65 under conversion or completed by June 2001; maiden flight 13 December 2001 (D-ASAE, c/n 477); certified by LBA and FAA eight days later.

General Freighter: Similar to A300-600F, but with side door and cargo loading system able to handle all sizes of freight from small packets to large containers. Launch customer Air Hong Kong, which announced order for six in January 2003 (two delivered by 1 October 2004), with further four on option.

CUSTOMERS: Federal Express became A300-600 Freighter launch customer July 1991 with order for 25 and commitments for 50 more, of which 11 confirmed as orders in September 1996; all now delivered; total subsequently increased to 42. UPS placed order on 9 September 1998 for 30 PW4158 powered A300F4-600R Freighters plus options on a further 15 (later confirmed and a further 15 firm orders, to total 60, of which 45 delivered and in operation by 1 October 2004); 30 more then on option. Deliveries began mid-2000; in 2005, UPS cancelled its option on final 30 and reduced 60 total to 53, following decision to order A380; deliveries due for completion in July 2007.

AIRBUS A300 CONVERTIBLE AND FREIGHTER ORDERS
(at 1 November 2006)

Customer	Version	Qty
Air Hong Kong	A300F4-600R	8
Federal Express	A300F4-605R	42
Galaxy	A300F4-600R	1
Korean Air	A300F4-203	2
Kuwait Airways	A300C4-620	3
Sagawa Express	A300-600F	1
United Parcel Service	A300F4-600R	53
Total		**110**

STRUCTURE: Generally similar to A300-600. Main differences are large port-side main deck cargo door, reinforced cabin floor, smoke detection system in main cabin; main deck cargo door is on opposite side to door of forward underfloor hold, allowing simultaneous loading or unloading at all positions.

POWER PLANT: Options as for A300-600R; first example was first Airbus aircraft powered by GE CF6-80C2A5 with FADEC.

DIMENSIONS, EXTERNAL: As A300-600R, plus:
Main deck cargo door (fwd, port):
Height (projected) ..... 2.57 m (8 ft 5¼ in)
Width ..... 3.58 m (11 ft 9 in)
Height to sill ..... 4.91 m (16 ft 1 in)

DIMENSIONS, INTERNAL:
Cabin main deck usable for cargo:
Length ..... 33.45 m (109 ft 9 in)
Min height ..... 2.01 m (6 ft 7 in)
Max height:
ceiling trim panels in place ..... 2.22 m (7 ft 3½ in)
without ceiling trim panels ..... 2.44 m (8 ft 0 in)
Volume ..... 192.0–203.0 m³ (6,780–7,169 cu ft)

WEIGHTS AND LOADINGS (basic Convertible, A: with CF6-80C2A5 engines, B: with PW4158 engines):
Manufacturer's weight empty:
A, passenger mode ..... 82,555 kg (182,000 lb)

United Parcel Service A300F4-600R taking off

1158602

B, passenger mode ..... 82,470 kg (181,815 lb)
A, freight mode ..... 80,345 kg (177,130 lb)
B, freight mode ..... 80,260 kg (176,945 lb)
Operating weight empty:
A, passenger mode ..... 93,550 kg (206,240 lb)
B, passenger mode ..... 93,475 kg (206,075 lb)
A, freight mode ..... 81,600 kg (179,895 lb)
B, freight mode ..... 81,525 kg (179,730 lb)
Max payload (structural):
A, passenger mode ..... 36,448 kg (80,354 lb)
B, passenger mode ..... 36,523 kg (80,519 lb)
A, freight mode ..... 48,400 kg (106,705 lb)
B, freight mode ..... 48,475 kg (106,870 lb)
Max T-O weight: A, B ..... 170,500 kg (375,900 lb)
Max landing weight: A, B ..... 140,000 kg (308,650 lb)
Max zero-fuel weight: A, B ..... 130,000 kg (286,600 lb)

WEIGHTS AND LOADINGS (basic Freighter variant of -600R):
Manufacturer's weight empty:
A ..... 78,335 kg (172,700 lb)
B ..... 78,250 kg (172,510 lb)
Operating weight empty: A ..... 79,050 kg (174,275 lb)
B ..... 78,980 kg (174,120 lb)
Max payload (structural):
A, range mode ..... 50,950 kg (112,325 lb)
B, range mode ..... 51,020 kg (112,480 lb)
A, payload mode ..... 54,750 kg (120,705 lb)
B, payload mode ..... 54,820 kg (120,855 lb)
Max T-O weight: A, B:
range mode ..... 170,500 kg (375,900 lb)
payload mode ..... 165,100 kg (363,980 lb)
Max landing weight: A, B:
range mode ..... 140,000 kg (308,650 lb)
payload mode ..... 140,600 kg (309,970 lb)
Max zero-fuel weight: A, B:
range mode ..... 130,000 kg (286,600 lb)
payload mode ..... 133,800 kg (294,980 lb)

PERFORMANCE:
Range with max (structural) payload, allowances for 30 min hold at 460 m (1,500 ft) and 200 n mile (370 km; 230 mile) diversion:
A, B, range mode ..... 2,650 n miles (4,908 km; 3,050 miles)
A, B, payload mode ..... 1,900 n miles (3,519 km; 2,186 miles)

AIRBUS A320

TYPE: Twin-jet airliner.

PROGRAMME:

DEVELOPMENT MILESTONES

A320-100	
Launched	23 Mar 84
First flight	22 Feb 87
Certification	26 Feb 88
First delivery (Air France)	28 Mar 88
Subsequent versions	
A320-200	
Certification	8 Nov 88

Launched 23 March 1984; four aircraft development programme (first flight 22 February 1987 by F-WWAI); JAA (UK/French/German/Dutch) certification of A320-100 with CFM56-5 engines, for two-crew operation, awarded 26 February 1988; first deliveries (Air France and British Airways) 28 and 31 March 1988 respectively; JAA certification of A320-200 with CFM56-5s received 8 November 1988, followed by FAA type approval for both models 15 December 1988; certification with V2500 engines (first flown 28 July 1988) received 20 April (JAA) and 6 July 1989 (FAA), deliveries with this power plant (to Adria Airways) beginning 18 May 1989; FAA approved common type rating on A320 and A321 without further training in early 1994; 500th A320 delivered, 20 January 1995, to United Airlines; 1,000th member of family (an A319) and 1,001st (A320 for United Airlines) were delivered 15 April 1999. Chosen by Thales as platform for its competitor in the South Korean Air Force's E-X AEW&C requirement. In 2000, Airbus agreed to transfer A320 assembly from Toulouse to Hamburg, where A319 and A321 already produced, EASA approval for 180 minute ETOPS granted in April 2004, Tianjin, China, to become additional final assembly line in 2009.

Airbus A320 of Kuwaiti airline Jazeera Airways 1158609

Cabin innovations unveiled in 2004 included a prototype cinema-style fold-up seat for the A320 family, designed to allow passengers to stow baggage in the overhead bins without blocking the aisle. It was hoped to certify the new design by the end of that year. In September 2004, Airbus announced successful completion, aboard an A320, of the first in-flight trial of GSM mobile telephones aboard an airliner, linking them to ground-based networks via the Globalstar satcom network. It hoped to offer passengers this facility from 2006. An A320 delivered to China Eastern on 26 July 2005 was the 2,500th aircraft of A318/319/320/321 family produced; the 4,000th aircraft of that family was also ordered in 2005.

CURRENT VERSIONS: **A320-100**: Initial version (21 ordered). Superseded by A320-200. Max T-O weight 68,000 kg (149,940 lb); fuel capacity (usable) 24,090 litres (6,364 US gallons; 5,299 Imp gallons).

A320-200: Now called simply **A320**. Basic version from third quarter 1988; differs from initial A320-100 in having wingtip fences, wing centre-section fuel tank and higher maximum T-O weights.

Detailed description applies to A320-200.

A320 Prestige: Member of ACJ family; Prestige interior as described under Accommodation heading in description of A319.

A320 Enhanced: Upgraded version, for new production or retrofit; development proceeding in 2006. Airframe improvements include two designs of winglets, flight tested on company testbed F-WWBA and an aircraft provided by jetBlue Airways; redesigned upper wing/fuselage fairing and engine pylons; and more fuel-efficient variants of CFM56 and V2500 engines. Internal improvements to include lighter cabin liners and brighter lighting; a 10 per cent increase in overhead storage capacity; lower cabin noise; and enhanced avionics. Availability targeted for 2008, but winglet change currently in abeyance.

MPA 320: Proposed maritime patrol version as replacement for Dassault-Breguet Atlantic 1; see AMC entry.

A320 research: An A320 was used for riblet research 1989–91. In mid-1998 Airbus Industrie began testing an experimental laminar-flow fin on an A320; air is sucked through small holes in the leading edge to reduce drag and save fuel.

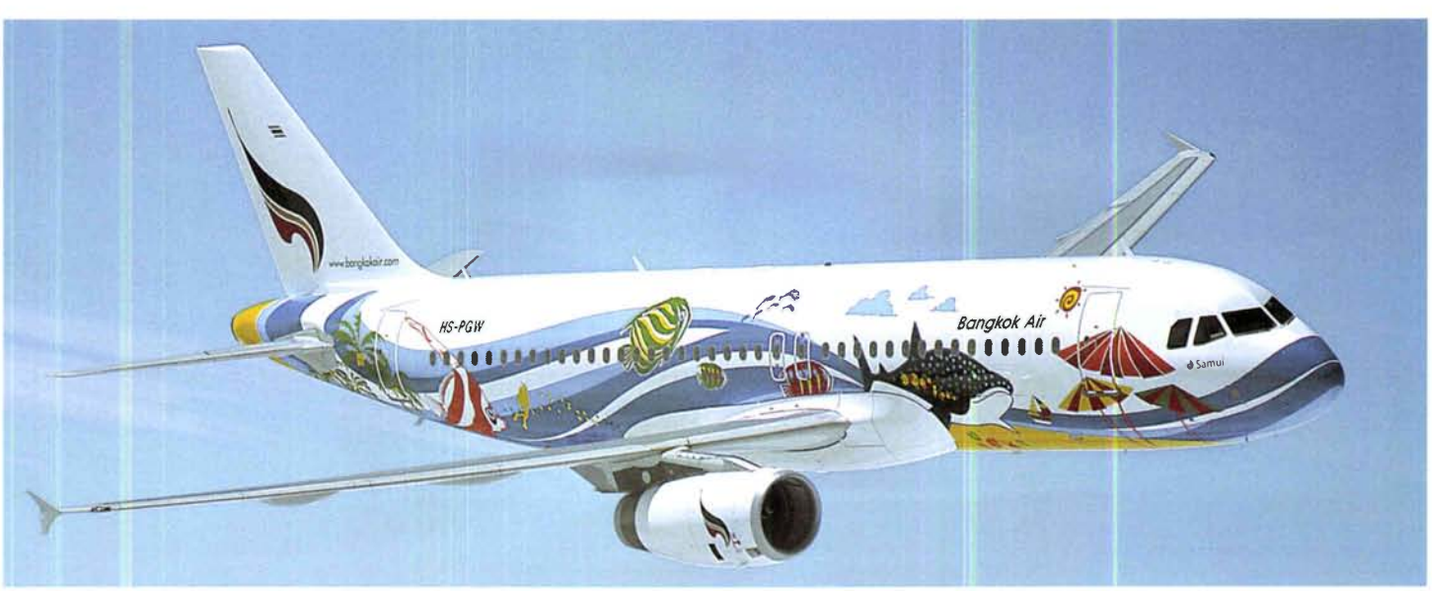
A320 Freighter, Convertible and Quick-Convertible: Freight variants under consideration; cargo capacities would be in the region of 20,000 kg (44,090 lb), 22,000 kg (48,500 lb) and 30,000 kg (66,140 lb), respectively. EADS EFW began feasibility studies in 2001 into producing freight versions of the A320 and A321. Early studies considered Hindustan Aeronautics as potential partner, but in mid-2006 EADS revealed details of a preliminary joint venture (50/50 shares) with Russian companies Irkut and RSK MiG. This proposes passenger-to-freighter (P2F) conversion of A320s, starting in about 2011, with work shared between EFW in Dresden and RSK MiG at Lukhovitsy. Freighter would be positioned in market as a cargo 'feeder' variant, with an expected payload capacity of some 21 to 23 tonnes.

NSR: In-house provisional designation (New Short Range) for eventual A320 successor. Studies under way in 2006.

A318: Shortened version of A320; *described separately.*

A319: Shortened version of A320; *described separately.*

A321: Stretched version of A320; *described separately.*



A highly decorated A320 of the Bangkok Airways fleet 1158606

AIRBUS A320 MARKS AND VARIANTS

Series	Mark	Power Plant	FAA Certification
100	111	CFM56-5A1	15 Dec 88
200	211	CFM56-5A1	15 Dec 88
200	212	CFM56-5A3	26 Nov 90
200	214	CFM56-5B4 or 5B4/P or 5B4/2P	12 Dec 96
200	231	V2500-A1	6 Jun 89
200	232	V2527-A5	12 Nov 93
200	233	V2527E-A5	17 Nov 95

Series	Variant	MTOW (kg)
100	000	68,000
200	000	73,500
200	001	68,000
200	003	75,500
200	007	77,000
200	008	73,500
200	009	75,500
200	010	77,000
200	011	75,500
200	012	77,000
200	013	71,500
200	014	73,500

Notes: Variant parameters may include differences in data other than max T-O weight. Except as constrained by Series, Variants are applicable to several engine options.

CUSTOMERS: Total 2,591 sold by 1 November 2006, of which 1,601 then delivered.

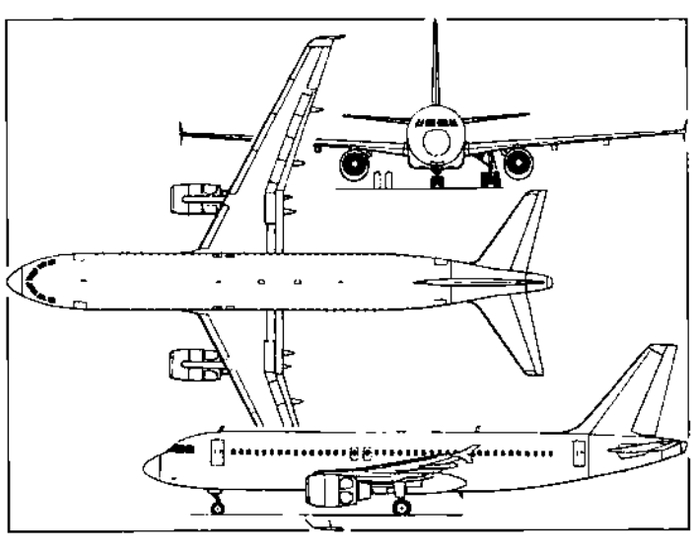
AIRBUS A320 ORDERS
(at 1 November 2006)

Customer	Qty
ACES	8
Adria Airways	5
Aegean Airlines	11
AERCAP	15
Aer Lingus	13
Aero Lloyd	4
Aeroflot	1
Aerostar	12
Aerventure	47
AirAsia	100
Air Berlin	45
Airblue	2
Air Cairo	4
Air Caledonie International	1
Air Canada	28
Air China Zhejiang Company	3
Air Deccan	62
Air France group	30
Air Inter Europe	22
Air Jamaica	4
Air Malta	2
Air New Zealand	5
Air One	30
Alafco	4
Alitalia	11
All Nippon Airways	31
Ansett Australia	19
Asiana Airlines	4
Austrian Airlines	8
Babcock and Brown	2
Blue Wings	16
Boullioun Aviation Services	24
British Airways	35
British Midland Airways	6
Canadian Airlines International	2
Cebu Air	2
China Aviation Supplies	90
China Eastern Airlines	34
China Eastern Xibei Airlines	13
China Southern Airlines	50
CIT Leasing	57
Condor Flugdienst	12
Croatia Airlines	2
Cyprus Airways	8
Czech Airlines	6
Dragonair	5
Edelweiss Air AG	3
Egyptair	12
Finnair	9
First Choice Airways	4
Flightlease	9
Frontier Airlines	10
GATX/CL AIR	37
GATX/Flightlease	2
GB Airways	8
GECAS	116
GPA	51
Gulf Air	14
Iberia	66
Iberworld	2
ILFC	201
Indian Airlines	35
IndiGo	70
Interjet	10
Jazeera Airways	10
jetBlue Airways	173
Kawasaki Leasing International	8
Kingfisher Airlines	32
Kuwait Airways	3
LAN Chile	18
Lotus Air	1
LTU	4
Lufthansa	47
Mexicana	16
Monarch Airlines	2
MyTravel Airways	6
NIKI	9
Northwest Airlines	80
Nouvelair	2
ORIX Corporation	24
Philippine Airlines	13
Qantas	20
Qatar Airways (incl Amiri Flight)	10
RBS Aerospace	33
Royal Jordanian	3
SALE	45
Sabena	3
Shenzhen Airlines	18
Shorouk Air	2
Sichuan Airlines	8
Silkair	10
South African Airways	22
Spanair	11
SriLankan Airlines	2
Sudan Airways	1
Swissair	17
Syrian Arab Airlines	6
TACA	43
TAM	44
TAP-Air Portugal	5
Tiger Airways	16
Thomas Cook	2
TransAsia Airways	5
Tunis Air	12
Turkish Airlines	19
United Airlines	117
US Airways	56
Virgin America	11
Wizz Air	32
Private customers	6
Undisclosed	10
Total	**2,591**

COSTS: Average cost of A320-200 USD53.7 million, depending on choice of engines, customisation and design weights (2001).

DESIGN FEATURES: First subsonic commercial aircraft to have composites for major primary structures, and centralised maintenance system; advanced-technology wings have 25° sweepback at quarter-chord, 5° 6′ 36″ dihedral plus experience from A310 and significant commonality with other Airbus aircraft where cost-effective; 6° tailplane dihedral.

FLYING CONTROLS: A320 is first subsonic commercial aircraft equipped for fly-by-wire (FBW) control throughout entire normal flight regime, and first to have sidestick controller (one for each pilot) instead of control column and aileron wheel. Thales/SFENA digital FBW system features five main computers and operates, via electrical signalling and hydraulic jacks, all primary and secondary flight controls; pilot's pitch and roll commands are applied through sidestick controller via two different types of computer; these have redundant architecture to provide safety levels at least as high as those of mechanical systems they replace; system incorporates flight envelope protection features to a degree that cannot be achieved with conventional mechanical control systems and its computers will not allow aircraft's structural and aerodynamic limitations to be exceeded; even if pilot holds sidestick fully forward, it is impossible to go beyond aircraft's maximum operating speed (VMO) for more than a few seconds; if pilot holds sidestick fully back, aircraft is controlled to an 'alpha floor' angle of attack, a safe airspeed above stall and throttles opened automatically to ensure positive climb. Nor is it possible to exceed *g* limits while manoeuvring. If a bank



Airbus A320 twin-turbofan single-aisle 150/179-seat airliner *(Dennis Punnett)*
1158561

angle of more than 30° is commanded with the sidestick, the bank angle is automatically returned to 30° when pressure is released.

Fly-by-wire system controls ailerons, elevators, spoilers, flaps and leading-edge slats; rudder movement and tailplane trim connected to FBW system, but also signalled mechanically when used to provide final back-up pitch and yaw control, which suffices for basic instrument flying. Each wing has five-segment leading-edge slats (one inboard, four outboard of engine pylon), two-segment Fowler trailing-edge flaps, and five-segment spoilers forward of flaps; all 10 spoilers used as lift dumpers, inner six as airbrakes, outer eight and ailerons for roll control and outer four and ailerons for gust alleviation; slat and flap controls by Liebherr and Lucas.

STRUCTURE: Generally similar to A310, but with AFRP for fuselage belly fairing skins; CFRP for fin leading-edge and fin/fuselage fairing; CFRP for wing fixed leading/ trailing-edge bottom access panels and deflectors, trailing-edge flaps and flap track fairings, spoilers, ailerons, fin (except leading-edge), rudder, tailplane, elevators, nosewheel/mainwheel doors, and main gear leg fairing doors. A320 was first airliner to go into production with CFRP tailplane.

Airbus France builds centre front fuselage (forward of wing leading-edge), cabin rear doors, nosewheel doors, centre wing box and engine pylons, and is responsible for final assembly; centre and rear fuselage, tailcone, wing flaps, fin, rudder and commercial furnishing undertaken by Airbus Deutschland; Airbus UK builds main wings, including ailerons, spoilers and wingtips, and main landing gear leg fairings; Belgian consortium Belairbus produces leading-edge slats; Airbus España responsible for tailplane, elevators, mainwheel doors, and sheet metal work for parts of rear fuselage; Mitsubishi builds wingroot shroud box under Airbus UK subcontract; AVIC I of China provides wing components and signed an MoU in November 2000 to increase its participation, possibly leading to complete wing production by 2007; GKN Aerospace providing cargo door actuators from January 2002. Parts suppliers in Russia include Sokol (from December 2003) and Irkut (from 2006). Final assembly undertaken at Toulouse until 2000, now at Hamburg, to be joined by Tianjin from 2009.

LANDING GEAR: Hydraulically retractable tricycle type, with twin wheels and oleo-pneumatic shock-absorber on each unit (four-wheel main-gear bogies, for low-strength runways, optional). Dowty main units retract inward into wing/body fairing; steerable Messier-Bugatti nose unit retracts forward; nosewheel steering angle ±75°, (effective turning angle ±70°). Tyre size 46×16 or 46×17.0R20 (30 ply) on main gear and 30×8.8 or 30×8.8-R15 (16 ply) on nose gear; optional tyres for main gear are 49×17 or 49×17R20 or 49×19R20 or 46×16-20 or 49×19-20. Tyres for main-gear bogie option are 915×300R16 or 36×11 or 46×17.0R20. Carbon brakes standard. Minimum ground turning radius 13.80 m (45 ft 3¼ in) about nosewheels, 22.90 m (75 ft 1½ in) about mainwheels. Minimum width of pavement for 180° turn 23.1 m (75 ft 9¼ in).

POWER PLANT: Two turbofans. Options comprise IAE V2500-A1, V2527-A5 or V2527E-A5, all 110.3 kN (24,800 lb st), CFM International CFM56-5A1 of 111.2 kN (25,000 lb st); CFM56-5A3 of 117.9 kN (26,500 lb st); or CFM56-5B4, -5B4/P or -5B4/2P of 120.1 kN (27,000 lb st). Nacelles by Rohr Industries; thrust reversers by Hispano-Suiza (pivoting door types for CFM56 engines, by IAE (cascade types) for V2500). Dual-channel FADEC system standard on each engine.

Standard usable fuel capacity in wing and wing centre-section tanks is 23,860 litres (6,303 US gallons, 5,249 Imp gallons); further 82 litres (21.6 US gallons, 18.0 Imp gallons) unusable. One or two additional centreline tanks (ACTs), each holding 2,900 litres (766 US gallons, 638 Imp gallons), can be fitted in rear underfloor baggage/cargo hold.

ACCOMMODATION: Standard crew of two on flight deck, with one (optionally two) forward-facing folding seats for additional crew members; seats for four cabin attendants. Single-aisle main cabin has seating for up to 179 (FAR) or 180 (JAR) passengers, depending upon layout, with locations at front and rear of cabin for galley(s) and lavatory(ies). Multiple customer choice of four-, five- and six-abreast layouts and standard or double-width aisle. Typical two-class layout has 12 seats four-abreast at 91.5 cm (36 in) pitch in 'super first' and 138 six-abreast at 81 cm (32 in) pitch economy class; alternative 152 six-abreast seats (84 business + 68 economy) at 86 and 78 cm (34 and 31 in) pitch respectively; single-class economy layout could offer 164 seats at 81 cm (32 in) pitch, or up to 179 in high density configuration. Compared with existing single-aisle aircraft, fuselage cross-section is significantly increased, permitting use of wider triple seats to provide higher standards of passenger comfort; five-abreast business class seating provides standard equal to that offered as first class on major competitive aircraft. In addition, wider aisle permits quicker turnrounds. Overhead stowage space superior to that available on existing aircraft of similar capacity, and provides ample carry-on baggage space; best use of underseat space for baggage is provided by improved seat design and optimised positioning of seat rails.

Passenger doors at front and rear of cabin on port side, forward one having optional integral airstairs, service door opposite each of these on starboard side. Two overwing emergency exits each side. Fuselage double-bubble cross-section provides increased baggage/cargo hold volume and working height, and ability to carry seven containers derived from standard interline LD3 type. As base is same as that of LD3, all existing wide-body aircraft and ground handling equipment can accept these containers without modification. Forward and rear underfloor baggage/cargo holds, plus overhead lockers; with 164 seats, overhead stowage space per seat is 0.06 m³ (2.0 cu ft). Mechanised cargo loading system will allow up to seven LD3-based containers to be carried in freight holds (three forward and four aft). Additional bulk cargo hold at rear, underfloor.

SYSTEMS: Liebherr/ABG-Semca air conditioning. Hamilton Sundstrand/Nord-Micro pressurisation. Honeywell 36-300 APU standard; Honeywell 131-9(A) or APIC APS 3200 available as standard options. All are interchangeable on A318/319/320/321 family. Primary electrical system powered by two Hamilton Sundstrand 90 kVA constant frequency generators, providing 115/200 V three-phase AC at 400 Hz; third generator of same type, directly driven at constant speed by APU, can be used during ground operations and, if required, during flight. Hydraulic system pressure 207 bar (3,000 lb/sq in).

AVIONICS: *Flight:* Fully equipped ARINC 700 digital avionics including advanced digital automatic flight control and flight management systems. AFCS integrates functions of SFENA autopilot and Honeywell FMS; Honeywell air data and inertial reference system.

Instrumentation: Each pilot has two Thales/VDO electronic flight instrumentation system (EFIS) displays (primary flight display and navigation display); PFD was first on an airliner to incorporate speed, altitude and heading. Between these two pairs of displays are two Thales/VDO electronic centralised aircraft monitor (ECAM) displays developed from those on A310 and A300-600; upper display incorporates engine performance and warning, lower display carries warning and system synoptic diagrams.

DIMENSIONS, EXTERNAL:

Wing span	34.09 m (111 ft 10 in)
Wing chord at root	6.10 m (20 ft 0 in)
Wing aspect ratio	9.5
Length overall	37.57 m (123 ft 3 in)
Fuselage: Max width	3.94 m (12 ft 11 in)
Max depth	4.14 m (13 ft 7 in)
Height overall	11.76 m (38 ft 7 in)
Tailplane span	12.45 m (40 ft 10 in)
Wheel track (c/l of shock-struts)	7.59 m (24 ft 11 in)
Wheelbase	12.65 m (41 ft 6 in)
Passenger doors (port, forward and rear), each:	
Height	1.85 m (6 ft 1 in)
Width	0.81 m (2 ft 8 in)
Height to sill	3.415 m (11 ft 2½ in)
Service doors (stbd, forward and rear), each	as corresponding passenger doors
Overwing emergency exits (two port and two stbd), each:	
Height	1.02 m (3 ft 4 in)
Width	0.51 m (1 ft 8 in)
Underfloor baggage/cargo hold doors (stbd, forward and rear), each:	
Height	1.25 m (4 ft 1⅛ in)
Width	1.82 m (5 ft 11½ in)

DIMENSIONS, INTERNAL:

Cabin, excl flight deck: Length	27.50 m (90 ft 2¼ in)
Max width	3.68 m (12 ft 1 in)
Max height	2.16 m (7 ft 1 in)
Aisle width: standard	0.48 m (1 ft 7 in)
option 1	0.58 m (1 ft 11 in)
option 2	0.635 m (2 ft 1 in)
option 3	0.69 m (2 ft 3 in)
Underfloor baggage/cargo holds:	
Length: forward	4.85 m (15 ft 11 in)
rear	9.80 m (32 ft 2 in)
Max width	2.63 m (8 ft 7½ in)
Max height	1.24 m (4 ft 1 in)
Volume: forward	13.30 m³ (469 cu ft)
rear	24.15 m³ (853 cu ft)

AREAS:

Wings, gross	122.40 m² (1,317.5 sq ft)
Ailerons (total)	2.74 m² (29.49 sq ft)
Trailing-edge flaps (total)	21.10 m² (227.12 sq ft)
Leading-edge slats (total)	12.64 m² (136.06 sq ft)
Spoilers (total)	8.64 m² (93.00 sq ft)
Airbrakes (total)	2.35 m² (25.30 sq ft)
Vertical tail surfaces (total)	21.50 m² (231.4 sq ft)
Horizontal tail surfaces (total)	31.00 m² (333.7 sq ft)

WEIGHTS AND LOADINGS (typical 150-passenger configuration. A: CFM56-5B4/P engines, B: V2527-A5s):

Operating weight empty: A	42,100 kg (92,815 lb)[1]
B	42,482 kg (93,657 lb)
Baggage capacity	
forward hold	3,402 kg (7,500 lb)
rear hold	4,536 kg (10,000 lb)
bulk hold	1,497 kg (3,300 lb)
Max payload: A	18,633 kg (41,079 lb)
B	18,518 kg (40,825 lb)
Max fuel	19,159 kg (42,238 lb)
Max T-O weight: basic	73,500 kg (162,040 lb)
option 1	75,500 kg (166,445 lb)
option 2	77,000 kg (169,755 lb)
Max ramp weight: basic	73,900 kg (162,920 lb)
option 1	75,900 kg (167,330 lb)
option 2	77,400 kg (170,635 lb)
Max landing weight: basic	64,500 kg (142,195 lb)
options 1 and 2	66,000 kg (145,505 lb)
Max zero-fuel weight: basic	61,000 kg (134,480 lb)
options 1 and 2	62,500 kg (137,790 lb)
Max wing loading:	
basic	599.5 kg/m² (122.79 lb/sq ft)
option 1	615.8 kg/m² (126.13 lb/sq ft)
option 2	628.1 kg/m² (128.64 lb/sq ft)
Max power loading (V2527 engines):	
basic	312 kg/kN (3.06 lb/lb st)
option 1	320 kg/kN (3.14 lb/lb st)
option 2	327 kg/kN (3.20 lb/lb st)

[1] *Options raise OWE to a maximum of 43,000 kg (94,800 lb)*

PERFORMANCE (engines A and B as for Weights and Loadings, C: CFM56-5A3/5B4, D: 77,000 kg; 169,755 lb max T-O weight):

Max operating Mach No. (VMO)	0.82
Optimum cruising speed	M0.78
Max operating speed	350 kt (648 km/h; 403 mph) IAS
Max rate of climb at S/L	152 m (500 ft)/min
Initial cruise altitude	11,280 m (37,000 ft)
Max certified altitude	12,130 m (39,800 ft)
Service ceiling, OEI	5,945 m (19,500 ft)
T-O distance at S/L, ISA + 15°C: A	1,960 m (6,430 ft)
B	1,950 m (6,400 ft)
C	2,180 m (7,155 ft)
D	2,250 m (7,385 ft)
Landing distance at max landing weight:	
A, B, C, D	1,490 m (4,890 ft)
Runway ACN (flexible runway, category B):	
twin-wheel, standard 45×16R20 tyres	41
four-wheel bogie option, 36×11-16 Type VII or 900×300-R16	22

Range with 150 passengers and baggage in two class layout, FAR domestic reserves and 200 n mile (370 km; 230 mile) diversion:

basic: A	2,592 n miles (4,800 km; 2,982 miles)
B	2,596 n miles (4,807 km; 2,987 miles)
option 1: A	2,800 n miles (5,185 km; 3,222 miles)
B	2,871 n miles (5,317 km; 3,303 miles)
option 2:	
A, C	3,045 n miles (5,639 km; 3,504 miles)
B	3,065 n miles (5,676 km; 3,527 miles)

OPERATIONAL NOISE LEVELS (ICAO Annex 16, Chapter 3: A, B and C as for performance):

T-O: A	88.0 EPNdB (91.5 limit)
B	84.8 EPNdB (91.5 limit)
C	85.4 EPNdB (91.5 limit)
Sideline: A	94.4 EPNdB (96.8 limit)
B	92.8 EPNdB (96.8 limit)
C	93.8 EPNdB (96.8 limit)

Approach: A ..... 96.4 EPNdB (100.5 limit)
B ..... 95.9 EPNdB (100.5 limit)
C ..... 96.0 EPNdB (100.5 limit)

AIRBUS A318

TYPE: Twin-jet airliner.
PROGRAMME:

DEVELOPMENT MILESTONES

A318	
Announced	7 Sep 98
Launched	26 Apr 99
First flight	15 Jan 02
Public debut	6 May 02
Certification	23 May 03
First delivery (Frontier Airlines)	22 Jul 03

Short-bodied version of A319 (itself a truncated A320). Formally announced at Farnborough Air Show, 7 September 1998, although known to be under consideration (as A319M5) since late 1997 when AVIC/AIA/STPL AE316/AE317 venture became uncertain. Smallest aircraft in Airbus family; programme launched 26 April 1999 with orders, commitments and options for 109 aircraft; launch customer Air France (via ILFC). Final assembly at Hamburg, resulting in some A319 production being moved to Toulouse. First metal cut November 2000; final assembly began 9 August 2001; three scheduled for completion in 2002.

Prototype (F-WWIA; 1,599th of A320 family) made maiden flight 15 January 2002, powered by PW6000 engines. Public debut at ILA, Berlin, 6 to 12 May 2002. Second prototype, F-WWIB, flew 3 June 2002; shown at Farnborough July 2002. Certification originally planned for October and service entry December 2002; however, delays in PW6000 programme caused revised schedule; as a result, F-WWIA re-engined with CFM56-5B/Ps, making maiden flight in this form on 29 August 2002 and receiving JAA certification 23 May 2003. FAA approval came in following month, preceding initial deliveries to Frontier Airlines (N80IFR, 22 July) and Air France (F-GUGA, 9 October 2003). Second prototype allocated to development of the PW6000-powered version; maiden flight (PW6124As) 9 December 2005 and EASA certification later that month. Undergoing trials in mid-2006 to obtain steep approach (5.5°) approval for operation into airports such as London City Airport where surrounding obstacles or restrictive noise regulations apply.

CURRENT VERSIONS: **A318-100:** Basic version.

A318 Elite: Business jet; announced at NBAA Convention, Orlando, Florida, 9 November 2005; offered in partnership with cabin outfitter Lufthansa Technik; up to 14 and 18 passengers (Elite and Elite +, respectively); range 4,000 n miles (7,408 km; 4,603 miles). EASA certification 21 December 2005. Launch customer Comlux of Zurich, Switzerland, whose first aircraft (D-AUAA/HB-IPP) made maiden flight 10 October 2006; first delivery in initial quarter of 2007; five (plus five options) ordered by National Air Services in November 2005 for delivery to Jeddah, Saudi Arabia, from late 2006. Member of ACJ (Airbus Corporate Jet) family; see entry for A319.

AIRBUS A318 MARKS AND VARIANTS

Series	Mark	Power Plant	EASA Certification
100	111	CFM56-5B8/P	23 May 03
100	112	CFM56-5B9/P	23 May 03
100	121	PW6122A	21 Dec 05
100	122	PW6124A	21 Dec 05

Series	Variant	MTOW (kg)
100	000	59,000
100	001	61,500
100	002	63,000
100	003	64,500
100	004	66,000
100	005	68,000
100	006	56,000
100	007	61,000
100	008	64,000

Notes: Variant parameters may include differences in data other than max T-O weight. Except as constrained by Series, Variants are applicable to several engine options.

CUSTOMERS: International Lease Finance Corporation (ILFC) signed MoU for up to 30 aircraft on 17 November 1998, subject to launch of project, followed by firm order 30 April 1999. First conditional airline customer, TWA, signed LoI on 9 December 1998 for 50, confirming 25 by firm order 14 December 1999 but cancelled when TWA taken over by American Airlines; other early customers included Egyptair (three on 17 July 1999 — first firm airline order, followed by two further examples, but subsequently all cancelled). Total orders 90, of which 31 delivered, at 1 November 2006. Despite slow start, in 2004 Airbus was predicting long-term sales of 300 to 400 A318s.

AIRBUS A318 ORDERS
(at 1 November 2006)

Customer	Engines	Qty
Air France group	CFM	18
Comlux Aviation	CFM	3
Frontier Airlines	CFM	9
GECAS	CFM	12
JetAlliance		1
LAN Chile		20
National Air Services		2
Tarom	TBD	4
US Airways	PW	15
Private customers		6
Total		**90**

COSTS: Programme cost estimated as USD300 million. Unit price USD41.7 million (2001).

DESIGN FEATURES: Shorter fuselage and taller fin than rest of A320 family, with which it has 95 per cent commonality, including A319 wing, pylon and interface. Laser welding (rather than riveting) used on lower fuselage to reduce costs and weight; first use of this technology on airliner. Common pilot type rating with A319, A320 and A321.

FLYING CONTROLS: As A320.

STRUCTURE: As A320, but fuselage 4½ frames (2.39 m; 7 ft 10 in) shorter than A319; 0.79 m (2 ft 7 in) removed forward and 1.60 m (5 ft 3 in) aft of wing. Redesigned cargo doors. Fin has tip extension. Assembled in Germany by Airbus Deutschland, and Tianjin from 2009. China will have share of production work to offset AE31X project cancellation.

LANDING GEAR: As A320. Minimum ground turning radius 11.30 m (37 ft 1 in) about nosewheels, 19.50 m (63 ft 11¾ in) about mainwheels.

POWER PLANT: Designed originally for two 98.3 kN (22,100 lb st) Pratt & Whitney PW6122A or 105.9 kN (23,800 lb st) PW6124A turbofans with clamshell-type thrust reversers; A318 is launch aircraft for PW6000 family. Alternative (and first in-service) power plant is 96.1 kN (21,600 lb st) CFM International CFM56-5B8/P or 103.6 kN (23,300 lb st) CFM International CFM56-5B9/P, officially announced 4 August 1999. Thrust reversing and deflection, fuel tank capacities and locations as A320.

ACCOMMODATION: Two flight crew plus three cabin crew. Typical passenger capacity eight first class and 99 second class with 96/81 cm (38/32 in) seat pitch, or 117 in single-class seating; high-density seating for 129 passengers; certified for up to 136. Front and rear passenger doors on port side; service door opposite each on starboard side. Overwing emergency exit each side. A318 will not carry containerised freight due to smaller baggage doors (of which size reduced to maintain same engine nacelle clearance for loading vehicles as A319).

SYSTEMS: Generally as A320; new-generation cabin intercom data system (CIDS).

AVIONICS: Generally as A320, but with new LCD screens.

DIMENSIONS, EXTERNAL: As A320 except:
Length overall ..... 31.45 m (103 ft 2 in)
Height overall ..... 12.55 m (41 ft 2 in)
Wheelbase ..... 10.25 m (33 ft 7½ in)
Baggage doors (each): Height ..... 1.24 m (4 ft 1 in)
Width ..... 1.28 m (4 ft 2½ in)

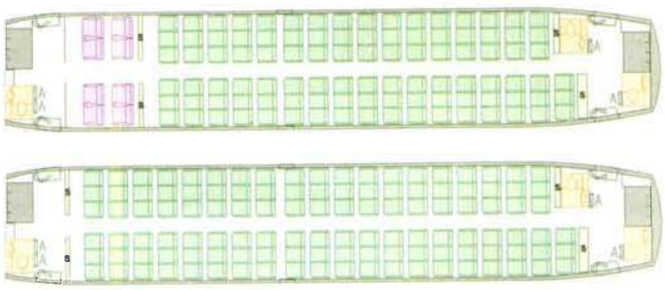
DIMENSIONS, INTERNAL: As A320 except:
Cabin: Length ..... 21.38 m (70 ft 1¾ in)
Underfloor baggage/cargo holds:
Length: forward ..... 2.57 m (8 ft 5in)
rear ..... 6.07 m (19 ft 11 in)
Volume: forward ..... 6.51 m^3 (230 cu ft)
rear ..... 14.70 m^3 (519 cu ft)

AREAS: As A320 except:
Fin and rudder (total, incl tab) ..... 21.50 m^2 (231.4 sq ft)

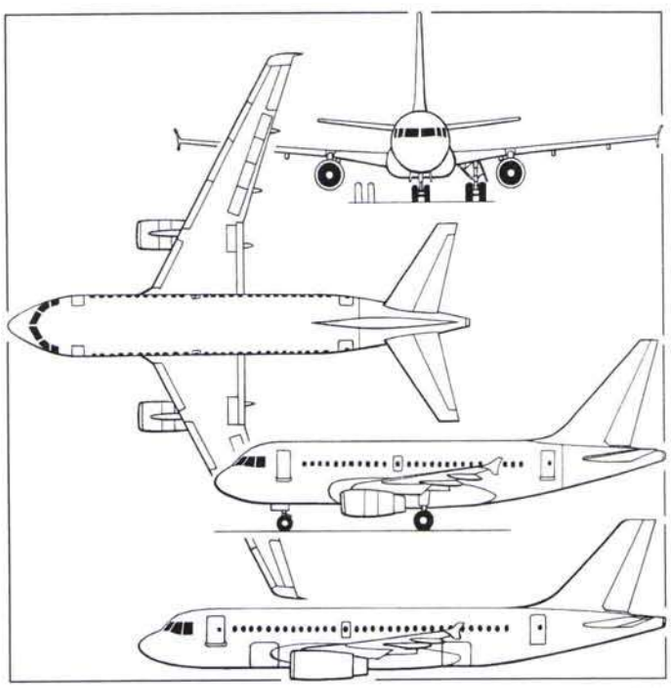
WEIGHTS AND LOADINGS:
Typical operating weight empty ..... 39,035 kg (86,057 lb)
Baggage capacity:
forward hold ..... 1,614 kg (3,558 lb)
rear hold ..... 2,131 kg (4,698 lb)
bulk hold ..... 1,372 kg (3,025 lb)
Max payload ..... 13,965 kg (30,788 lb)
Max T-O weight: basic ..... 59,000 kg (130,075 lb)
option ..... 68,000 kg (149,915 lb)
Max ramp weight: basic ..... 59,400 kg (130,955 lb)
option ..... 68,400 kg (150,800 lb)
Max landing weight: basic ..... 56,000 kg (123,460 lb)
option ..... 60,000 kg (132,275 lb)
Max zero-fuel weight: basic ..... 53,000 kg (116,845 lb)
options ..... 55,500 kg (122,355 lb)
Max wing loading: basic ..... 481.2 kg/m^2 (98.57 lb/sq ft)
option ..... 555.6 kg/m^2 (113.79 lb/sq ft)
Max power loading, CFM56-5B8/P engines:
basic ..... 307 kg/kN (3.01 lb/lb st)
option ..... 354 kg/kN (3.47 lb/lb st)

PERFORMANCE:
Max operating Mach No. (MMO) 0.82
Max operating speed ..... 350 kt (648 km/h; 403 mph) IAS
Max certified altitude ..... 12,200 m (40,000 ft)
Runway ACN: flexible Cat. B runway: basic MTOW 29
option 3 MTOW 34
T-O run at basic MTOW, 500 n mile (925 km; 575 mile) mission, elevation 610 m (2,000 ft), ISA +15°C:
PW6122 ..... 1,670 m (5,479 ft)
CFM56 ..... 1,630 m (5,348 ft)
Landing run at MLW, S/L, ISA:
PW6122 ..... 1,332 m (4,370 ft)
CFM56 ..... 1,355 m (4,446 ft)

An Air France A318 shows off its planform 1158603



Airbus A318 representative cabin layouts for 107 seats (top) and 117 seats
A: attendant's seat, S: screen 0044887



General arrangement of the Airbus A318 with additional side view (lower) of A319 *(James Goulding)* 1158562

Range with 107 passengers, FAR domestic reserves, 200 n miles (370 km; 230 miles) diversion, max payload:
basic MTOW:
PW6122 ..... 1,462 n miles (2,707 km; 1,682 miles)
CFM56 ..... 1,455 n miles (2,694 km; 1,674 miles)
option 1 MTOW:
PW6122 ..... 1,960 n miles (3,630 km; 2,255 miles)
CFM56 ..... 1,980 n miles (3,667 km; 2,278 miles)
option 2 MTOW:
PW6122 ..... 2,820 n miles (5,222 km; 3,245 miles)
CFM56 ..... 2,880 n miles (5,333 km; 3,314 miles)
option 3 MTOW ..... 3,250 n miles (6,019 km; 3,740 miles)

OPERATIONAL NOISE LEVELS (estimated):
T-O with PW6122 at MTOW ..... 79.7 EPNdB
Sideline ..... 90.4 EPNdB
Approach ..... 89.7 EPNdB

AIRBUS A319

TYPE: Twin-jet airliner.

PROGRAMME:

DEVELOPMENT MILESTONES

A319	
Launched	10 Jun 93
Rolled out	24 Aug 95
First flight	29 Aug 95
Certification	10 Apr 96
First delivery (ILFC)	25 Apr 96
Entered service (Swissair)	8 May 96
Subsequent versions	
ACJ	
Announced	15 Jun 97
First flight	12 Nov 98
First delivery (Al Kharafi)	8 Nov 99

Short-fuselage A320. Airbus Board officially authorised start of sales 22 May 1992; programme launched 10 June 1993. Final assembly of first aircraft (F-WWDB, the 546th of the A319/320/321 family) began 23 March 1995; rolled out at Hamburg 24 August; first flight (with CFM56-5A engines) on 29 August; second aircraft (F-WWAS, No. 572) flew (with CFM56-5A engines and commercial interior) 31 October 1995; 650 hour flight test programme resulted in initial certification (CFM56-5B) on 10 April 1996 (CFM56-5A and V2500-A5 followed); first delivery, HB-IPV to ILFC on 25 April 1996 and immediately to Swissair on 30 April, flying first service on 8 May; F-WWAS re-engined with IAE V2524 engines, first flight 22 May 1996 and certified on 18 December 1996; other 1996 first receipts included Air Inter (F-GPMA 21 June); Lufthansa (D-AILA 19 July); and Air Canada (C-FYIY 12 December). JAA 120 minute ETOPS approval granted 14 February 1997 and extended to ACJ in December 2000; 180-minute ETOPS (all versions) granted by EASA April 2004. 1,000th member of A320 family (an A319 for Air France via ILFC) delivered 15 April 1999.

CURRENT VERSIONS: **A319-100:** Baseline version.

Description applies to A319-100.

ACJ: Airbus Corporate Jetliner. Announced at 1997 Paris Air Show. Standard aircraft will carry up to 40 passengers over a range of 6,300 n miles (11,667 km; 7,250 miles), cruising at 12,500 m (41,000 ft) at speeds of up to M0.82. Certified as a commercial airliner to Cat. IIIb landing criteria and 180-minute ETOPS, and will convert easily to airliner configuration. First customer, announced on 18 December 1997, is Mohamed Abdulmohsin Al Kharafi of Kuwait. First aircraft (G-OMAK, 913th of A320 family), type A319-132, first flew 12 November 1998 and delivered to Jet Aviation, Switzerland, for outfitting on 31 December 1998; customer receipt 30 October 1999, operated by Twinjet Aircraft for Al Kharafi. JAR certification (as amendment of A319 certificate) received August 1999. Demonstrator F-WWIC first flew (as D-AVYB) 28 May 1999 and to Toulouse for trials 31 May; is 910th of A320 family, but followed c/n 913; eventually sold to UAE Air Force.

Orders and commitments totalled more than 30 by mid-2002, of which 14 then delivered; see accompanying table for latest customer list. FAA (FAR Pt 121) certification for both scheduled service and private operation in USA received October 2002.

Set world record non-stop 15 hour 13 minute flight of 6,918 n miles (12,812 km; 7,961 miles) from Santiago to Le Bourget on 16 June 1999.

Airbus announced in 2000 that production of the ACJ would be restricted to four per year until 2003; this was increased to six, due to demand. Four companies approved for outfitting: Lufthansa Technik (LHT), Hamburg; Jet Aviation, Basle; Associated Air Center, Dallas; and EADS Sogerma, Toulouse.

ACJ 'family' now includes A318 Elite and A320 Prestige; sales totalled 65 in November 2006.

A319LR: Long-range variant of ACJ; launched February 2003, when offered with 48-seat all business class interior and 35,400 litre (9,352 US gallon; 7,787 Imp gallon) fuel capacity, giving range of 4,500 n miles (8,334 km; 5,178 miles). Second aircraft for Qatar Airways (two-class layout for 110 passengers) is to this standard; entered service August 2003. Three more ordered by 30 September 2003; two for PrivatAir via CIT (48-seat all business class cabin) and one undisclosed.

A319 Executive: Variant of ACJ; 44-seat interior; lacks ACJ's auxiliary fuel tanks; 3,400 n mile (6,296 km; 3,912 mile) range. Three ordered by 30 September 2003; two for PrivatAir via CIT and one for Blue Moon Aviation (US) via SALE.

AIRBUS A319 MARKS AND VARIANTS

Series	Mark	Power Plant	FAA Certification
100	111	CFM56-5B5 or -5B5/P	20 Jun 97
100	112	CFM56-5B6 or -5B6/P or -5B6/2P	30 Aug 96
100	113	CFM56-5A4	20 Jun 97
100	114	CFM56-5A5	20 Jun 97
100	115	CFM56-5B7 or -5B7/P	22 Oct 02
100	131	V2522-A5	20 Jun 97
100	132	V2524-A5	20 Jun 97
100	133	V2527M-A5	22 Oct 02

Series	Variant	MTOW (kg)
100	000	64,000
100	001	70,000
100	002	75,700

Notes: Variant parameters may include differences in data other than max T-O weight. Except as constrained by Series, Variants are applicable to several engine options.

CUSTOMERS: Total of 1,400 (including 47 ACJs) sold, of which 911 delivered, by 1 November 2006.

AIRBUS A319 AND ACJ ORDERS
(at 1 November 2006)

Customer	Qty
AERCAP	7
Aero Services Executive	1[1]
Aeroflot	4
Aerventure	23
Air Berlin	15
Air Canada	37
Air China	32[1]
Air France group	19[1]
Air Inter Europe	9
Air Mauritius	2
Al Kharafi Group	2[1]
Alitalia	12
Austrian Airlines	7
Azerbaijan Hava Yollari	4[1]
BH Airlines	2
Boullioun Aviation Services	2
Brazilian Air Force	1[1]
British Airways	33
Cebu Air	10
China Aviation Supplies	40
China Eastern Airlines	5
China Southern Airlines	16
CIT Leasing	32
Croatia Airlines	4
Cyprus Airways	2
Czech Airlines	6
DaimlerChrysler Aviation	1[1]
Druk Air	2
easyJet	140
Eurofly	1[1]

A319 in the livery of AtlasJet International, one of two operating on lease in 2006

1158607

Customer	Qty
Finnair	5
French Air Force	2[1]
Frontier Airlines	19
GATX/CL AIR	1
GECAS	69
Germanwings	23
Hainan Airlines	28
Hamburg International	14
Iberia	20
ILFC	158
Indian Airlines	19
Italian Air Force	4[1]
JAT	8
JetAlliance	1
Kingfisher Airlines	1
LAN Chile	15
Lufthansa	25
NIKI	2
Northwest Airlines	82
Pharmair Corporation	1
Qatar Airways	3[1]
RBS Aerospace	4
Royal Thai Air Force	1[1]
SALE	8
Sabena	15
SAS	4
Shenzhen Airlines	3
Sichuan Airlines	8
Silkair	6
Skybus	65
South African Airways	11
Spirit Airlines	7
Swissair	6
TACA	15
TAM	15
TAP-Air Portugal	13
Tunis Air	4
United Airlines	78
US Airways	114
Venezuelan Air Force	1[1]
Virgin America	8
Volaris	16
Wizz Air	4
Other executive and private customers	22
Undisclosed	1
Total	**1,400**

[1] Indicates (or includes) ACJ

COSTS: Total development cost estimated at USD275 million, entirely financed by Airbus Industrie. A319-100 cost approximately USD48.7 million depending on choice of engines and level of customisation (2001); ACJ cost USD36 million (2001), excluding outfitting of between USD4 million and USD10 million.

DESIGN FEATURES: Seven fuselage frames shorter than A320 (1.60 m; 5 ft 3 in forward of wing, 2.13 m; 7 ft 0 in aft); modified rear cargo hold; bulk hold door and forward overwing emergency exit deleted; derated engines; otherwise little changed. Seats 124 passengers in typical two-class layout, compared with 150 in A320 and 185 in A321; range of 3,550 n miles (6,574 km; 4,085 miles) said to be the longest in this category of airliner; common pilot type rating with A320 and A321.

FLYING CONTROLS: Same flight deck and flying control system as A320.

STRUCTURE: As A320. Assembled in Germany by Airbus Deutschland, alongside the stretched A321; partner workshares rearranged to maintain overall balance between France and Germany.

LANDING GEAR: As A320, but 46×16 or 46×17.0R20 main tyre options only. Minimum ground turning radius 12.10 m (39 ft 8½ in) about nosewheels, 20.60 m (67 ft 7 in) about mainwheels.

POWER PLANT: Two turbofans. Options comprise CFM56-5B5, -5B5/P or -5A4, all 97.9 kN (22,000 lb st); IAE V2522-A5 of 102.5 kN (23,040 lb st); CFM56-5B6, -5B6/P or -5B6/2P or -5A5, all 104.5 kN (23,500 lb st); IAE V2524-A5 of 108.9 kN (24,480 lb st), IAE V2527M-AS of 110.3 kN (24,800 lb st); or CFM56-5B7 or -5B7/P of 120.1 kN (27,000 lb st).

Standard (three tanks) fuel as for A320: 23,860 litres (6,303 US gallons; 5,249 Imp gallons) usable. Up to six additional centreline tanks (ACT) for maximum (nine tanks) of 40,640 litres (10,737 US gallons; 8,939 Imp gallons).

ACCOMMODATION: Typically 124 passengers (eight in 'super first' class plus 116 economy); maximum 145 passengers in all-economy configuration. Built-in airstairs in ACJ.

'Prestige' cabin option for ACJ configures forward and centre sections with dining and work areas complete with tables, lounge and bar; aft cabin has private office area and enclosed bedroom. Amenities include 64 kbyte communications links, large-screen video displays, external video cameras for security and flight progress monitoring, and additional aft cabin soundproofing.

DIMENSIONS, EXTERNAL: As A320 except:

Length overall	33.83 m (111 ft 0 in)
Wheelbase	11.05 m (36 ft 3 in)

DIMENSIONS, INTERNAL: As A320 except:

Cabin length (excl flight deck)	23.77 m (77 ft 11¾ in)
Underfloor baggage/cargo holds:	
Length: forward	3.35 m (11 ft 0 in)
rear	7.67 m (25 ft 2 in)
Volume: bulk total	27.64 m³ (976 cu ft)

WEIGHTS AND LOADINGS:

Typical operating weight empty:	
standard	40,160 kg (88,537 lb)
option	41,203 kg (90,837 lb)
Baggage capacity: forward hold	2,268 kg (5,000 lb)
rear hold	3,020 kg (6,600 lb)
bulk hold	1,497 kg (3,300 lb)
Max payload	16,653 kg (36,714 lb)
Max ramp weight: basic	64,400 kg (141,975 lb)
option	75,900 kg (167,330 lb)
Max T-O weight: basic	64,000 kg (141,095 lb)
option	75,500 kg (166,450 lb)
Max landing weight: basic	61,000 kg (134,480 lb)
option	62,500 kg (137,790 lb)
Max zero-fuel weight: basic	57,000 kg (125,665 lb)
option	58,500 kg (128,970 lb)
Max wing loading:	
basic	522.9 kg/m² (101.09 lb/sq ft)
option	616.8 kg/m² (126.34 lb/sq ft)
Max power loading: basic, CFM56-5B5	327 kg/kN (3.21 lb/lb st)
option, CFM56-5B7	314 kg/kN (3.08 lb/lb st)

PERFORMANCE (A: with CFM56-5A4, CFM56-5B5 or V2522-A5; B: with CFM56-5A5, CFM56-5B6 or V2524-A5):

Max operating Mach No. (MMO)	0.82
Max operating speed	350 kt (648 km/h; 403 mph) IAS
Typical operating Mach No.	0.78
Max rate of climb	152 m (500 ft)/min
Max certified altitude: A319	12,130 m (39,800 ft)
ACJ	12,500 m (41,000 ft)
Service ceiling, OEI	6,400 m (21,000 ft)
T-O distance, S/L ISA+15°C:	
basic: A	1,720 m (5,643 ft)
option: B	2,640 m (8,661 ft)

Airbus A319 of US operator Volaris

1158610

Hamburg take-off for the Brazilian Air Force's A319 Airbus Corporate Jet

1158611

Landing distance, S/L ISA: A, B ..... 1,430 m (4,692 ft)
Range on normal fuel tankage with 124 passengers and baggage, FAR domestic reserves and 200 n mile (370 km; 230 mile) diversion:
A, at T-O weight 64,000 kg (141,095 lb) ..... 1,813 n miles (3,357 km; 2,086 miles)
B, at T-O weight 75,500 kg (166,450 lb) ..... 3,697 n miles (6,846 km; 4,254 miles)
OPERATIONAL NOISE LEVELS (A, B as above):
T-O: A ..... 82.5 EPNdB
B ..... 82.4 EPNdB
Sideline: A ..... 92.6 EPNdB
B ..... 92.2 EPNdB
Approach: A ..... 93.9 EPNdB
B ..... 94.2 EPNdB

AIRBUS A321

TYPE: Twin-jet airliner.
PROGRAMME:

DEVELOPMENT MILESTONES

A321-100	
Announced	22 May 89
Launched	24 Nov 89
Rolled out	3 Mar 93
First flight	11 Mar 93
Certification	17 Dec 93
First delivery (Lufthansa)	27 Jan 94
Entered service (Lufthansa)	18 Mar 94
Subsequent versions	
A321-200	
Launched	12 Apr 95
First flight	12 Dec 96
First delivery (Monarch Airlines)	24 Apr 97

Stretched version of A320. Announced 22 May and launched 24 November 1989; four development aircraft; rolled out 3 March 1993, first flight with V2530 lead engine 11 March 1993 (F-WWIA), second aircraft with alternative CFM56-5B engine in May 1993; V2530-powered version received European JAA certification 17 December 1993; CFM56-5B2-powered version certified by JAA 15 February 1994; CFM56-5B1 certified by JAA 27 May 1994; first delivery (D-AIRA to Lufthansa) 27 January 1994; first service with Lufthansa 18 March 1994. A321 powered by CFM56-5Bs passed cold-weather trials in Kiruna, January 1994; first with alternative engine handed over to Alitalia 18 March 1994. JAA approval for Cat. III automatic landings achieved in December 1994. 120-minute ETOPS granted 29 May 1996 and upgraded to 180-minute approval in April 2004. The 100th A321 (Alitalia's I-BIXZ) flew 1 July 1998. A321 also recommended by Northrop Grumman as platform for Joint STARS, competing for NATO's Airborne Ground Surveillance requirement (later dropped) and by Raytheon for the Republic of Korea Air Force's E-X AEW&C competition.

CURRENT VERSIONS: **A321-100:** Initial version.

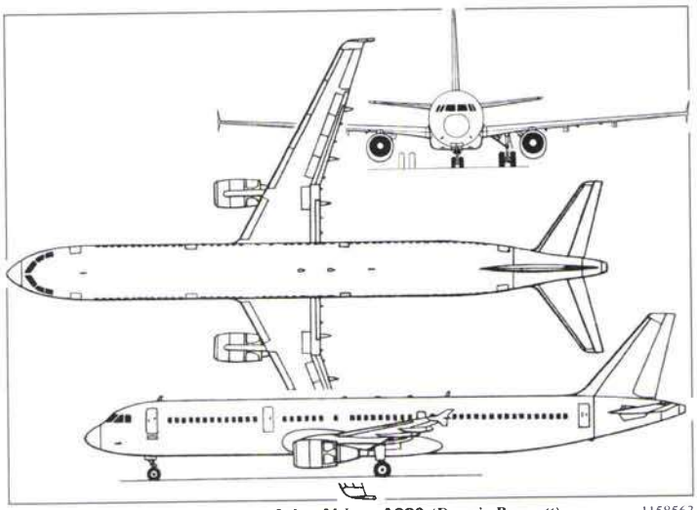
A321-200: Extended-range version, launched 12 April 1995; features reinforced structure, higher-thrust versions of existing engines and optional additional centre tank (ACT), capacity 2,900 litres (766 US gallons; 638 Imp gallons) which increases maximum T-O weight to 89,000 kg (196,210 lb) and range by 350 n miles (648 km; 402 miles). A321-200 expected to have increased market appeal on North American domestic routes; charter routes between northern and southern Europe; and on scheduled routes between Europe and Middle East. First aircraft flew 12 December 1996 at Hamburg; became G-OZBC of Monarch Airlines and delivered 24 April 1997. Higher-MTOW version, with option of second ACT, launched January 1999; first customer Spanair, delivery September 2000.

A321CJ: Airbus Industrie reported to be considering a corporate version with additional fuel tanks; no formal plans to launch announced by third quarter 2006.

A321 Freighter: EADS EFW conducting feasibility studies into an A321 Freighter with capacity for 14 standard pallets.

AIRBUS A321 MARKS AND VARIANTS

Series	Mark	Power Plant	FAA Certification
100	111	CFM56-5B1 or -5B1/P or -5B1/2P	20 Dec 95
100	112	CFM56-5B2 or -5B2/P	20 Dec 95
100	131	V2530-A5	20 Dec 95



A321 stretched development of the Airbus A320 *(Dennis Punnett)* 1158563

Series	Mark	Power Plant	FAA Certification
200	211	CFM56-5B3/P o r-5B3/2P	18 Sep 97
200	231	V2533-A5	18 Sep 97

Series	Variant	MTOW (kg)
100	000	83,000
100	002	83,000
100	003	85,000
200	000	89,000
200	000	93,000

Notes: Variant parameters may include differences in data other than max T-O weight. Except as constrained by Series, Variants are applicable to several engine options.

CUSTOMERS: Total of 651 sold, of which 364 delivered by 1 November 2006.

AIRBUS A321 ORDERS
(at 1 November 2006)

Customer	Qty
AERCAP	3
Aer Lingus	3
Aero Looyd	5
Aeroflot	10
Air Canada	10
Air China	24
Air France group	4
Air Inter Europe	7
Air Macau	1
Alitalia	23
All Nippon Airways	7
Asiana Airlines	8
Austrian Airlines	6
Blue Wings	4
Bmed	7
Boullioun Aviation Services	4
British Airways	16
British Midland Airways	6
China Aviation Supplies	50
China Eastern Airlines	15
China Northern Airlines	10
China Southern Airlines	25
CIT Leasing	8
Dragonair	2
Egyptair	4

1133353

Spanair Airbus A321

Customer	Qty
Finnair	4
Flightlease	1
GATX/CL AIR	7
GB Airways	7
GECAS	10
Iberia	19
ILFC	80
Indian Airlines	20
IndiGo	30
Kingfisher Airlines	4
Leisure International Airways	2
LTU	2
Lufthansa	41
Middle East Airlines	6
Monarch Airlines	7
MyTravel Airways	4
Onur Air	2
Qatar Airways	2
Royal Air Maroc	4
Sabena	3
SALE	5
SAS	8
Shanghai Airlines	5
Sichuan Airlines	6
Spanair	3
Spirit Airlines	7
Swissair	6
TACA	5
TAM	4
TAP-Air Portugal	3
TransAsia Airways	6
Turk Hava Yollari	12
US Airways	43
Vietnam Airlines	15
Undisclosed	6
Total	**651**

COSTS: A321-200† unit cost approximately USD65.6 million, depending on engine choice and customisation level (2001).

DESIGN FEATURES: Compared with A320, A321 has 4.27 m (14 ft 0 in) fuselage plug immediately forward of wing and 2.67 m (8 ft 9 in) plug immediately aft; pairs of wing fuel tanks unified and system simplified; other changes include local structural reinforcement of existing assemblies, slightly extended wing trailing-edge with double-slotted flaps, uprated landing gear and higher T-O weights.

STRUCTURE: As for A320 except for airframe changes noted under Design Features; front fuselage plug by Alenia and rear one by BAE Systems; final assembly and outfitting by Airbus Deutschland at Hamburg.

LANDING GEAR: Uprated, with 22 in wheel rims, 49×18.0–22 or 46×17.0R20 (30 ply) mainwheel tyres and increased energy brakes; wheels and brakes by Aircraft Braking Systems. Minimum ground turning radius 18.00 m (59 ft 0¾ in) about nosewheels, 27.60 m (90 ft 6½ in) about mainwheels.

POWER PLANT: Two turbofans. Options comprise: A321-100: IAE V2530-A5 of 133.0 kN (29,900 lb st); CFM56-5B1, -5B1/P or -5B1/2P of 133.4 kN (30,000 lb st); CFM56-5B2 or -5B2/P of 137.9 kN (31,000 lb st); and, for A321-200: IAE V2533-A5 of 140.6 kN (31,600 lb st); or CFM56-5B3/P or -5B3/2P of 142.3 kN (32,000 lb st).

Normal three-tank fuel capacity 23,700 litres (6,261 US gallons; 5,213 Imp gallons) usable. Fourth tank increases usable quantity to 26,600 litres (7,027 US gallons; 5,851 Imp gallons) in high pressure fuel system or 26,692 litres (7,051 US gallons 5,872 Imp gallons) in low pressure system. Fifth tank increases usable quantity to 29,684 litres (7,842 US gallons; 6,530 Imp gallons) low pressure (only).

ACCOMMODATION: Typically offers 24 per cent more seats and 40 per cent more hold volume than A320; examples are 185 passengers in two-class layout (16 'super first' class at 91 cm; 36 in seat pitch and 169 economy class at 81 cm; 32 in), or 220 passengers (certified limit) in all-economy high-density configuration. Each fuselage plug incorporates one pair of emergency exits, replacing single overwing pair of A320.

SYSTEMS: Choice of Honeywell 36-300 or APIC APS3200 APU; Honeywell 131-9(A) available from 1998; full commonality with A320 installation.

DIMENSIONS, EXTERNAL: As for A320 except:
- Length overall: 44.51 m (146 ft 0 in)
- Height overall: 11.81 m (38 ft 9 in)
- Wheelbase: 16.92 m (55 ft 6¼ in)
- Emergency exits (forward stbd and rear port/stbd, each):
  - Height: 1.52 m (5 ft 0 in)
  - Width: 0.76 m (2 ft 6 in)
- Emergency exit (forward port, usable also as passenger door):
  - Height: 1.85 m (6 ft 1 in)
  - Width: 0.76 m (2 ft 6 in)

DIMENSIONS, INTERNAL: As A320 except:
- Cabin, excl flight deck: Length: 34.44 m (113 ft 0 in)
- Underfloor baggage/cargo holds:
  - Length: forward: 8.15 m (26 ft 9 in)
  - rear: 11.40 m (37 ft 5 in)
  - Volume: forward: 22.81 m³ (806 cu ft)
  - rear: 28.93 m³ (1,022 cu ft)

WEIGHTS AND LOADINGS (A321-200):
- Typical operating weight empty: 49,200 kg (108,465 lb)
- Max fuel weight: three tanks: 18,960 kg (41,800 lb)
  - four tanks: 21,280 kg (46,914 lb)
  - five tanks: 23,746 kg (52,350 lb)
- Max ramp weight: basic: 83,400 kg (183,865 lb)
  - option: 93,900 kg (207,015 lb)
- Max T-O weight: basic: 83,000 kg (182,985 lb)
  - option: 93,500 kg (206,130 lb)
- Max landing weight: basic: 73,500 kg (162,035 lb)
  - option: 77,800 kg (171,520 lb)
- Max zero-fuel weight: basic: 69,500 kg (153,220 lb)
  - option: 73,800 kg (162,705 lb)
- Max wing loading:
  - basic: 677.0 kg/m² (138.66 lb/sq ft)
  - option: 762.6 kg/m² (156.20 lb/sq ft)
- Max power loading, CFM56-5B3:
  - **basic: 291 kg/kN (2.85 lb/lb st)**
  - **option: 328 kg/kN (3.21 lb/lb st)**

PERFORMANCE (A321-100, except where indicated; typical 185-passenger layout. C1: CFM56-5B1, V: V2530-A5, C2: CFM56-5B2, C3: CFM56-5B3, V2: V2533-A5):
- Max operating Mach No (MMO): 0.82
- Max operating speed: 350 kt (648 km/h; 403 mph) IAS
- Typical operating Mach No: 0.78
- Max rate of climb at S/L: 152 m (500 ft)/min
- Max certified altitude: 12,130 m (39,800 ft)
- Service ceiling, OEI: A321-100: 5,180 m (17,000 ft)
  - A321-200: 5,000 m (16,400 ft)
- T-O distance at max T-O weight, S/L, ISA +15°C:
  - C1: 2,220 m (7,285 ft)
  - V: 2,065 m (6,775 ft)
  - C2: 2,270 m (7,450 ft)
  - C3: 2,330 m (7,645 ft)
  - V2: 2,341 m (7,680 ft)
- Landing distance at max landing weight:
  - C1, V: 1,540 m (5,055 ft)
  - C2: 1,530 m (5,020 ft)
  - C3, V2: 1,577 m (5,175 ft)
- Runway ACN (flexible runway, category B):
  - basic: 48
- Range on normal fuel tankage with 185 passengers and baggage at typical airline OWE, FAR domestic reserves and 200 n mile (370 km; 230 mile) diversion: A321-100:
  - C1, C2:
    - basic: 2,138 n miles (3,959 km; 2,460 miles)
    - optional: 2,250 n miles (4,167 km; 2,589 miles)
  - V: basic: 2,253 n miles (4,172 km; 2,592 miles)
    - optional: 2,386 n miles (4,418 km; 2,745 miles)
  - A321-200:
    - with one ACT: 2,700 n miles (5,000 km; 3,107 miles)
    - with two ACT: 3,000 n miles (5,556 km; 3,452 miles)
  - V2: basic: 2,384 n miles (4,415 km; 2,743 miles)
    - with one ACT: 2,714 n miles (5,026 km; 3,123 miles)

OPERATIONAL NOISE LEVELS (ICAO Annex 16, Chapter 3, estimated):
- T-O: C1: 87.0 EPNdB (92.1 limit)
  - V: 85.4 EPNdB (92.1 limit)
- Sideline: C1: 96.2 EPNdB (97.2 limit)
  - V: 94.5 EPNdB (97.2 limit)
- Approach: C1: 96.1 EPNdB (100.9 limit)
  - V: 95.4 EPNdB (100.9 limit)

AIRBUS A340

TYPE: Wide-bodied airliner.

PROGRAMME:

DEVELOPMENT MILESTONES

A340-300	
Launched	5 Jun 87
First flight	25 Oct 91
Certification	22 Dec 92
First delivery (Air France)	26 Feb 93
Entered service (Air France)	29 Mar 93
Subsequent versions	
A340-200	
First flight	1 Apr 92
Certification	22 Dec 92
First delivery (Lufthansa)	29 Jan 93
Entered service (Lufthansa)	15 Mar 93
A340-600	
Launched	8 Dec 97
Rolled out	23 Mar 01
First flight	23 Apr 01
Public debut	16 Jun 01
Certification	29 May 02
First delivery (Virgin Atlantic)	22 Jul 02
Entered service (Virgin Atlantic)	1 Aug 02
A340-500	
Launched	17 Jun 97
Go-ahead	8 Dec 97
First flight	11 Feb 02
Certification	3 Dec 02
First delivery (Qatar Amiri Flight)	15 Sep 03

Launched 5 June 1987 as parallel programme with A330, uniquely offering twin- and four-engined variants of same basic design. First flight of four-engined A340-300 25 October 1991; A340-200 and -300 certified simultaneously by 18 European joint airworthiness authorities (JAA) on 22 December 1992; first deliveries to Lufthansa on 29 January 1993 (-200) and Air France on 26 February 1993 (-300); both versions entered service March 1993; both received FAA certification 27 May 1993. A340/A330 certified by JAA for GPS satellite navigation January 1994; successful trials conducted at Toulouse in October 1994 using differential global positioning (DGPS) for fully automatic landings, including roll-out. The 200th aircraft from A330/340 assembly line flew in November 1997; 100th A340 delivered to Singapore Airlines in February 1997; 180-minute ETOPS for Rolls-Royce Trent 700 engines awarded May 1996.

A340-500 and -600 were launched on 8 December 1997, at an estimated investment cost of USD2.9 billion. First flights took place on 11 February 2002 and 23 April 2001 respectively, followed by certifications on 3 December 2002 and 29 April 2002. A340-600 entered service with Virgin Atlantic 1 August 2002. 2,000th Airbus was A340-300 for Lufthansa, delivered 18 May 1999. 400th A330/A340 family member first flown 23 March 2001.

Cathay Pacific took delivery of an A340-300 covered with 700 m² (7,535 sq ft) of plastic film riblets in October 1996 in a trial intended to reduce fuel consumption (average ¾ tonne per medium- or long-range flight) by reducing drag (see illustrations in 1998–99 edition).

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Airbus A340-500 of Etihad Airways

CURRENT VERSIONS: **Initial A340-300:** Higher capacity version, carrying up to 375 passengers (standard) or 440 (optional) and powered initially by CFM56-5C2 turbofans. Able to carry typical load of 295 passengers over distances of 7,300 n miles (13,519 km; 8,400 miles).

Current A340-300: (engineering designation -300X) powered by 151.2 kN (34,000 lb st) CFM56-5C4 turbofans; maximum T-O weight 271,000 kg (597,450 lb) with optional MTOW of 275,000 kg (606,275 lb); stronger landing gear, and aerodynamic and engine refinements, plus optional additional centre tank (ACT) for increased fuel capacity compared with basic A340-300. First flight (F-WWJH; CFM56-5C4 engines) 25 August 1995; first delivery, to Singapore Airlines, 17 April 1996.

A340-300E: Enhanced version with upgraded CFM56-5C4/P engines (trial engine first flew on an A340 on 19 November 2002); optional increased MTOW of 276,500 kg (609,575 lb); new style cabin from A340-600. Initial customer, South African Airways, ordered six in 2002; first delivery 9 March 2004.

A340-300 Awiator: Company testbed (MSN001/F-WWAS) for Aircraft Wing with Advanced Technology Operation (Awiator) R & D programme to explore ways of reducing aircraft wake, drag, noise and fuel consumption, and other technologies, which could be applied to future Airbus designs. Programme began in July 2002 and is testing such features as enlarged winglets, modified inboard spoilers/airbrakes, turbulence sensors and various vortex devices; as of mid-2006 was funded to extent of EUR80 million, of which half provided by European Union. Primary goals are to improve lift and reduce noise. First series of flight tests, in 2003, evaluated attachment of a small trailing edge device ('mini TED') in form of narrow, non adjustable metal strip to an outboard landing flap; this followed in late 2005 and early 2006 by larger, movable, CFRP mini TEDs affixed to inboard flaps. Final phase, during second half of 2006, to flight test full set fitted to all flap trailing edges. After analysing test data, decision will be taken whether to apply this modification to production Airbuses.

Initial A340-200: Short-fuselage, longer range version of A340-300, with same initial power plant; seating capacity 420 passengers, but more typically 303 in a two class or 263 in three-class configuration; first flight (F-WWBA) 1 April 1992; entered service January 1993 with Lufthansa.

Current A340-200: Advanced version (previously referred to as A340-8000) with additional fuel in two tanks in rear cargo hold, strengthened fuselage and wings, CFM56-5C4 engines and 275,000 kg (606,275 lb) maximum T-O weight; first order placed March 1996 by Prince Jefri of Brunei for one VVIP aircraft, which first flew 19 December 1997 and was retained by Airbus during 1998; stored at Schönefeld-Berlin in 'green' condition, in1999. Sold to Jordan for Royal Flight. New-build aircraft no longer marketed by Airbus.

A340-400: Series discontinued in favour of A340-600.

A340-500: Ultra-long range variant of A340-600 able to carry (typically) 313 passengers in three classes across 8,650 n miles (16,020 km; 9,954 miles). Fuselage 3.20 m (10 ft 6 in) longer than A340-300, representing 14 frame shrink of A340-600, plus additional fuel in rear centre tank. Launched at 1997 Paris Air Show and received go-ahead December 1997. Commonality with existing A330/A340 variants allows cross crewing and employment of common cargo containers and interiors to minimise training, staffing, provisioning and maintenance costs. Claims to be the world's longest-range airliner, justified twice in 2004 by Singapore Airlines with flights to Los Angeles and New York. Former, on 3 February, covered 7,609 n miles (14,093 km; 8,757 miles) in 14 hours 42 minutes; latter, distance 8,963 n miles (16,600 km; 10,314 miles), completed in 18 hours 18 minutes on 28 June. Development time of A340-500/-600 series reduced by 25 per cent by use of Airbus Concurrent Engineering (ACE) shared CADD-CAD/CAM systems.

Compared with -300, has 0.53 m (1 ft 9 in) fuselage plug ahead of wings and 1.07 m (3 ft 6 in) plug to the rear; wings of increased chord (incorporating a third fuselage plug of 1.60 m; 5 ft 3 in) with span stretched to 63.45 m (208 ft 2 in); 31° 6' sweepback at quarter chord; taller vertical stabiliser is married to a new horizontal stabiliser to give increased chord fin with 0.50 m (1 ft 7¾ in) height extension. Max T-O weight 368,000 kg (811,300 lb). Landing gear adaptation involves replacement of central twin-wheel unit with forward retracting brakeable double-bogie unit. Rolls-Royce Trent 553 of 236 kN (53,000 lb st) chosen as power plant; this combines fan diameter of Trent 700 with scaled IP and HP compressors and turbines of Trent 800, plus new high-lift LP turbine. Honeywell 331-600 APU chosen for A340-500/-600 in March 1999. A340-500 initial launch commitments received from Air Canada, Emirates, SIA and ILFC. Maiden flight (F-WWTE, c/n 394) took place 11 February 2002; certified 3 December 2002. Higher gross weight version (380,000 kg; 837,755 lb) due for certification early 2007.

A340-600: Derivative of A340-300 with 20-frame fuselage stretch, 267 kN (60,000 lb st) class engines, increased horizontal tail area, full electrical control of rudder (replacing mechanical linkage between computer and actuator for both primary and secondary systems), additional fuel capacity, four-wheel central landing gear and 365,000 kg (804,690 lb) basic and 368,000 kg (811,300 lb) optional maximum T-O weights; can carry 380 three class passengers or 475 in all-economy class up to 7,500 n miles (13,890 km;

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B-6050, an Airbus A340-600 of China Eastern Airlines

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8,630 miles) and designed as Boeing 747 replacement with significantly lower costs and full commonality with A330/A340 family. Compared with A340-300, has same wing chord/fuselage centre-section, wing span, tailplane and fin modifications as -500, but with further 5.87 m (19 ft 3 in) plug ahead of wing and 3.20 m (10 ft 6 in) to the rear. Airbus and GE Aircraft Engines agreed in April 1996 that latter should be sole power plant source for -600, but this accord dissolved in February 1997 and Rolls-Royce Trent 556 of 249 kN (56,000 lb st) chosen on non-exclusive basis. Ram-air turbine fitted in underwing pod between engines on starboard wing. Launch commitments from Aerolineas Argentinas, Air Canada, Egyptair, Lufthansa, Swissair and Virgin Atlantic; initial firm order placed by Virgin on 15 December 1997 for eight, plus options. First metal cut 27 July 1998. Final assembly began June 2000; airframe completed September 2000 and engines fitted November 2000. Prototype (c/n 360) rolled out 23 March 2001 and first flew (F-WWCA) 23 April 2001; public debut at Paris Air Show, June 2001; second aircraft (c/n 371) handed to test department 8 June 2001 and first flown (F-WWCB) 18 June 2001; third test example, (c/n 376) flew 24 September 2001 (F-WWCC/G-VATL); three-aircraft 1,600 hour test programme completed. Programme of weight reduction and engine improvements implemented as a result of test data; weight optimisation to be achieved gradually by structural modifications; optimum configuration reached in 2003. Certification by JAA awarded 29 April 2002; first delivery (fourth aircraft, G-VSHY, to Virgin Atlantic) 22 July and entered service 1 August 2002. Higher gross weight (option 2) version launched at Paris Air Show, June 2003; expected to become standard version from mid-2006, following maiden flight 18 November 2005. Certified by EASA in April 2006; Qatar Airways is first customer, followed by Lufthansa, Virgin Atlantic and Etihad.

A340-600 Enhanced: Under study in 2005-06 as improved version incorporating some features of A350 (such as weight-saving materials and cabin changes), combined with RR Trent 1500 (1000/1700 family derivative) or GEnx engines; objective increased range and reduced DOC. No further details available as at late 2006.

A340-600F: Development study for freighter version; considered by UPS for order eventually placed for MD-11 freighters; airline has option to convert some of its A300-600F orders to A340-600Fs if required.

AIRBUS A340 MARKS AND VARIANTS

Series	Mark	Power Plant	FAA Certification
200	211	CFM56-5C2 or -5C2/F or -5C2/G	27 May 93
200	212	CFM56-5C3/F or -5C3/G	7 Jul 94
200	213	CFM56-5C4	2 Oct 94
300	311	CFM56-5C2 or-5C2/F or -5C2/G	27 May 93
300	312	CFM56-5C3/F or -5C3/G	7 Jul 94
300	313	CFM56-5C4	2 Oct 97
500	541	Trent 553-61	27 Jan 03
600	642	Trent 556-61	22 Jul 02

Series	Variant	MTOW (kg)
200	000	253,500
200	001	257,000
300	000	253,500
300	001	257,000
500	000	368,000
500	001	372,000
600	000	365,000
600	001	368,000

Notes: Variant parameters may include differences in data other than max T-O weight. Except as constrained by Series, Variants are applicable to several engine options.

CUSTOMERS: Sales at 1 November 2006 totalled 385, of which 330 delivered. See table.

AIRBUS A340 ORDERS
(at 1 November 2006)

Customer	Version	Qty
Aerolineas Argentinas	600	6
Air Canada	300,500,600	13
Air China	300	3
Air China Southwest	300	3
Air France group	200, 300	14
Air Mauritius	300	5
Air Tahiti Nui	300	4
Austrian Airlines	200	4[1]
Cathay Pacific	300	11
China Airlines (Taiwan)	300	6
China Eastern Airlines	300, 600	10
Egyptair	200	3
Emirates	500, 600	28
Etihad	500, 600	8
Finnair	300	3
Flightlease	200/300	2
Gulf Air	300	6
Iberia	300, 600	29
ILFC	200/300, 600	28
Kuwait Airways	300	4
LAN Chile	300	6
Lufthansa	200/300, 600	52
Olympic Airways	300	4
Philippine Airlines	300	8
Qatar Airways	600	4
Sabena	200	5
SAS	300	7
Singapore Airlines	300, 500	22
South African Airways	300, 600	12
SriLankan Airlines	300	3
Swiss International Air Lines	300	9
TAP-Air Portugal	300	4
Thai Airways International	500, 600	10
Turk Hava Yollari	300	7
UTA	200/300	7
Virgin Atlantic Airways	300, 600	27
Private customers	200/300,500,600	7
Total		**385**

[1] Option to purchase two of these for French Air Force announced by DGA 22 September 2005

COSTS: Development cost of A340-500/-600 set at USD2.9 billion, 20 per cent lower than basic A340. Unit cost of A340-300 USD161.1 million; A340-500 USD177.8 million; A340-600 USD186.4 million (2002 prices).

DESIGN FEATURES: A340 capitalises on commonality with A330 (identical wing/cockpit/tail unit and same basic fuselage) to create aircraft for different markets, and also has much in common (for example, existing Airbus wide-body fuselage cross-sections, A310/A300-600 fin (except on -500/-600), advanced versions of A320 cockpit and systems) with rest of Airbus range; FAA has approved cross-crew qualification between A320 series, A330 and A340.

New design wing (by BAE Systems), approximately 40 per cent larger than that of A300-600, has 30° sweepback at quarter-chord and winglets raked at 29° 42'; thickness/chord ratios 15.25 per cent at root, 11.27 per cent at inner kink, 9.86 per cent at outer kink and 10.60 per cent at tip. A340-500/600 wing 20 per cent larger than basic A340, has increased sweepback of 30° 6' and 1.60 m (5 ft 3 in) (removable) extension to each wingtip, rake angle 31° 30'.

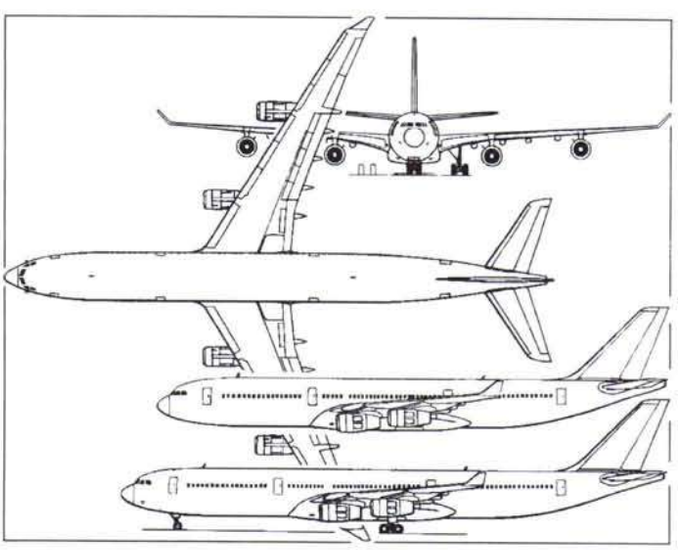
FLYING CONTROLS: In A330/A340 electronic flight control system (EFCS), roll axis is controlled by two individual outboard ailerons and five outboard spoiler panels on each wing; pitch axis control is by trimmable tailplane and separate left and right elevators; tailplane can also be mechanically controlled from flight deck, but fly-by-wire computer inputs are superimposed; single rudder is directly linked to rudder pedals, with dual yaw damping inputs superimposed. High-lift devices consist of full-span slats, flaps and aileron droop; speed braking and lift dumping by raising all six spoilers on each wing and raising all ailerons. Slats and flaps controlled outside main fly-by-wire complex by duplicated slat and flap control computers (SFCC).

Control surface maximum deflections (A340-500 and 600 in parentheses, where different): ailerons ±25° (inner +20°/–30°; outer ±25°); aileron droop 10°; elevator +15°/–30° (+17°/–30°); rudder ±31° 35' (±35°); flaps 32° (33° 40'); No 1. spoiler, speed brake 25°, lift dumper 25°; Nos. 2 and 3 spoilers, roll 35°, speed brake 30° (35°), lift dumper 50°; Nos. 4 and 5 spoilers (and No. 6), roll 35° (40°), speed brake 30° (40°), lift dumper 50°; slat No. 1 (21°); Nos. 2 to 7 slats 24°; stabilisers +2°/–14°.

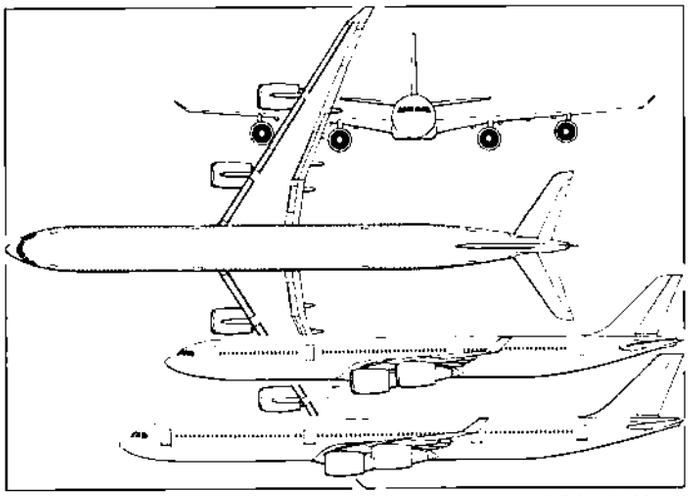
Control surface actuation by three hydraulic systems (green, yellow, blue); two powered control units (PCU) at each aileron and elevator are controlled either by primary or secondary flight control computers; single actuators at spoiler panels controlled by primary or secondary flight control computers; dual PCUs for fly-by-wire tailplane trimming, and for centrally located flap and slat actuators; three PCUs at rudder.

Fly-by-wire computers include three flight control primary computers (FCPC) and two flight control secondary computers (FCSC); each computer has two processors with different software; primary and secondary computers have different architecture and hardware; power supplies and signalling lanes are segregated; system provides stall

Lufthansa Airbus A340-600 1158613



Airbus A340-300 four-turbofan long-range airliner, with additional side view (upper) of A340-200 *(Dennis Punnett)* 1158564



Airbus A340-600 four-turbofan ultra-long-range airliner, with additional side view (upper) of A340-500 *(James Goulding)* 1158568

protection, overspeed protection and manoeuvre protection as in the A320, but the A330/340 computer arrangement maintains the protections for longer in the face of failures of sensors and inputs; ECPC and ECSC all operate continuously and provide comparator function to active channels, but only one in active control at any one control surface; reconfiguration logic can provide alternative control after failures; different normal and alternative control laws apply fly-by-wire basically as a g demand in pitch and rate demand in roll, plus complex manoeuvre limitations; if all three inertial systems fail (removing attitude information), system reverts to direct mode in which control surface angle is directly related to sidestick position; ultimate control mode is direct control of rudder and tailplane angle from rudder pedals and manual trim wheel, which is sufficient for accurate basic instrument flight.

Pilots have sidestick controllers and normal rudder pedals; EFIS instrumentation consists of duplicated primary flight displays (PFD), navigation displays (ND) and electronic centralised aircraft monitors (ECAM); three display management computers, with separate EFIS and ECAM channels, can each control all six displays in their four possible formats; flight path control by duplicated flight management and guidance and envelope computers (FMGEC); they control every phase of flight including course, attitude, engine thrust and flight planning using information from GPS and inertial systems; point of no return calculations made automatically for long-range flights in A340/A330. Control system data are collected for maintenance purposes by two flight control data concentrator (FCDC) computers. Honeywell Pegasus flight management system evaluated 1999, before January 2000 certification.

In normal flight, bank angle limited to 33° hands-off autopilot control and 67° with full stick displacement; airspeeds limited to 305 kt (565 km/h; 350 mph) and M0.82 under automatic flight control; if stick is held fully forward, the nose is automatically raised when airspeed reaches VMO + 15 kt (28 km/h; 17 mph); if nose is raised, equivalent protections apply; 'alpha max' (13° clean and 19° with flaps, slightly below maximum lift coefficient, is the greatest achievable with sidestick; 'alpha floor' is the angle of attack beyond which throttles progressively open to go-around power and airspeed is finally held steady just above stall, even if stick is continuously held back; alpha protection applied at 'normal' and 'hard' modes according to alpha rate; below protection speed (VPROT) of 142 kt (263 km/h; 163 mph) automatic and manual trimming stops; outer ailerons remain centred at over 200 kt (371 km/h; 230 mph); if a spoiler panel fails, the symmetrical opposite panel stops operating; if rudder yaw damping fails, pairs of spoiler panels are used instead; minimum speed marker on PFD adjusts to changing aircraft configuration; airbrake and pitch rate; fuel automatically transferred between wing and tailplane tanks to minimise trim drag when cruising above 7,620 m (25,000 ft).

Engines controlled by setting throttle levers to marks on quadrant, such as climb (CLB), maximum continuous and flexible take-off (Flex T-O); digital engine control makes detailed settings appropriate to altitude and temperature.

During landing and take-off, nosewheel steering, by rudder pedals, automatically disengages above 100 kt (185 km/h; 115 mph); demands for more than 4° /s nose-up pitch restrained near ground; maximum airspeeds for flaps and slats signalled on airspeed scale; trim automatically cancels effect of flaps; landing gear and airspeed; ailerons droop with full flap selection and deflect 25° up with spoilers in lift dump after touchdown; thrust reverser failure automatically countered by cancelling symmetrical opposite reverser; voice warning demands throttle closure at 6 m (20 ft) during landing flare; autothrottle disengaged when throttles closed at touchdown; on touch-and-go landing, trim automatically reset for take-off when Flex T-O power selected; engine failure in flight compensated automatically, with wings held level, slight heading drift and spoiler panels sucked down to avoid unnecessary drag. A340-600 has forward-facing taxi-aid cameras mounted in fin and belly fairing to assist pilots during ground manoeuvres.

STRUCTURE: A330 and A340 wings almost identical except latter strengthened in area of outboard engine pylon with appropriate modification of leading-edge slats 4 and 5, main three-spar wing box and leading/trailing-edge ribs and fittings of aluminium alloy, with Al-Li for some secondary structures, steel or titanium slat supports, approximately 13 per cent (by weight) of wings is of CFRP, GFRP or QFRP, including outer flaps and flap track fairings, ailerons, spoilers, leading/trailing-edge fixed surface panels and winglets; common fuselage for all initial versions, except in overall length (A340-300 same size as A330-300; A340-200 and A330-200 respectively eight and ten frames shorter; A340-500 and A340-600 described above; see also dimensions, below); construction generally similar to that of A310 and A300-600 except centre-section to accept new wings; tail unit (common to all versions except A330-200 and A340-500/600, which have larger tailplane, fin and rudder) utilises same CFRP fin as A300-600 and A310; new tailplane incorporates trim fuel tank and has CFRP outer main boxes bridged by aluminium alloy centre-section. A340-500/600 have Aircelle nacelles constructed from carbon composites.

Work-sharing along lines similar to those for A310 and A300-600, with percentages similar to those held in the original consortium. Airbus France thus responsible for flight deck, engine pylons, part of centre-fuselage, centre-section cabin doors, wing-to-body fairings and final assembly and outfitting at Toulouse; Airbus UK for wings and landing gear; Airbus Deutschland for most of fuselage, tailcone, fin, wing moving surfaces, cabin doors and interior; Airbus España for tailplane and forward starboard cabin doors; Belgian consortium Belairbus for leading-edge slats and slat tracks, Aircelle for engine nacelles. Japanese contributions from Bridgestone (tyres), Furukawa/Sky Aluminium (metal/plastics interfaces) and ShinMaywa (wing walkways). Airbus Deutschland (Bremen) developing lightweight spoiler for 2000 introduction. Before final assembly at Toulouse, Saint Nazaire (Airbus France) pre-assembles flight deck and three forward fuselage sections; and two (of three) rear fuselage sections.

LANDING GEAR: Main (four-wheel bogie) and twin-wheel nose units identical on all A330/340 versions. Main tyres size 54×21.0-23 or 46×17.0R20 or 1400×530R23 (32/36 ply); nose tyres 40.5×15.5-6 or 30×8.8R15 or 1050×395R16 (28 ply). A340-200/300 have additional twin-wheel auxiliary unit on fuselage centreline amidships, retracting rearward; A340-500 and -600 have four-wheel centre bogie, retracting forward. Goodyear tyres available on all units, Michelin and Bridgestone tyres also available for A340-500/600.

POWER PLANT: Four 138.8 kN (31,200 lb st) CFM56-5C2 turbofans initially, 144.6 kN (32,500 lb st) CFM56-5C3 and 151.2 kN (34,000 lb st) CFM56-5C4/P. CFM56 upgrade announced in July 2000, combining CFM56-5C with core of CFM56-5B/P. Rolls-Royce Trent 553-61 of 248 kN (55,780 lb st) in A340-500, Trent 556-61 of 260 kN (58,460 lb st) in A340-600.

A340-200/300: Maximum fuel capacity: (-200 and -300 until 1996) 138,600 litres (36,614 US gallons; 30,488 Imp gallons); (-200/300 1996-97) 140,640 litres (37,154 US gallons; 30,937 Imp gallons); (-200, 300, 1997 and subsequent deliveries) 141,500 litres (37,381 US gallons; 31,126 Imp gallons); (-200/300, 1997 and subsequent deliveries, including optional ACT) 148,700 litres (39,283 US gallons; 32,710 Imp gallons). Totals include 6,230 litres (1,646 US gallons, 1,370 Imp gallons) in tailplane trim tank.

A340-500: Capacity 214,405 litres (56,641 US gallons; 47,164 Imp gallons) total, including 771 litres (204 US gallons; 170 Imp gallons) unusable. Centre and wing group tanks as for A340-600; plus rear centre tank of 19,883 litres (5,2500 US gallons; 43,716 Imp gallons) and trim tank of 8,011 litres (2,116 US gallons, 1,762 Imp gallons.

A340-600: Capacity 194,897 litres (51,511 US gallons; 42,892 Imp gallons) total, including 761 litres (201 US gallons; 167 Imp gallons) unusable. Centre tank of 55,373 litres (14,732 US gallons; 12,181 Imp gallons); trim tank of 8,386 litres (2,215 US gallons; 1,845 Imp gallons) and six wing tanks: tanks 1/4 of 49,070 litres (12,963 US gallons, 10,794 Imp gallons), tanks 2/3 of 69,744 litres (18,425 US gallons; 15,342 Imp gallons) and outer tanks with combined 12,324 litres (3,256 US gallons; 2,711 Imp gallons).

ACCOMMODATION: Crew of two on flight deck (all versions); flight deck can be supplied with humidifier system. Passenger seating typically six-abreast in first class, six-abreast in business class and eight-abreast in economy (nine-abreast optional), all with twin aisles. A typical three-class layout seats 295 in A340-300, 239 in the A340-200, 313 in A340-500 and 380 in A340-600. Single-class seating capacities for A340-300/200/500/600 are 440, 420, 375 and 475 respectively. A340-300 is available with optional, removable, lower deck crew rest module, replacing pallet in rear cargo hold with a sleeper cabin for seven or eight cabin crew. Optional lower deck facilities in rear cargo hold of -600 include an area with stand-up headroom and lavatories plus up to eight crew rest bunks and galleys. A further facility is under study for -500 and -600 that could offer up to 10 full-length beds for passengers or a lower-deck lounge. A340-600 (except prototype) has two overwing Type III emergency exits in addition to standard eight Type A doors. Underfloor cargo holds house up to 32 LD3 containers or 11 standard 2.24 × 3.17 m (88 × 125 in) pallets in A340-300, 26 LD3s or nine pallets in A340-200, 30 LD3s or 10 pallets in A340-500, and 42 LD3s or 14 pallets in A340-600; front and rear cargo holds have doors wide enough to accept 2.44 × 3.17 m (96 × 125 in) pallets; all versions have a 19.7 m³ (695 cu ft) bulk cargo hold aft of the rear cargo hold.

SYSTEMS: Hamilton Sundstrand GTCP 331-350C APU.

AVIONICS: Airbus Future Air Navigation System (FANS-A), comprising SmithsIndustries digital control and display system married to Honeywell FMS, underwent testing end 1999 and was certified July 2000; can be retrofitted to all A330/A340s. Tenzing Communications in-flight e-mail/Internet access system was successfully tested on an A340-600 during flight testing with a full passenger load.

DIMENSIONS, EXTERNAL:

Wing span: A340-200/300	60.30 m (197 ft 10 in)
A340-500/600	63.45 m (208 ft 2 in)
Wing chord at root: A340-200/300	10.60 m (34 ft 9⅝ in)
A340-500/600	12.20 m (40 ft 0¼ in)
Wing aspect ratio: A340-200/300	10.1
A340-500/600	9.2
Length overall: A340-200	59.42 m (194 ft 11¼ in)
A340-300	63.68 m (208 ft 11 in)
A340-500	67.51 m (221 ft 6 in)
A340-600	74.96 m (245 ft 11 in)
Fuselage: Max diameter (all versions)	5.64 m (18 ft 6 in)
Height overall:	
A340-200/300	16.84 m (55 ft 3 in)
A340-500/600	17.75 m (58 ft 3 in)
Tailplane span: A340-300	19.41 m (63 ft 8 in)
A340-500/600	22.96 m (75 ft 4 in)
Wheel track (all versions)	10.69 m (34 ft 5 in)
Wheelbase: A340-200	23.47 m (77 ft 0 in)
A340-300	25.40 m (83 ft 4 in)
A340-500	27.58 m (90 ft 6 in)
A340-600	32.89 m (107 ft 11 in)

DIMENSIONS, INTERNAL:

Cabin:	
Length (excl flight deck):	
A340-200	46.08 m (151 ft 2 in)
A340-300	50.34 m (165 ft 2 in)
A340-500	53.54 m (175 ft 8 in)
A340-600	60.90 m (200 ft 1 in)
Max width	5.28 m (17 ft 4 in)
Max height	2.40 m (7 ft 10½ in)
Underfloor baggage/cargo holds:	
Max height	1.70 m (5 ft 7 in)
Width at floor	3.175 m (10 ft 5 in)
Volume: forward hold	
A340-300/-500 standard	69.1 m³ (2,442 cu ft)
A340-300/-500 option	80.5 m³ (2,844 cu ft)
A340-600 standard	92.2 m³ (3,256 cu ft)
A340-600 option	107.4 m³ (3,792 cu ft)
Volume: rear hold:	
A340-300 standard	55.6 m³ (1,965 cu ft)
A340-300 option	62.6 m³ (2,212 cu ft)
A340-500 standard	46.1 m³ (1,628 cu ft)
A340-500 option	53.7 m³ (1,896 cu ft)
A340-600 standard	69.1 m³ (2,442 cu ft)
A340-600 option	80.5 m³ (2,844 cu ft)

Volume: bulk hold (all versions) ..... 19.7 m^3 (695 cu ft)

AREAS:

Wings, gross:

A340-200/-300 ..... 361.60 m^2 (3,892.2 sq ft)

A340-500/-600 ..... 437.00 m^2 (4,703.8 sq ft)

WEIGHTS AND LOADINGS:

Operating weight empty:

A340-200 current ..... 129,500 kg (285,500 lb)

A340-300 basic ..... 129,300 kg (285,050 lb)

A340-300 option ..... 130,200 kg (287,050 lb)

A340-500 basic ..... 170,900 kg (376,770 lb)

A340-500 option ..... 174,800 kg (385,375 lb)

A340-600 basic ..... 177,800 kg (391,975 lb)

A340-600 option ..... 181,900 kg (401,025 lb)

Baggage capacity:

A340-200:

forward hold ..... 18,507 kg (40,801 lb)

rear hold ..... 15,241 kg (33,601 lb)

bulk hold ..... 3,468 kg (7,646 lb)

A340-300:

forward hold ..... 22,861 kg (50,400 lb)

rear hold ..... 18,507 kg (40,801 lb)

bulk hold ..... 3,468 kg (7,646 lb)

A340-500:

forward hold ..... 24,494 kg (54,000 lb)

rear hold ..... 16,330 kg (36,001 lb)

bulk hold ..... 3,458 kg (7,624 lb)

A340-600:

forward hold ..... 30,482 kg (67,201 lb)

rear hold ..... 22,861 kg (50,400 lb)

bulk hold ..... 3,468 kg (7,646 lb)

Max payload (maximum weight options):

A340-200: initial ..... 43,500 kg (95,900 lb)

A340-300 basic ..... 50,900 kg (112,215 lb)

A340-500 ..... 54,100 kg (119,270 lb)

A340-600 ..... 64,300 kg (141,755 lb)

Max T-O weight:

A340-200: basic ..... 253,500 kg (558,875 lb)

option ..... 257,000 kg (566,600 lb)

A340-300: basic ..... 275,000 kg (606,275 lb)

option ..... 276,500 kg (609,575 lb)

A340-500: basic ..... 368,000 kg (811,300 lb)

option 1 ..... 372,000 kg (820,125 lb)

option 2 ..... 380,000 kg (837,750 lb)

A340-600: basic ..... 365,000 kg (804,675 lb)

option 1 ..... 368,000 kg (811,300 lb)

option 2 ..... 380,000 kg (837,750 lb)

Max ramp weight:

A340-200: basic ..... 254,400 kg (560,850 lb)

option ..... 257,900 kg (568,575 lb)

A340-300: basic ..... 275,900 kg (608,250 lb)

option ..... 277,400 kg (611,550 lb)

A340-500: basic ..... 369,200 kg (813,950 lb)

option 1 ..... 373,200 kg (822,750 lb)

option 2 ..... 381,200 kg (840,400 lb)

A340-600: basic ..... 366,200 kg (807,325 lb)

option 1 ..... 369,200 kg (813,950 lb)

option 2 ..... 381,200 kg (840,400 lb)

Max landing weight:

A340-200 ..... 181,000 kg (399,025 lb)

A340-300 basic ..... 190,000 kg (418,875 lb)

A340-300 option ..... 192,000 kg (423,275 lb)

A340-500: basic ..... 240,000 kg (529,105 lb)

option 1 ..... 243,000 kg (535,725 lb)

option 2 ..... 246,000 kg (542,325 lb)

A340-600 basic ..... 256,000 kg (564,380 lb)

option 1 ..... 259,000 kg (570,995 lb)

option 2 ..... 265,000 kg (584,225 lb)

Max zero-fuel weight:

A340-200 ..... 169,000 kg (372,575 lb)

A340-300 basic ..... 178,000 kg (392,425 lb)

A340-300 option ..... 181,000 kg (399,025 lb)

A340-500: basic ..... 225,000 kg (496,050 lb)

option 1 ..... 230,000 kg (507,075 lb)

option 2 ..... 232,000 kg (511,475 lb)

A340-600: basic ..... 242,000 kg (533,525 lb)

option 1 ..... 245,000 kg (540,125 lb)

option 2 ..... 251,000 kg (553,350 lb)

Max wing loading:

A340-200: basic ..... 701.0 kg/m^2 (143.59 lb/sq ft)

option ..... 710.7 kg/m^2 (145.57 lb/sq ft)

A340-300: basic ..... 760.5 kg/m^2 (155.76 lb/sq ft)

option ..... 764.7 kg/m^2 (156 61 lb/sq ft)

A340-500: basic ..... 842 1 kg/m^2 (172.48 lb/sq ft)

option 1 ..... 851.3 kg/m^2 (174.35 lb/sq ft)

option 2 ..... 869.6 kg/m^2 (178.10 lb/sq ft)

A340-600: basic ..... 835.2 kg/m^2 (171.07 lb/sq ft)

option 1 ..... 842.1 kg/m^2 (172.48 lb/sq ft)

option 2 ..... 869.6 kg/m^2 (178.10 lb/sq ft)

PERFORMANCE:

Max operating Mach No. (MMO) 0.86

Max operating speed ..... 330 kt (611 km/h; 380 mph) IAS

Typical operating Mach No :

A340-200/300 ..... 0.82

A340-500/600 ..... 0.83

Stalling speed:

A340-300, at 267,000 kg (588,625 lb), wheels up:

flaps up ..... 161 kt (299 km/h; 186 mph)

flaps down ..... 133 kt (247 km/h; 153 mph)

Max certified altitude: all ..... 12,525 m (41,100 ft)

T-O field length at S/L, basic MTOW, ISA + 15°C:

A340-200 ..... 3,017 m (9,900 ft)

A340-300 ..... 3,125 m (10,250 ft)

A340-500 (estimated) ..... 3,125 m (10,250 ft)

A340-600 ..... 3,140 m (10,300 ft)

Range at typical OWE, international allowances and 200 n mile (370 km; 230 mile) diversion:

A340-200 with 239 passengers ..... 8,000 n miles (14,816 km; 9,206 miles)

A340-300 with 295 passengers:

basic ..... 7,200 n miles (13,334 km; 8,285 miles)

optional ..... 7,400 n miles (13,704 km; 8,515 miles)

A340-500 with 313 passengers ..... 8,650 n miles (16,019 km; 9,954 miles)

A340-600 with 380 passengers:

basic ..... 7,500 n miles (13,890 km; 8,630 miles)

OPERATIONAL NOISE LEVELS (at basic MTOW):

T-O, fly-over: A340-300 ..... 95.6 EPNdB

A340-600 ..... 93.5 EPNdB

Sideline: A340-300 ..... 96.1 EPNdB

A340-600 ..... 95.5 EPNdB

Approach: A340-300 ..... 96.9 EPNdB

A340-600 ..... 99.9 EPNdB

AIRBUS A330

TYPE: Wide-bodied airliner.

PROGRAMME:

DEVELOPMENT MILESTONES

A330-300	
Launched	5 Jun 87
First flight	2 Nov 92
Certification	21 Oct 93
First delivery (Air Inter)	30 Dec 93
Entered service (Air Inter)	17 Jan 94
Subsequent versions	
A330-200	
Launched	24 Nov 95
First flight	13 Aug 97
Public debut	16 Nov 97
Certification	31 Mar 98
First delivery (Canada 3000)	29 May 98

Twin-engined A330 was developed simultaneously with four-engined A340; launched 5 June 1987; first flight (F-WWKA) with GE engines 2 November 1992; first R-R Trent 700-powered A330 flew 31 January 1994; simultaneous European and US certification with initial GE CF6-80E1 engines received 21 October 1993; first delivery (Air Inter) December 1993, entered service January 1994; certification with PW4164/4168 obtained 2 June 1994; A330 powered by GE CF6-80E1 with FADEC granted 120-minute ETOPS approval May 1994; Aer Lingus flew first ETOPS services across the Atlantic in May 1994; A330 powered by PW4164/4168 granted 90-minute ETOPS approval November 1994; certification with R-R Trent achieved 22 December 1994; 90-minute ETOPS approval granted before first delivery, to Cathay Pacific Airways, 24 February 1995. Further extensions of ETOPS to 180 minutes granted on 6 February 1995 (GE engines), 4 August 1995 (P&W) and 17 June 1996 (R-R); 180-minute ETOPS for PW4168A-powered A330-300 granted July 1999; and for -200 and -300 with Trent 772Cs on 20 April 2006.

All main structural and systems information common to both A330 and A340 is listed in A340 entry. Differences in A330 given here.

CURRENT VERSIONS: **A330-300:** Baseline version; seating capacity 295 in three classes (12 first, 42 business, 241 economy) Payload increase of 7,000 kg (15,432 lb) offered for standard A330-300 in October 1993. Maximum T-O weight increased to 217,000 kg (478,400 lb) from November 1995 to allow typical 335 passengers to be carried 4,850 n miles (8,982 km; 5,581 miles), further increase to 230,000 kg (507,050 lb) with range increased to 5,600 n miles (10,370 km, 6,444 miles) offered in 1997; first aircraft to this standard ordered by Air Canada in 1997, but first in service was a Korean Air example in May 1999. Optional higher maximum T-O weight of 233,000 kg (513,675 lb) available from early 2001; earlier 230,000 kg (507,050 lb) versions can be retrofitted.

A330-200: Extended-range version; launched 24 November 1995; 10-frame reduction in fuselage length to 59.00 m (193 ft 6¾ in); maximum T-O weight 230,000 kg (507,050 lb); higher MTOW available from early 2001, as per A330-300. 253 passengers in three classes (12 first, 36 business, 205 economy) or 293 passengers in two classes; range with 253 passengers 6,650 n miles (12,315 km; 7,652 miles); engine choice as for A330-300; initial order, for 13, placed in March 1996 by ILFC. First flight (c/n 181, F-WWKA, with CF6-80E1 engines) 13 August 1997 was followed by public debut at Dubai Air Show in November 1997. Canada 3000 first user (on lease from ILFC) with first flight of production aircraft (C-GGWA) 20 January 1998 and delivery on 29 May 1998 following FAA/JAA/Transport Canada certification on 31 March 1998. First direct airline order from Korean Air, received second built in June 1998 (c/n 195, with PW4000 engines) following 4 December 1997 first flight and May 1998 certification. Version with Rolls-Royce Trents (re-engined first prototype) flew 24 June 1998 and following JAR and Transport Canada certification in January 1999 was delivered to Air Transat in February 1999. First with uprated CF6-80A1A3s delivered to Air France 17 December 2001.

AirTanker consortium bid for UK Future Strategic Tanker Aircraft (FSTA) contract offered A330-200 tankers, using new airframes converted by Cobham, which would enter service in 2007; selected as preferred platform January 2004.

A330-100: Proposed nine-frame reduction of A330-200; not built.

A330-200F: Proposed freighter version; possible DC-10/MD-11 replacement; planned launch at Paris Air Show in June 2001 was deferred to unspecified date; re-surfaced mid-2006, with formal launch then expected before year-end (though not announced by mid-November) and service entry forecast for fourth quarter 2009. Reported letter of intent for 30 from unidentified customer. Maximum payload 64,300 kg (141,755 lb) over 4,000 n miles (7,408 km; 4,603 miles). Capacity for 23 2.24 × 3.17 m (88 × 125 in) pallets or containers, or 22 size 2.44 × 3.17 m (96 × 125 in) on main deck; and a combination of up to eight such pallets and two LD3 containers on the lower deck. Max fuel capacity 139,090 litres (36,744 US gallons; 30,596 Imp gallons). OWE 108,700 kg (239,640 lb); MTOW 233,000 kg (513,675 lb); MLW 182,000 kg (401,240 lb); MZFW 173,000 kg (381,400 lb). Main deck cargo door same size as on A300-600F. Cross-crew qualification with A320/A340/A380 families. Estimated market for 200 aircraft over 10 years.

A330-500: Proposed eight-frame reduction of A330-200, announced July 2000 and initially internally designated A330-M18; suspended in favour of A380 programme.

A350: Originally an A330 derivative; *now described separately.*

Airbus A330-200 of Yemen Airways *(Yemenia)*

1158615

AIRBUS A330 MARKS AND VARIANTS

Series	Mark	Power Plant	FAA Certification
200	201	CF6-80E1A2	1 Apr 03
200	202	CF6-80E1A4	31 Mar 98
200	203	CF6-80E1A3	1 Nov 02
200	223	PW4168A	21 Jun 99
200	243	Trent 772B-60	21 Dec 00
300	301	CF6-80E1A2	21 Oct 93
300	321	PW4164	21 Jun 99
300	322	PW4168	21 Jun 99
300	323	PW4168A	8 Oct 99
300	341	Trent 768-60	21 Dec 00
300	342	Trent 772-60	21 Dec 00
300	343	Trent 772B-60	21 Dec 00

Series	Variant	MTOW (kg)
200	020	230,000
300	000	212,000
300	001	184,000
300	002	212,000
323/343 only	020	230,000
323 only	022	233,000
323 only	050	230,000
323 only	052	233,000

Notes: Variant parameters may include differences in data other than max T-O weight. Except as constrained by Series, Variants are applicable to several engine options.

CUSTOMERS: Total of 595 sold, of which 437 delivered, by 1 November 2006. See table.

AIRBUS A330 ORDERS
(at 1 November 2006)

Customer	Version	Qty
Aer Lingus	200,300	5
Air Algérie	200	5
Air Caledonie International	200	2
Air Canada	300	8
Air Caribes	300	1
Air China	200	20
Air France group	200	8
Air Inter Europe	300	4
Air Mauritius	200	2
Asiana Airlines	300	6
Austrian Airlines	200	3
British Midland Airways	200	1
Cathay Pacific Airways	300	26
China Airlines (Taiwan)	300	14
China Eastern Airlines	200, 300	20
China Southern Airlines	200, 300	14
CIT Leasing	200, 300	20
Corsair	200	2
Dragonair	300	5
Egyptair	200	7
Emirates	200	28
Etihad	200	12
EVA Air	200	3
Flightlease	200	9
Garuda Indonesia	300	9
GECAS	200	20
Gulf Air	200	6
ILFC	200, 300	95
Jet Airways	200	10
Kingfisher Airlines	200	5
KLM	200	6
Korean Air	200, 300	19
LTU	300	5
Lufthansa	300	15
Malaysia Airlines	300	10
Monarch Airlines	200	2
MyTravel Airways	200, 300	7
Northwest Airlines	200, 300	40
Philippine Airlines	300	8
Qantas	200, 300	16
Qatar Airways	200, 300	26
Royal Australian Air Force	200	5
Sabena	200	3
SAS	300	4
SriLankan Airlines	200	6
Swissair	200	4
TAM	200	5
TAP-Air Portugal	200	5
Thai Airways International	300	12
Turk Hava Yollari	200	5
US Airways	200, 300	19
Private customers	200	3
Total		**595**

Cyprus Airways A330-200 en route, against an inhospitable background

1158614

COSTS: A330-200 USD135.3 million; A330-300 USD150.6 million (2002).

FLYING CONTROLS: Control surface maximum deflections: ailerons ±25°; aileron droop 10°; elevator +15°/–30°; rudder ±30°; flaps 32°; No. 1 spoiler, speed brake 23°, lift dumper 35°; Nos. 2 to 6 spoilers, roll 35°, speed brake 30°, lift dumper 50°; slats 23°; stabilisers +2°/–14°.

POWER PLANT: Two turbofans. Initial application was 287 kN (64,530 lb st) GE CF6-80E1A2 turbofans (297 kN; 64,530 lb st E1A4 on longer-range version); alternative engines, using common pylon and mount, GE CF6-80E1A3 (each 305 kN; 68,530 lb st), P&W PW4168/A (305 kN; 68,600 lb st), R-R Trent 772-60/772B-60A (316 kN, 71,100 lb st), PW4164 (287 kN; 64,500 lb) and Trent 768-60 (300 kN; 67,500 lb st).

Fuel capacities: A330-200: Total 139,527 litres (36,860 US gallons; 30,693 Imp gallons), of which 437 litres (115.4 US gallons; 96.1 Imp gallons) unusable. Wing tanks total 91,648 litres (24,212 US gallons; 20,160 Imp gallons); centre tank 41,643 litres (11,001 US gallons; 9,160 Imp gallons); trim tank 6,236 litres (1,647 US gallons; 1,372 Imp gallons).

A330-301/321/322/341/342: Total 97,525 litres (25,764 US gallons; 21,453 Imp gallons), of which 354 litres (93.4 US gallons; 77.9 Imp gallons unusable. Wing tanks total 91,404 litres (24,147 US gallons; 20,107 Imp gallons); trim tank 6,121 litres (1,617 US gallons; 1,346 Imp gallons).

A330-323/343: Total 98,239 litres (25,952 US gallons; 21,610 Imp gallons), of which 354 litres (93.4 US gallons; 77.9 Imp gallons) unusable. Wing tanks total 92,112 litres (24,334 US gallons; 20,262 Imp gallons); trim tank 6,127 litres (1,619 US gallons; 1,348 Imp gallons).

ACCOMMODATION: A330-200 and -300 certified for 375 passengers, with three pairs of Type A and one pair of Type 1 emergency exits, or 379 passengers with four pairs of Type A exits.

DIMENSIONS, EXTERNAL: As A340-200/300 except:

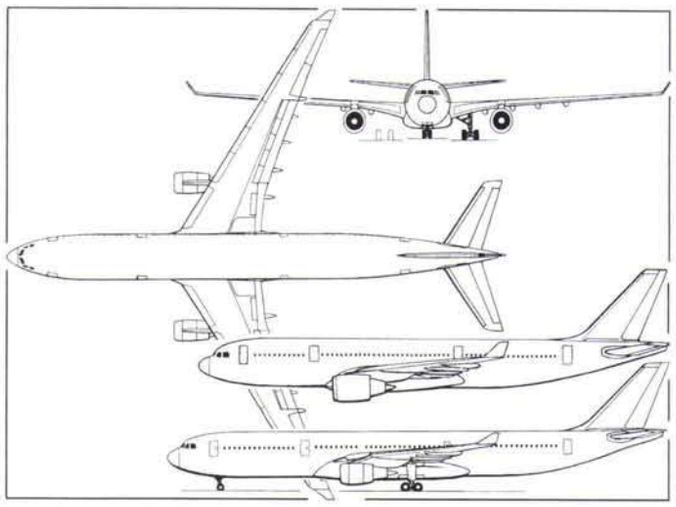
Length overall: A330-200	59.00 m (193 ft 7 in)
A330-300	63.58 m (208 ft 7 in)
Height overall: A330-200	17.88 m (58 ft 8 in)
A330-300	16.84 m (55 ft 3 in)

DIMENSIONS, INTERNAL: As A340-200/300 except:

Underfloor baggage/cargo holds:	
Volume: forward hold:	
A330-200 basic	55.0 m^3 (1,944 cu ft)
A330-200 option	62.6 m^3 (2,212 cu ft)
A330-300 basic	69.1 m^3 (2,442 cu ft)
A330-300 option	80.5 m^3 (2,844 cu ft)
Volume: rear hold:	
A330-200 basic	46.1 m^3 (1,628 cu ft)
A330-200 option	53.7 m^3 (1,896 cu ft)
A330-300 basic	55.6 m^3 (1,965 cu ft)
A330-300 option	62.6 m^3 (2,212 cu ft)
Volume: bulk hold (all versions)	19.7 m^3 (695 cu ft)

WEIGHTS AND LOADINGS (C: with CF6-80E1A3/A4, P: with PW4168A, T: with Trent 772B):

Operating weight empty, basic versions, three-class layout: C	120,500 kg (265,655 lb)
P	121,100 kg (266,980 lb)
T	120,600 kg (265,875 lb)
A330-300: C	124,500 kg (274,475 lb)
P	125,100 kg (275,800 lb)
T	124,600 kg (274,695 lb)
Baggage capacity:	
A330-200:	
forward hold	18,869 kg (41,599 lb)
rear hold	15,241 kg (33,601 lb)
bulk hold	3,468 kg (7,646 lb)
A330-300:	
forward hold	22,861 kg (50,400 lb)
rear hold	18,507 kg (40,800 lb)
bulk hold	3,468 kg (7,646 lb)
Max payload, basic versions: A330-200: C	47,500 kg (104,720 lb)
P	46,900 kg (103,395 lb)
T	47,400 kg (104,500 lb)
A330-300: C	48,500 kg (106,925 lb)
P	47,900 kg (105,600 lb)
T	48,400 kg (106,705 lb)
Max ramp weight:	
A330-200/-300: basic	230,900 kg (509,045 lb)
option	233,900 kg (515,660 lb)
Max T-O weight:	
A330-200/-300: basic	230,000 kg (507,060 lb)
option	233,000 kg (513,675 lb)
Max landing weight:	
A330-200 basic	180,000 kg (396,825 lb)
A330-200 option	182,000 kg (401,250 lb)
A330-300 basic	185,000 kg (407,855 lb)
A330-300 option	187,000 kg (412,265 lb)
Max zero-fuel weight:	
A330-200 basic	168,000 kg (370,375 lb)
A330-200 option	170,000 kg (374,775 lb)
A330-300 basic	173,000 kg (381,400 lb)
A330-300 option	175,000 kg (385,810 lb)
Max wing loading:	
A330-200/-300 basic	633.4 kg/m^2 (129.74 lb/sq ft)
A330-200/-300 option	644.4 kg/m^2 (131.97 lb/sq ft)



Airbus A330-300 twin-turbofan airliner, with additional side-view of A330-200
(James Goulding) 1158566

PERFORMANCE:

Max operating Mach No. (MMO)	0.86
Max operating speed	360 kt (666 km/h; 414 mph) IAS
Typical operating Mach No.	0.82
Max certified altitude	12,525 m (41,100 ft)
T-O field length at S/L, ISA + 15°C, Trent 772B engines:	
A330-200, basic MTOW	2,530 m (8,300 ft)
A330-200, option MTOW	2,652 m (8,700 ft)
A330-300, basic MTOW	2,515 m (8,250 ft)
A330-300, option MTOW	2,606 m (8,550 ft)
Landing field length at S/L, ISA + 15°C, Trent 772B engines:	
A330-200, option MLW	1,722 m (5,650 ft)
A330-200, option MLW	1,753 m (5,750 ft)
Range, typical OWE plus max passengers, international allowances and 200 n mile (370 km; 230 mile) diversion:	
A330-200 at option MTOW	6,650 n miles (12,315 km; 7,652 miles)
A330-300 at option MTOW	5,600 n miles (10,371 km; 6,444 miles)

OPERATIONAL NOISE LEVELS (A330-300. A: 217,000 kg (478,400 lb) with Trent 768; B: 230,000 kg (507,050 lb) with Trent 772):

T-O, flyover: A	89.8 EPNdB
B	98.0 EPNdB
Sideline: A	96.5 EPNdB
B	101.0 EPNdB
Approach: A	96.8 EPNdB
B	104.0 EPNdB

AIRBUS A350

Promotional designation: A350 XWB

TYPE: Wide-bodied airliner.

PROGRAMME: Earlier hints of project, as counter to longer-range variants of Boeing 787 Dreamliner, gained credence at Farnborough Air Show, July 2004; A350 designation confirmed two months later. Originally conceived as lighter-weight, longer-range A330 derivative, achievable by 'maximum effect with minimum change'. However, reappraisal in 2004-05 resulted in virtually new design having only some 10 per cent commonality with A330, while retaining almost identical external appearance. Go-ahead approved 10 December 2004. Original basic definition frozen in late April 2005, and go-ahead announced 6 October 2005, with service entry then targeted for mid-2010. However, major reappraisal took place during first half of 2006 as result of airline feedback, resulting in fresh presentation 17 July 2006 at Farnborough International Air Show, now of much-revamped design with title A350 XWB, indicating eXtra Wide Body, and three additional projected variants.

Following formal programme launch on 1 December 2006, revised programme for XWB now looking at design freeze in third quarter 2008; first flight mid-2011; service entry in mid-2012 for A350-900, with -800 following in about 1Q13 and -1000 in 1Q14.

CURRENT VERSIONS: **A350-800:** Up to 270 passengers in three-class configuration; 334 kN (75,000 lb st) class engines.

A350-900: Up to 314 passengers in three-class configuration; 387 kN (87,000 lb st) class engines.

A350-900F: Freighter version of -900.

A350-900R: Ultra-long-range version of -900.

By some airlines' standards, Dragonair's A330-300s may seem a little overdressed 1158616

Computer-generated impression of the revamped A350 XWB 1154692

A350-1000: Up to 350 seats in three-class configuration or 375 in all-economy class; 423 kN (95,000 lb st) class engines.

CUSTOMERS: Conditional orders for 140 of original A350 by October 2005 from Air Europa (10 -800s plus two on option; first to commit, in December 2004); US Airways (20); Qatar Airways (60 -800/900s); GECAS (10); Kingfisher (five -800s); TAM (eight -900s); Alafco (12 -800s plus six on option); CIT Group (five); plus 10 undisclosed.

Firm orders 100 (69 -800s and 31 -900s) for XWB by mid-November: see table. Additional commitments at that time for 122: Bangkok Airways (six), China Aviation Supplies (20), GECAS (10), Qatar Airways (60), Singapore Airlines (20) and Yemenia (six). Break-even estimated at approximately 450 sales.

AIRBUS A350 ORDERS
(at mid-November 2006)

Customer	Version	Qty
Air Europa	800	10
Alafco	800	12
CIT Leasing	800	5
Eurofly	800	3
Finnair	900	9
ILFC	800	8
	900	8
Kingfisher Airlines	800	5
TAM	900	10
TAP-Air Portugal	800	6
	900	4
US Airways	800	20
Total		**100**

DESIGN FEATURES: Major changes compared with original A350 design (see 2006-07 *Jane's All the World's Aircraft*) are: (1) a new cabin cross-section 0.305 m (12 in) wider than the A330, with parallel section from door 1 to door 4 and 51 cm (2 in) wider panoramic windows; (2) new wing with 3° more sweep, increasing econ cruising Mach number to 0.85; (3) new engines (see Current Versions) offering more thrust, a 2 per cent improvement in sfc and 5 per cent lower maintenance costs; and (4) new systems derived from the A380, 10 per cent lower airframe maintenance, and fly-by-wire pilot commonality with A320/340/380.

Wing sweepback increased to 33° at quarter-chord.

FLYING CONTROLS: Inboard wing slats replaced by A380-type 'droop nose' leading-edges.

STRUCTURE: Generally as for A330, but materials breakdown differs, with most of structure now made up of composites (45 per cent), Al-Li (17 per cent), steel, aluminium and titanium. CFRP used extensively in wings, keel, floor beams and rear pressure bulkhead; Al-Li in fuselage; titanium for engine pylons; 'Glare' fibre/metal laminate for parts of upper fuselage. Laser welding of some fuselage panels. Three-spar CFRP wings with metal ribs. Planned to outsource about 5 per cent of manufacture to China and 3 per cent to Russia.

LANDING GEAR: Generally similar to A330, but structural weight-saving obviates need for centre-fuselage bogies. Messier-Dowty main units.

POWER PLANT: Twin Rolls-Royce Trent XWB turbofans on all versions initially; General Electric GEnx alternative may be offered for -800 and -900 later. Fuel capacity 142,421 litres (36,750 US gallons; 30,601 Imp gallons).

ACCOMMODATION: Two pilots and eight cabin crew. Twin-aisle layout with typical seating capacity as listed under Current Versions, eight (2-4-2) or nine abreast (3-3-3) in economy and six abreast (2-2-2) in first/business class. Modular cabin, designed to be re-configurable overnight.

Underfloor capacity (-800) 26 LD3 containers or eight pallets and two LD3s; or (-900) 11 pallets or 34 LD3s; plus, in both cases, bulk cargo volume. Rest areas for flight crew below flight deck, for cabin crew above rear bulk hold area. Economy class seats 44.5 cm (17.5 in) wide for nine-abreast layout, or 49 cm (19.25 in) for eight abreast; improved headroom (1.63 m; 5 ft 4 in) at window seats; sidewall panels resculpted to increase cabin internal width.

SYSTEMS: Electrical power generation by engine bleed air. Cabin pressurised to 1,830 m (6,000 ft) or less equivalent altitude and humidity increased to 20 per cent to improve passenger comfort. Flow management system adapts cabin airflow to passenger load as further environmental improvement. Hydraulic system 207 bar (3,000 lb/sq in). Honeywell HGT 1500 provides 1,119 kW (1,500 shp) for air conditioning, engine starting and in-flight emergency power.

AVIONICS: Flight control architecture includes A380 onboard information system, HUD, vertical display, dual integrated standby instrument system (ISIS), onboard airport navigation system and 'brake to vacate' airport guidance system. Honeywell RDR-4000 weather radar.

Following details all provisional:

DIMENSIONS, EXTERNAL:
Wing span: 800, 900 ..... 61.09 m (200 ft 5 in)
Length overall: 800 ..... 59.00 m (193 ft 6¾ in)
900 ..... 64.87 m (212 ft 10 in)
Fuselage: Max width ..... 5.91 m (19 ft 4¾ in)
Height overall: 800 ..... 17.17 m (56 ft 4 in)
900 ..... 16.61 m (54 ft 6 in)

DIMENSIONS, INTERNAL:
Cabin:
Length: 800 ..... 45.57 m (149 ft 6 in)
900 ..... 51.94 m (170 ft 5 in)
Max width: 800, 900 ..... 5.36 m (17 ft 7 in)
Aisle width
first/business clas ..... 53.3 cm (21 in)
economy class ..... 46.4 cm (18¼ in)
Bulk hold volume: 800, 900 ..... 19.7 m^3 (695 cu ft)
Total volume (pallets + LD3s + bulk cargo):
800 ..... 114.7 m^3 (4,050 cu ft)
900 ..... 147.2 m^3 (5,200 cu ft)

AREAS:
Wings, gross (reference) ..... 362.0 m^2 (3,896.5 sq ft)

WEIGHTS AND LOADINGS:
Max T-O weight:
800 ..... 245,000 kg (540,125 lb)
900 ..... 265,000 kg (584,225 lb)
1000 ..... 290,000 kg (639,350 lb)
Max wing loading: 800 ..... 676.8 kg/m^2 (138.62 lb/sq ft)
900 ..... 732.0 kg/m^2 (149.93 lb/sq ft)
1000 ..... 801.1 kg/m^2 (164.08 lb/sq ft)

PERFORMANCE (estimated):
Max operating Mach number (MMO) 0.86
Long-range cruising speed M0.83
Econ cruising speed M0.85
Range with max passengers and typical international reserves, incl 200 n mile (370 km; 230 mile) diversion:
800 ..... 8,800 n miles (16,297 km; 10,126 miles)
900 ..... 7,500 n miles (13,890 km; 8,630 miles)

AIRBUS A380

TYPE: High-capacity airliner.

PROGRAMME:

DEVELOPMENT MILESTONES

Programme go-ahead	8 Dec 99
First orders (Emirates and Air France)	24 Jul 00
Launched	19 Dec 00
First metal cut	23 Jan 02
Rolled out	18 Jan 05
First flight	27 Apr 05
Certified	12 Dec 06

Engineering work began in early June 1994; known as A3XX until December 2000; separate A3XX directorate (Large Aircraft Division) formed within Airbus in March 1996; concept definition began April 1996; Airbus allocated approximately 40 per cent of programme to new partners. Full-size mockup of fuselage cross-section shown at Paris in 1997; completed, including partial concept interior, in 2000.

Airbus Industry Supervisory Board authorised programme go-ahead 8 December 1999; commercial launch authorised 23 June 2000; industrial launch and A380 designation confirmed 19 December 2000, on receipt of required 50th launch order. Test programme calls for 2,200 flying hours over 15 months. Trent 900 engine began flight testing in No. 2 position on A340-300 testbed (F-WWAI) 17 May 2004. Static testing at Toulouse began 25 May 2004; fatigue testing at Dresden from November 2005.

First metal and CFRP cut at Nantes (France) 23 January 2002; at Bremen (Germany) 14 March 2002; at Varel (Germany) April 2002; at Filton (UK) 23 August 2002; at Illescas (Spain) 14 February 2003. First metal cut for wing centre-section 'bathtub' by EADS Military Aircraft at Augsburg 18 February 2003; first Saab-built wing leading-edge components delivered 24 April 2003; new Airbus UK factory at Broughton opened 31 January 2003. Six main subassemblies for static test aircraft (front, centre and rear fuselage, tailcone, tail unit and wings) arrived in Toulouse by April 2004 for final assembly. Followed in May (wings, fuselage) and June 2004 (horizontal and vertical tail surfaces) by major subassemblies for first flying prototype, MSN (Manufacturer's Serial Number) 001, which was rolled out on 18 January 2005 and made its 3 hour 54 minute maiden flight on 27 April. First CFRP and metal for centre wing box of A380-800F cut at Nantes 12 April 2005.

Static test programme (airframe 5000) started January 2005 and was due for completion by end of 2006. Fatigue testing (airframe 5001) began at Dresden September 2005 and had reached 14,500 load cycles (of 47,500 planned) by July 2006; completion due in 2008.

First four prototypes (MSN001, 002, 004 and 007) had amassed 1,626 flight hours in 496 sorties by 13 July 2006, with fifth (009) flying before end of August; cumulative hours by five aircraft 2,358 (745 flights) by 3 November 2006. As of mid-June 2006, 15 A380s had been assembled (including the two static/fatigue test airframes) and parts manufacture for MSN36 had begun. Certification targets then remained at October 2006 for Rolls-Royce version and March 2007 for the Alliance-engined A380. However, problems with wiring installations, plus Airbus internal difficulties, had caused a six to seven month delay in delivery times, with only one aircraft (for Singapore Airlines) then expected by end 2006 and total for 2007 restricted to nine. Further delivery slippage revealed on 3 October 2006 with news that initial delivery (003 to Singapore Airlines) had been rescheduled to October 2007, with next 13 to follow in 2008, 25 in 2009 and 45 (including first A380-800F) in 2010. Joint EASA/FAA certification received 12 December 2006, despite other programme problems.

CURRENT VERSIONS (SPECIFIC): **MSN001 (F-WWOW):** First prototype, for airframe, systems and flight trials; R-R Trent 970 engines (311 kN; 70,000 lb st). Moved to final assembly 7 July 2004. First flight 27 April 2005; VMU (minimum unstick speed) trials at Istres AB July 2005. Total of 277 flights, 943 hours, completed by 13 July 2006.

MSN002 (F-WXXL): Third prototype (second to be built, third to fly); first flight 3 November 2005 and to Hamburg five days later to receive first fully equipped passenger cabin; total 24 flights (89 hours) by 13 July 2006; departed 4 September 2006 on first of four early long-range flight trials; remainder 13 to 30 November 2006; eventual delivery to Etihad; R-R engines.

MSN003 (F-WWSA): Fifth to be built and flown (maiden flight 7 May 2006). Initial customer aircraft for Singapore Airlines (9V-SKA); R-R engines. Delivery rescheduled for October 2007.

A380 prototype MSN004, appropriately liveried for the occasion, visits Singapore's Changi Airport *(Paul Jackson)* 1158590

MSN004 (F-WWDD): Second prototype (third to be built, second to fly): first flight 18 October 2005; airframe and systems trials, then eventual delivery to Etihad; R-R Trent 970 engines. Airport compatibility visits in October/November 2005 to Frankfurt, Singapore, Melbourne, Sydney and Kuala Lumpur, and on 18 May 2006 to London Heathrow. 'Hot and high' trials in Medellin, Colombia, 11 to 13 January 2006, and cold-weather trials at Iqaluit, Canada, 6 to 10 February 2006, displaying later in latter month at Asian Aerospace show in Singapore. Total of 193 flights (588 hours) by 13 July 2006.

MSN005 (F-WWSB): Seventh to be built; second for Singapore Airlines; R-R engines. First flight 19 July 2006.

MSN006 (F-WWSC): Eighth to be built; third for Singapore Airlines; R-R engines. First flight 17 November 2006.

MSN007 (F-WWSD): Fourth flying prototype (fourth to be built); first flight 19 February 2006. To production standard; second with fully equipped cabin. Evacuation test at Hamburg 26 March 2006 (873 people exiting in 78 seconds). Two flights (total six hours) by 13 July 2006. Route-proving flights in 2006, eventual delivery to Etihad. R-R engines initially, then GP7200s.

MSN008 (F-WWSE): Ninth aircraft; fourth for Singapore Airlines; R-R engines.

MSN009 (F-WWEA): Fifth prototype; first with (and used to test and certify) GP7270 engines. Maiden flight 25 August 2006. Total 31 flights (over 110 hours) by 31 October 2006, including high-altitude tests of Addis Ababa and hot-weather trials in Abu Dhabi; cold-weather tests at Iqaluit scheduled for January 2007, then route-proving flights for Emirates and Air France.

CURRENT VERSIONS (GENERAL): **A380-700:** Potential short-fuselage version, more closely aligned to Boeing 747 replacement market. Not yet launched.

A380-800: Baseline launch version; nominal 555 passengers in three-class layout and range of over 8,000 n miles (14,816 km; 9,206 miles). Initial subvariants A380-841 with Trent 970 engines; A380-861 with GP7270 engines.

Following description applies to A380-800 except where indicated.

A380-800F: All-cargo version, carrying 150,000 kg (330,700 lb) of payload over 5,600 n miles (10,371 km; 6,444 miles). Initial subvariants A380-843F with Trent 977 engines; A380-863F with GP7277 engines. Some composites replaced by aluminium-lithium (Al-Li).

A380-900: Potential stretched version, initially known as A3XX-200; 12 frames longer; 656 seats in three-class layout and up to 990 at high density. Increased MTOW and fuel volume. Not yet launched.

A380 MRTB: Projected military version (multirole transport/bomber); *described separately*.

CUSTOMERS: Total of 166 orders and commitments by 31 December 2006 (see table). Potential market for 1,200 and over 300 cargo aircraft in A380 class up to 2020. Initial customers, on 24 July 2000, were Air France (10, plus four options); and Emirates, which committed to five A380s and two A380-800Fs, plus five options, subsequently increased to 20 passenger examples plus 10 options and 2 freighters in November 2001; further 21 of passenger version ordered 16 June 2003 and options subsequently cancelled. First recipient Singapore Airlines to receive aircraft 010 and 012, followed by Emirates with 011 and 013 and Qantas with 014. Federal Express became A380-800F launch customer in January 2001, confirming order 18 months later, but order switched to Boeing 777 in November 2006.

COSTS: Estimated development cost USD10.7 billion for whole A380 family given during June 2001, of which USD3.1 billion was sought from risk-sharing partners. Projected unit cost at launch was USD217 million for passenger version and USD233 million for freighter; revised to average unit price for A380-800 of USD265 million by mid-2002.

DESIGN FEATURES: Conventional in external appearance except for two rows of windows, but incorporates new developments in structures, materials, systems, landing gear design and aerodynamics. Dassault CATIA and IBM computer-aided design. Flight deck commonality with in-service Airbuses permits crew cross-qualification.

Fuselage is vertically orientated oval three-deck arrangement; this 'vertical ovoid' accommodates 10 passengers abreast on main deck and eight-abreast on upper deck, offering greater space per passenger than Boeing 747. Seating ranges from a nominal 555 (22 first class and 334 economy on main deck and 96 business and 103 economy on upper deck) in three-class layout to 840 in high-density, shorter-range applications. Typical launch customer layouts vary from 480 to about 550 passengers. Dual-lane boarding stair allows four-aisle boarding and deplaning through main deck.

Lower deck can accommodate shop, bar, restaurant and/or normal range of 38 LD3 cargo containers or 13 pallets and 18.4 m^3 (650 cu ft) of bulk freight; main deck is large enough to accommodate two 2.44 × 2.44 m (8 ft 0 in × 8 ft 0 in) containers side by side in the freighter version.

Modifications to engines, nacelles and aerodynamics at customer request late in the launch phase have resulted in major reductions in noise levels.

Wing sweep at 25 per cent chord 35° 44' inboard, 34° 28' outboard; dihedral 5° 36'. Vertical tail sweptback 40° at 25 per cent chord.

FLYING CONTROLS: Three-section, single-slotted flaps incorporate droop-nose device to improve climb performance. Three-section ailerons and two actuators on each wing, plus eight spoilers with individual actuators. Leading-edge slats in two sections inboard of engines; three between engines; and three outboard, each side. Elevators have two panels and actuators on each side; rudder also has two panels and actuators. Flaps, ailerons and engines have all been specifically positioned to keep wake vortex at a minimum. Tailplane incidence trimmable +2/–10°. Elevator travel +20/–30°, rudders ±30°.

STRUCTURE: Extensive use of CFRP for all flaps and spoilers, rear pressure bulkhead, centre wing box (first in CFRP on any Airbus), all tail surfaces, tailcone aft of fin leading-edge intersection with fuselage, and engine cowlings; equates to 22 per cent of aircraft. Further 3 per cent is of new 'Glare' material, consisting of alternate layers of aluminium and glass fibre-reinforced adhesive which offers significant weight reduction and fatigue/damage resistance, developed by Stork Aerospace with Technical University of Delft and Netherlands National Aerospace Laboratories; tested on a German Air Force A310 from October 1999 and used on upper fuselage shell. Laser beam welding, which reduces cost and weight, used to attach stringers to lower fuselage panels. Wing leading-edge constructed of thermoplastics. Outer wings metal bonded.

Upper deck floor beams on A380-800 constructed of CFRP; those in A380-800F aluminium-lithium; throughout the structure, lighter 2524 aluminium alloys used in place of more traditional 2024.

Work allocation of major subassemblies is Airbus France (St Nazaire): flight deck and centre fuselage; Airbus Deutschland (Hamburg): forward centre fuselage, rear fuselage; Airbus Deutschland (Stade): fin and rudder; Airbus UK (Broughton): wing main panels; Airbus España: wing/fuselage fairings, belly fairing and fixed horizontal tail; Airbus France (Toulouse): engine pylons and final assembly. For more detailed breakdown, see table.

Transport of major components undertaken by purpose-built Chinese-built Ro-Ro ship (MV *Ville de Bordeaux*) from Hamburg via UK and St Nazaire (forward centre fuselage disembarked, joined to flight deck and re-embarked, accompanied by centre fuselage), the aircraft set is then transferred to barge at Bordeaux and joined by Spanish-built elements for river transport to within 80 km (50 miles) of Toulouse, completing journey by road. New 228 × 120 × 23 m (748 × 394 × 75.5 ft) component assembly hall at Airbus Deutschland's Hamburg site started 6 December 2001 and inaugurated 21 May 2003; Airbus France's 490

AIRBUS A380 ORDERS AND COMMITMENTS
(at mid-November 2006)

Airline	Passenger	Freighter	Options	Engines	Order confirmed
Air France group	10	—	—	GP7200	18 Jun 01
China Southern Airlines	5	—	—	Trent 900	28 Jan 05
Emirates	43	—	—	GP7200	4 Nov 01
Etihad Airways	4	—	—	TBD	1 Dec 04
ILFC	10	—	—	GP7200	17 Jun 01
Kingfisher Airlines	5	—	—	TBD	15 Jun 05
Korean Air	5	—	—	GP7200	23 Oct 03
Lufthansa	15	—	—	Trent 900	20 Dec 01
Penerbangan Malaysia	6	—	—	Trent 900	11 Dec 03
Qantas Airways	12	—	8	Trent 900	6 Mar 01
Qatar Airways	2	—	—	TBD	9 Dec 03
Singapore Airlines	10	—	9	Trent 900	16 Jul 01
Thai Airways International	6	—	—	TBD	awaited
United Parcel Service	—	10	—	GP7200	10 Jan 05
Virgin Atlantic Airways	6	—	—	Trent 900	25 Apr 01
Total	**139**	**10**	**17**		

× 250× 46 m (1,608 × 820 × 151 ft) final assembly hall at Toulouse inaugurated 7 May 2004.

Once completed, 'green' aircraft flown to Hamburg for internal fitting out. European and Middle Eastern aircraft delivered from Hamburg; those for rest of world return to Toulouse before despatch to customer.

LANDING GEAR: Goodrich main landing gear; each four-wheel wing-mounted unit weighs 2,310 kg (5,093 lb) and each six-wheel underfuselage unit weighs 4,080 kg (8,995 lb). Messier-Dowty twin-wheel nose landing gear. Michelin AIR X NZG tyres: 1400×530 R 23 (40 ply) on A380-800 main units, pressure 15 bar (218 lb/sq in); 1270×455 R 22 (32 ply) on nose unit, pressure 14.1 bar (205 lb/sq in); corresponding sizes for -800F are 56×22.0 R 24 (40 ply) and 1400×530 R 23 (40 ply). Bridgestone (Japan) is alternative tyre supplier. Underfuselage main gear set slightly aft of underwing units. Normal steering on nose gear and rear axle of body gear; back-up steering of nose gear in event of hydraulic power loss. Carbon brakes on all main group wheels. Manoeuvring compatible with 45 m (148 ft) wide runways and 23 m (75.5 ft) wide taxiways; U-turn possible on 60 m (200 ft) wide runways, by differential braking or asymmetrical thrust; turn radius about nosewheel with 70° steering lock is 32.6 m (107 ft), about wingtip 53.8 m (177 ft); about outboard main landing gear (min taxiway width) 50.9 m (167 ft).

POWER PLANT: A380-800 is currently offered with a choice of 311 kN (70,000 lb st) Alliance (GE/P&W) GP7270 or Rolls-Royce Trent 970 turbofans; A380-800F with 340 kN (76,500 lb st) GP7277 or Trent 977. Thrust reversers on inboard engines only. Airbus Industrie and Rolls Royce signed an MoU specifying the Trent as favoured power plant in November 1996; certified in December 2005. Trent 970 initially certified at 311 kN (70,000 lb st) but derated to 302 kN (68,000 lb st), with eventual growth to 374 kN (84,000 lb st). FADEC for GP7270 under development by BAE Systems Controls and Hispano-Suiza.

Alliance GP7200 series uses same core as power plants for Boeing 747X and long-range 767. Detailed design work was due to have started in August 2001 but slipped to early 2003, with a first run achieved in March 2004, certified at 363 kN (81,500 lb st) in December 2005; first flight, in MSN009, 25 August 2006.

Standard nominal fuel capacity of both versions is 310,000 litres (81,893 US gallons; 68,192 Imp gallons); increasable to 355,850 litres (94,007 US gallons; 78,278 Imp gallons) with optional extra fuel tanks in wing centre box for longer-range A380-800F. Pressure refuelling points below wing leading edges, each side, between engines.

ACCOMMODATION: Flight deck crew of two, located at mezzanine level between main and upper deck, with access via main deck; rest areas are provided for crew below flight deck area. Upper deck typically carrying 96 business class and 103 tourist class passengers with eight attendants on folding seats, eight galleys, seven lavatories and five crew rest bunks. Lower deck with 22 first class and 234 tourist class passengers, 12 attendants, nine galleys and 10 lavatories. Potable water capacity 1,700 litres (449 US gallons; 374 Imp gallons) normal; 2,266 litres (598 US gallons; 498 Imp gallons) optional; waste water capacity 2,100 litres (555 US gallons; 462 Imp gallons. Underfloor capacity 38 LD3 containers or 13 pallets (seven forward and six aft of centre wing box).

Five main deck and three upper deck cabin doors/Type A emergency exits on each side of fuselage; Goodrich evacuation slides, those for upper decks stored within the airframe rather than the door. Seat pitches: first class 173 cm (68 in), business class 122 cm (48 in), economy class 81 or 84 cm (32 or 33 in). Airbus 'Prestige' interior (see description of A319 for details) planned as VIP transport option.

A380F has crew doors both sides to flight deck; 12-seat crew rest and courier transit area on upper deck, with emergency exits each side; and rear door, main deck, aft of cargo door, port. Container/pallet capacity is 17 to 25 size 3.17 × 2.44 × 2.08 m (125 × 96 × 82 in) on upper deck, 29 to 33 size 3.17 × 2.44 × 2.44 m (125 × 96 × 96 in) on main deck, and 13 size 3.17 × 2.44 × 1.63 m (125 × 96 × 64 in), or 38 LD3s, on lower deck.

SYSTEMS: Integrated modular avionics (IMA) system provided by Thales Avionics in conjunction with Diehl Avionik Systeme using computing modules slotted into cabinets throughout aircraft. Rockwell Collins supplying Ethernet avionics communications infrastructure at 100 Mbit/s speed with full duplex networking. Variable frequency AC electrical generating systems to be incorporated. Cameras fitted to top of fin and under fuselage for taxying assistance. Fuel management systems provided by Parker Aerospace including in-tank sensors and wiring, avionics and software to fit into IMA system.

Eaton 345 bar (5,000 lb/sq in) hydraulic system using eight engine-driven pumps and four electric pumps. Two hydraulic networks (yellow and green) and two electrical networks (red and orange) for flight controls, each of the latter using at least two different systems in case of failure of any one, each system fully independent; thus aircraft fully controllable via either hydraulic or electrical power to control surfaces, enhancing safety. Hydraulic system uses lighter, more compact pipework compared with earlier Airbus products. Wing-mounted landing gear powered by green system; underfuselage main gear runs on yellow system. Power generation systems with 180 kVA variable frequency generators for each engine provided by Hamilton Sundstrand. P&WC PW980A 1,342 kW (1,800 shp) APU.

Onboard oxygen generator (OBOGS) optional.

Computer-aided impression of A380F freighter in UPS livery 1158640

A380 MAJOR INTERNAL SYSTEMS SUPPLIERS

System	Supplier
Air conditioning	Hamilton Sundstrand/L'hotellier
Air data	Goodrich
APU	Pratt & Whitney Canada
Brake-by-wire	Messier-Bugatti
Cargo loading system	Goodrich
Electrical harnesses	Labinal
Electrical power distribution	ECE/Intertechnique
Electrical power generation	Aerolec (Thales Avionics/Goodrich)
Environmental control	Nord-Micro
Evacuation	Goodrich/Diehl Avionik
Fire detection	Siemens-Cerberus/Meggitt
Flight deck displays	Thales Avionics/Diehl Avionik
Flight management	Honeywell
Fuel distribution	FR HiTEMP/Intertechique
Fuel quantity and management	Parker Aerospace
Hydraulic	Eaton Corporation
Ice detection	Goodrich
Oxygen	Dräger/AirLiquide
Pneumatic	Honeywell
Primary flight controls	Goodrich (ailerons, elevators and rudder); Liebherr (spoilers)
Ram-air turbine (emergency electrical power generation)	Hamilton Sundstrand
Supplementary cooling	Fairchild Controls/Microtecnica
Water and waste management	Monogram Systems

AVIONICS: Honeywell flight management system, with Thales/Diehl displays; Rockwell Collins com/nav standard (includes VHF-920 and HF-900 data radios, multimode receiver, VOR-900 omnirange/marker beacon receiver, DME-900 and ADF-900). Elta ADT 406 ELT. Honeywell RDR-4000 colour weather radar. Dual Thales HUDs optional. Larger, more interactive displays and extended integrated modular avionics corrected by ethernet datalink. Cockpit layout, by Airbus Toulouse division, compatible with other Airbus family members.

Eight new-generation 15 × 20 cm (6 × 8 in) LCDs form centre of package. Pilots can modify objects such as performance and navigation objects inside the screens using a cursor. The cursor is controlled by a new addition to the cockpit – a fixed, wireless, trackball integrated into the pedestal. Cursor control has been made possible by moving away from an 'MS-DOS-like' systems environment to a modern user-friendly 'Windows-like' system in the A380, using a cursor to control and command.

New features specific to the displays include a split-screen feature on the navigation screen. In addition to the conventional horizontal graphic display there is an additional vertical view, from which pilots can see a cut along the trajectory of the aircraft containing all data relevant to the vertical trajectory, such as safety altitudes, terrain, weather or vertical flight plan.

A380 second prototype MSN004 wearing the livery of second customer Emirates during its airport compatibility tour in late 2005 1158639

A380 MAJOR AIRFRAME INDUSTRIAL PARTNERS

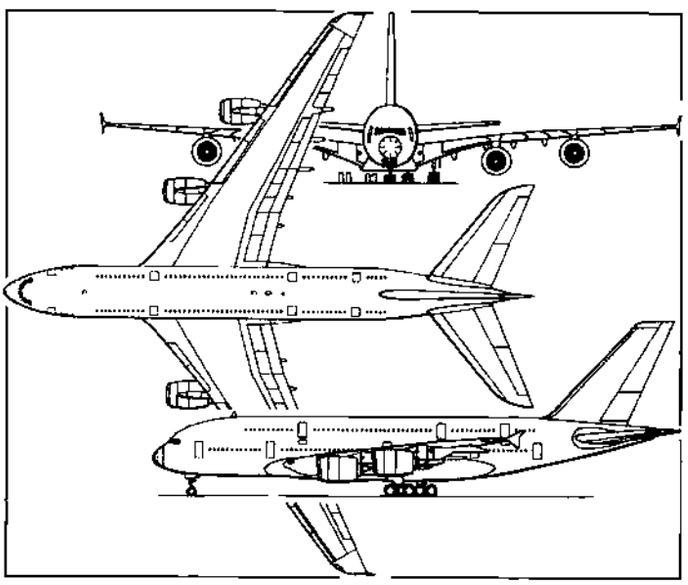
Country	Company	Item
Australia	Hawker de Havilland	Wingtip fences
Austria	Fischer Advanced Composites	Flap track fairings; CFRP window frames; other components
Belgium	Belairbus[1]	Wing slat tracks and droop noses
	Sabca[1]	Centre rear lower fuselage shell
Finland	Patria Finavicom[1]	Composites wing spoilers
France	EADS Socata[1]	Nose lower structure; nosewheel doors
	EADS Sogerma Services[1]	Centre rear main deck floor; flight deck seats
	Hurel-Hispano	Engine nacelles and thrust reversers
	Latécoère[1]	Upper deck passenger doors; lower nose section
	Mecachrome	Wing spars; upper and lower floor assemblies
	Messier-Dowty	Nose landing gear
	Michelin	Tyres
Germany	EADS Military Aircraft[1]	Wing inner inboard fixed leading-edges
	Eurocopter Deutschland[1]	Passenger and cargo doors
Italy	Alenia Aeronautica[1]	Centre upper and forward lower fuselage
Japan	Bridgestone	Tyres
	Fuji[1]	Vertical tail composites assemblies
	JAMCO	Upper floor deck crossbeams; vertical tail reinforcements
	Mitsubishi	Front and rear lower cargo doors
	Nippi[1]	Tailplane tips
	ShinMaywa	Wing root end fillet fairings
Korea, South	KAI	Wing bottom panels
Malaysia	CTRM[1]	Wing fixed leading-edge lower panels and inboard outer fixed leading-edges
Netherlands	Stork Aerospace[1]	Thermoplastic wing leading-edge 'J-noses'; selected forward and aft fuselage panels
Spain	Aries	Elevator and rudder components
	Gamesa[1]	Rear fuselage metal structures
	MASA	Tailplane leading/trailing-edges and ribs; wing ribs
	Sacesa	Belly fairing panels
Sweden	Saab Aerostructures[1]	Wing fixed leading-edge outboard of inner engine nacelles
Switzerland	RUAG Aerospace[1]	D-nose skins for wing inner fixed leading-edge and outer fixed trailing-edge
UK	BAE Systems Aerostructures[1]	Wing inboard outer fixed leading-edges
	Dunlop Aerospace	Nosewheels and brakes
	GKN Aerospace Services[1]	Wing fixed trailing-edge composites secondary structures; flap track beams
USA	Goodrich	Main landing gear
	Honeywell	Mainwheels and brakes
	Ralee Engineering	Wing top skin stringers

[1] Risk-sharing partner

Onboard information system (OIS) offers flight crews easy access to non-avionics-related information and applications. This includes access to flight manuals, maintenance tools, cabin log books, passenger lists and more. As the system uses web technology, information can be passed in real time from ground to air and vice-versa. The OIS also provides passengers with web-browsing facilities. Flight crew access the OIS from display units, integrated at either side of the instrument panel, using a keyboard installed in the folding table. Onboard maintenance system (OMS) provides real-time information to ground crew. Honeywell terrain guidance and on-ground navigation integrated into FMS.

DIMENSIONS, EXTERNAL:

Wing span ... 79.80 m (261 ft 9¾ in)
Wing chord: at root ... 17.70 m (58 ft 0¾ in)
mean aerodynamic ... 12.30 m (40 ft 4¼ in)
Wing aspect ratio ... 7.5
Length: overall ... 73.00 m (239 ft 6 in)
fuselage ... 70.40 m (230 ft 11¾ in)
Fuselage: Max width ... 7.14 m (23 ft 5 in)
Max height ... 8.41 m (27 ft 7 in)
Height overall ... 24.10 m (79 ft 0¾ in)
Fin chord: at root ... 12.05 m (39 ft 6½ in)
at tip ... 4.70 m (15 ft 5 in)
Tailplane span ... 30.37 m (99 ft 7¾ in)
Wheel track, max (wing gear outer rims) ... 14.335 m (47 ft 0¼ in)
Wheel track (c/l shock-absorbers): wing gear ... 12.455 m (40 ft 10¼ in)
fuselage gear ... 5.265 m (17 ft 3¼ in)
Wheelbase (c/l shock-absorbers): wing gear ... 33.58 m (110 ft 2 in)
fuselage gear ... 36.855 m (120 ft 11 in)
Distance between engine centres:
inboard ... 29.60 m (97 ft 1¼ in)
outboard ... 51.40 m (168 ft 7½ in)
Passenger doors (16, each): Height ... 1.93 m (6 ft 4 in)
Width ... 1.07 m (3 ft 6¼ in)
Height to sill: upper forward ... 7.85 m (25 ft 9 in)
upper centre ... 7.90 m (25 ft 11 in)
upper rear ... 7.92 m (25 ft 11¾ in)
main front ... 5.07 m (16 ft 7½ in)
main No. 2 ... 5.09 m (16 ft 8½ in)
main No. 3 (emergency) ... 5.13 m (16 ft 10 in)
main No. 4 ... 5.16 m (16 ft 11¼ in)
main No. 5 ... 5.18 m (17 ft 0 in)
Upper deck cargo door (A380-800F, port):
Max width ... 3.68 m (12 ft 1 in)
Max height ... 2.23 m (7 ft 3¾ in)
Height to sill ... 7.93 m (26 ft 0¼ in)
Main deck cargo door (A380-800F, port):
Max width ... 4.27 m (14 ft 0 in)
Max height ... 2.61 m (8 ft 6¾ in)
Height to sill ... 5.15 m (16 ft 10¾ in)
Forward cargo hold door (stbd):
Max width ... 2.79 m (9 ft 1¾ in)
Max height ... 1.80 m (5 ft 10¾ in)
Height to sill: A380 ... 3.02 m (9 ft 11 in)
A380F ... 3.05 m (10 ft 0 in)
Rear cargo hold door (stbd):
Max width ... 3.10 m (10 ft 2 in)



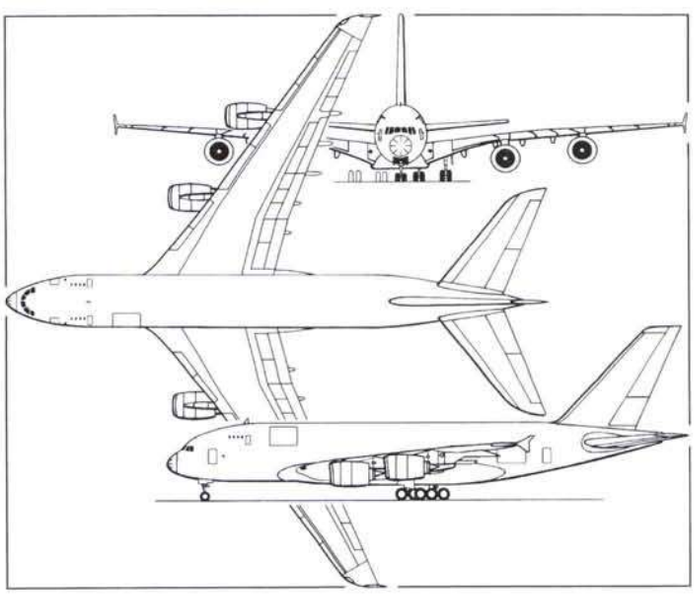
Airbus A380-800 555-seat airliner *(James Goulding)* 1158567

Max height ... 1.80 m (5 ft 10¾ in)
Height to sill: A380 ... 3.12 m (10 ft 2¾ in)
A380F ... 3.14 m (10 ft 3½ in)
Bulk cargo door (stbd):
Max width ... 1.13 m (3 ft 8½ in)
Max height ... 0.90 m (2 ft 11½ in)
Crew door (A380F): as A380 passenger
Height to sill ... 5.03 m (16 ft 6 in)
Crew rest emergency exit (A380F):
Height to sill ... 7.80 m (25 ft 7 in)
Clearance beneath engines at max ramp weight:
inboard ... 1.03 m (3 ft 4½ in)
outboard ... 1.88 m (6 ft 2 in)
Pilot's eye above ground level ... 7.09 m (23 ft 3¼ in)

DIMENSIONS, INTERNAL:

Cabin, A380-800: Length ... 50.68 m (166 ft 3¼ in)
Max width: main deck ... 6.58 m (21 ft 7 in)
upper deck ... 5.92 m (19 ft 5 in)
Width at floor: main deck ... 6.20 m (20 ft 4 in)
upper deck ... 5.33 m (17 ft 6 in)
Cargo volume, usable (container/pallet):
lower deck: forward ... 90.0 m³ (3,178 cu ft)
aft ... 72.0 m³ (2,543 cu ft)

Airbus A330 simulating its aerial tanker counterpart with assistance from two Panavia Tornados *(Paul Jackson)* 1042954



Airbus A380F freighter *(James Goulding)* 1158568

bulk: A380-800 ..... 14.3 m³ (505 cu ft)
A380-800F ..... 18.4 m³ (650 cu ft)
main deck (A380-800F) ..... 508.0 m³ (17,940 cu ft)
upper deck (A380-800F) ..... 250.0 m³ (8,829 cu ft)
Total volume (containers + bulk):
A380-800 ..... 171.0 m³ (6,039 cu ft)
A380-800F ..... up to 1,134 m³ (40,047 cu ft)

AREAS:
Wings, gross ..... 845.0 m² (9,095.5 sq ft)
Fin ..... 122.3 m² (1,316.4 sq ft)

WEIGHTS AND LOADINGS:
Typical operating weight empty:
A380-841 ..... 270,015 kg (595,275 lb)
A380-861 ..... 270,281 kg (595,875 lb)
A380-843F ..... 250,560 kg (552,400 lb)
A380-863F ..... 250,826 kg (552,975 lb)
Max payload: A380-841 ..... 90,985 kg (200,575 lb)
A380-861 ..... 90,720 kg (200,000 lb)
A380-843F ..... 151,440 kg (333,875 lb)
A380-863F ..... 151,175 kg (333,275 lb)
Max fuel weight: standard ..... 247,502 kg (545,650 lb)
optional ..... 284,108 kg (626,350 lb)
Max T-O weight: A380-800 ..... 560,000 kg (1,234,575 lb)
A380-800F, basic ..... 590,000 kg (1,300,725 lb)
A380-800F, optional ..... 600,000 kg (1,322,775 lb)
Max ramp weight: A380-800 ..... 562,000 kg (1,239,000 lb)
A380-800F, basic ..... 592,000 kg (1,305,150 lb)
Max landing weight:
A380-800, basic ..... 386,000 kg (850,975 lb)
A380-800F ..... 427,000 kg (941,375 lb)
Max zero-fuel weight:
A380-800 ..... 361,000 kg (795,875 lb)
A380-800F, basic ..... 402,000 kg (886,250 lb)
A380-800F, optional ..... 379,000 kg (835,550 lb)
Max wing loading:
A380-800 ..... 662.7 kg/m² (135.74 lb/sq ft)
A380-800F ..... 698.2 kg/m² (143.01 lb/sq ft)
Max power loading:
A380-800 ..... 463 kg/kN (4.54 lb/lb st)
A380-800F ..... 433 kg/kN (4.25 lb/lb st)

PERFORMANCE (estimated, GP7200 series engines except where indicated):
Max operating speed ..... M0.89 (340 kt; 630 km/h; 391 mph)
Econ cruising Mach No. 0.82
Approach speed ..... 141 kt (261 km/h; 162 mph)
Initial cruising altitude ..... 10,670 m (35,000 ft)
Service ceiling ..... 13,100 m (42,980 ft)
T-O field length, ISA + 15°C:
A380-800, Trent 970 ..... 2,987 m (9,800 ft)
A380-800, GP7270 ..... 3,030 m (9,940 ft)
A380-800F ..... 3,009 m (9,870 ft)
Landing field length at MLW, ISA + 15°C:
A380-800 ..... 2,103 m (6,900 ft)
Runway ACN ..... approx 68
Time from brake release to FL330:
A380-800, Trent 970 ..... 23 min
A380-800, GP7270 ..... 25 min
A380-800F, Trent 977 ..... 26 min
A380-800F, GP7277 ..... 28 min
Range:
A380-800 with 555 passengers ..... 8,000 n miles (14,816 km; 9,206 miles)
A380-800F: basic, with 150 t payload ..... 5,600 n miles (10,371 km; 6,444 miles)
extended range mode, with 127 t payload ... 6,900 n miles (12,778 km; 7,940 miles)

OPERATIONAL NOISE LEVELS: Designed to have a 12 EPNdB cumulative margin to ICAO Stage 4 noise limits; also complies with London airports' 'Quota Count 2' category for departures (3 dB quieter than, or half the noise energy level of, most in-service Boeing 747s)

AIRBUS MULTIROLE TANKER-TRANSPORT (MRTT)

TYPE: Tanker-transport.

PROGRAMME: Belgian, Canadian, French, German and Thai air forces already operate A310s variously fitted for VIP, troop and/or freight transport. Airbus has delegated development and marketing of flight refuelling versions to its major partners, using either pre-owned or new aircraft. Demonstrator MRTT produced by conversion of former airline A310-324 N816PA; undertook compatibility trials with RAF aircraft, July 1995. Marketing efforts originally centred on the A310 version, which was offered for the RAF's FSTA (future strategic tanker aircraft) requirement, only to be replaced by fresh proposal based on A330.

Four Luftwaffe A310-300s being converted into dual-point MRTTs, first of which (1027) flew 20 December 2003. Canada is having two CC-150 Polaris MRTs converted into MRTTs in same programme. Modification involves installation of Flight Refuelling Mk 32-900 HDUs beneath wings plus associated plumbing and operator equipment on flight deck.

A330-200 being developed as strategic tanker/transport and was chosen by the AirTanker consortium as most suitable platform for UK FSTA programme. Consortium members EADS, Rolls-Royce, Thales and FRA conceived a private finance initiative (PFI) solution with service entry in 2008 and programme life of 27 years; AirTanker bid selected on 26 January 2004 and is expected to involve a mix of about 16 new-build and second-hand A330-200s powered by Rolls-Royce Trent 772B engines; at same time, it was revealed that several key aspects of PFI solution must still be resolved before formal signature of contract. By early 2005, these difficulties still not overcome, although AirTanker optimistic of securing contract signature in early 2006.

A330-based tanker also offered to Australia for AIR 5402 requirement for up to five aircraft; tenders submitted by Airbus and rival Boeing in October 2003; Airbus contender selected, with announcement on 16 April 2004 confirming that five A330-203MRTT aircraft would be delivered in 2008-11; formal signature of contract took place 20 December 2004. First aircraft to undergo tanker modification by EADS CASA from May 2006; remaining four will be converted in Australia by Qantas Defence in partnership with Australian Aerospace. ADI and GKN Aerospace, with Qantas also to provide lifetime support. In addition to tanker modifications, RAAF aircraft also to feature Northrop Grumman AN/AAQ-24 DIRCM, but will apparently not incorporate chaff/flare dispensers. Operating unit expected to be 33 Squadron at Richmond, with IOC in 2009.

Following collapse of plan to lease Boeing KC-767, US Air Force had to restart tanker procurement programme on competitive basis; Boeing expected to compete, with EADS planning to counter with variant of Airbus A330-200, initially known as KC-330, but since redesignated KC-30. EADS North America plans to build assembly centre in Mobile, Alabama, if successful in securing USAF contract; this could undertake assembly of up to 25 aircraft per year. EADS announced teaming agreement with Northrop Grumman on 7 September 2005 under which KC-30 would be assembled at Mobile and then transferred to separate Northrop Grumman facility for final modifications before delivery to USAF. As many as 400 aircraft of chosen type could be purchased over period of 20 years, with USAF now hopeful of selecting winner in 2007 and accepting initial four aircraft in FY10, with full-rate production to begin in FY12.

CURRENT VERSIONS: Interim MRT (MultiRole Transport) version of A310, without tanker capability, converted by Elbe Flugzeugwerke, Dresden and Lufthansa Technik, Hamburg, for Luftwaffe. Structural strengthening and 3.50 m × 2.50 m (11 ft 5¾ in × 8 ft 2½ in) cargo door added in port forward fuselage. Capacity of up to 214 passengers; or 36 tonnes of cargo/passengers; or 56 stretchers and six intensive care patients in the casevac role. First redelivered from Dresden in June 1999; four of seven Luftwaffe A310s returned to service as MRTs by early 2002. Luftwaffe aircraft proved partially incompatible with military cargo handling equipment and upper deck therefore rarely used for freight; full conversion of two MRTs to MRTT, plus conversion of further pair of standard aircraft directly to MRTT, being undertaken between 2002 and 2005; first tanker kit delivered by EADS CASA in November 2002, with first flight following modification on 20 December 2003. Initial two

Artist's impression of USAF KC-30 1151732

aircraft modified at Dresden and handed over to German and Canadian forces in joint delivery ceremony on 29 September 2004. Remaining Luftwaffe A310s comprise two in VIP configuration and one passenger transport.

DESIGN FEATURES: Conversions offer greater refuelling and transport capability than earlier airliners in combination with modern aircraft with better lifetime costs and longer life expectancy. Possible roles include tanker with underwing HDUs and fuselage-mounted boom and/or hose transfer systems and carrying in excess of 111,270 kg (245,300 lb) of fuel (139,060 litres; 36,737 US gallons; 30,590 Imp gallons); and cargo and personnel transports which can be combined with refuelling, medevac, airborne command post and reconnaissance/airborne warning.

EADS has completed design of new advanced refuelling boom system (ARBS) which was expected to begin 300 to 400 hours of flight trials on an Airbus A310-304 in late 2005; this aircraft was rolled out at Getafe, Spain on 23 December 2005, following modification by EADS CASA. ARBS will thereafter be adapted for use by A330 and is to be installed on Australian aircraft, which will also have two Mk 32-905E HDUs. Maximum boom fuel flow rate is to be 4,550 litres, (1,200 US gallons; 1,000 Imp gallons) per minute. Retracted length of ARBS is 10,85 m (35 ft 7 in); extended length is 17,63 m (57 ft 10 in). Approximate weight of ARBS is 1,202 kg (2,650 lb).

Airbus conversions offer payloads from 35,000 to 50,000 kg (77,161 to 110,231 lb), full payload transatlantic range, long on-station time, combined boom and hosereel transfer capability (fuel transfer rate at each refuelling point of 1,590 litres (420 US gallons; 350 Imp gallons) per minute), standard Airbus forward port-side freight door (projected height 2,57 m; 8 ft 5¼ in, width 3,58 m; 11 ft 9 in); quick-change main deck layout, probe or receptacle fuel receiver capability; commonality with existing airliners and same worldwide support resources, predictable spares requirements and longer remaining airframe life.

About 100 civil operators fly A300/310, and first-generation Airbus airliners now available on second-hand market; military rendezvous and self-protection systems can be fitted; main deck can be converted with palletised seating for up to 272 passengers in under 24 hours; up to 28,000 kg (61,729 lb) of additional fuel can be carried in tanks in underfloor cargo compartments.

DIMENSIONS, EXTERNAL(310: A310-300 MRTT, 330: A330-200 MRTT):

Length overall, incl probe: 310	47,36 m (155 ft 4½ in)
330	59,69 m (195 ft 10 in)

DIMENSIONS, INTERNAL:

Usable cabin length: 310	43,90 m (144 ft 0 in)
330	45,00 m (147 ft 7¾ in)
Cabin height: both	2,28 m (7 ft 5¾ in)
Max cabin width: both	5,29 m (17 ft 4¼ in)
Underfloor freight hold volume:	
310	80,0 m³ (2,825 cu ft)
330	136,0 m³ (4,803 cu ft)

WEIGHTS AND LOADINGS:

Operating weight empty:	
310	80,830 kg (178,200 lb)
330	120,500 kg (265,650 lb)
Max non-fuel payload: 310	37,000 kg (81,571 lb)
330	61,300 kg (135,140 lb)
Max normal fuel capacity:	
310	47,940 kg (105,690 lb)
330	111,270 kg (245,300 lb)
Additional fuel: 310	28,240 kg (62,258 lb)
Max T-O weight:	
normal, 310	157,000 kg (346,125 lb)
330	230,000 kg (507,075 lb)
optional, 310	164,000 kg (361,550 lb)
330	233,000 kg (513,675 lb)
Max ramp weight: 310	164,900 kg (363,550 lb)
330	233,900 kg (515,650 lb)
Max landing weight: 310	124,000 kg (273,375 lb)
330	182,000 kg (401,250 lb)
Max zero-fuel weight: 310	114,000 kg (251,325 lb)
330	170,000 kg (374,775 lb)

PERFORMANCE:

Refuelling speed:	
both, boom	240–320 kt (444–592 km/h; 276–368 mph)
both, hose and drogue:	
S/L to FL275	200–325 kt (370–602 km/h; 230–374 mph)
FL275 to FL350	M0,82
T-O run: 310	2,347 m (7,700 ft)
Max range, standard fuel:	
310	4,800 n miles (8,889 km; 5,523 miles)
Max range, using transferable fuel:	
310	7,200 n miles (13,334 km; 8,285 miles)
330	9,000 n miles (16,668 km; 10,357 miles)

AIRBUS AEW&C

TYPE: Airborne early warning and control system.

PROGRAMME: A310 originally selected by Raytheon Systems as airborne platform in unsuccessful bid for the Australian Project Wedgetail AEW&C requirement in which it competed against Boeing 737 and Lockheed Martin C-130J. Featured Elta Phalcon 360° phased-array radar in a fixed dorsal dome; formally announced in January 1997. Australia

Airbus A310 AEW&C proposal with non-rotating Elta radar above rear fuselage *(Paul Jackson)* 0062385

selected Boeing 737 in July 1999, but A310 AEW&C also offered to Turkey (again unsuccessfully) and South Korea, which was originally due to select E-X platform shortly before the end of 2004 and award contract for four aircraft in 2005. Programme delayed by one year, resulting in relaunch in June 2005 for unspecified number of aircraft. At that time, proposals expected from Boeing and IAI/Elta Systems in addition to two contenders based on Airbus aircraft platform, specifically the A320 (Thales) and A321 (L-3 Communications). Total acquisition cost expected to be around USD2 billion.

AIRBUS A321 AGS

TYPE: Airborne ground surveillance system.

PROGRAMME: Northrop Grumman chose the A321 as its preferred Joint STARS platform to compete for NATO's AGS (airborne ground surveillance) requirement. Considered in 1996 and rejected on cost grounds, the A321 was reconsidered in the light of NATO's unwillingness to accept a Boeing 707-based solution. Plans called for selection in 2002 and IOC, with six aircraft, by 2007, but implementation delayed by US refusal to release all technology. Northrop Grumman's original AGS proposal featured the US Army's AN/APY-X RTIP (Radar Technology Insertion Program) with an electronically scanned antenna array, giving spot/swath SAR, wide area MTI, ultra-high resolution SAR, inverse SAR and long-range high-resolution MTI modes. However, concerns over technology transfer resulted in substitution of TCAR (transatlantic co-operative AGS radar) as prime sensor, this being the result of blending US and European expertise and technology. The definitive AGS will have 10 to 12 operator stations.

By 2002, Northrop Grumman, EADS and Galileo Avionica had teamed up to promote TIPS (Transatlantic Industrial Proposed Solution; www.tips-ags.com), which is based on A321 airframe and will involve participation of wide range of subcontractors throughout NATO countries. General Dynamics Canada, Indra and Thales had joined industrial team by 9 January 2004, when operating proposal submitted to NATO. National Armament Directors' conference approved proposal on 16 April 2004 (rejecting rival Raytheon bid) with intention of awarding contract in second quarter of 2005; however, on 28 April 2005, EUR23 million project definition study contract signed, with EUR500 million design and development contract then expected to follow in early 2006. Contract for EMD phase should follow at the end of 2008, with acquisition phase beginning in mid-2010. At this time, NATO considering initial fleet of five A321 manned platforms and seven Global Hawk UAVs. . By 2004, AGS envisaged with A321 "almost certainly" having sensor raised above rear fuselage (in "topknot" position) and Northrop Grumman RQ-4B Global Hawk UAVs as 'gap-fillers'. IOC anticipated in last quarter of 2010, with four aircraft and 18 ground stations to provide minimum single-orbit coverage. Full requirement may be 12 and 48, respectively, although six and 24 would ensure two simultaneous missions.

'Topknot' radar installation on Airbus A321 AGS

1151728

AIRTECH

AIRCRAFT TECHNOLOGY INDUSTRIES

PARTICIPATING COMPANIES

EADS CASA: (Spain)

Dirgantara: (Indonesia)

Airtech was formed by CASA (now part of EADS) and IPTN (now known as Dirgantara) to develop the CN-235 twin-turboprop transport; responsibility for design and production was shared equally between the two companies. The partnership applied only to the Series 10 and Series 100/110, with later versions being developed independently by CASA, according to a statement by that company.

AIRTECH CN-235

Spanish Air Force designations: T.19A and T.19B

TYPE: Twin-turboprop transport; maritime surveillance twin-turboprop.

PROGRAMME:

DEVELOPMENT MILESTONES

Design began	Jan 1980
First prototype material cut	May 1981
Rolled out	10 Sep 1983
First flight	11 Nov 1983
Certification	20 Jun 1986
First flight, production	19 Aug 1986
First delivery (Merpati)	15 Dec 1986
Entered service (Merpati)	1 Mar 1988

Launched as joint venture between CASA and Indonesian manufacturer IPTN (now Dirgantara, which see), which formed Airtech company to manage programme. Series 10 and Series 100/110 versions covered by this agreement; subsequent versions, notwithstanding Indonesian Series 220 and 330 equivalents, stated by CASA to be wholly Spanish.

Preliminary design began January 1980, prototype construction May 1981; one prototype completed in each country, with simultaneous roll-outs 10 September 1983; first flights 11 November 1983 (by CASA's ECT-100) and 30 December 1983 (IPTN's PK-XNC); Spanish and Indonesian certification 20 June 1986; first flight of production aircraft 19 August 1986; FAA type approval (FAR Pts 25 and 121) 3 December 1986; deliveries began 15 December 1986 from IPTN line and 4 February 1987 from CASA; entered service (with Merpati Nusantara Airlines) 1 March 1988; JAR 25 type approval October 1993.

Licence agreement with TAI (see Turkish section) announced January 1990, initially to assemble and later to manufacture locally 50 of 52 ordered; first flight of Turkish-assembled aircraft 24 September 1992; first delivery 13 November 1992; final air force delivery 10 August 1998, but TAI subsequently produced follow-on batch of nine maritime patrol variants and may build further 10 for maritime missions.

In 1995, CASA unilaterally launched development of a stretched CN-235, as C-295; this is described under CASA heading in Spanish section.

CURRENT VERSIONS: **CN-235 Series 10:** Initial production version (15 built by each company), with CT7-7A engines.

CN-235 Series 100/110: Generally as Series 10, but CT7-9C engines in new composites nacelles; replaced Series 10 in 1988 from 31st production aircraft. Series 100 is Spanish-built and, following JAA certification, was certified by FAA in February 1992. Series 110 is Indonesian-built, with improved electrical, warning and environmental systems to comply with JAR 25; certification of this version achieved in Europe (JAA), July 1995.

Detailed description applies to the above version except where indicated.

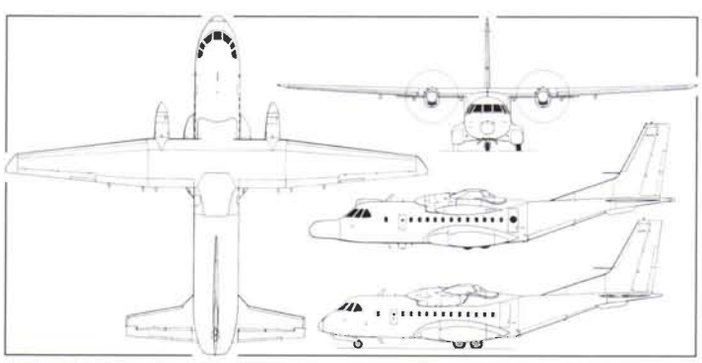
CN-235 Series 200/220: Structural reinforcements to cater for higher operating weights, aerodynamic improvements to wing leading-edges and rudder, reduced field length requirements and much-increased range with maximum payload; Series 200 is Spanish-built and was certified by FAA March 1992. Series 220 is Indonesian-built, with improvements similar to Srs 110; prototype, flown early 1996, is converted from a company development aircraft (PK-XNV, the 20th production aircraft from the Indonesian line); orders include eight for Malaysian Air Force, of which six completed to Srs 220 standard (including three for maritime patrol) by early 1998 (34th to 39th Indonesian-built), with remaining two to be completed in VIP configuration. Revised leading-edge shape led to requirement to requalify pneumatic de-icer boots, delaying initial deliveries. Further orders for Series 220 from South Korea (eight, including one for VIP use and one for VVIP use) and Pakistan (four, including one for VIP use).

CN-235 Series 300/330: IPTN originally offered Series 330 **Phoenix** (with new Honeywell avionics, ARL-2002 EW system and 16,800 kg; 37,037 lb MTOW) to Royal Australian Air Force to meet Project Air 5190 tactical airlift requirement, but was forced by financial constraints to withdraw in 1998. Separately, CASA offered its own Series 300 to meet the same specification.

CN-235 Series 300 under certification in 2000 with an open-systems avionics architecture, based on MIL-STD-1553B and ARINC 429 digital databusses. Full NVG-compatible cockpit; four-dimensional navigation system with avionics suite, including Thales (Sextant) Topdeck colour weather radar, radios, solid-state flight data and cockpit voice recorders, enhanced TCAS, enhanced GPWS and four 152 × 203 mm (6 × 8 in) LCDs; twin HUDs and Totem 3000 ring laser gyro INS optional. Other features include in-flight refuelling capability, improved pressurisation (2,440 m; 8,000 ft cabin environment at 7,620 m; 25,000 ft) and provision for optional twin nosewheel installation to provide better soft-field taxying capability.

CN-235 AEW: Proposals were revealed in December 1995 for fitment of an Ericsson Erieye electronically scanned phased-array radar above the fuselage of a CN-235. Initial interest was from the Indonesian Air Force, but primarily in the ocean surveillance role;

Colombian Air Force CN-235s 0587695



CASA CN-235 twin-turboprop multipurpose transport, with additional side view (centre) of a representative CN-235 MPA *(Dennis Punnett)* 0507150

retrofit of three existing aircraft was considered, but has not been undertaken. Radar, three surveillance operators' positions and associated equipment increase aircraft weight by approximately 2,000 kg (4,409 lb). No recent news of this proposal has been received.

CN-235ER: Extended range version (based on Series 300) originally selected by US Coast Guard in 2002 as fixed wing element of Project Deepwater re-equipment programme, but subsequently shelved in favour of the basic CN-235 Series 300M MPA, described separately.

CN-235 M: Other military transport versions.

CN-235 MP Persuader: Maritime patrol and surveillance versions. CN-235 MP Persuader is CASA version. In service with Irish Air Corps (two) and Turkey (nine: six for Navy, three for Coast Guard, assembled by TAI at Ankara). In mid-1999, Turkey sought proposals from at least seven potential integrators of surveillance systems to provide radar, FLIR and an acoustics suite for naval CN-235s; on 6 September 2002, contract signed with Thales covering supply and integration of maritime patrol mission equipment by 2006. Contract worth US$350 million and could be followed by further 10 systems to equip additional batch of aircraft.

CN-235 Series 300M MRS MPA (Medium Range Surveillance Maritime Patrol Aircraft): CASA version for US Coast Guard, which ordered initial two and took option on further six of anticipated 35 HC-235 aircraft in FY03 budget at cost of US$87.4 million. Delivery expected in 2006 and will feature EADS CASA Fully Integrated Tactical System (FITS), including multimode search radar; EO/IR sensors; VHF, UHF and HF communications, SATCOM terminal and large observation windows. Entire tactical system will be palletised, allowing aircraft to be easily reconfigured for use as personnel and/or cargo transport.

CN-235 MPA: Indonesian-developed version, available either with lengthened nose housing radar and IFF; or with normal CN-235 nose, plus belly radar; CN-235 prototype PK-XNC served as testbed. Maximum T-O weight 15,400 kg (33,951 lb), endurance more than 8 hours. Provision for quick-change configuration for general transport, communications or other duties.

Indonesia confirmed initial three firm orders (of planned six aircraft) in May 2000, when Thomson-CSF (now Thales) selected to supply AMASCOS airborne maritime situation control system, comprising Elettronica ALR-733 RWR, T-CSF Ghito thermal imager and Sextant Gemini navigation computer. At least one aircraft used as testbed in 2002. In early 2004, Thales systems reportedly being installed on three aircraft, with Thales anticipating sale of further three systems to Indonesia by mid-2004. Brunei chose Boeing as Argo Systems integrator for its three aircraft in late 1995, specifying individual sensors in October 1996 as AN/AAQ-21 FLIR, BAE Sky Guardian ESM, Cossor 3500 IFF and AN/APS-134 radar, plus two operators' consoles. Five surveillance aircraft for Indonesia Navy were under construction in early 2005. Brunei also planning to acquire three, but these yet to appear.

CN-235 QC: Quick-change cargo/passenger version; certified by Spanish DGAC May 1992.

CN-245: Indonesian stretched version; not built.

C-295: Spanish stretched version; described separately under CASA heading.

N2XXM: Project abandoned.

CUSTOMERS: Refer to table. By 1 January 2005 CASA had delivered 163 and Dirgantara 55, for a total of 218. Further 10 then under construction at Dirgantara and two awaiting customers at CASA.

One (s/n 660-49) acquired (presumably second-hand) by USAF Special Operations Command in 1998. Turkey signed a lease agreement on 16 April 1999 to allow a one-year renewable lease of two Turkish Air Force CN-235s to Jordan. Three Merpati aircraft leased to Air Venezuela from May 1999; three leased to Asian Spirit Airlines, Philippines, from March 2000, including two on lease-purchase. One CN-235-300 (first of this subvariant in service) leased by Austrian Ministry of Defence for six months from April 2000. CN-235 is contender in Taiwanese Air Force requirement for 18 light transports, and for the US Army Airborne Common Sensor platform requirement. Winner of US Coast Guard Project Deepwater competition, with 35 aircraft initially expected to be acquired, although total number could decrease to no more than 20.

CN-235 also in contention for US Army FCA (Future Cargo Aircraft) programme, in conjunction with C-295. Army has initial requirement for 33 aircraft to replace Shorts C-23B and expects to award contract in January 2007.

COSTS: USD17.1 million (2002) programme unit cost, Malaysia.

DESIGN FEATURES: Optimised for short haul operations, enabling it to fly four 860 n mile (1,593 km; 990 mile) stage lengths (with reserves) before refuelling and to operate from paved runways or unprepared strips; high-mounted wing; pressurised fuselage (including baggage compartment) of flattened circular cross-section, with upswept rear end incorporating cargo ramp/door; sweptback fin (with dorsal fin) and rudder; low-set non-swept fixed incidence tailplane and elevators; two small ventral fins; vortex generators on rudder and elevator leading edges; optional extended nose radome.

NACA 65_3-218 aerofoil with no dihedral/constant chord centre-section; tapered outer panels have 3° dihedral and 3° 51' 36" sweepback at quarter-chord.

FLYING CONTROLS: Conventional and manual. Ailerons, elevators and rudder statically and dynamically balanced (duplicated actuation for ailerons); mechanical servo tab and electric trim tab in each aileron, rudder and starboard elevator; trim tab only in port elevator; single-slotted inboard and outboard trailing-edge flaps (each pair interchangeable port/starboard), actuated hydraulically by Dowty irreversible jacks.

STRUCTURE: Conventional semi-monocoque, mainly of aluminium alloys with chemically milled skins; composites (mainly glass fibre or glass fibre/Nomex honeycomb sandwich, with some carbon fibre and Kevlar) for leading/trailing-edges of wing/tail moving surfaces, wing/fuselage and main landing gear fairings, wing/fin/tailplane tips, engine nacelles, ventral fins and nose radome. Propeller blades are of glass fibre, with metal spar and urethane foam core.

CASA builds wing centre-section, inboard flaps, forward and centre fuselage, engine nacelles; Dirgantara builds outer wings, outboard flaps, ailerons, rear fuselage and tail unit; both manufacturers use numerical control machinery extensively. Final assembly line in

Maritime surveillance CN-235 MP Persuader of the Irish Air Corps *(Paul Jackson)* 0569649

CN-235 PRODUCTION
(at 1 January 2005)

Customer	Qty	Series	First order	First aircraft	First delivery	Delivered	Mfr
Civil version:							
Binter Canarias (Spain)	4[2]	10	10 Jun 88	EC-EMO	22 Dec 88	4	CASA
Binter Mediterraneo (Spain)	5	100[1]	19 Dec 89	EC-FAD	4 Sep 90	5	CASA
Mandala Airlines (Indonesia)	3	110		—	—	—	Dirgantara
Merpati Nusantara (Indonesia)	15	10		PK-MNA	15 Dec 86	15	Dirgantara
Devon Holding & Leasing[12] (USA)	4	300	2002	N168D	2002	4	CASA
Military version:							
Abu Dhabi Air Force	7	110	—	810	31 Aug 93	7	Dirgantara
Botswana Defence Force	2	10	10 Jun 86	OG-1	21 Dec 87	2	CASA
Brunei Air Wing	3	MPA		—	—	—	Dirgantara
	1	110		ATU-501	1997	1	Dirgantara
Chilean Army	3	100	12 Feb 89	E-216	31 Aug 89	3	CASA
Colombian Air Force	3	200	Jul 97	1260	28 Jan 98	3	CASA
Ecuadorean Army	1	100	6 Jun 89	AEE-502	6 Jun 89	1	CASA
	1	300		AEE-503	12 Jan 05	1	CASA
Ecuadorean Navy	1	100	27 Jul 88	ANE-204	13 Jun 89	1	CASA
French Air Force	15[3]	200	11 Apr 90	043	28 Feb 91	15	CASA
	5	200	2002	152	2002	5	CASA
Gabon Air Forces	1	100	26 Feb 90	TR-KJE	19 Mar 91	1	CASA
Indonesian armed forces	24[4]	110		A-2301	12 Jan 93	7	Dirgantara
Irish Air Corps	1[5]	100	3 Apr 91	250	10 Apr 91	1	CASA
	2	MP	3 Apr 91	252	8 Dec 94	2	CASA
Malaysian Air Force	8[6]	220		M44-01	26 Aug 99	7	Dirgantara
Moroccan Air Force	7[7]	100	19 Sep 89	CNA-MA	27 Sep 90	7	CASA
Oman Police	2	100	15 Feb 92	A40-CU	14 Jan 93	2	CASA
Pakistan Air Force	4	220	29 Jun 01	04-043	28 Jan 04	4	Dirgantara
Panama National Guard	1[8]	10	19 Mar 87	SAN-265	13 Sep 88	1	CASA
Papua New Guinea Defence Force	2	100	26 Oct 91	P2-0501	15 Nov 91	2	CASA
Saudi Air Force	4	10	5 Feb 84	118	9 Feb 87	4	CASA
South African Air Force (ex-Bophuthatswana Air Force)	1	10	29 May 90	8026	6 Jan 91	1	CASA
South Korean Air Force[13]	12	100	19 Aug 92	078	13 Nov 93	12	CASA
	8	220	21 Oct 97	044	18 Dec 01	8	Dirgantara
Spanish Air Force	2[9]	10	16 Nov 88	T.19-01	7 Dec 88	2	CASA
	18	100	28 Dec 90	T.19-03	1 Feb 91	18	CASA
Thai Ministry of Agriculture and Co-operatives	2	220	Oct 96	2221	Apr 99	2	Dirgantara
Turkish Air Force	52[10]	100	11 Dec 90	051	25 Jan 92	52	TAI/CASA
Turkish Navy	6	MP	23 Sep 98	TCB-651	23 Dec 01	6	TAI/CASA
Turkish Coast Guard	3	MP	23 Sep 98	TCSG-551	23 Dec 01	3	TAI/CASA
US Coast Guard	2	MP	20 Feb 04	—	2006	—	CASA
Venezuela	2	MP	30 Mar 05				CASA
Subtotals	**237**					**209**	
Demo/trials	5[11]	(various)		EC-016		5	CASA
	5	(various)		PK-XNT		5	Dirgantara
Prototype	1	-		PK-XNC		1	Dirgantara
Crashed on test	1	MP		TCSG-552 (No.1)		1	TAI/CASA
Totals	**249**					**221**	

[1] Converted from Series 100 to Series 200
[2] Withdrawn 1998; three to Luftmeister, South Africa; one to Turkish Army (lost 16 May 2001)
[3] Including option on seven taken up in February 1996; first eight as Srs 100, but upgraded to Srs 200 from 1999
[4] Includes five Navy and three Air Force aircraft under construction in January 2005
[5] Withdrawn at end of lease, 1995
[6] Including two VIP versions ordered in 2002 for 2005 delivery
[7] Includes one VIP version
[8] To Flight International (USA) 1995
[9] VIP version
[10] 50 built in Turkey by TAI
[11] Includes one -100QC; plus one -200QC sold in 1996 to East Texas Aircraft Services Corporation
[12] Appears to be a US government company
[13] South Korea considering acquisition of up to 30 Dirgantara-built aircraft in exchange for two submarines

Notes: Operators of second-hand aircraft include Austral (Argentina), Colombian Navy and Thai Police

each country. Part of tail unit built by ENAER Chile under subcontract from CASA. TAI (Turkey) initially assembled under licence before progressing gradually to local manufacture.

LANDING GEAR: Messier-Bugatti retractable tricycle type with levered suspension, suitable for operation from semi-prepared runways. Electrically controlled hydraulic extension/retraction, with mechanical back-up for emergency extension. Oleo-pneumatic shock-absorber in each unit. Each main unit comprises two wheels in tandem, retracting rearward into fairing on side of fuselage. Mainwheels semi-exposed when retracted. Single steerable nosewheel (±48°) retracts forward into unpressurised bay under flight deck. Dunlop 28×9.00–12 (12 ply) tubeless mainwheel tyres standard, pressure 5.17 bar (75 lb/sq in) on civil version, 5.58 bar (81 lb/sq in) on military version; low-pressure mainwheel tyres optional, size 11.00-12 (10 ply), pressure 3.45 bar (50 lb/sq in). Dunlop 24×7.7 (10/12 ply) tubeless nosewheel tyre, pressure 5.65 bar (82 lb/sq in) on civil version, 6.07 bar (88 lb/sq in) on military version; optional 8.50×10 (12 ply). Dunlop hydraulic differential disc brakes; Dunlop anti-skid units on main gear. Chilean Army aircraft used in Antarctic have wheel/ski gear. Minimum ground turning radius 9.50 m (31 ft 2 in) about nosewheel, 18.98 m (62 ft 3¼ in) about wingtip.

POWER PLANT: Two General Electric CT7-9C turboprops (CT7-9C3 in Srs 300), each flat rated at 1,305 kW (1,750 shp) (S/L, to 41°C) for take-off and 1,394.5 kW (1,870 shp) up to 31°C with automatic power reserve. Hamilton Sundstrand 14RF-21 (14RF-37 in Srs 300) four-blade constant-speed propellers, with full feathering and reverse-pitch capability. Fuel in two 1,042 litre (275 US gallon; 229 Imp gallon) integral main tanks in wing centre-section and two 1,592 litre (421 US gallon; 350 Imp gallon) integral outer-wing auxiliary tanks; total fuel capacity 5,264 litres (1,391 US gallons; 1,158 Imp gallons), of which 5,128 litres (1,355 US gallons; 1,128 Imp gallons) are usable. Single pressure refuelling point in starboard main landing gear fairing; gravity filling point in top of each tank. Propeller braking permits starboard engine to be used as on-ground APU. Oil capacity 14 litres (3.7 US gallons; 3.1 Imp gallons).

ACCOMMODATION: Crew of two on flight deck, plus cabin attendant (civil version) or third crew member (military version). Accommodation in commuter version for up to 44 passengers in four-abreast seating, at 76 cm (30 in) pitch, with 22 seats each side of central aisle. Lavatory, galley and overhead luggage bins standard. Pressurised baggage compartment at rear of cabin, aft of movable bulkhead; additional stowage in rear ramp area and in overhead lockers. Can also be equipped as mixed passenger/cargo combi (for example, 19 passengers and two LD3 containers), or for all-cargo operation, with roller loading system, carrying four standard LD3 containers, five LD2s, or two 2.24 × 3.18 m (88 × 125 in) and one 2.24 × 2.03 m (88 × 80 in) pallets; or for military duties, carrying up to 57 fully equipped troops or 46 paratroops (51 troops or paratroops on Srs 300). Other options include layouts for aeromedical airlift (18 stretchers and two medical attendants on Srs 300), electronic warfare, geophysical survey or aerial photographic duties.

Main passenger door, outward- and forward-opening with integral stairs, aft of wing on port side, serving also as a Type I emergency exit. Type III emergency exit facing this door on starboard side. Crew/service downward-opening door (forward, starboard) has built-in stairs, and serves also as a Type I emergency exit, or as passenger door in combi version; second Type III exit opposite this door on port side. Wide ventral door/cargo ramp in underside of upswept rear fuselage, for loading of bulky cargo. Accommodation fully air conditioned and pressurised.

SYSTEMS: Hamilton Sundstrand air conditioning system, using engine compressor bleed air. Honeywell electropneumatic pressurisation system (maximum differential 0.25 bar; 3.6 lb/sq in) giving cabin environment of 2,440 m (8,000 ft) up to operating altitude of 5,480 m (18,000 ft) on Srs 200; Srs 300 cabin pressurisation increased to 0.38 bar (5.5 lb/sq in), giving cabin environment of 2,350 m (7,700 ft) at altitude of 7,620 m (25,000 ft). Hydraulic system, operating at nominal pressure of 207 bar (3,000 lb/sq in), comprises two engine-driven, variable displacement axial electric pumps, a self-pressurising standby mechanical pump, and a modular unit incorporating connectors, filters and valves; system is employed for actuation of wing flaps, landing gear extension/retraction, wheel brakes, emergency and parking brakes, nosewheel steering, cargo ramp and door, and propeller braking. Accumulator for back-up braking system.

28 V DC primary electrical system powered by two 400 A Auxilec engine-driven starter/generators, with two 24 V 37 Ah Ni/Cd batteries for engine starting and 30 minutes' (minimum) emergency power for essential services. Constant frequency single-phase AC power (115/26 V) provided at 400 Hz by three 600 VA static inverters (two for normal operation plus one standby); two three-phase engine-driven alternators for 115/200 V variable frequency AC power. Fixed oxygen installation for crew of three (single cylinder at 124 bar; 1,800 lb/sq in pressure); three portable units and individual masks for passengers.

Pneumatic boot anti-icing of wing (outboard of engine nacelles), fin and tailplane leading-edges. Electric anti-icing of propellers, engine air intakes, flight deck windscreen, pitot tubes and angle of attack indicators. Engine fire detection and extinguishing system.

AVIONICS (CIVIL): *Comms:* Two Rockwell Collins VHF-22B com radios, one Avtech DADS crew interphone, Rockwell Collins TDR-90 ATC transponder. Fairchild A-100A cockpit voice recorder, Avtech PACIS PA system. Dorne & Margolin ELT 8-1 emergency transmitter. Optional second TDR-90; optional HF-230 radio.

Radar: Rockwell Collins WXR-300 weather radar.

Flight: Two VIR-32 VOR/ILS/marker beacon receivers; DME-42; ADF-60A; two 332D-11T vertical gyros; two MCS-65 directional gyros; two ADI-85A; two HSI-85; two RMI-36; APS-65 autopilot/flight director; ALT-55B radio altimeter; two 345A-7 rate of turn sensors (all by Rockwell Collins); SFENA H-301 APM standby attitude director indicator; Hamilton Sundstrand Mk II GPWS; and Fairchild/Teledyne flight data recorder. Options include second DME-42 and ADF-60A, Rockwell Collins RNS-325 radar nav, Litton LTN-72R inertial nav or Global GNS-500A Omega navigation system.

Instrumentation: Rockwell Collins EFIS-85B five-tube CRT system standard.

AVIONICS (MILITARY) (INDONESIAN AIRCRAFT): *Comms:* Rockwell Collins AN/ARC-182 VHF/UHF; Rockwell Collins HF 9000 HF; IFF.

Flight: Rockwell Collins VIR-32 VHF nav; Litton LTN92 GPS-aided INS; Rockwell Collins DF-206A ADF; Rockwell Collins AN/APS-65F autopilot; GPWS

Instrumentation: Rockwell Collins EFIS-85B(14) EFIS (four or five screens). IPTN developing cockpit lighting system compatible with night vision goggles.

AVIONICS (MILITARY): Series 300: Thales Avionics Topdeck suite (see Current Versions) as core system.

Flight: Twin ADU 3000 air data units, GPSs and AHRSs; radar altimeter; TCAS; GPWS; weather radar; optional Totem 3000 LINS, Cat. II landing capability, MLS and satcom.

Instrumentation: Four 152 × 203 mm (6 × 8 in) LCDs; optional HUDs. Optional electro-optical sensors display imagery on LCDs. NVG compatibility.

Mission: Four-dimensional navigation FMS calculates high-altitude and computed air release points for load-dropping.

AVIONICS (PERSUADER): *Radar:* Litton APS-504(V)5 US Coast Guard aircraft to have Telephonics AN/APS-143(V)3 surveillance radar.

Mission: FLIR-2000HP undernose-mounted night vision system and Litton AN/ALR-85(V) ESM system, fully integrated via a central tactical processor with reconfigurable consoles. CAE AN/ASQ-508(V) MAD system selected for Turkish Navy and Coast Guard aircraft in late 2003.

AVIONICS (CN-235 MPA): *Radar:* BAE Systems Seaspray 4000 or Raytheon AN/APS-134 (LW) or Thales Ocean Master 100.

Flight: Litton LN92 ring laser gyro INS; Trimble TNL 7900 Omega/GPS.

Mission: Argo data processing and display system with multifunction consoles. BAE Systems Sky Guardian SG-300, or Argo Systems AR-700 or Litton AN/ALR-93(V)4 ESM. FLIR Systems AN/AAQ-21 Safire or BAE Systems MRT FLIR. Cossor 3500 IFF interrogator. (Trials aircraft originally equipped with APS-504 and Ocean Master; SG-300. Reconfigured by 1994 with AN/APS-134, MRT, AR-700, LN92 and TNL 7900. Further alternatives available at customer's option.)

Mission: Argo data processing and display system with multifunction consoles. BAE Systems Sky Guardian SG-300, or Argo Systems AR-700 or Litton AN/ALR-93(V)4 ESM. FLIR Systems AN/AAQ-21 Safire or BAE Systems MRT FLIR. Cossor 3500 IFF interrogator (Trials aircraft originally equipped with APS-504 and Ocean Master; SG-300. Reconfigured by 1994 with AN/APS-134, MRT, AR-700, LN92 and TNL 7900. Further alternatives available at customer's option.)

EQUIPMENT: Navigation lights, anti-collision strobe lights, 600 W landing light in front end of each main landing gear fairing, taxying lights, ice inspection lights, emergency door lights, flight deck and flight deck emergency lights, cabin and baggage compartment lights, individual passenger reading lights, and instrument panel white lighting, all standard. Hand-type fire extinguishers on flight deck (one) and in passenger cabin (two); smoke detector in baggage compartment.

ARMAMENT (MILITARY VERSION): Three attachment points under each wing. Weapons can include AGM-84 Harpoon anti-ship missiles; Indonesian MPA version (which see) can be fitted with two Mk 46 torpedoes or AM 39 Exocet anti-shipping missiles.

Data follow for CASA-built Srs 300.

DIMENSIONS, EXTERNAL:

Wing span	25.81 m (84 ft 8 in)
Wing chord: at root	3.00 m (9 ft 10 in)
at tip	1.20 m (3 ft 11¼ in)
Wing aspect ratio	10.2
Length overall, standard nose	21.40 m (70 ft 2½ in)
Fuselage: Max width	2.90 m (9 ft 6 in)
Max depth	2.615 m (8 ft 7 in)
Height overall	8.18 m (26 ft 10 in)
Tailplane span	10.60 m (34 ft 9¼ in)
Wheel track (c/l of mainwheels)	3.90 m (12 ft 9½ in)
Wheelbase	6.92 m (22 ft 8½ in)
Propeller diameter: Srs 200	3.35 m (11 ft 0 in)
Srs 300	3.66 m (12 ft 0 in)
Propeller ground clearance	1.66 m (5 ft 5¼ in)
Distance between propeller centres	7.00 m (22 ft 11½ in)
Passenger door (port, rear) and service door (stbd, fwd): Height	1.70 m (5 ft 7 in)
Width	0.73 m (2 ft 4¾ in)
Height to sill	1.22 m (4 ft 0 in)
Paratroop doors (port and stbd, rear, each):	
Height	1.75 m (5 ft 9 in)
Width	0.90 m (2 ft 11½ in)
Height to sill	1.22 m (4 ft 0 in)
Ventral upper door (rear): Length	2.365 m (7 ft 9 in)
Width	2.35 m (7 ft 8½ in)
Height to sill	1.22 m (4 ft 0 in)
Ventral ramp/door (rear): Length	3.04 m (9 ft 11¾ in)
Width	2.35 m (7 ft 8½ in)
Height to sill	1.22 m (4 ft 0 in)
Type III emergency exits (port, fwd, and stbd, rear):	
Height	0.92 m (3 ft 0¼ in)
Width	0.51 m (1 ft 8 in)

DIMENSIONS, INTERNAL:

Cabin, excl flight deck: Length	9.65 m (31 ft 8 in)
Max width	2.70 m (8 ft 10¼ in)
Width at floor	2.365 m (7 ft 9 in)
Max height	1.90 m (6 ft 2¾ in)
Floor area	22.8 m² (246 sq ft)
Volume	43.2 m³ (1,527 cu ft)

AREAS:

Wings, gross	59.10 m² (636.1 sq ft)
Ailerons (total, incl tabs)	3.14 m² (33.80 sq ft)
Trailing-edge flaps (total)	10.87 m² (117.00 sq ft)
Fin, incl dorsal fin	11.11 m² (119.59 sq ft)
Rudder, incl tabs	4.20 m² (45.21 sq ft)
Tailplane	21.20 m² (228.2 sq ft)
Elevators (total, incl tabs)	6.17 m² (66.41 sq ft)

WEIGHTS AND LOADINGS (Srs 300):

Operating weight empty	9,909 kg (21,846 lb)
Max payload	6,000 kg (13,228 lb)
Max fuel weight	4,230 kg (9,326 lb)
Max T-O weight	16,500 kg (36,376 lb)
Max ramp weight	16,550 kg (36,486 lb)
Max landing weight	16,500 kg (36,376 lb)
Max zero-fuel weight	15,400 kg (33,951 lb)
Max wing loading	279.2 kg/m² (57.19 lb/sq ft)
Max power loading (without APR)	6.33 kg/kW (10.39 lb/shp)

PERFORMANCE (Srs 300):

Max cruising speed	246 kt (455 km/h; 283 mph)
Max rate of climb at S/L	183 m (600 ft)/min
Service ceiling	9,145 m (30,000 ft)
Service ceiling, OEI	4,275 m (14,020 ft)
T-O run	398 m (1,305 ft)
T-O to 15 m (50 ft)	754 m (2,474 ft)
Landing from 15 m (50 ft)	603 m (1,978 ft)
Range:	
with max fuel	2,701 n miles (5,003 km; 3,108 miles)
with 4,000 kg (8,818 lb) payload	1,549 n miles (2,870 km; 1,783 miles)
with max payload	393 n miles (727 km; 452 miles)
g limits: at MTOW	+2.5/−1
below 14,100 kg (31,085 lb)	+3/−1

ALENIA/AERMACCHI/EMBRAER

ALENIA/AERMACCHI/EMBRAER

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Development and promotion of the AMX attack fighter was undertaken under the name of AMX International. This company has now been dissolved, leaving the individual partners responsible for the final production aircraft and continued support of the Brazilian and Italian fleets. Production of a small follow-on batch for Venezuela has been abandoned.

ALENIA/AERMACCHI/EMBRAER AMX

Brazilian Air Force designations: A-1A and A-1B
Italian Air Force name: Ghibli (Desert Wind)

TYPE: Attack fighter.

PROGRAMME:

DEVELOPMENT MILESTONES

Requirement issued	Jun 1977
First flight	15 May 1984
Production go-ahead	mid-1986
First flight, production	11 May 1988
First delivery (Italian AF)	Apr 1989

Resulted from June 1977 Italian Air Force specification for small tactical fighter-bomber; original Aeritalia/Aermacchi partnership joined by Embraer July 1980; formed AMX International to develop, market and manufacture aircraft. This now replaced by companies' individual efforts. Seven single-seat prototypes built (first flight 15 May 1984): production of first 30 (Italy 21, Brazil nine), and design of two-seater, began mid-1986; first production aircraft rolled out at Turin 29 March 1988, making first flight 11 May; second contract (Italy 59, Brazil 25, including six and three two-seaters respectively) placed 1988.

Deliveries to Italian Air Force (six for Reparto Sperimentale di Volo at Pratica di Mare) began April 1989; production A-1 for Brazilian Air Force (s/n 5500) made first flight 12 August 1989, deliveries (two to Nucleo A-1 training nucleus at Santa Cruz) following from 17 October 1989; in-flight refuelling test programme completed (by Embraer) August/September 1989; first flight by first (of three) two-seat AMX-T prototypes 14 March 1990 (MM55024), followed by second on 16 July; first flight of Embraer two-seater (serial number 5650), 14 August 1991; third production batch authorised early 1992 (one year late); first two-seater for Brazilian Air Force (5650) delivered 7 May 1992.

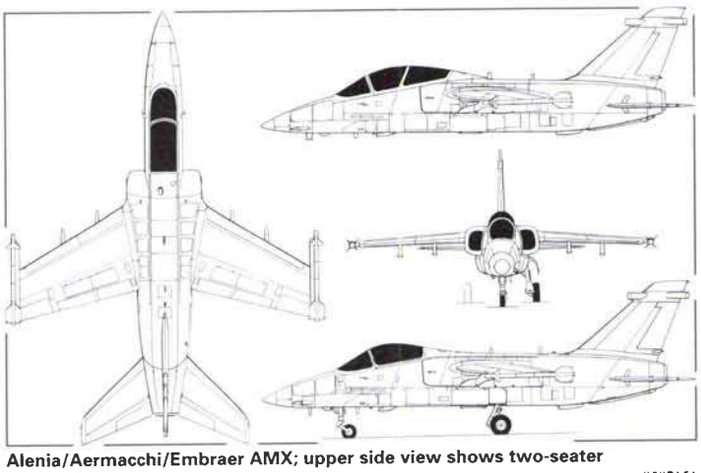
Italian single-seater production temporarily halted following delivery on 1 February 1993 of 72nd aircraft (MM7160); resumed late 1994, with both AMX and first production batch of AMX-T. Final Italian single-seater delivered in 1997; total 110, comprising 74 built by Alenia and 36 by Aermacchi. Batch 4 (35 AMX and 16 AMX-T) and Batch 5 (42 AMX and 9 AMX-T) cancelled. Final Italian two-seater followed in 1998; 26 built: 17 Alenia, nine Aermacchi. Production continued in Brazil, where 50th was delivered on 1 December 1998 and last in 1999.

Istrana- and Amendola-based AMX squadrons flew 252 combat sorties (667 flying hours) during Operation Allied Force against Yugoslavia in 1999, dropping 39 Opher LGBs.

CURRENT VERSIONS: **AMX**: Replaced G91R/Y and some F-104G/S in Italian Air Force (eight squadrons originally planned) and some EMB-326GB Xavante in Brazilian Air Force for close support/interdiction/reconnaissance, sharing counter-air duties with IDS Tornado (Italy) and F-5E/Mirage 50 (Brazil); in service with five Italian Stormi (see table) and 10° and 16° Grupos (Brazil); Brazilian Air Force aircraft (designated **A-1A**) differ primarily in avionics and weapon delivery systems, have two 30 mm guns instead of Italian version's single multibarrel 20 mm weapon and are usually fitted with in-flight refuelling probes.

AMX-MLU: Mid-life upgrade originally to be undertaken jointly by Brazil and Italy, but subsequently abandoned because of high cost and limited funding. Italy then opted for more limited upgrade project to be undertaken by Alenia during 2006-09. Known as AMX-ACOL (Aggiornamento Capacita Operative e Logistica; Operational and Logistic Capabilities Update), this includes GPS navigation, an improved EW suite, updated communications and IFF, colour MFD, integration of Thales CLDP laser designator pod and ability to use newer weapons such as JDAM; consideration also reportedly given to installing new real-time reconnaissance pod. In this guise, Italy expects first upgraded aircraft (CSX7189) to be available for service in September 2006; 43 single- and 12 two-seat aircraft on order; further 11 options; delivery of 55th due end 2009; service life extended to 2015.

Brazilian Air Force two-seat AMX-T *(Embraer)* 1151726



Alenia/Aermacchi/Embraer AMX; upper side view shows two-seater *(Dennis Punnett)* 0507151

Super AMX: Designation of two-seater unsuccessfully offered to South Africa. Would have featured wide-angle HUD, 'glass cockpit', improved HOTAS, GPS, HMD, integrated defensive aids, new radar and new weapons.

Detailed description applies to single-seater except where indicated.

AMX-T: Second cockpit accommodated by removing forward fuselage fuel tank and relocating environmental control system; dual controls, canopy, integration of rear cockpit GEC-Marconi HUD monitor, and oxygen systems, designed/redesigned by Embraer; intended both as operational trainer and, suitably equipped, for such roles as EW, reconnaissance and maritime attack; most Italian AMX-Ts assigned to operational squadrons of 32° Stormo; others assigned, one per squadron, as trainers. Brazilian designation **A-1B.**

AMX-ATA: Venezuela announced intent to acquire eight two-seaters in September 1999, but contract not finalised until 18 December 2002, by which time total had increased to 12, comprising eight standard trainer aircraft and four electronic warfare aircraft. Venezuelan aircraft were to have Elta EL/M-2032 radar and Elbit avionics. Deliveries were due to begin in 2005, but did not do so and it appears that procurement has been abandoned.

AMX-ATA 2: Light combat aircraft and advanced trainer for export with AMX-MLU avionics and non-afterburning EJ200 engine.

AMX-E: Original proposal envisaged two-seat EW version for use as escort jammer and SEAD platform with AGM-88 HARM missiles. Flight controls removed from rear cockpit. MM55027 used for development. Feasibility study completed but further development cancelled. Subsequently, AMX-E version resurrected in different form for Venezuela, which to receive four aircraft outfitted with Elta Electronics EW suite. System able to undertake passive and active countermeasures and uses elements of EL/L-8222 Comprehensive Self Protection Pod, which includes RWR, MAWS, LWR, electro-magnetic jammers and expendables.

CUSTOMERS: Total of 192 (136 Italy/56 Brazil, including 26 and 11 two-seaters) delivered by March 2000 (see table) to original partners. Italy has placed all remaining Batch 1 aircraft in reserve for possible sale. By 1998, 23 Batch 2 aircraft had been upgraded to 'pre-FOC' (full operational capability) standard and plans were in hand to modify 15 to FOC. These 38 plus all 56 remaining from Batch 3 (FOC), formed baseline fleet of 94, though AMI active inventory quoted as 104 aircraft by May 1999. Total of 66 aircraft (comprising 19 single-seaters from Batch 2 and 35 single-seaters and 12 two-seaters from Batch 3) earmarked for upgrade to ACOL configuration between 2005 and 2009, of which 55 on firm order. Brazil planned to begin major mid-life upgrade of 53 single- and two-seaters at end of 2004, with enhanced aircraft to be known as A-1AM and A-1BM respectively. Project includes installation of SCP-01 multimode radar, wide-angle HUD, three colour MFDs, NVG compatibility, HOTAS controls and a revised communications suite with datalink by Rhode & Schwarz. This upgrade will be accomplished over six years at estimated cost of USD400 million.

COSTS: USD18.75 million unit cost (1999) quoted for subsequently abandoned AMX-T Venezuelan programme.

DESIGN FEATURES: Intended for high-subsonic/very low-altitude day/night missions, in poor visibility and, if necessary, from poorly equipped or partially damaged runways. Required fatigue life of 4,000 hours being extended to 6,000 hours.

Wing sweepback 31° on leading-edges, 27° 30' at quarter-chord; thickness/chord ratio 12 per cent.

FLYING CONTROLS: Hydraulically actuated ailerons and elevators; leading-edge slats and Fowler double-slotted trailing-edge flaps (each two-segment on each wing, positions 0, 30 and 41°) actuated electrohydraulically; pair of hydraulically actuated spoilers forward of each flap pair, deployable separately in inboard and outboard pairs; fly-by-wire control of spoilers, rudder and variable incidence tailplane by Alenia/BAE Systems flight control computer; ailerons, elevators, rudder have manual reversion for fly-home capability, even with both hydraulic systems inoperative; spoilers serve also as airbrakes/lift dumpers.

STRUCTURE: Mainly aluminium alloy except for carbon fibre fin and elevators; shoulder-mounted wings, each with three-point attachment to fuselage, have three-spar torsion box with integrally stiffened skins; oval-section semi-monocoque fuselage, with rear portion (including tailplane) detachable for engine access.

Work split gives programme leader Alenia 46.7 per cent (centre-fuselage, nose radome, tail surfaces, ailerons and spoilers); Aermacchi has 23.6 per cent (forward fuselage including gun and avionics integration, canopy, tailcone) and Embraer 29.7 per cent (air intakes, wings, leading-edge slats, flaps, wing pylons, external fuel tanks and reconnaissance pallets); single-sourced production, with final assembly lines in Italy and Brazil.

LANDING GEAR: Hydraulically retractable tricycle type, of Messier-Bugatti levered suspension design, built in Italy by Magnaghi (nose unit) and in Brazil by ELEB (main units). Single wheel and oleo-pneumatic shock-absorber on each unit. Nose unit retracts forward; main units retract forward and inward, turning through approximately 90° to lie almost flat in underside of engine air intake trunks. Nosewheel hydraulically steerable (±6° normal; ±45° with full pedal movement), self-centring, and fitted with anti-shimmy device. Towing travel ±90°. Mainwheel tyres size 670×210-12 (18 ply), pressure 9.65 bar (140 lb/sq in); nosewheel tyre size 18×5.5-8 (10 ply), pressure 10.70 bar (155 lb/sq in). Hydraulic brakes and fully modulated anti-skid system. No brake-chute. Runway arrester hook. Minimum ground turning radius 7.53 m (24 ft 8½ in).

POWER PLANT: One 49.1 kN (11,030 lb st) Rolls-Royce RB 168 Spey Mk 807 non-afterburning turbofan, built under licence in Italy by Fiat, Piaggio and Alfa Romeo Avio, in association

AMX PRODUCTION

	Italy				Brazil				
Batch	**AMX**	**First aircraft**	**AMX-T**	**First aircraft**	**AMX (A-1A)**	**First aircraft**	**AMX-T (A-1B)**	**First aircraft**	**Total**
1	19	MM7089	2	MM55024	8	5500	1	5650	30
2	53	MM7108	6	MM55026	22	5508	3	5651	84
3	38	MM7161	18	MM55034	15	5530	7	5654	78
Total	110		**26**		**45**		**11**		**192**

Notes: Excludes seven single-seat prototypes and 12 aircraft for Venezuela

ITALIAN AMX UNITS

Squadron	Wing	Base	Type	First aircraft and acceptance	
13° Gruppo	32° Stormo	Amendola	AMX	MM7112	Nov 94
			AMX-T[1]	MM55029	by Apr 95
14° Gruppo	2° Stormo	Rivolto[2]	AMX	MM7130	10 Jul 91
			AMX-T[1]	MM55028	24 Nov 94
28° Gruppo[5]	3° Stormo	Villafranca	AMX	MM7129	Jun 93
			AMX-T[1]	MM55029	by Dec 94
101° Gruppo[3]	32° Stormo	Amendola	AMX	MM7091	31 Jul 95
			AMX-T	MM55030	21 Nov 94
103° Gruppo	51° Stormo	Istrana	AMX	MM7098	30 Sep 89
			AMX-T[1]	MM55027	by Apr 95
132° Gruppo	51° Stormo	Istrana[6]	AMX	MM7110	15 Nov 90[4]
			AMX-T[1]	MM55037	4 Dec 95

[1] One aircraft only
[2] At Istrana until February 1994
[3] Unit initially re-equipped as 201° Gruppo (until 31 July 1995): AMX OCU
[4] Initial working up at Istrana
[5] Disbanded 29 September 1997
[6] Villafranca until March 1999

BRAZILIAN AMX UNITS

Squadron	Wing	Base	First delivery
1° Esquadrão 'Adelfi'	16 Grupo de Aviação	Santa Cruz	Formed 7 November 1990[1]
1° Esquadrão 'Poker'	10 Grupo de Aviação	Santa Maria	1996
3° Esquadrão 'Centauro'	10 Grupo de Aviação	Santa Maria	1998

[1] Out of Nucleo A-1, originally established 7 November 1988

with Companhia Eletro-Mecânica (CELMA) in Brazil. Self-sealing, compartmented, rubber fuselage bag tanks and two integral wing tanks with combined capacity of 3,500 litres (924.6 US gallons; 770 Imp gallons). Brazilian AMX carry 200 litres (52.8 US gallons; 44.0 Imp gallons) more internal fuel in additional saddle tank behind cockpit. Auxiliary fuel tanks of up to 1,100 litres (290 US gallons; 242 Imp gallons) capacity can be carried on each inboard underwing pylon, and up to 580 litres (153 US gallons; 128 Imp gallons) on each outboard pylon. Single-point pressure or gravity refuelling of internal and external tanks. In-flight refuelling capability (probe and drogue system) is standard.

ACCOMMODATION: Pilot only, on Martin-Baker Mk 10L zero/zero ejection seat; 18° downward view over nose. One-piece wraparound windscreen (reinforced on Brazilian aircraft); one-piece hinged canopy, opening sideways to starboard. Cockpit pressurised and air conditioned. Tandem two-seat combat trainer/special missions version also produced, with Mk 10LY-2 (front) and Mk 10LY-3 (rear) seats.

SYSTEMS: Microtecnica environmental control system (ECS) provides air conditioning of cockpit, avionics and reconnaissance pallets, cockpit pressurisation, air intake and inlet guide vane anti-icing, windscreen demisting and anti-*g* systems. Duplicated redundant hydraulic systems, driven by engine gearbox, operate at pressure of 207 bar (3,000 lb/sq in); both actuate primary flight control system (aileron, elevators and rudder) and secondary (flap and slat system); No. 1 circuit additionally supplies outboard spoilers, nosewheel steering and gun; No. 2 also supplies inboard spoilers and landing gear actuation. Primary electrical system AC power (115/200 V at fixed frequency of 400 Hz) supplied by two 30 kVA IDG generators, with two transformer-rectifier units for conversion to 28 V DC; 36 Ah Ni/Cd battery for emergency use, to provide power for essential systems in the event of primary and secondary electrical system failure. Aeroeletrônica (Brazil) external power control unit. Fiat FA 150 Argo APU for engine starting. APU-driven electrical generator for ground operation. Liquid oxygen system.

AVIONICS: All avionics/equipment packages pallet-mounted and positioned for rapid access. Modular design and space provisions within aircraft permit retrofitting of alternative avionics.

Comms: UHF and VHF com, and IFF.

Radar: Pointer ranging radar in Italian AMXs is I-band set modified from Elta (Israel) EL/M-2001B and built in Italy by FIAR. Brazilian aircraft were originally intended to have Teenasa/SMA-built (Alenia) SCP-01 Scipio radar, but this was not installed at time of production due to local bankruptcies of two Brazilian companies selected to produce the radar. It will now be fitted as part of the mid-life upgrade.

Flight: Litton Italia INS, with standby AHRS and Tacan, for Italian Air Force; VOR/ILS for Brazil. Data processing, with Microtecnica air data computer. BAE Systems MED 2067 video monitor display in rear cockpit of two-seater, for use by instructor/navigator as HUD monitor.

Instrumentation: Alenia computer-based weapon aiming and delivery, incorporating radar and Alenia stores management system; digital data displays (OMI/Alenia head-up, Alenia multifunction head-down, and weapons/nav selector). Provision for night vision goggles.

Mission: Italian aircraft of 3° Stormo equipped with Oude Delft Orpheus reconnaissance pods, and was an internal sensor suite being sought for deployment in 2001. This is believed to have been cancelled, but was to have comprised any one of three interchangeable Aeroeletrônica (Brazil) pallet-mounted photographic systems installed internally in forward fuselage, complementing external IR/EO pod on centreline pylon. Each system fully compatible with aircraft, and not affecting operational capability. Camera bay in lower starboard side of fuselage, forward of mainwheel bay.

Self-defence: Elettronica active and passive ECM, including fin-mounted radar warning receiver.

ARMAMENT: One M61A1 multibarrel 20 mm cannon, with 350 rounds, in port side of lower forward fuselage of aircraft for Italian Air Force (one 30 mm DEFA 554 cannon on each side in aircraft for Brazilian Air Force). Single stores attachment point on fuselage centreline, plus two attachments under each wing, and wingtip rails for two AIM-9L Sidewinder or similar IR air-to-air missiles (MAA-1 Piranha on Brazilian aircraft). Fuselage and inboard underwing points each stressed for loads of up to 907 kg (2,000 lb); outboard underwing points stressed for 454 kg (1,000 lb) each; wingtip stations stressed for 113 kg (250 lb) each. Twin carriers can be fitted to all five stations. Total external stores load 3,800 kg (8,377 lb). Attack weapons can include free-fall or retarded Mk 82/83/84 bombs, laser-guided bombs, cluster bombs, air-to-surface missiles (including area denial, anti-radiation and anti-shipping weapons), electro-optical precision-guided munitions and rocket launchers.

Exocet firing trials conducted 1991; Marte trials 1994; carriage trials of GBU-16 Paveway II LGB on Italian AMX in 1995 and aircraft used Elbit Opher LGB system during Operation Allied Force over Kosovo, May-July 1999.

Upgraded Brazilian aircraft will have additional weapons capability, including indigenous MAR-1 anti-radiation missile as well as precision guided munitions. MAR-1 expected to enter service in 2005, with inital deployment on standard A-1A aircraft of 10° GAv at Santa Maria. Upgraded Italian aircraft to be compatible with JDAM.

DIMENSIONS, EXTERNAL:

Wing span:	
excl wingtip missiles and rails	8.875 m (29 ft 1½ in)
over missiles	9.97 m (32 ft 8½ in)
Wing aspect ratio	3.8
Wing taper ratio	0.5
Length: overall	13.23 m (43 ft 5 in)
fuselage	12.55 m (41 ft 2 in)
Height overall	4.55 m (14 ft 11¼ in)
Tailplane span	5.20 m (17 ft 0¾ in)
Wheel track	2.15 m (7 ft 0¾ in)
Wheelbase	4.70 m (15 ft 5 in)

AREAS:

Wings, gross	21.00 m² (226.0 sq ft)
Ailerons (total)	0.88 m² (9.47 sq ft)
Trailing-edge flaps (total)	3.86 m² (41.55 sq ft)
Leading-edge slats (total)	2.07 m² (22.28 sq ft)
Spoilers (total)	1.30 m² (13.99 sq ft)
Fin (exposed)	4.265 m² (45.91 sq ft)
Rudder	0.83 m² (8.93 sq ft)
Tailplane (total exposed)	5.10 m² (54.90 sq ft)
Elevators (total)	1.00 m² (10.76 sq ft)

WEIGHTS AND LOADINGS (all versions):

Operational weight empty	7,000 kg (15,432 lb)
Max fuel weight: internal	2,720 kg (5,997 lb)
external	1,726 kg (3,805 lb)
Max external stores load	3,800 kg (8,377 lb)
T-O weight (clean)	9,694 kg (21,371 lb)
Typical mission T-O weight	10,750 kg (23,700 lb)
Max T-O weight	13,000 kg (28,660 lb)
Normal landing weight	7,000 kg (15,432 lb)
Combat wing loading (clean)	457.1 kg/m² (93.62 lb/sq ft)
Max wing loading	619.1 kg/m² (126.79 lb/sq ft)
Max power loading	265 kg/kN (2.60 lb/lb st)

PERFORMANCE (A at typical mission weight of 10,750 kg; 23,700 lb with 907 kg; 2,000 lb of external stores, B at max T-O weight with 2,721 kg; 6,000 lb of external stores, ISA in both cases):

Max level speed: at S/L	M0.83
at 9,140 m (30,000 ft)	M0.86
Max rate of climb at S/L	3,124 m (10,250 ft)/min
Service ceiling	12,800 m (41,995 ft)
T-O run at S/L: A	631 m (2,070 ft)
B	982 m (3,220 ft)

T-O to 15 m (50 ft) at S/L: B ..... 1,442 m (4,730 ft)
Landing from 15 m (50 ft) at S/L: B ..... 753 m (2,470 ft)
Landing run at S/L ..... 505 m (1,657 ft)
Attack radius, allowances for 5 min combat over target and 10% fuel reserves:
lo-lo-lo: A ..... 300 n miles (556 km; 345 miles)
B ..... 285 n miles (528 km; 328 miles)
hi-lo-hi: A ..... 480 n miles (889 km; 553 miles)
B ..... 500 n miles (926 km; 576 miles)
Ferry range with two 1,000 litre (264 US gallon; 220 Imp gallon) drop tanks, 10% reserves ..... 1,800 n miles (3,333 km; 2,071 miles)
g limits ..... +7.33/−3

AM

AIRBUS MILITARY SAS

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SENIOR VICE-PRESIDENT COMMERCIAL: Richard Thompson
CUSTOMER INTERFACE DIRECTOR: Angel Hurtado
VICE-PRESIDENT MARKETING: David R Jennings

PARTICIPATING COMPANIES
Airbus SAS (France)
EADS CASA (Spain)
FLABEL (Belgium)
TAI (Turkey)

Airbus Military was legally established in January 1999 as a 'Société par Actions Simplifiées' as the prospective manufacturer of the Airbus A400M, formerly known as the Future Large Aircraft (FLA). Airbus is the major (63 per cent) shareholder in Airbus Military; TAI, OGMA and FLABEL are full risk-sharing partners. Airbus Military has assigned overall programme management, during development, to Airbus in Toulouse; as the programme reaches the production phase, responsibility will progressively transfer to Spain.

Conceptual work was undertaken by the European FLA Group (Euroflag). Euroflag Srl originally formed 17 June 1991, with headquarters in Alenia head office in Rome, to manage European FLA development. Aerospatiale, Alenia, British Aerospace, CASA and Daimler-Benz Aerospace Airbus (DaimlerChrysler from 1998) had equal shares in Euroflag Srl; MoUs established 1992 with FLABEL (SABCA, SONACA, ASCO and BARCO) of Belgium, OGMA of Portugal and Turkish Aerospace Industries (TAI) of Turkey to allow integrated participation in FLA programme; BAE and FLABEL were industrial, not national, partners contributing their own funds, although the UK government announced in December 1994 that membership was to be upgraded to national participation.

The partners agreed in September 1994 to industrialise the programme by transferring it to their existing airliner production company; formal announcement was made on 14 June 1995 that Airbus Military Company would be established. This eventually occurred in January 1999, when it replaced Euroflag, which then disbanded. Programme makes use of Airbus procedures and industrial infrastructure and takes advantage of technologies developed for Airbus airliners. The projected percentage shares for R&D financing at that time were Germany 25.7, France 17.2, UK 15.5, Italy 15.1, Spain 12.4, Turkey 6.9, Belgium 4.1 and Portugal 3.1.

By early 1997, the FLA programme had lost development sponsorship by the principal participating governments, although military commitments remained, subject to the aircraft being produced with commercial funding. Programme weakened in 1997 by unilateral German negotiations with Ukraine over Antonov An-7X (Westernised An-70), which ultimately proved fruitless.

Airbus Military submitted responses to the seven-nation FLA RFP (request for proposals, dated September 1997) on 29 January 1999 and to the competitive Future Transport Aircraft (FTA) RFP issued to Boeing, Airbus and Lockheed Martin by Belgium, France, Spain and the UK on 31 July 1998. Acceptance of A400M formally announced by all seven members on 27 July 2000; subsequently, on 19 June 2001, MoU signed by seven of nine participating nations (Belgium, France, Germany, Luxembourg, Spain, Turkey and the UK) concerning joint procurement through OCCAR, with Italy and Portugal expected to follow suit in the near future. In the event, Italy announced intention to withdraw from project on 25 October 2001, with Portugal following suit in early 2003.

Programme encountered further difficulties in early 2002. Although OCCAR signed memorandum of understanding with Airbus Mlitary Company on 18 December 2001 for 196 aircraft for eight countries, Germany failed to secure parliamentary approval for funding before agreement expired on 31 January 2002; Germany finally announced intention to go ahead with purchase at beginning of December 2002, by which time the number of aircraft involved had fallen from 73 to 60. Subsequently, on 27 May 2003, launch order for 180 aircraft signed in Bonn by OCCAR and Airbus Military Company, with industrial programme formally launched four days later, on 31 May; previously, on 6 May, Europrop International TP400-D6 engine chosen to power the A400M.

Clarification of the programme organisation led to Airbus Military being reconstituted as a Spanish company, Airbus Military S.L, with registered offices in Madrid. Shareholders comprise Airbus (representing EADS and BAE Systems), EADS CASA of Spain, FLABEL of Belgium and TAI of Turkey.

AIRBUS MILITARY A400M

TYPE: Medium transport/multirole.
PROGRAMME:

DEVELOPMENT MILESTONES

Requirement issued (Euroflag established)	Apr 89
Feasibility study completed	May 95
Airbus Military Company established	Jan 99
Technical/commercial proposals to MoDs	Jan 99
Programme launched (official go-ahead)	May 03
First metal cut	Jan 05
First powerplant test run	Feb 06
First flight (scheduled)	Jan 08
First delivery (France)	Oct 09

Original FIMA programme replaced April 1989 by five-nation industry MoU to develop four-turbofan, new technology transport to replace C-130 Hercules and C.160 Transall; Independent European Programme Group (IEPG) defined Outline European Staff Target (OEST) during 1991; initial studies undertaken by Euroflag (European Future Large Aircraft Group) organisation, which name reflected working designation Future Large Aircraft (FLA). Western European Union report in third quarter of 1991 concluded Euroflag FLA should form core of future European military transport capability to support Rapid Reaction Corps; national armament directors of Belgium, France, Germany, Italy, Portugal, Spain and Turkey affirmed support for 12 month prefeasibility study completed by Euroflag in late 1992; UK MoD declined involvement, but retained observer status; UK participation privately maintained by BAe and Shorts (10 per cent of BAe work); European Staff Target and intergovernmental MoU signed by seven nations in 1993; full feasibility programme officially started October 1993, by which time cargo hold width and height increased from original 3.66 m (12 ft 0 in) and 3.55 m (11 ft 7¼ in), respectively; study finished May 1995 and submitted to European defence ministries. Meanwhile, FLA underwent profound change in April 1994 when turbofans deemed incapable of providing desired performance; aircraft recast with four turboprops of new design. Discussion of a 'close association' between Euroflag and Airbus Industrie began third quarter of 1993 and formalised in June 1995.

Artist's impression of Airbus Military A400M 1040469

Airbus A400M cockpit mockup was accepted by the customer (OCCAR) on 22 September 2006 1040470

Launch of the predevelopment phase (PDP) was postponed at least six months from early 1996 as a result of funding uncertainties. Original intention was for PDP to run from 1996 to 1998 and define a comprehensive specification for the aircraft and contractual forms and conditions against which the partner nations would make commitments. Full development and production phase (DPP) scheduled to follow directly on from PDP and terminate with first flight in 2002. Customer deliveries were then planned to begin in 2004.

France announced funding withdrawal from FLA development on 13 May 1996 and UK failed to rejoin the programme later that year, despite intention announced in December 1994 (when the RAF purchased Lockheed Martin C-130J Hercules). However, Germany became first to sign a European Staff Requirement, on 24 July 1996, although having terminated official funding for FLA development in previous month. AMC accordingly announced a 'single-phase' programme in May 1996.

The new programme schedule started in mid-1998 with a set of formal prelaunch activities (PLA), largely funded by industry and lasting 12 months, leading to a fully documented proposal for the Airbus A400M. This contained the technical proposal, including the aircraft specification and performance guarantees, and the commercial proposal with firm and fixed prices; a full set of contractual terms and conditions; and detailed planning of the single-phase programme. Strategic workshares (detailed enough to allow industry to provide the necessary resources to complete the proposal) were agreed at the start of PLA.

February 1999 delivery of the A400M proposal, initiated a 12-month period of negotiation of individual national requirements before planned official launch during early 2000 to meet an ESR now supported by Belgium, France, Germany, Italy, Spain, Turkey and the UK, but not Portugal. The 'PLA + single phase' programme provides industry with an uninterrupted development schedule and strong commitments from governments, while it also meets the customers' requirement that industry carries as much of the development risk as possible.

A meeting in March 2000 saw Belgium, France, Italy, Spain and Turkey identify a requirement for 131 A400Ms (37 fewer than expected) while, on 16 May, UK announced its intention to buy 25 aircraft (becoming first to fully commit). France and Germany

followed on 9 June 2000. Seven participating nations announced selection of A400M on 27 July, committing to 225, including one for Luxembourg, although Turkey had reduced planned procurement to 10 at time of MoU signature in June 2001. Portugal announced requirement for four shortly thereafter and subsequently rejoined programme as a risk-sharing and industrial partner in early 2001. By June 2001, however, number of aircraft had fallen to three and Portugal subsequently withdrew in early 2003. MoU of 18 December 2001 on development and acquisition of A400M covered 196 aircraft, omitting 16 for Italy which, in late October 2001, revealed it would not proceed with purchase. Formal launch was expected in early 2002, but was delayed for over a year as consequence of German failure to obtain parliamentary funding approval. However, Germany made commitment in December 2002 to 60 aircraft and programme officially launched on 27 May 2003, with signature of contract for 180 aircraft by OCCAR (Organisation Conjointe de Co-operation en natière d'Armement), acting on behalf of seven launch customers, and Airbus Military.

Subsequently, in 2005, South Africa and Malaysia ordered eight and four aircraft respectively and became programme partners. Engine selection announced 6 May 2003; propeller on 24 July 2003; Milestone 1 (submission of quality plan) passed 29 August 2003, this accepted by OCCAR on 14 October 2003; Milestone 2 (launch of engine development) achieved 20 January 2004; landing gear selection 9 February 2004. First metal cut (in Germany) on 26 January 2005, with first powerplant run (engine and propeller combination) successfully accomplished at Istres, France, on 28 February 2006. Flight trials of engine/propeller combination to be undertaken on Hercules testbed modified by Marshall Aerospace at Cambridge, UK; this due to fly for first time in early 2007 and will perform approximately 200 hours of airborne testing.

Notable production-related events in 2006 included launch of wing fabrication at Filton in February, with final assembly of first wing beginning on 25 July in anticipation of delivery to Seville in first quarter of 2007; delivery of first rear fuselage section shells to Bremen by EADS Military Air Systems on 31 March; delivery of first fuselage components by TUSAS Aerospace Industries of Turkey in April; delivery of first fuselage top shells by Denel of South Africa in mid-year; start of integrated fuselage assembly process at Bremen on 24 July; transfer of first nose section by Airbus France from Méaulte to St Nazaire for installation of equipment (hydraulics, electrical systems, avionics and furnishings); and fitting out of first fuselage at Bremen from October. Major fuselage assemblies due to be virtually complete by end of 2006, with transfer to Seville scheduled to take place in early 2007, enabling final assembly to start in first quarter of that year.

Some 2,500 hours of developmental flight testing will be performed at EADS CASA's Seville plant and Airbus' Toulouse facility, with certification by a single authority; first six aircraft to be used for development, of which five will be refurbished and sold on completion of test duties, with final aircraft retained by Airbus Military as company-owned prototype. First aircraft to be delivered will be seventh A400M, scheduled for hand-over to French Air Force in October 2009. EADS CASA at Seville will have sole production line, assembling components supplied by partners in from Belgium, France, Germany, Malaysia, South Africa, Spain, Turkey and the UK.

A timetable of 56 months between contract and first flight has been agreed, with first delivery and IOC of a common configuration'logistics' aircraft 77 months after contract signature. Maiden flight scheduled for early in 2008; deliveries to begin in October 2009. Production programme anticipates delivery of three aircraft in 2009, 17 in 2010, 27 in 2011, 26 in 2012 and about 28 per year thereafter. France and Turkey will be first to accept aircraft, with Germany and the UK receiving their first A400Ms in 2010; Spain following in 2011, Luxembourg in 2017 and Belgium in 2018 Final deliveries to original customers in 2021.

AIRBUS A400M EQUIPMENT SUPPLIERS

AAR Cargo Systems	Floor-based cargo loading system, aerial delivery system
AB Electronic Ltd	Halosensor drill position locator
AERnnova	Wing stringers
Aerofit, Inc	Fittings
Aerospace Display Systems, LLC	Electronic clocks
Aerosud Pty Ltd	Nose fuselage flexible lining, cargo hold lining, wing tip, cockpit linings, rigid bulkhead
Airbus Deutschland GmbH	Wing panels, centre fuselage, vertical tail plane box & assembly, flaps, rear fuselage assembly, fuselage furnishing, pre-final assembly line
Airbus SAS	Centre wing box, nose fuselage, nose landing gear bay, engine mounts, sponsons, rudder, wing fuselage fairing, cockpit furnishings
Airbus UK	Outer wing box, flaps
Air Liquide - Direction des Techniques	Onboard oxygen generating system
Alema Automation	Forward hatch
Alenia Aeronautica SpA	Aft fuselage
AOA Apparatebau Gauting GmbH	Fans, fuel pumps, smoke detection
Argosy International, Inc	Prepregs
ASG Luftfahrttechnik & Sensorik GmbH	Hand pump
Aries Complex, SA	Wing flap parts, wing fixed vane assembly
Astronautics Corp of America	Network server system
Axon Cable SAS	MIL-STD-1553 cable assemblies
BAE Systems (UK)	FADEC (with Hispano-Suiza)
Barry Controls Aerospace	Engine vibration isolators, APU mounts
B/E Aerospace Inc (Wellington)	Integrated passenger and crew oxygen system
Behr Industry GmbH & Co KG	Heat exchangers
Bell-Memphis, Inc	Control cable turnbuckles
Bohler Uddeholm Group	Leading edge titanium pylon forgings
Breeze-Eastern	Parachute line retrieval winch
Capewell Life Support/Aerial Delivery Systems	Aerial delivery platform, buffer stop assembly, tow plate
Castle Aero	Sponsons
CESA	Hydraulic reservoirs, including sensors, landing gear hydraulic equipment
Chelton (Electrostatics) Ltd	Static dischargers, tuneable V/UHF antenna, VDR antenna, IFF antenna, passive V/UHF antenna, Satcom
Cincinnati Machine	Composites machining equipment
Cobham Composites Ltd	Composites structures
Composite Industrie SA	Nose fuselage air conditioning ducts
Composites Technology Research Malaysia	Vertical tail plane trailing edge, vertical tail plane leading edge, horizontal tail plane trailing edge, nacelle extension fairing
Crane Aerospace/Hydro-Aire Inc	Braking & anti-skid control system
Crissair Inc	Check valves
Denel Aviation	Fuselage top-shells, carbon composites wing-fuselage fairing
Didsbury Engineering Co Ltd	Minilift hoist
Diehl Avionik Systeme	Doors control and monitoring system
DRS Electronic Warfare & Network Systems, Inc	Wideband wireless network
Dunlop Aircraft Tyres	Bias ply nose and main tyres
EADS CASA	Horizontal stabiliser, flap track fairings, vertical tail plane leading and trailing edges, elevators, nacelles
EADS Defence & Security Division	Digital map generator system, mission management computer, defensive aids computer
EADS Socata	Sponsons, nose landing gear doors
EADS Sogerma	Troop seats, cockpit seats
EADS Test & Services	Automatic test equipment
Eaton Aerospace, Fluid Power Division	Reservoir filling and ground service panel
ECE	Emergency power system contactors
EIS Aircraft GmbH	Troop seating
Engelhard Corp	Ozone converter
EUFA Europa Fasteners GmbH	Fasteners
Europrop International GmbH	TP400-D6 engines
Falgayras	Windshield wiper system
Fastening Systems Intl, Inc	Blind rivet tooling
Flight Refuelling Ltd	Air refuelling system including Mk 908E wing pods and Mk 808E fuselage refuelling units
Froude Hofmann	Engine test stand
GKN Aerospace	Metal and composites wing trailing edge subassemblies, composites wing spars, wing leading and trailing edge composites details and panels, aluminium alloy engine air inlet
Goodrich Corporation, Power Systems	Main and auxiliary power unit electric generators (via Aerolec)
Goodrich Corporation Sensor Systems	SmartProbe air data system
Goodrich Corporation Actuation Systems	Flap actuation package
Hamilton Sundstrand Electric Systems	Secondary electrical power distribution centre, ram air turbine emergency power system
Hamilton Sundstrand Power Systems	APU
Hexcel Composites	Honeycomb and prepreg
Hispano Suiza	Electrical wiring harnesses, electronic control unit, accessory gear box, control system integration, fuel pump, fuel metering unit, injectors
HR Smith (Technical Developments) Ltd	Antennas
Hyde Aero Products Ltd	Wing leading edge metallic details
Icore International Ltd	PTFE hoses
Indra Sistemas, SA	Radar warning receiver
Intertechnique	Anti-ice system control unit, electrical functions software, hydraulic system monitoring unit, oxygen system control unit, fuel measurement and management system
Johns Manville, Inc	Fibre glass insulation blankets and felt
KTN Kunststofftechnik Nobitz GmbH	Centre fuselage air conditioning ducts
Labinal	Non-ARINC avionics racks and relay boxes, nose fuselage and cockpit electrical harnesses
LASELEC SA	UV laser wire and cable marking equipment
Latelec	Avionics racks
Leach International Europe SA	Primary electrical power distribution centre
Le Creneau Industriel	Machine tools
Liebherr-Aerospace Lindenberg GmbH	Primary flight control actuators, nacelle anti-ice system, bleed air and leak detection (with EADS CASA), air generation and temperature control systems/VCS/CPCS
Lomas Engineering Ltd	Cutting tools
MTI Leewood GmbH	Nose fuselage insulation
Magellan Aerospace Corp	Structural components
Magnaflux	Zyglo fluorescent penetrant
Magnolia Plastics, Inc	Epoxy syntactics
Mecachrome SA	Wing ribs
Meggitt Safety Systems Inc	Fire detection system
Mensor Corporation	Air data test sets
Messier Bugatti	Wheels and brakes, SLK (steering, landing & kneeling) systems
Messier-Dowty	Landing gear
Microtecnica	Propeller control module
MRC Bearings	Engine and gearbox bearings
MS Composites	Cockpit armoured protection
M Torres Disenos Industriales S A	Machine tools
Nichols Airborne Division	Electric motor pumps
NMB Minebea UK Ltd	Spherical bearings
Nord-Micro AG & Co OHG	De-icing timer for propeller de-icing system
Norwich Aero	Temperature & speed sensors
Olutex	Centre fuselage insulation

Omega Technologies, Inc	Fastener installation and removal tools, hole drilling and preparation tools
Otto Fuchs KG	Horizontal tail plane inner fitting forging
Pacific Scientific HTL/Kin-Tech Division	Fire extinguishing (engines)
Pall GmbH Luftfahrttechnik	Reservoir pressurisation unit and bleed air restrictor
Pall Aerospace	Filters
Parker Aerospace, Air & Fuel Division	Fuel tank inerting systems
Patria Aerostructures Oy	Vertical tail plane tip fairing
PFW Aerospace AG	Cargo handling system, structural floor and drainage system, aerial delivery system
PPG Aerospace Transparencies	Cockpit windows
Ratier Figeac	FH386 eight-bladed propeller system, trimmable horizontal stabiliser actuator
Rheinmetall Defence Electronics GmbH	Cargo hold loadmaster control system electronics
Rockwell Collins	Avionics full duplex ethernet, avionics communications router, direction finder, HF-9500 communications system, satcom
Rohde & Schwarz International GmbH	M3AR family software radios, ELCRODAT 4-2 crypto units
Rotastat	Electric motors
RTI Intl Metals, Inc	Titanium
Saab Aerostructures	Crew door
Saab Avitronics	High lift control computer
SABCA	Vertical tail plane stringers, flap master supports
Saft America Inc	Ultra low maintenance rechargeable nickel-cadmium batteries
Schroth Safety Products GmbH	Troop restraint systems
Sener Ingeniería & Sistemas SA	Horizontal stabiliser structural design
Sirio Panel SpA (via Tusas Aerospace)	LED lighting system, including cargo, service, external and emergency lights and power sources
Sirio Panel SpA	Integrated control panel system including integrated control panels, front face panels, lighting management units
Smiths Aerospace (Aerostructures)	In-flight refuelling probe
Smiths Aerospace Digital	ViDP video distribution & processing system
Sonaca SA	Wing fixed leading edges, main landing gear doors, leading edge cowlings, wing anti-icing system
Stratoflex Products Div	Flexible hoses and quick disconnect valves
TEAM	Passenger address system
Tech SAT GmbH	Core system of military test facility
Techspace Aero SA	Oil systems for TP400 engine
Techtest	Emergency locator transmitter
Teledyne Relays	Relays and switches
Thales Avionics Electrical Systems	Electrical power generation system
Thales Avionics SA	FMS400 flight management system, integrated modular avionics, FLIR, control and display system, incl interactive LCD screens, TACAN
Transport Dynamics Corp	Bearings
Tritech Precision Products Ltd	Machined and cast fuel connectors
Tusas Aerospace Industries	Forward centre fuselage, tailcone and top shell on rear fuselage, paratroop doors and hatch doors, ailerons and spoilers, interior and exterior lighting
Valley-Todeco, Inc	Bearings and bolts
Weston Aerospace Ltd	Sensor suite for TP400M engine

CURRENT VERSIONS: Primarily for carriage of military personnel and outsize cargoes such as helicopters, armoured fighting vehicles, trucks and 40 ft ISO containers. Also designed to provide full aerial delivery and tactical air land capability, particularly into soft, natural surface airstrips. Typical strategic air transport capability will be 30,000 kg (66,139 lb) payload over 2,400 n miles (4,445 km; 2,762 miles) with military reserves, or 20,000 kg (44,092 lb) payload over 3,450 n miles (6,389 km; 3,970 miles). A400M standard specification allows aircraft to be used in air-to-air refuelling (AAR) role with addition of underwing hose and drogue dispensing pods; alternatively, A400M can be modified to operate as a single-hose centreline refueller, with a pallet-mounted hose drum unit, secured to the closed rear ramp. Fuel load can be increased by installation of two additional tanks in cargo hold, up to total capacity of 11,375 kg (25,078 lb). With additional fuel tanks installed, an A400M could transfer 40,000 kg (88,185 lb) of fuel at a point 400 n miles (740 km; 460 miles) from base with loiter time of two hours. A400M speed envelope permits safe refuelling of fighter and large multi-engined aircraft, as well as helicopters. On an AAR mission, including two hours loiter on station at range of 500 n miles (926 km; 575 miles), A400M would have potential 'give-away' of about 35,000 kg (77,162 lb) and still retain sufficient fuel to return to base with normal reserves. Single-point AAR configuration can transfer fuel at rate of up to 1,800 kg (3,965 lb)/min; two-point configuration has maximum fuel transfer rate of 1,200 kg (2,646 lb)/min. In December 2005, France, Germany and Spain confirmed intent to purchase AAR kit for A400M from Flight Refuelling of UK; France and Germany will each receive 10 Mk 908E shipsets (20 pods), while Spain requires nine shipsets. France and Germany also to obtain Mk 808E centreline hose drum refuelling units, having signed for five and six respectively.

CUSTOMERS: See table. Procurement agency is OCCAR in Bonn, acting for all seven European launch countries. Average planned production capacity is 28 aircraft per year to meet demand from launch and subsequent export customers. Export market estimated at about 450 aircraft over 25 years, with A400M expected to account for some 200 of this total. Most recent customer is Malaysia, which signed contract for four AAR-capable A400Ms in Langkawi on 8 December 2005; initial pair to be delivered in 2013, with remaining two following in 2014. To replace total of 14 C-130s, so further orders appear feasible. Chile had previously emerged as customer for three in mid-2005, but change of government in March 2006 resulted in review of plan and eventual abandonment. Australia and Canada both considered to be potential customers, but both opted to acquire Boeing C-17 Globemaster III.

First Airbus A400M fuselage on completion of assembly at Bremen in September 2006 1040471

A400M ORDERS
(at November 2006)

Country	Qty
Belgium	7
France	50
Germany	60
Luxembourg	1
Malaysia	4
South Africa	8
Spain	27
Turkey	10
UK	25
Total	**192**

COSTS: Total development cost expected to be around EUR5.5 billion. Unit price approximately EUR100 million for the Common Standard aircraft (2006).

DESIGN FEATURES: High-wing, T-tailed aircraft with rough-field landing gear and much larger cabin/hold floor area and cross-section than C-130/C-160, permitting high payload factors with low-density cargo, vehicles or mixed passenger/cargo loads. Use of propellers felt to be essential for steep tactical approaches to landing; hot-and-high airfield performance; adequate thrust-reverse performance for taxying and short landing; for maximising power response; and for minimising FOD vulnerability. Long-range cruising speed of M0.68 to M0.72 up to 11,280 m (37,000 ft). Tactical mission parameters of low-level flight down to 150 m (500 ft) AGL in IMC in manual or automatic operation on predetermined route with civil standard of safety; 92 m (300 ft) night VMC in manual operation; 46 m (150 ft) day VMC in manual operation. Minimum service life 30,000 hours, including allowance for low-level flight and short-field performance. Optimised for autonomous deployment; Airbus Military offering 15-day away-from-base serviceability guarantee, all necessary support being within flight crew's capabilities.

Wing sweep 15° at 25 per cent chord; anhedral 4°; taper ratio 0.345; mean aerodynamic chord 5.671 m (18 ft 7¼ in). Tailplane sweep 32.5° at 25 per cent chord.

FLYING CONTROLS: Fly-by-wire, hydraulically powered; all control surfaces electrically signalled, adapted to military requirements and specific mission profiles; ailerons and elevator actuated by a hydraulic circuit, which powers one actuator, and an electrical circuit, which powers an electro-hydrostatic actuator; rudder actuated by two electrical back-up hydraulic actuators, each powered by one hydraulic circuit and one electrical circuit. Five spoilers and two-section fixed-vane flaps on each wing; tailplane trimmable by screw-jack. No slats. Spoilers used for roll control, lift dumping and as speed brakes.

STRUCTURE: Aluminium alloy, with titanium alloy in highly loaded areas (around windscreen, wing/fuselage joint and landing gear anchorage) and glass fibre or carbon fibre for lightly loaded components (landing gear doors and various fairings). Tailplane has aluminium alloy central joint and two outer composites box structures; elevator primary structure of carbon fibre. Constant-chord fin has two-spar (originally three-spar, but later changed) main box, trailing-edge shroud and single-piece rudder, all primarily of composites, plus hybrid metal/composites removable leading-edge. Rudder of carbon fibre, with aluminium, hinge-connecting ribs. Extensive use of carbon fibre composites in wing for skins, stringers, spars and moving surfaces; metal for ribs, fixed leading-edges, engine mountings and fuselage pick-ups. Front spar at 15 per cent chord; composites rear spar at 62.5 per cent chord. Modern design and manufacturing techniques expected to afford major reductions in maintenance man-hour requirements and increases in aircraft availability/survivability.

LANDING GEAR: Retractable Messier-Dowty tricycle type with sufficient 'flotation' for semi-prepared and/or unsurfaced runways. Each main unit has six wheels in tandem pairs, retracting rearwards into fairings on fuselage sides. Each pair of mainwheels has independent, lever-type shock-absorbers. Mainwheel tyres, size 43×15.5-17, pressure 8.83 bar (128 lb/sq in). Twin nosewheels retract forwards. Nosewheel tyres, size 37×14.0-14, pressure 7.86 bar (114 lb/sq in). Emergency gravity extension of all units. Multidisc carbon brakes on mainwheels can operate differentially to assist steerable nosewheel in ground manoeuvring. Turning radius: landing gear 15 m (50 ft); wingtip 28.6 m (94 ft). Operable from CBR4 soft field. Mainwheels can 'kneel' for loading and unloading of large tracked and wheeled vehicles. Hydraulic strut at rear of each sponson supports and stabilises aircraft during loading and unloading.

POWER PLANT: Choice initially settled on three-shaft 7,457 to 9,694 kW (10,000 to 13,000 shp) turboprop TP400 developed by Fiat Avio, ITP, MTU, Rolls-Royce, SNECMA and

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Techspace Aero, although this also rejected in February 2002 on basis of being too costly and too heavy as well as insufficiently powerful. Engine competition subsequently re-opened, with European and Canadian manufacturers submitting proposals. Airbus announced engine decision 6 May 2003, when EuroProp International (ITP, MTU, Rolls-Royce and Snecma) TP400-D6 selected in preference to Pratt & Whitney Canada PWC180.

Each engine provides 9,694 kW (13,000 shp) thermodynamic power de-rated to 8,203 kW (11,000 shp) for take-off. Engine has a three-shaft configuration, an offset gearbox and dual-channel FADEC with propeller control. Engines are 'handed', with one of each wing pair rotating in opposite direction to the other, offering reduction in torque and elimination of asymmetric airflow over wing. This 'down between' engine configuration also improves asymmetric handling in event of one engine becoming inoperative.

Eight-blade FH386 composites curved propellers to be supplied by Ratier-Figeac/Hamilton Sundstrand. Propeller tip speed 290 m/s (951 ft/s) at M0.68, 842 rpm maximum speed for take-off. Composites blades with integral de-icing blankets. Full reversal of pitch will allow aircraft to back up 2° slope at MTOW on concrete surface (1° on soft surface). Adjacent propellers turn in opposite directions to produce DBE (down between the engines) airflow. Viewed from rear Nos.1 (port outer) and 3 (stbd inner) turn clockwise; Nos. 2 and 4, anticlockwise Advantages comprise more symmetric airflow, weight savings, reduced wing loading, increased (4 per cent) and better lift distribution, quieter cargo bay, better OEI handling, and reduced empennage area (fin 17 per cent; horizontal tail 12 per cent).

Ultra Electronics Tuned Vibration Absorber System (TVAS) active noise and vibration control system to be installed; this entails fitment of 200 active vibration absorbers to fuselage and central electronic control unit.

Fuel capacity 64,000 litres (16,907 US gallons; 14,078 Imp gallons) in seven tanks (one tank per engine, one transfer tank per wing, one centre tank); electric pumps and valves all mounted outside tanks. Detachable in-flight refuelling probe. Provision for inert gas system; provision for Flight Refuelling Mk 908E wing-mounted refuelling pods; optional Mk 808E hose drum unit (HDU) in cargo hold; and up to two optional additional fuel tanks, totalling up to 14,400 litres (3,804 US gallons; 3,168 Imp gallons), in fuselage Any standard A400M can be converted to a tanker within two hours. Pressure refuelling, with gravity back-up.

ACCOMMODATION: Two-man, NVG-compatible flight deck with dual sidestick controllers and additional optional forward-facing workstation for third 'mission crew member' to assist with tactical and special tasks, when required. View from flight deck exceeds JAR 25 and MIL-STD-850B. Provision for bulletproof flight deck windows, 68 mm (2¾ in) thick, and armour protection around crew's and loadmaster's seats. Loadmaster station forward of and overlooking cargo area. Two commercial standard unisex lavatories in lower deck, starboard, front; two fixed, screened urinals and fixed hand-basin, starboard, rear. Flight crew rest area with two foldaway bunks; seat for fourth occupant on left, in front of bunks, with fifth seat as part of right-hand side of the bunk.

Two passenger doors forward; two rear. Forward, port, for normal access; forward, starboard, for emergency exit; rear doors for paratroop dropping. Two lateral sliding windows in cockpit equipped with rope for emergency evacuation of flight deck; two emergency exit hatches in front and rear roof for flight crew and passengers. Cargo door, hinged at aft end, raised hydraulically to hold roof for loading via rear ramp. Optional closed-circuit TV surveillance of cargo hold, with imagery selectable on flight deck displays.

Cargo floor with 238 tiedown rings capable of holding 11,340 kg (25,000 lb) loads; 10 tiedown rings capable of holding 11,340 kg (25,000 lb) loads on forward part of ramp; and 46 tiedown rings capable of holding 4,536 kg (10,000 lb) loads on the ramp. A400M loads can include M113, Warrior or LAV-III armoured vehicles; Super Puma or NH90 or two Tiger or Apache helicopters; nine pallets (88 × 108 in military or 88 × 125 in civil); plus 54 troops and second loadmaster on permanent (tip-up) sidewall seats; two 20 ft ISO containers; Patriot SAM system; six light trucks with trailers; 66 stretchers and 25 medical attendants available as optional medical evacuation configuration; or 116 armed troops or paratroops on sidewall and removable centreline seats.

SYSTEMS: FBW FCS derived from Airbus airliners, including sidestick controllers (left hand for captain, right hand for co-pilot, with conventional central power-lever throttle quadrant).

Electrical power provided by four variable frequency generators, each of 75 kVA. Additional power from three-phase generator on APU (90 kVA, A320 type, with in-flight restart capability) in right-hand side of rear wing fairing; three-phase generator on RAT; emergency battery; and external power receptacle. DC power from three 300 A battery charger rectifier units (BCRU) and one transformer/rectifier unit (TRU); two BCRU feed separated, main DC busbars and charge two batteries; one BCRU feeds the 'flight essential' busbar and the emergency busbar and charges the emergency battery; and one TRU feeds the APU starting system. Three Ni/Cd batteries are additional source for DC power.

Two hydraulic systems, Blue and Yellow, each operating at 207 bar (3,000 lb/sq in). Blue (driven by Nos. 1 and 2 engines) powers port aileron and elevator, spoilers on each wing, RAT retraction, normal and parking brakes, cargo ramp, cargo door, toes, sponson step, air deflector and ground stabiliser struts. Yellow (Nos. 3 and 4 engines) responsible for starboard aileron and elevator, spoilers on each wing, alternate brake, nosewheel steering, landing gear, landing gear doors and kneeling/raising. Both systems power flaps, flap wing tip brakes, rudder and trimmable horizontal stabiliser. Each system has 140 litre (37.0 US gallon; 30.8 Imp gallon)/min engine-driven pump and 40 litre (10.6 US gallon; 8.8 Imp gallon)/min alternate current motor pump; power transfer unit between systems for emergency use. Actuation by Moog.

Pneumatic system for air conditioning and pressurisation; wing and engine air intake anti-icing; engine starting; and pressurisation of other onboard systems. Two computers control four engine air bleed units. Interior divided into three air conditioning zones; one for flight deck and two in cargo hold. Cabin pressure altitude 2,440 m (8,000 ft) when flying at 11,280 m (37,000 ft)

Aircraft lighting compliant with JAR 25 and with Type II, class B, NVG operation. External lighting allows covert military operation during all flight phases, including in-flight refuelling.

Cargo handling system operated by single loadmaster, managed via loadmaster work station (LMWS), which interfaces with aerial delivery system, military mission management system, electronic instrument system, weight and CG computation, load and delivery planning and cargo loads database update.

The aircraft integrated monitoring and diagnostic system (AIMDS) provides support for A400M line maintenance and servicing, as well as for updating of databases and software of on-board avionics systems. Interaction and data exchange with avionics systems is organised around a network server system (NSS) architecture, which hosts several applications These include the central maintenance system (CMS) which collects maintenance data and aids the maintenance operator in assessment of origin of failures. Many avionics systems constantly monitor their own status and relay it to the CMS for recording, allowing this information to be used to generate reports according to the different failure messages. CMS also enables ground operators to perform status tests of specific avionics systems on request for troubleshooting purposes. A data loading and configuration system (DLCS) maintains an up-to-date record of aircraft hardware/software configuration and allows operators to update databases and software of many avionics systems. The aircraft condition monitoring system (ACMS) provides usage and life monitoring data for engines, propellers, APU and environmental control system packs. Finally, the structural lifetime monitoring system (LTMS) is an optional item of equipment which can collect information on airframe fatigue condition and provide hard landing detection and local limit load monitoring Authorised AIMDS users, including crew members, maintenance technicians and security/electronic warfare officers, can access it for maintenance purposes or to load/offload mission-related data using an aircraft multipurpose access terminal (AMAT) in the cockpit or a portable multipurpose access terminal (PMAT) connected to one of five ports fitted at various locations around the aircraft, with all operations being recorded and linked to the operator, who must use a dedicated PIN (personal identification number) when accessing the system.

AVIONICS: *Comms:* HF and V/UHF with COMSEC capability, SELCAL and optional Inmarsat SATCOM Audio management system, wireless intercom system, cockpit voice recorder and passenger address system ELT and IFF transponder.

Radar: Weather/navigation radar, with indication of turbulence and windshear; replaceable by optional military radar with ground mapping mode

Flight: Three inertial platforms with embedded air data systems, VOR, DME, Tacan, ADF (optional), multimode receiver (ILS, MLS and GNSS), military GPS, two radar altimeters, ATC transponder, Enhanced-GPWS and TCAS. Digital terrain-referenced navigation system, future air navigation system (FANS A), tactical ground collision avoidance system (T-GCAS), FLIR-enhanced vision system, terrain masking low level flight system, Cat IIIA automatic landing capability and formation keeping system as options. Thales developing tactical air navigation and enhanced infra-red vision system (EVS), with imagery from latter to be presented on HUD.

Instrumentation: Two digital wide-angle HUDs; eight identical full-colour 152× 203 mm (6 × 8 in) head-down displays (HDDs); two keyboard devices and two cursor control devices (CCDs); a ninth identical HDD, a third keyboard device and a third CCD as options for a third crew member.

Mission: Two flight management computers and two military mission management computers; optional MIDS tactical datalink.

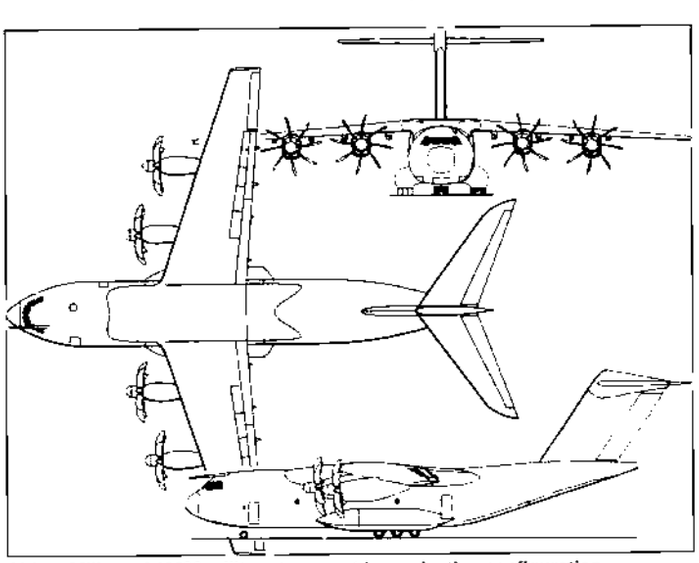
Self-defence: Modular defensive aids subsystem (DASS) with optional elements including central computer, RWR, MWS (passive/active), LWR, expendables dispensing system (chaff/flare), direct energy infra-red countermeasures (DIRCM) and towed radar decoy. EADS Defence Electronics and Thales jointly developing Multi-Colour Infra-Red Alerting Sensor (MIRAS) missile warning system for A400M.

EQUIPMENT: Loadmaster work station, eight medical evacuation stretchers, four life rafts, short deployment kit, Breeze-Eastern cargo winch with 32,000 kg (70,548 lb) pull capacity at forward end of cargo hold, removable in-flight refuelling probe, centralised built-in test equipment, aircraft multipurpose access terminal; all supplied as standard equipment.

Optional equipment includes OBIGGS fuel tank inerting system, armouring kit for protection of flight-deck and loadmaster workstation, armour cockpit windsreen and side windows kit, Breeze-Eastern 5-tonne power crane in roof above cargo ramp, bi-directional powered rollers, cargo bay fuel tanks, third crew member work station, structural lifetime monitoring system, central guidance vertical restraint device to permit aerial delivery of two rows of 1.22 m (4 ft 0 in) wide CDS containers, equipment for full medical evacuation role, seat pallets and video cameras to monitor cargo hold, aerial delivery and in-flight refuelling.

DIMENSIONS, EXTERNAL:

Wing span	42.36 m (138 ft 11¾ in)
Wing chord: at root	7.36 m (24 ft 1¾ in)
at tip	2.54 m (8 ft 4 in)
Wing aspect ratio	8.1
Length: fuselage	39.09 m (128 ft 3 in)
overall	45.10 m (147 ft 11½ in)
Height overall	14.68 m (48 ft 2 in)
Wheel track (mean)	6.22 m (20 ft 4¾ in)
Wheelbase: mean	13.29 m (43 ft 7¼ in)
front	11.76 m (38 ft 7 in)
rear	14.82 m (48 ft 7½ in)
Propeller diameter	5.335 m (17 ft 6 in)
Cargo ramp: Length	5.84 m (19ft 2 in)
Width	4.00 m (13 ft 1½ in)
Height to sill	1.60 m (5 ft 3 in)
Cargo door: Length	7.76 m (25 ft 5½ in)
Crew door: Length	1.46 m (4 ft 9½ in)
Width	0.79 m (2 ft 7 in)
Emergency door: Length	1.22 m (4 ft 0 in)
Width	0.76 m (2 ft 6 in)
Height to sill	1.60 m (5 ft 3 in)
Paratroop door: Length	2.10 m (6 ft 10¾ in)
Width	0.90 m (2 ft 11½ in)
Height to sill	1.60 m (5 ft 3 in)



Airbus Military A400M military transport in production configuration
(Paul Jackson) 1158979

DIMENSIONS, INTERNAL:
- Hold: Length excl ramp ..... 17.71 m (58 ft 1¼ in)
- Length of ramp ..... 5.40 m (17 ft 8½ in)
- Width at floor, continuous ..... 4.00 m (13 ft 1½ in)
- Height: forward of wing box ..... 3.85 m (12 ft 7½ in)
- aft of wing box ..... 4.00 m (13 ft 1½ in)
- Floor area: incl ramp ..... 92.4 m² (995 sq ft)
- Volume: incl ramp (approx) ..... 356 m³ (12,570 cu ft)
- excl ramp (approx) ..... 274 m³ (9,680 cu ft)

AREAS:
- Wing, gross ..... 221.50 m² (2,384.2 sq ft)
- Ailerons (each) ..... 3.94 m² (42.41 sq ft)
- Flaps (per wing) ..... 20.24 m² (217.86 sq ft)
- Spoilers (per wing) ..... 6.90 m² (74.27 sq ft)
- Fin ..... 46.43 m² (499.8 sq ft)
- Tailplane ..... 67.00 m² (721.2 sq ft)
- Elevators (total) ..... 11.49 m² (123.68 sq ft)

WEIGHTS AND LOADINGS:
- Operating weight empty ..... 76,500 kg (168,655 lb)
- Max payload: logistic 2.25*g* ..... 37,000 kg (81,571 lb)
- tactical 2.5*g* ..... 30,000 kg (66,139 lb)
- Max T-O weight: logistic 2.25*g* ..... 136,500 kg (300,925 lb)
- tactical 2.5*g* ..... 127,500 kg (281,100 lb)
- Max landing weight: logistic 2.25*g* ..... 120,000 kg (264,550 lb)
- tactical 2.25*g* ..... 113,000 kg (249,125 lb)
- Max zero-fuel weight: logistic 2.25*g* ..... 113,500 kg (250,225 lb)
- tactical 2.5*g* ..... 106,5000 kg (234,800 lb)
- Max wing loading: logistic 2.25*g* ..... 616.3 kg/m² (126.21 lb/sq ft)
- tactical 2.5*g* ..... 575.6 kg/m² (117.90 lb/sq ft)
- Max power loading: logistic 2.25*g* ..... 4.16 kg/kW (6.84 lb/shp)
- tactical 2.5*g* ..... 3.97 kg/kW (6.38 lb/shp)

PERFORMANCE (estimated):
- Max operating speed and Mach No. (VMO/MMO) ... M0.72 (300 kt; 555 km/h; 345 mph)
- Normal cruising Mach No. 0.68
- Airdrop speed ..... 125–200 kt (232–370 km/h; 144–230 mph)
- Max rate of climb at S/L ..... 1,219 m (4,000 ft)/min
- Cruise ceiling: normal operations ..... 11,280 m (37,000 ft)
- special operations ..... 12,192 m (40,000 ft)
- Logistic mission range at long-range cruise speed; reserves as per MIL-C-5011B (5% trip fuel and 30 min hold at 445 m (1,500 ft)
- with 30,000 kg (66,139 lb) payload ..... 2,400 n miles (4,444 km; 2,761 miles)
- with 20,000 kg (44,092 lb) payload ..... 3,450 n miles (6,389 km; 3,970 miles)
- Ferry range ..... 4,750 n miles (8,797 km; 5,466 miles)

ATR

AVIONS DE TRANSPORT REGIONAL INTEGRATED

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PARTICIPATING COMPANIES
Alenia Aeronautica: Italy
EADS: International

ATR reinforced flight deck door 1158863

First Aerospatiale/Aeritalia (later Alenia) agreement July 1980; ATR programme started 4 November 1981; Groupement d'Intéret Economique (50:50 joint management company) formally established 5 February 1982 to develop ATR series of transport aircraft. ATR became a single corporate entity on 1 June 2001 with the formal establishment of ATR Integrated combining the activities of the two partners, still with GIE status and around 500 employees. Holding is 50 per cent each. Workforce 570 in December 2004. Revenue for 2005 was USD469 million, compared with USD543 million in 2004.

Assembly or licensed production by Xian Aircraft in a new factory at Shenzhen, near Hong Kong, was discussed, but not pursued; Xian already produces rear fuselage components for ATR. Fuselage and wing production remain subcontracted to Alenia Aeronautica and EADS Sogerma (for Airbus France) respectively, though Alenia planning in mid-2006 to transfer some manufacturing work to Romaero in Romania.

ATR marketing and support office opened in Washington 15 July 1986; ATR airline support centre in Singapore opened 18 November 1988; ATR Training Centre (ATC) opened in Toulouse 1 July 1989; these functions taken over by AI(R) from 1996, but returned when this joint venture with BAe was dissolved on 1 July 1998. Second ATC, in Bangkok, opened in 1997. Beijing office opened in September 2003. Phased production lines introduced in 1999 have reduced delivery times to three months from one year. The 600th ATR was delivered to Air Dolomiti on 28 April 2000 and 700th to Air Deccan on 8 September 2006. Toulouse and Washington distribution centres to be relocated in 2006 to Paris (Roissy) and Miami respectively. ATR's Asset Management arm is responsible for second-hand sales.

The ATR family logged its 10 millionth flight on 10 October 2000. Sales by 30 September 2006 totalled 401 ATR 42s and 433 ATR 72s, or 834 in all, of which 699 (385 ATR 42s and 314 ATR 72s) had been delivered by 12 July 2006 to 125 operators in 73 countries, including 2005 deliveries of five and 10 respectively. Including 48 second-hand aircraft, ATR delivered 63 aircraft in 2005 compared with 62 in 2004. Worldwide fleet of cargo versions totalled 66 at 1 January 2006, including 33 in North America and 24 in Europe. Orders and options for the first half of 2006 totalled 47 and 25 respectively for a 130-aircraft backlog. Output for the year was predicted at 26 aircraft, with 44 planned in 2007 and about 55 in 2008. Of the overall total orders, 349 (111 ATR 42s and 238 ATR 72s) are of the -500 series, from 102 customers.

In 2002, ATR developed a modified internal door designed to resist unauthorised flight deck incursions, in anticipation of the FAA's 9 April 2003 deadline for all airliners to be retrofitted to this standard. By mid-2002, ATR had received 100 firm orders for the modified door from American Eagle (first customer), Finnair, Jet Airways and Trans States Airlines. The new door is resistant to forcible impacts of up to 300J and penetration of 9 mm and 44 Magnum ammunition. Total of 260 doors sold by October 2004.

ATR 42

TYPE: Twin-turboprop airliner.

DEVELOPMENT MILESTONES

42	
Programme launched	4 Nov 81
First flight	16 Aug 84
Certification	24 Sep 85
First delivery	3 Dec 85
42–500	
Programme launched	14 Jun 93
First flight	16 Sep 94
Certification	28 Jul 95
First delivery	31 Oct 95

PROGRAMME: Joint launch by Aerospatiale (now in EADS) and Aeritalia (now Alenia) in November 1981, following June 1981 selection of P&WC PW120 turboprop as basic power plant; first flights of two prototypes 16 August 1984 (F-WEGA) and 31 October 1984 (F-WEGB); first flight production aircraft 30 April 1985; simultaneous certification to JAR 25 by France and Italy 24 September 1985, followed by USA (FAR Pt 25) 25 October 1985, Germany 12 February 1988, UK 31 October 1989; deliveries began 3 December 1985 to Air Littoral. Certified with large cargo door 2003; launch customer Northern Air Cargo of Alaska.

Series 500, with 'new look' interior, announced at Paris Air Show 14 June 1993; first flight F-WWEZ (c/n 443) 16 September 1994; French and UK certification 28 July 1995; first delivery (F-OHFF to Air Dolomiti) 31 October 1995. FAA certification 13 May 1996.

CURRENT VERSIONS: **ATR 42–300:** Initial version; entered service 1985; phased out of production in 1996. Two Pratt & Whitney Canada PW120 turboprops, each flat rated at 1,342 kW (1,800 shp) for normal operation and 1,492 kW (2,000 shp) OEI; Hamilton Sundstrand 14SF four-blade constant-speed fully feathering and reversible-pitch propellers.

ATR 42–320: Identical to 42–300 except for optional 1,566 kW (2,100 shp) PW121 engines for improved hot/high performance; OWE increased/payload decreased by 5 kg (11 lb). Entered service 1987; phased out in 1996.

ATR 42–400: P&WC PW121A engines with six-blade Hamilton Sundstrand 568F propellers; maximum cruising speed 266 kt (493 km/h; 306 mph); maximum range 825 n

An ATR 42-500 of Air Caledonie 1158867

miles (1,527 km; 949 miles) with full payload. First flight 12 July 1995 (F-WWEF/OK-AFE); two Srs 420s ordered for CSA, and both delivered 14 March 1996, having received DGAC certification on 27 February. No further civil aircraft.

ATR 42–500: Principal ATR 42 version from 1995. Compared with Series 300, has more powerful engines and six-blade propellers, reinforced wings to allow greatly increased cruising speed and higher weights; all systems improvements of ATR 72, including flight management computers; cockpit, elevators and fin from ATR 72–210; strengthened landing gear; electrically operated main doors; reinforced fuselage and wing centre-section.

Description applies to ATR 42–500, except where indicated.

ATR 42 Quick-Change: (formerly Tube previously Cargo QC) Quick-change interior to hold nine containers. Available as new-build or retrofit. Cabin equipped with smoke detectors, air distribution shut-off valve and modifications necessary for certification for full freighter operations. Conversion takes about 30 minutes. Launch customer, DHL Aviation of South Africa, received first of two converted –300s in October 2000.

ATR 42 full freighter version: Fully dedicated freight transport version (bulk, containers or pallets). Various conversions available, including 'Tube' and/or large cargo door (LCD). Full freighter version available with Alenia Aeronautica STC.

'Tube' package offered by Aeronavali includes E-class cabin compartment with floor reinforced to 400 kg/m_2 (82 lb/sq ft). Total volume for cargo is 56 m_3 (1,978 cu ft); max payload 5,883 kg (12,970lb). Parallel cabin section 10.25 m (33 ft 7½ in) long and tapered section 4.47 m (14 ft 8 in) long, with positions for up to four spider nets. MTOW in this configuration is 16,900 kg (37,258 lb); MLW 16,400 kg (36,156 lb); MZFW 15,540 kg (34,260 lb). Other 'Tube' modifications by independent outfitters also available.

LCD installation is part of the STC, and provides a 2.94 × 1.80 m (9 ft 7¾ in × 5 ft 10¾ in) upward-opening cargo door on port side at front to permit loading of three 224 × 274 cm (88 × 108 in) pallets or five LD3 containers. Max payload for an ATR 42 fitted with both 'Tube' and LCD is 5,300 kg (11,684 lb). First such retrofit, for Northern Air Cargo, took place in 2003.

ATR 42 F: Military/paramilitary freighter with modified interior, reinforced cabin floor, port-side cargo/airdrop door can be opened in flight; can carry 3,800 kg (8,377 lb) of cargo or 42 passengers over 1,250 n miles (2,315 km; 1,438 miles). One delivered to Gabon 1989.

ATR Calibration: Projected navaid calibration version.

ATR 42 L: Projected freighter with lateral cargo door; available as ATR 42 Large Cargo Door (see above).

ATR 42 Météo: One second-hand ATR 42-300 (F-HMTO) converted for (and financed almost entirely by) Météo France, the French meteorological organisation. Conversion undertaken by EADS Sogerma Services, to whom aircraft delivered in September 2002. Modification between March and December 2003; qualification flight testing throughout 2004; delivered to customer July 2005 and expected to enter service by early 2006. Intended as major scientific research asset (Safire programme), with functions including atmospheric pollution measurement, ice crystal photography, solar radiation analysis and ocean wave height measurement. Airframe changes included addition of 70 external attachment points for scientific sensors, extra ports in fuselage underside and an 80 kg (176 lb) capacity pylon for a particle measurement instrumentation system under each wing, mid-way between engine and tip. The PW120 engines were upgraded to ATR42-320 standard. Internally, accommodation was provided for up to seven scientists and up to 25 kVA of additional electrical power for their instruments. Total scientific payload 2,500 kg (5,512 lb). Aircraft acquired for EUR4 million; modification programme cost a further EUR8 million.

ATR 42 MP Surveyor: Maritime and rescue version; *described separately*.

CUSTOMERS: Total 401 firm orders, of which 385 delivered, by 12 July 2006. Four ordered and 10 delivered in 1998; 14 ordered and 12 delivered in 1999; six (plus four options) sold in 2000; five (all-500s) delivered in 2001 and five in 2002. Ten -500s ordered and three delivered in 2003; one by Air Tahiti in May 2004. Seventeen -500s ordered in 2005 by FinnComm Airlines (eight), Air Madagascar (one), Air Caledonie (one) and Pakistan International (seven); five (all -500s) delivered, to CSA (four) and FinnComm (one).

COSTS: ATR 42–500: development cost USD50 million; unit price USD14.2 million (2004).

DESIGN FEATURES: Designed to JAR 25/FAR Pt 25; high wing of medium aspect ratio, with constant-chord centre section and tapered outer panels; T-type tail with tapered tailplane and sweptback fin and fillet; pannier-mounted main landing gear.

Wing section Aerospatiale RA-XXX-43 (NACA 43 series derivative); thickness/chord ratio 18 per cent at root, 13 per cent at tip; constant-chord, no-dihedral centre-section with 2° incidence at root; outer panels 3° 6' sweepback at quarter-chord and 2° 30' dihedral.

FLYING CONTROLS: Conventional and manual. Lateral control assisted by single spoiler surface ahead of each outer flap; each aileron has electrically actuated trim tab; fixed incidence tailplane; horn-balanced rudder and elevators, each with electrically actuated trim tab; two-segment double-slotted flaps on offset hinges with Ratier-Figeac hydraulic actuators. Flap settings 0, 15, 25 and 35°.

STRUCTURE: Two-spar fail-safe wings, mainly of aluminium alloy, with leading-edges of Kevlar/Nomex sandwich; wing top skin panels aft of rear spar are of Kevlar/Nomex with carbon reinforcement; flaps and ailerons have aluminium ribs and spars, with skins of carbon fibre/Nomex and carbon/epoxy respectively; fuselage is fail-safe stressed skin, mainly of light alloy except for Kevlar/Nomex sandwich nosecone, tailcone, wing/body fairings, nosewheel doors and main landing gear fairings; fin (attached to rearmost fuselage frame) and tailplane carbon structure; CFRP/Nomex sandwich rudder and elevators; dorsal fin of Kevlar/Nomex and GFRP/Nomex sandwich; engine cowlings of CFRP/Nomex and Kevlar/Nomex sandwich, reinforced with CFRP in nose and underside; propeller blades have metal spars and GFRP/polyurethane skins.

EADS France originally responsible for design and construction of wings and engine nacelles, flight deck and cabin layout, installation of power plant, flying controls, electrical and de-icing systems, and final assembly and flight testing of civil passenger versions; wing manufacture and testing reallocated to EADS Sogerma at Bordeaux from late 2001. Alenia Aeronautica builds fuselage and tail unit, installs landing gear, hydraulic system, air conditioning and pressurisation systems. ATR 42/72 manufactured at St Nazaire and Nantes (France), Pomigliano d'Arco and Capodichino (Italy), and assembled in Toulouse.

LANDING GEAR: Hydraulically retractable tricycle type, of Messier-Dowty trailing-arm design, with twin wheels and oleo-pneumatic shock-absorber on each unit. Nose unit retracts forward, main units inward into fuselage and large underfuselage fairing. Goodrich wheels and multiple-disc mainwheel brakes and Hydro-Aire anti-skid units. Mainwheel tubeless tyres, size 32×8.8R16 (10/12 ply), pressure 8.69 bar (126 lb/sq in) or H34×10.0R16 (14 ply). Nosewheel tubeless tyres, size 450×190-5 (10 ply), pressure 4.34 bar (63 lb/sq in) or 450×190R5 (10 ply). Minimum ground turning radius: at nosewheel 10.14 m (33 ft 3½ in); at mainwheel 8.26 m (27 ft 1¼ in); at wingtip 17.40 m (57 ft 1 in).

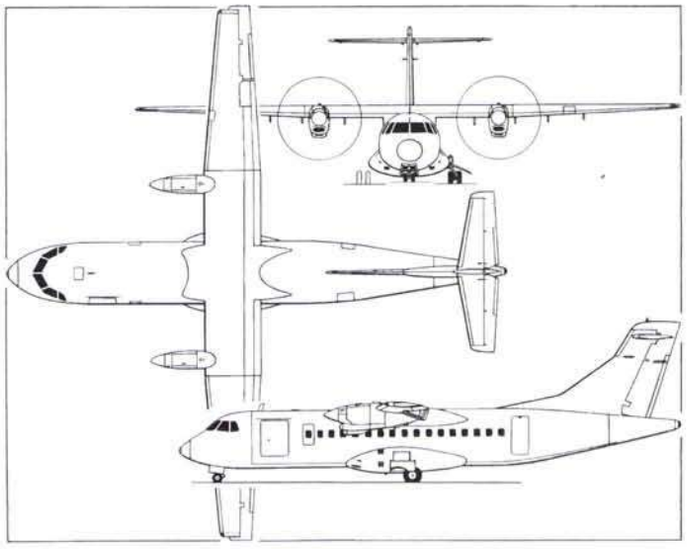
POWER PLANT: Two 1,790 kW (2,400 shp) Pratt & Whitney Canada PW127E turboprops; ATR 72–210 nacelles; six-blade Ratier-Figeac/Hamilton Sundstrand 568F propellers with new electronic control giving faster response and better synchrophasing (as for ATR 72–500 from 1996). Propeller brake on starboard engine to enable engine to be used as auxiliary power unit for internal air conditioning.

Fuel in two integral tanks in spar box, total capacity 5,736 litres (1,515 US gallons; 1,262 Imp gallons). Single pressure refuelling point in starboard wing leading-edge. Gravity refuelling points in wing upper surface. Oil capacity 40 litres (10.6 US gallons; 8.8 Imp gallons).

ACCOMMODATION: Crew of two on flight deck; folding seat for observer. Seating for 42 passengers at 84 cm (33 in) pitch; or 46, 48 (standard) or 50 passengers at 76 cm (30 in) pitch; compared with Series 300, ATR 42–500 has completely new interior with new ceiling and sidewalls, indirect lighting, more sound damping; call buttons and reading lights relocated; overhead bins lengthened to 2 m (6 ft 6¾ in) to accommodate skis, golf clubs and fishing equipment carried as hand baggage. Further option of restyled 'Elegance' cabin furnishing introduced in mid-2003 for new aircraft or as retrofit. Baggage volume increased by 40 per cent. Corporate version also available; executive seating for eight to 24 passengers plus lounge area. Active noise control system, previously offered as an option, is no longer available. Instead, ATR 42–500s have structural acoustic treatment comprising reinforcement of seven fuselage frames adjacent to the propeller plane; dynamic vibration absorbers in this area; and internal aluminium skin damping material forward and aft of wing.

Passenger door, with integral steps, at rear of cabin on port side. Front baggage/cargo compartment between flight deck and passenger cabin, with access from inside cabin and separate loading door on port side; lavatory, galley, wardrobe and seat for cabin attendant at rear of passenger cabin, with service door on starboard side; rear baggage/cargo compartment aft of passenger cabin; additional baggage space provided by overhead bins and underseat stowage. Entire accommodation, including flight deck and baggage/cargo compartments, pressurised and air conditioned. Emergency exit via rear passenger and service doors, and by window exits on each side at front of cabin.

Current 'Elegance' passenger accommodation of ATR family 1158868



ATR 42 twin-turboprop regional transport *(Dennis Punnett)* 1158759

SYSTEMS: Improved in parallel with development of ATR 72; following refers to baseline aircraft. Honeywell air conditioning and Softair pressurisation systems, utilising engine bleed air. Pressurisation system (nominal differential 0.41 bar; 6.0 lb/sq in) provides cabin altitude of 2,040 m (7,000 ft) at altitudes up to FL250.

Two independent hydraulic systems, each at pressure of 207 bar (3,000 lb/sq in), driven by electrically operated Abex pump and separated by interconnecting valve controlled from flight deck; system flow rate 7.9 litres (2.09 US gallons; 1.74 Imp gallons)/min; one system actuates wing flaps, spoilers, propeller brake, emergency wheel braking and nosewheel steering; second system for landing gear and normal braking. Kléber-Colombes pneumatic system for de-icing of wing leading-edges, tailplane leading-edges and engine air intakes; noses of aileron and elevator horns have full-time electric anti-icing.

Main electrical system is 28 V DC, supplied by two Auxilec 12 kW engine-driven starter/generators and two Ni/Cd batteries (43 Ah and 15 Ah), with two solid-state static inverters for 115/26 V single-phase AC supply; 115/200 V three-phase supply from two 20 kVA frequency-wild engine-driven alternators for anti-icing of windscreen, flight deck side windows, stall warning and airspeed indicator pitots, propeller blades and control surface horns. Eros/Puritan oxygen system. Instead of APU, starboard propeller braked and engine run to give DC and 400 Hz power, air conditioning and hydraulic pressure.

AVIONICS: Rockwell Collins com/nav equipment. Improved in parallel with development of ATR 72; following refers to baseline aircraft. For ATR 42-500, see ATR 72-500 description.

Comms: CVR, PA system.

Radar: Honeywell P-660 weather radar.

Flight: Honeywell DFZ 600 AFCS; AZ-800 ADCs; AH 600 AHRS with avionics standard communication bus; Hamilton Sundstrand GPWS; L-3 digital FDR; Rockwell Collins DME; Honeywell FMZ-800 flight management system and dual GPS receivers installed in four Continental Airlines ATR 42s to allow autonomous approaches.

Instrumentation: EZ-820 electronic flight instrument system.

DIMENSIONS, EXTERNAL:

Wing span	24.57 m (80 ft 7½ in)
Wing chord: at root	2.57 m (8 ft 5¼ in)
at tip	1.41 m (4 ft 7½ in)
Wing aspect ratio	11.1
Length overall	22.67 m (74 ft 4½ in)
Fuselage max width	2.865 m (9 ft 4½ in)
Height overall	7.59 m (24 ft 10¾ in)
Elevator span	7.31 m (23 ft 11¾ in)
Wheel track (c/l of shock-struts)	4.10 m (13 ft 5½ in)
Wheelbase	8.78 m (28 ft 9¾ in)
Propeller diameter	3.96 m (13 ft 0 in)
Distance between propeller centres	8.10 m (26 ft 7 in)
Propeller fuselage clearance	0.82 m (2 ft 8¼ in)
Propeller ground clearance	1.17 m (3 ft 10 in)
Passenger door (rear, port): Height	1.75 m (5 ft 9 in)
Width	0.75 m (2 ft 5½ in)
Height to sill (at OWE)	1.46 m (4 ft 9½ in)
Service door (rear, stbd): Height	1.22 m (4 ft 0 in)
Width	0.61 m (2 ft 0 in)
Height to sill	1.375 m (4 ft 6¼ in)
Standard cargo/baggage door (fwd, port): Height	1.575 m (5 ft 2 in)
Width	1.295 m (4 ft 3 in)
Height to sill (at OWE)	1.17 m (3 ft 9¼ in)
Large cargo door (fwd, port, optional): Height	1.80 m (5 ft 11 in)
Width	2.95 m (9 ft 8 in)
Height to sill (at OWE)	1.05 m (3 ft 5¼ in)
Emergency exits (fwd, each): Height	0.91 m (3 ft 0 in)
Width	0.51 m (1 ft 8 in)
Crew emergency hatch (flight deck roof): Length	0.51 m (1 ft 8 in)
Width	0.48 m (1 ft 7 in)

DIMENSIONS, INTERNAL:

Cabin:	
Length (excl flight deck, incl toilet and baggage compartments)	14.72 m (48 ft 3½ in)
Max width	2.57 m (8 ft 5¼ in)
Max width at floor	2.26 m (7 ft 5 in)
Aisle width	0.46 m (1 ft 6 in)
Max height	1.90 m (6 ft 3 in)
Floor area	31.0 m² (334 sq ft)
Volume	58.0 m³ (2,048 cu ft)
Baggage/cargo compartment volume:	
front (42–46 passengers)	6.0 m³ (212 cu ft)
front (48 passengers)	4.8 m³ (170 cu ft)
front (50 passengers)	3.6 m³ (127 cu ft)
rear	4.8 m³ (170 cu ft)
total front & rear (46 passengers)	10.8 m³ (381 cu ft)
Containerised cargo volume: 4 pallets	30.0 m³ (1,059 cu ft)
5 LD3	22.4 m³ (791 cu ft)
Bulk cargo volume: with 4 pallets	11.9 m³ (420 cu ft)
with 5 LD3	10.0 m³ (353 cu ft)
Gross usable cargo volume	56.0 m³ (1,978 cu ft)

AREAS:

Wings, gross	54.50 m² (586.6 sq ft)
Ailerons (total)	3.12 m² (33.58 sq ft)
Flaps (total)	11.00 m² (118.40 sq ft)
Spoilers (total)	1.12 m² (12.06 sq ft)
Fin, excl dorsal fin	12.48 m² (134.33 sq ft)
Rudder, incl tab	4.00 m² (43.05 sq ft)
Tailplane	11.73 m² (126.26 sq ft)
Elevators (total, incl tabs)	3.92 m² (42.19 sq ft)

WEIGHTS AND LOADINGS:

Operating weight empty	11,250 kg (24,802 lb)
Max fuel weight	4,500 kg (9,921 lb)
Max payload	5,450 kg (12,015 lb)[1]
Max ramp weight	18,770 kg (41,380 lb)
Max T-O weight	18,600 kg (41,005 lb)
Max landing weight	18,300 kg (40,345 lb)
Max zero-fuel weight	16,700 kg (36,817 lb)[1]
Max wing loading	341.3 kg/m² (69.90 lb/sq ft)
Max power loading	5.20 kg/kW (8.54 lb/shp)

[1] *Optional increase of 300 kg (661 lb)*

PERFORMANCE:

Max cruising speed at FL170 at 97% MTOW	300 kt (556 km/h; 345 mph)
Time to climb to FL170	9.9 min
Service ceiling OEI, ISA +10°C, 97% MTOW	5,485 m (18,000 ft)
T-O distance: ISA, S/L	1,165 m (3,825 ft)
ISA +10°C at 915 m (3,000 ft) for 300 n mile (556 km; 345 mile) stage with 48 passengers	1,163 m (3,815 ft)
FAR landing field length:	
S/L at landing weight with 48 passengers	1,040 m (3,415 ft)
S/L at MLW	1,126 m (3,695 ft)
Runway ACN for flexible runway, category B	10
Range with max fuel	1,600 n miles (2,963 km; 1,841 miles)
Max range with 48 passengers	840 n miles (1,555 km; 966 miles)

OPERATIONAL NOISE LEVELS:

Flyover	76.6 EPNdB
Sideline	80.7 EPNdB
Approach	92.4 EPNdB

ATR 42 MP SURVEYOR

TYPE: Maritime surveillance twin-turboprop.

PROGRAMME: Variant of ATR 42 airliner developed by Alenia Aeronautica. Exhibited in model form at Dubai Air Show, November 1995. Initially designated **SAR 42** and **ATR 42MP**. First airframe modified by Officine Aeronavali's Capodichino plant; maiden flight (CMX62166) in Surveyor configuration, but without equipment installed, 1 February 1999, was also delivery to Alenia at Caselle for systems integration. Italian civil certification received 24 October 1999; first delivery 14 December 1999.

CURRENT VERSIONS: Other missions include vessel search, identification and surveillance; maritime and coastal surveillance; pollution detection; search and rescue; medical evacuation; and VIP/troop/cargo/corporate/humanitarian transport.

ATR 42 MP Surveyor: Basic model, *as described.*

CUSTOMERS: Two ordered by Guardia di Finanza (Italian customs service) 1996 and first aircraft (MM62165) delivered that November but in normal transport configuration for training; converted to operational version in 2000; is ATR 42-400 for first two aircraft; third aircraft based on 42-500. All these now delivered.

Italian Guardia Costiera (Coast Guard) ordered one plus another option for unarmed version; first delivery (MM62170 '10-01', formerly of Italian Air Force) 30 May 2001; second aircraft delivered 2003.

No further orders reported by end of October 2006.

Data as ATR 42-400, except particulars below.

POWER PLANT: Two 1,566 kW (2,100 shp) Pratt & Whitney Canada PW121A turboprops driving Ratier-Figeac/Hamilton Sundstrand 568F six-blade propellers. Option for additional 650 kg (1,433 lb) of auxiliary fuel.

ACCOMMODATION: Flight crew of two, plus three mission operators in modified cabin. Rest/debrief area towards rear of cabin; galley/lavatory facilities at rear. Observer's station with bubble window each side of fuselage aft of wing. Rear door (port side) modified for in-flight opening, with Type I emergency exit opposite; civil-style large freight door in forward port side. SAR package behind rest area.

AVIONICS: *Comms:* VHF/UHF transceiver, AM-FM, VHF/FM/HF com transceiver, transponder/IFF, interphone and optional secure datalink.

Radar: Raytheon SV 2022 360° search radar; weather radar from ATR 42 retained.

Flight: ADS, VOR, DME, ADF, optional Tacan, FMS, IRS, INS/GPS, radio altimeter, direction-finder.

ATR 42 MP Surveyor 1158864

Mission: Galileo Avionica Airborne Tactical Observation and Surveillance system (ATOS) comprises mission management system; communications subsystem; L-3 Wescam turret beneath starboard landing gear pannier containing Galileo FLIR; daylight TV sensor; Spectrolab SX16E searchlight and Thiokol LUU-2B/B flare launcher all mounted in pod on starboard side of forward fuselage; Elettronica ALR-733 ESM, MIL-STD-1553B, RS-422 and ARINC 429 databus system. Two multifunction operator consoles with 48 cm (19 in) display, 25 cm (10 in) sensor display, keyboard, trackball, joystick and colour printer on starboard side; communications console. Provision for future growth of sensor suite.

EQUIPMENT: SAR equipment includes searchlight, loudspeakers and flare launcher. IR/UV scanner and optional SLAR and MVR for pollution detection.

ARMAMENT: Optional FN Herstal HPM twin machine gun pod on port side of forward fuselage.

WEIGHTS AND LOADINGS:

Typical operating weight empty	13,275 kg (29,266 lb)
Max payload	3,425 kg (7,551 lb)
Optional auxiliary fuel	650 kg (1,433 lb)
Max T-O weight	18,600 kg (41,005 lb)
Max landing weight	18,300 kg (40,345 lb)
Zero-fuel weight: typical	13,200 kg (29,101 lb)
max	16,700 kg (36,817 lb)

PERFORMANCE (at max T-O weight except where indicated):

Max cruising speed at FL160 at 97% MTOW	281 kt (520 km/h; 323 mph)
Typical patrol speed at FL20 at 90% MTOW:	
for max range	189 kt (350 km/h; 217 mph)
for max endurance	135 kt (250 km/h; 155 mph)
Service ceiling, OEI, at 97% MTOW	3,960 m (13,000 ft)
T-O distance at S/L, ISA	1,050 m (3,445 ft)
Landing distance at MLW, S/L, ISA	1,150 m (3,775 ft)
Ferry range	2,019 n miles (3,740 km; 2,323 miles)
Endurance on station:	
at 200 n mile (370 km; 230 mile) radius	8 h
at 600 n mile (1,111 km; 690 mile) radius	3 h 30 min

ATR 72

TYPE: Twin-turboprop airliner.

PROGRAMME:

DEVELOPMENT MILESTONES

72	
Programme launched	15 Jan 86
First flight	27 Oct 88
Certification	25 Sep 89
First delivery (Kar Air)	27 Oct 89
72-500	
First flight	19 Jan 96
Certification	14 Jan 97
First delivery (American Eagle)	31 Jul 97

Stretched version of ATR 42; announced at 1985 Paris Air Show; launched 15 January 1986; three development aircraft built: first flights 27 October 1988 (F-WWEY), 20 December 1988 (F-WWEZ, c/n 108) and 18 April 1989 (OH-KRA, c/n 126); French and US certification 25 September and 15 November 1989 respectively; deliveries, to Kar Air of Finland, began 27 October 1989 (OH-KRB); UK certification 30 July 1993. Large cargo door certified 2002; launch customer Farnair of Switzerland.

CURRENT VERSIONS: **ATR 72–200:** Initial production version; two Pratt & Whitney Canada PW124B turboprops, each rated at 1,611 kW (2,160 shp) for normal take-off and 1,790 kW (2,400 shp) with ATPCS; Hamilton Sundstrand 14SF-11 four-blade propellers. Also cargo version, capable of carrying 13 small containers. Now discontinued.

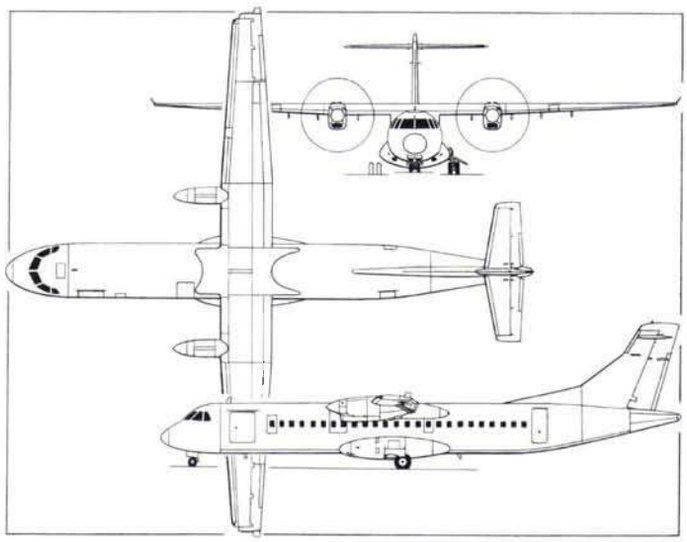
ATR 72–210: Improved hot/high performance version with PW127 engines rated at 1,849 kW (2,480 shp) and Hamilton Sundstrand 247F propellers with composites blades on steel hubs; ATPCS power 2,059 kW (2,760 shp); carries 17 to 19 more passengers than standard ATR 72 in WAT-limited conditions; French and US certification 15 and 18 December 1992, German on 24 February 1993; first delivery December 1992.

ATR 72–500: Launched as ATR 72-210A. Improved hot/high performance version with PW127 engines, six-blade propellers and redesigned interior. First flight 19 January 1996; DGAC certification achieved 14 January 1997; first delivery (to American Eagle) 31 July 1997.

Description applies to ATR 72–500, except where indicated.

ATR 72 Quick-Change: Similar to ATR 42 Quick-Change, except capacity for 13 ATR containers; conversion time approx 45 minutes.

ATR 72 full freighter version: Remarks as for equivalent ATR 42. Total cargo volume 75.5 m³ (2,666 cu ft); parallel cabin section 14.75 m (48 ft 4¾ in) long, with positions for up to six spider nets. MTOW in this configuration 22,000 kg (48,501 lb); MLW 21,350 kg (47,069 lb); MZFW 20,000 kg (44,092 lb). LCD as for ATR 42 freighter; permits loading of five 224 × 274 cm (88 × 108 in) pallets or seven LD3 containers. Max payload for first-generation aircraft fitted with "tube" and LCD is 8,093 kg (17,842 lb). First retrofit (to c/n 108) completed for Farnair by Aeronavali (subsidiary of Alenia Aeronautica) in June 2002; second for same customer, in 2004.



ATR 72–200 (two Pratt & Whitney Canada PW124B turboprops)
(Dennis Punnett) 1158760

ATR 72 ASW: Projected anti-submarine warfare version, based on ATR 42 but also offering 1,270 kg (2,800 lb) payload including torpedoes, depth charges and anti-ship missiles. Turkish Navy opted in March 2005 for 10 ATR 72-500s equipped for both maritime patrol and ASW with Thales Amascos mission system and Oceanmaster surveillance radar; deliveries to begin in 2007.

CUSTOMERS: Total 433 ATR 72s ordered up to 30 September 2006, of which 314 delivered by 12 July 2006. Deliveries in 1998 totalled 21 and in 1999 numbered 23. Orders in 2000 totalled 18 plus six options; 15 (all –500s) delivered in 2001, 14 in 2002 and six in 2003; further 11 (Binter Canarias six, Air Tahiti four, Air New Zealand one) ordered by July 2004. Orders in 2005 totalled 73 from Air Deccan (30), Air Caraïbes (one), Air Caledonie (two), Air Madagascar (two), CCM Airlines (six), Turkish Navy (10 ASW), Air Tahiti (one), Binter Canarias (one) and Kingfisher Airlines (20).

COSTS: ATR 72-500, USD17.5 million (2004).

DESIGN FEATURES: As ATR 42 (which see), but with more power, more fuel, greater wing span/area, and longer fuselage for up to 74 passengers.

FLYING CONTROLS: As for ATR 42 but vortex generators ahead of ailerons and aileron horn balances shielded by wingtip extensions; vortex generators under leading-edge of elevators. Flap settings 0, 15 and 30°.

STRUCTURE: Generally as for ATR 42, but new wings outboard of engine nacelles have CFRP front and rear spars, self-stiffening CFRP skin panels and light alloy ribs, resulting in weight saving of 120 kg (265 lb); sweepback on outer panels 2° 18′ at quarter-chord. Trials of an all-composites tail assembly were conducted in 1997 and the structure incorporated in all production aircraft from 1998. The major airframe inspection period for the ATR 72 was increased on 2 October 1997 from 24,000 to 36,000 cycles, with a corresponding reduction in maintenance cost, bringing it in line with the ATR 42 family.

LANDING GEAR: Messier-Hispano-Bugatti units with Dunlop wheels (tyres size H34×10.0R16 (14 ply), pressure 7.86 bar; 114 lb/sq in) and structural carbon brakes; nosewheel tyre as ATR 42. Minimum ground turning radius: at nosewheel 12.45 m (40 ft 10¼ in); at mainwheel 8.26 m (27 ft 1¼ in); at wingtip 19.74 m (64 ft 9¼ in).

POWER PLANT: *ATR 72–500:* Two Pratt & Whitney Canada PW127F turboprops, each rated at 1,864 kW (2,500 shp) for normal flight and 2,051 kW (2,750 shp) for take-off, driving Ratier-Figeac/Hamilton Sundstrand 568F six-blade, all-composites propellers. Fuel capacity 6,337 litres (1,674 US gallons; 1,394 Imp gallons), comprising ATR 42 tanks, plus additional 637 litres (168 US gallons; 140 Imp gallons) in outer wings; pressure refuelling point in starboard main landing gear fairing.

ACCOMMODATION: Basic 68 passengers at 79 cm (31 in) seat pitch; other seating configurations range from 64 seats at 81 cm (32 in) to 72 seats at 76 cm (30 in) or high-density 74 seats at 74 cm (29 in); plus second cabin attendant's seat. Corporate version also available: typical seating for 44 passengers plus lounge area. Single baggage compartment at rear of cabin; two at front. Forward door, with a service door opposite on starboard side. Service door on each side at rear, that on port side replaced by a passenger door when cargo door is fitted at front. Two additional emergency exits (one each side); both rear doors also serve as emergency exits. Increased-capacity air conditioning system.

ATR 72-500 of Kingfisher Airlines 1158869

AVIONICS (ATR 72–500): *Comms:* Rockwell Collins VHF transceiver and Mode 5 transponder; EADS Socata ELT; Loral CVR.
Radar: Honeywell weather radar.
Flight: Rockwell Collins VOR/ILS/MKR, ADF and DME; Honeywell EFIS (EADI and EHSI) and air data computer.
Instrumentation: Honeywell ASI, VSI and altimeter; Aeronetics RMI; Smiths standby compass; Thales standby horizon, altimeter and ASI.

DIMENSIONS, EXTERNAL: As ATR 42 except:

Wing span	27.05 m (88 ft 9 in)
Wing chord at tip	1.59 m (5 ft 2½ in)
Wing aspect ratio	12.0
Length overall	27.17 m (89 ft 1¾ in)
Height overall	7.65 m (25 ft 1¼ in)
Wheelbase	10.77 m (35 ft 4 in)
Propeller ground clearance: at OWE	1.21 m (3 ft 11½ in)
at max ramp weight	1.12 m (3 ft 8 in)
Passenger door (rear, port): Height	1.73 m (5 ft 8 in)
Width	0.635 m (2 ft 1 in)
Height to sill	1.375 m (4 ft 6¼ in)
Cargo door (fwd, port): Height	1.575 m (5 ft 2 in)
Width	1.295 m (4 ft 3 in)
Height to sill	1.12 m (3 ft 8 in)

DIMENSIONS, INTERNAL:

Cabin:	
Length (excl flight deck, incl toilet and baggage compartments)	19.21 m (63 ft 0¼ in)
Cross-section	as for ATR 42
Floor area	41.7 m² (449 sq ft)
Volume	76.0 m³ (2,684 cu ft)
Baggage/cargo compartment volume:	
front (68 passengers)	5.8 m³ (205 cu ft)
rear	4.8 m³ (169.5 cu ft)
total	10.6 m³ (374.5 cu ft)
Containerised cargo volume: 5 pallets	42.6 m³ (1,504 cu ft)
7 LD3	31.4 m³ (1,109 cu ft)
Bulk cargo volume: with 5 pallets	13.3 m³ (470 cu ft)
with 7 LD3	11.7 m³ (413 cu ft)
Gross usable cargo volume	75.5 m³ (2,666 cu ft)

AREAS: As ATR 42 except:

Wings, gross	61.0 m² (656.6 sq ft)
Ailerons (total)	3.75 m² (40.36 sq ft)
Flaps (total)	12.28 m² (132.18 sq ft)
Spoilers (total)	1.34 m² (14.42 sq ft)

WEIGHTS AND LOADINGS:

Operating weight empty	12,950 kg (28,550 lb)
Max fuel weight	5,000 kg (11,023 lb)
Max payload: standard	7,350 kg (16,204 lb)
optional	7,850 kg (17,306 lb)
Max T-O weight: standard	22,500 kg (49,604 lb)
optional	22,800 kg (50,265 lb)
Max ramp weight: standard	22,670 kg (49,979 lb)
optional	22,970 kg (50,640 lb)
Max landing weight: standard	22,350 kg (49,273 lb)
Max zero-fuel weight: standard	20,300 kg (44,754 lb)
optional	20,800 kg (45,856 lb)
Max wing loading: standard	368.9 kg/m² (75.55 lb/sq ft)
optional	373.8 kg/m² (76.55 lb/sq ft)
Max power loading: standard	5.49 kg/kW (9.02 lb/shp)
optional	5.56 kg/kW (9.14 lb/shp)

PERFORMANCE:

Max cruising speed at FL170, at 97% MTOW: both	276 kt (511 km/h; 318 mph)
Econ cruising speed at FL230, at 95% MTOW	248 kt (459 km/h; 285 mph)
Service ceiling	7,620 m (25,000 ft)
Service ceiling, OEI, ISA + 10° C, 97% MTOW	4,330 m (14,200 ft)
T-O balanced field length: at S/L, ISA: basic	1,290 m (4,235 ft)
optional	1,333 m (4,375 ft)
at FL30, ISA +10° C, at T-O weight, 68 passengers: both	1,300 m (4,2655 ft)
Landing field length at S/L, at MLW: both	1,067 m (3,500 ft)
Runway ACN for flexible runway, category B	13
Still air range, reserves for 87 n mile (161 km; 100 mile) diversion and 45 min:	
max payload: basic	890 n miles (1,650 km; 1,025 miles)
optional	1,004 n miles (1,860 km; 1,155 miles)
max fuel and zero payload	1,956 n miles (3,622 km; 2,251 miles)

OPERATIONAL NOISE LEVELS:

Flyover	79.0 EPNdB
Sideline	83.2 EPNdB
Approach	92.2 EPNdB

BELL/AGUSTA

BELL/AGUSTA AEROSPACE COMPANY (BAAC)

11700 Plaza America Drive, Suite 1000, Reston, Virginia, 20190
Web: www.bellagusta.com
MANAGING DIRECTOR: Louis P Bartolatta Jr
EXECUTIVE MANAGING DIRECTORS:
Don Barbour (BA609 Programme)
Antonio Giovannini (AB139 Programme)

PARTICIPATING COMPANIES
Bell Helicopter Textron: see under USA
Agusta: see under Italy

Bell and Agusta announced on 8 September 1998 that they had agreed to establish a joint venture to manage development of two new aircraft: the BA609 tiltrotor, previously a Bell and Boeing programme, and the AB139, a new helicopter announced on the same day. Following approval of both boards, a definitive agreement was signed on 6 November 1998. Bell is the majority shareholder and intended to undertake final assembly for AB139s delivered to North America. Agusta, which has built Bell helicopters under licence since 1952, is investing and participating in development of the BA609, manufacturing some components and assembling those sold in Europe and certain other parts of the world. Additionally, AgustaWestland was responsible for the AB139's development and certification, with participation by Bell. A military version was revealed in July 2000. Flight testing of the AB139 began in February 2001, followed by the BA609 in March 2003. Bell/Agusta company headquarters relocated from Fort Worth, Texas, to Reston, Virginia, in March 2005.

In December 2005, AgustaWestland announced it would purchase Bell's 25 per cent of AB139 programme and make its own provision for a parallel US assembly line in Philadelphia. The helicopter was subsequently designated AW 139. BA609 remains a joint venture, although AgustaWestland to increase its share of development investment, thereby raising its stake in the programme from 25 to 40 per cent.

BELL/AGUSTA BA609

TYPE: Light utility tiltrotor.
PROGRAMME:

DEVELOPMENT MILESTONES

Announced	Feb 96
Design submitted	May 97
First prototype material cut	Aug 97
Mockup unveiled	Jun 97
Ground-running began	6 Dec 02
First flight	7 Mar 03
First transition to aircraft mode	22 Jul 05

Having earlier joined in partnership to develop the military V-22 tiltrotor, Bell Boeing revealed in February 1996 that studies were in progress for a nine-passenger civil tiltrotor aircraft in the 6,350 kg (14,000 lb) weight class, with the preliminary designation D-600.

Bell/Agusta BA609 prototype during 2005 flight testing (landing gear doors not fitted during first series of trials) 1133989

Subsequently, on 18 November 1996, the two companies announced that a joint venture was being established to design, develop, certify and market a six- to nine-passenger civil tiltrotor as the Bell Boeing 609.

Boeing withdrew as a partner on 1 March 1998 and Bell subsequently teamed with Agusta to develop, produce and market the tiltrotor as the BA609; this arrangement was formally announced at the Farnborough Air Show in September 1998. Agusta is investing and participating in BA609 development and will be responsible for assembly of BA609s sold in Europe and elsewhere.

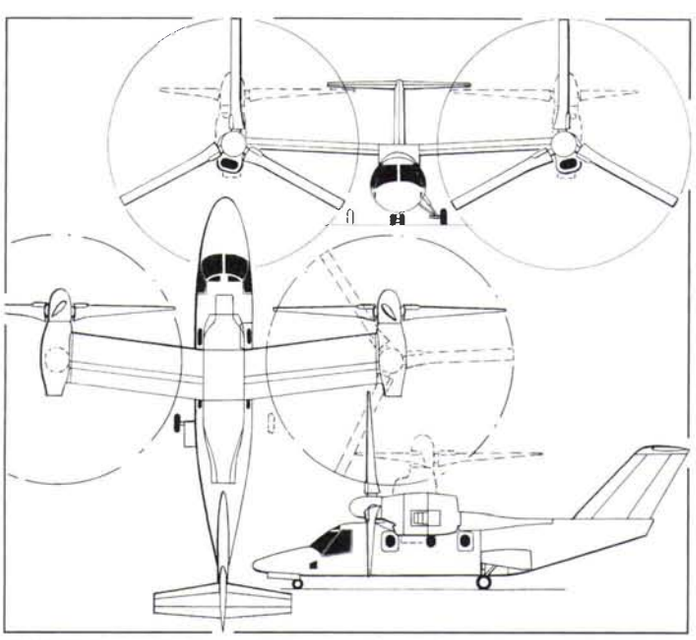
Preliminary design review completed May 1997. Manufacture of parts for prototypes began at Philadelphia, August 1997. Full-size mockup first exhibited at Paris Air Show, June 1997.

Ground-running trials began on 6 December 2002. First flight of the prototype (N609TR) took place (in the vertical mode only) on 7 March 2003, rescheduled from late 2002, following decision in April 2002 to slow development and certification as consequence of delays in Bell Boeing V-22 Osprey programme, the latter being leader in technology development. Prototype flew some 14 hours in first two months, with rotors angled up to 15° forward before being disassembled for examination. Flight testing resumed on 3 June 2005 with a 1.3 hour flight, followed by the first full conversion to aircraft mode on 22 July 2005 when the BA609 reached a maximum speed of 190 kt (352 km/h; 219 mph). Second prototype (N609AG, c/n 60002), built by AgustaWestland at Cameri, Italy; began ground runs 13 July 2006; first flew 9 November 2006.

Four prototypes are being produced for 36-month flight test programme leading to certification in 2007 under FAR Pt 25 (fixed-wing aircraft) and Pt 29 (helicopters), plus Pt 21.17(b) Special Conditions for unique components. To be capable of single-pilot IFR operation. Prototype used primarily for expansion of flight envelope, while second, third and fourth airframes are dedicated to systems certification, avionics and icing approval, and FAA function and reliability, respectively. Second prototype, built at AgustaWestland plant in Italy; third airframe (also Italian) will be dedicated to icing and other certification tests, while fourth (US) aircraft will serve as avionics test and certification airframe. Certification in FAA Powered Lift category, including two-crew IFR and flight into known icing approvals, expected in 2010.

CURRENT VERSIONS: **BA609**: Initial version *as described*.

Second, Italian-built, Bell/Agusta BA609 on its maiden flight, 9 November 2006 1040379



Bell/Agusta BA609 tiltrotor aircraft *(James Goulding)* 1158944

HV-609: Multimission version proposed by Bell and Lockheed Martin to satisfy US Coast Guard 'Deepwater' re-equipment programme as potential replacement for Dassault HU-25 Guardian, Eurocopter HH-65 Dolphin and Sikorsky HH-60J Jayhawk. Missions could include drug interdiction and SAR, with 30 to 50 HV-609s possibly being acquired.

UV-609: Utility version conceived by Bell for US Army combat role, including casualty evacuation, command and control, logistic support and light utility/troop transport tasks. Manufacturer also promoting UV-609 to US Marine Corps as potential training system for V-22 Osprey.

619: Projected 19-seat version aimed at commuter market; not launched by March 2003.

620: Proposed 22-seat version conceived by Bell Boeing team; no recent news received and concept may have lapsed.

CUSTOMERS: Order book opened 2 February 1997 at Heli Expo, with first order placed soon after by unspecified customer. Total of 70 ordered by 40 customers in 18 countries by March 2003; purchasers identified to date include Helitech Pty of Australia; Lider of Brazil; Canadian Helicopter Corporation and Northern Mountain Helicopters Inc of Canada; Petroleum Tiltrotors International of Dubai; Aero-Dienst GmbH of Germany; Mitsui of Japan; United Industries of South Korea; Helikopter Services of Norway; Lloyd's Investments of Poland; Bristow of the UK; Massachusetts Mutual Life Insurance, Austin Jet and Petroleum Helicopters of the USA; and Air Center Helicopters Inc of the US Virgin Islands. Briefing given to US Coast Guard, late 1997, followed by demonstration by XV-15 tiltrotor concept demonstrator aboard Coast Guard cutter *Mohawk* off Key West, Florida, in May 1999.

COSTS: USD8 million to USD10 million, depending on configuration.

DESIGN FEATURES: Combines the most favourable aspects of helicopter and aeroplane performance in passenger-carrying role. T tail configuration instead of endplate fin layout used by earlier tiltrotor designs (XV-15 and V-22 Osprey); this raises horizontal tailplane above rotor wake to minimise fore and aft pitching moment at transition phase of flight. Size of wing determined by requirement for it to hold all fuel for CG and safety considerations. Composites cross-shafts keep both proprotors turning in event of engine failure. Manual screwjack facility exists whereby the proprotors can be tilted into helicopter mode if cross-shafts fail. Designed using three-dimensional CATIA digital computer design system. Airframe has design life of 20,000 flight hours.

Refer also to Bell Boeing V-22 description for explanation of tiltrotor concept and for its extension to four-proprotor configuration.

FLYING CONTROLS: BAE Systems triplex digital fly-by-wire flight control system, with Dowty Aerospace actuators. T tail with conventional elevators; no rudder. Two-segment trailing-edge flaperons.

STRUCTURE: Aluminium fuselage structure with composites skinning; composites wing. Production fuselages, including cockpit, cabin and systems installation, will be built by risk sharing partner Fuji Heavy Industries of Japan, which may also establish a third production line if substantial orders are won from the Japanese government; cabin doors and fuselage tailcone supplied by Kawasaki; wing and nacelles by Bell at Fort Worth, with final assembly line at new Bell tiltrotor manufacturing facility in Amarillo, Texas and at Agusta facility in Italy. Fuselage in three major sections; nose, centre and tail, with fuselage skin incorporating graphite stringers with Japanese Toray composites material. Same used for wing and nacelles, with upper and lower wing surfaces produced as single pieces.

LANDING GEAR: Retractable tricycle type, with twin nosewheels and single wheel on each main unit. Messier-Dowty overseeing design, development and manufacture of integrated landing gear system, including legs, wheels, tyres, brakes, brake control and landing gear control systems.

POWER PLANT: Two 1,447 kW (1,940 shp) Pratt & Whitney Canada PT6C-67A turboshaft engines, installed in tilting nacelles at wingtips, each driving a three-blade proprotor. Nacelle interface units by AMETEK Aerospace Systems. Rockwell Collins EICAS; modified oil system, with dual pumps, to generate sufficient oil pressure when operating in vertical mode; several planetary gears also removed to achieve direct drive 30,000 rpm output. Nacelle transition achieved in 20 seconds. Fuel in integral wing tanks; usable capacity 1,401 litres (370 US gallons; 308 Imp gallons). Provision for auxiliary fuel tanks.

ACCOMMODATION: Crew of two, side by side on flight deck, with dual controls. Maximum of nine passengers in standard aircraft in 2+2+2+3 configuration. Optional layouts provide for six passengers in executive layout, eight passengers in double club configuration, or two stretchers and three attendants in EMS configuration. Crew and passenger door on starboard side, forward of wing. Accommodation pressurised and air conditioned; pressurisation differential 0.38 bar (5.50 lb/sq in). Transparencies by Sully Produits Speciaux of France.

SYSTEMS: Equipped for flight into known icing. Lucas Aerospace DC electrical power systems. Intertechnique brushless electric pumps and motor-operated shut-off valves.

AVIONICS: Rockwell Collins Pro Line 21 package as standard.

Comms: Dual VHF radios; Mode S transponder. Cockpit voice recorder included as standard.

Radar: Optional Rockwell Collins WXR-800 solid-state weather radar.

Flight: Dual VOR/ILS, DME and ADF, with integrated control of sensors by dual Rockwell Collins RTU-4200 radio tuning units. Rockwell Collins ALT-4000 radar altimeter optional. GPS included as standard, along with TCAS and FDR.

Instrumentation: Three 250 × 200 mm (10 × 8 in) active matrix colour LCD adaptive flight displays, including two primary flight displays and one multifunction display. Standby instrument system by Goodrich Aerospace.

Following data are provisional.

DIMENSIONS, EXTERNAL:

Proprotor diameter (each)	7.9 m (26 ft)
Width, rotors turning	18.3 m (60 ft)
Length overall	13.4 m (44 ft)
Max diameter of fuselage	1.75 m (5 ft 9 in)
Height to top of fin	4.6 m (15 ft)
Wheel track	3.0 m (10 ft)
Wheelbase	5.8 m (19 ft)
Distance between proprotor centres	10.0 m (33 ft)
Passenger door: Width	0.76 m (2 ft 6 in)

DIMENSIONS, INTERNAL:

Cabin: Length	4.09 m (13 ft 5 in)
Max width	1.47 m (4 ft 10 in)
Max height	1.42 m (4 ft 8 in)
Baggage hold volume	1.4 m³ (50 cu ft)

AREAS:

Rotor discs, each	49 m² (530 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	4,765 kg (10,500 lb)
Max T-O weight	7,620 kg (16,800 lb)
Max disc loading	77.4 kg/m² (15.85 lb/sq ft)

PERFORMANCE:

Max cruising speed	275 kt (509 km/h; 316 mph)
Max rate of climb at S/L	457 m (1,500 ft)/min
Service ceiling	7,620 m (25,000 ft)
Service ceiling, OEI	3,901 m (12,800 ft)
Hovering ceiling, OGE	1,525 m (5,000 ft)
Range: normal fuel capacity with 2,500 kg (5,500 lb) payload at 250 kt (463 km/h; 288 mph)	750 n miles (1,389 km; 863 miles)
with auxiliary fuel tanks	1,000 n miles (1,852 km; 1,151 miles)
Endurance, normal fuel	3 h

BOEING/BAE SYSTEMS

BOEING/BAE SYSTEMS

PARTICIPATING COMPANIES

Boeing (Integrated Defense Systems): see under USA

BAE Systems: see under UK

Original McDonnell Douglas Corporation (MDC) and Hawker Siddeley companies initially associated in 1969 through US procurement of Harrier; relationship further developed with US Navy selection of BAE Systems Hawk; both types built at St Louis, although production of the Harrier II ended in 1997. Joint work undertaken on advanced combat aircraft (later known as JSF), with additional participation of Northrop Grumman, until next-stage contracts were awarded to competing designs in November 1996. Boeing took over MDC in August 1997. Production of T-45 Goshawk continues, albeit at less than minimum economic rate, but procurement to end with batch of 12 aircraft in FY07.

BOEING/BAE SYSTEMS T-45 GOSHAWK

TYPE: Advanced jet trainer.

PROGRAMME:

DEVELOPMENT MILESTONES

Official go-ahead	18 Nov 1981
First order	26 Jan 1988
First prototype material cut	Feb 1986
First flight	16 Apr 1988
First delivery	23 Jan 1992
Entered service	27 Jun 1992

Carrier-capable version of BAE Systems Hawk selected 18 November 1981 (from five other candidates) as winner of US Navy VTXTS (now T45TS) competition for undergraduate jet pilot trainer to replace T-2C Buckeye and TA-4J Skyhawk; original plan was for initial 54 'dry' (land-based) T-45Bs followed by 253 carrier-capable'wet' T-45As; B model eliminated in FY84 in favour of 300 (and then 302) T-45As; FSD phase began October 1984; construction of two prototypes by Douglas began February 1986; funding approved 16 May 1986 for first three production lots. Lot 1 production contract (12 aircraft) awarded 26 January 1988; FSD prototypes made first flights 16 April (162787) and November 1988 (162788); original planned date for first deliveries (October 1989) delayed by further airframe and power plant changes requested by US Navy.

Announced 19 December 1989 that entire T45TS programme to be transferred to McDonnell Aircraft Co at St Louis; modified FSD prototypes made first flights September and October 1990; two Douglas production aircraft (163599 and '600) delivered to NATC Patuxent River, Maryland, on 10 October and 15 November 1990; first carrier landing (162787 on USS *John F Kennedy*) 4 December 1991; first McAir production aircraft (163601) flew at St Louis 16 December 1991 and handed over to USN 23 January 1992. Production one per month in 1995 following successful passing of US DoD Milestone III review on 17 January 1995 authorising full-rate production.

Digital/'glass cockpit' developed as 'Cockpit 21'; first to this standard (37th aircraft, 163635) made first flight 19 March 1994; planned production line introduction at 73rd aircraft, to be delivered October 1996, was delayed; flight trials of prototype aboard USS *John C Stennis* conducted April to May 1996 and successfully completed with 30 May approval for 'Cockpit 21' installation from 84th aircraft (165080), which first flew on 21 October 1997 and formally rolled-out on 31 October. Earlier aircraft being retrofitted with 'Cockpit 21' from FY03, following a validation conversion of T-45A 163651 in 1998.

Beginning in 2000, all T-45s fitted with modified engine air intakes during routine servicing at NAS Kingsville; new intake has the top 'lip' extended forward, giving a raked profile, improving engine airflow at high angles of attack and reducing number of surges and compressor stalls.

CURRENT VERSIONS: **T-45A:** Baseline version, with analogue instruments. Total of 83 produced, of which surviving 73 programmed for upgrade to T-45C standard.

T-45C: Digital ('Cockpit 21') avionics version with new computer, digital databus, data transfer cartridge and Litton GINA (GPS/INS assembly); first aircraft 165080; otherwise as T-45A; sole external difference is GPS antenna on spine of T-45C, immediately behind canopy.

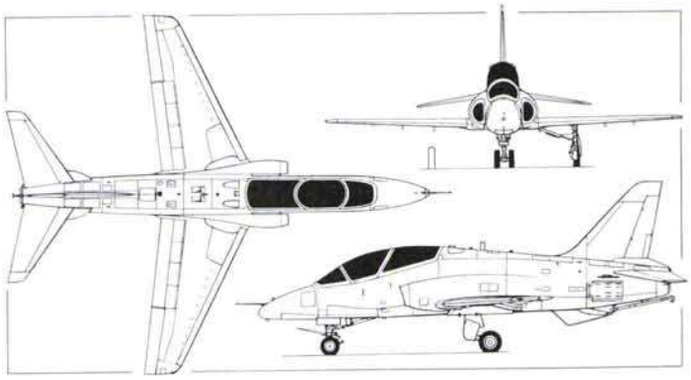
CUSTOMERS: US Navy; two FSD prototypes and 223 production aircraft currently envisaged, with deliveries to terminate at the end of 2009. Final delivery of FY00 was 127th production aircraft; 139th delivered to US Navy in October 2001; 150th on 8 August 2002, with more than 180 delivered by end of October 2005. Complete T45TS programme also involves 19 flight simulators (built by Hughes Training Inc); 48 computer-aided instructional devices, one training integration system mainframe, six electronic classrooms, 155 terminals, plus academic materials and contractor-operated logistic support. USN T45TS requirement stipulated 42 per cent size reduction in (TA-4 and T-2) training fleet, 25 per cent fewer flight hours, and 46 per cent fewer personnel.

Four training squadrons (VT) to equip: VT-21 and VT-22 of Training Wing 2 at Kingsville, Texas, in 1992–96; VT-9 and VT-23 (which redesignated VT-7 on 1 October 1999) of TW-1 at Meridian, Mississippi, 1997–2003. TW-2 assigned early aircraft; TW-1 received about 90 'Cockpit 21' Goshawks (first official handover to VT-23 15 December 1997, aircraft having been received on 10 December). TW-2 accepted first new-build T-45C (165641) in late 2004 and will eventually also be fully equipped with this version, largely as a result of retrofit programme involving surviving T-45A aircraft. Small number of T-45s wear 'Marines' titles to reflect the proportion (about 13 per cent) of USMC student pilots being trained on the type.

VT-21 operational 27 June 1992 for instructor training; four-aircraft operational evaluation begun by VT-21 on 18 October 1993 for one month first phase; student training begun 4 January 1994; first student flight 11 February 1994; first solo 23 March 1994; deployed to Miramar for deck landing course on aircraft carrier, September 1994; course graduated 5 October 1994. Second phase of operational evaluation (advanced tactics/weapons and carrier qualification) on USS *Dwight D Eisenhower* ended with clearance for fleet introduction being recommended on 5 July 1994. VT-23 (now VT-7) of TW-1 began student training on 8 July 1998; VT-9 began re-equipping in 2003. T-45 syllabus is 119 sorties (156 hours) plus 100 simulator sessions (95.4 hours).

In April 2000, 1,000th student graduated from T45TS course; fleet passed 200,000 hours in March 1999. By May 2001, T-45s had flown 342,000 hours, made 22,000 deck landings and trained 1,328 pilots; first aircraft exceeded 5,000 hours in April 2001. Fleet passed 450,000 hours and 28,500 carrier landings in February 2003, at which time total of 1,800 students had graduated.

Boeing/BAE Systems T-45C Goshawk of training squadron VT-9 *(Paul Jackson)* 1047211



Boeing/BAE Systems T-45C Goshawk tandem-seat basic and advanced trainer with revised intake shape *(Dennis Punnett)* 0099603

US NAVY PROCUREMENT

FY	Lot	Qty	First aircraft
88	1	12	163599
89	2	24	163611
92	3	12	163635
93	4	12	163647
94	5	12	165057
95	6	12	165069[1]
96	7	12	165081
97	8	12	165457
98	9	15	165469
99	10	15	165484
00	11	15	165598
01	12	14	165613
02	13	6	165627
03	14	8	165633
04	15	14	165641
05	16	10	
06	17	6	
07	18	12	
Total		**223**	

[1] 'Cockpit 21' installed from 12th of this batch (165080).

COSTS: Original USD316 million for 12 aircraft in FY96 procurement augmented by USD6,830,421 for addition of 'Cockpit 21' modifications. Official unit cost USD17.2 million (1999); FY02 purchase of six aircraft valued at USD180.6 million, with USD218.2 million appropriation in FY03 for eight aircraft and USD339.2 million in FY04 for 14 aircraft.

DESIGN FEATURES: Carrier-capable adaptation of existing trainer design for cost and risk reduction. Generally as for two-seat BAE Systems Hawk Srs 60, but redesigned (including deeper and longer forward fuselage) and strengthened to accommodate new landing gear and withstand carrier operation (incidentally increasing fatigue life to 14,400 flying hours, although 28,800 hours achieved on static testing airframe); twin airbrakes of composites material; fin height increased by 15.2 cm (6 in) and single ventral fin added; rudder modified; tailplane span increased by 10.2 cm (4 in); wingtips squared off; nose tow launch bar added; underfuselage arrester hook, deployable 20° to each side of longitudinal axis. No provision for gun or outboard underwing hardpoints.

FLYING CONTROLS: Differences from two-seat BAE Systems Hawk include electrically actuated/hydraulically operated full-span wing leading-edge slats (operation limited to landing configuration); aileron/rudder interconnect; two fuselage-side airbrakes instead of one under fuselage and associated autotrim system for horizontal stabiliser when brakes deployed; BAE Systems yaw damper computer and addition of 'smurf' (side-mounted unit root fin), a small curved surface forward of each tailplane leading-edge root, to eliminate pitch-down during low-speed manoeuvres; Dowty actuators for slats and airbrakes.

STRUCTURE: BAE Systems (principal subcontractor) builds wings, centre and rear fuselage, fin, tailplane, windscreen, canopy and flying controls. Intended fatigue life of 14,000 hours. Batch of 54 composites tailplanes being built by Boeing for retrofit to extant T-45s.

LANDING GEAR: Wide-track hydraulically retractable tricycle type, stressed for vertical velocities of 7.28 m (23.9 ft)/s. Single wheel and long-stroke oleo (increased from 33 cm; 13 in of standard Hawk to 63.5 cm; 25 in) on each main unit; twin-wheel steerable nose unit with 40.6 cm (16 in) stroke. Articulated main gear, by AP Precision Hydraulics, is of levered suspension (trailing arm) type with a folding side-stay. Cleveland Pneumatic nose gear, with Sterer digital dual-gain steering system (high gain for carrier deck operations). Nose gear has catapult launch bar and holdback devices. Main units retract inward into wing, forward of front spar; nose unit retracts forward. All wheel doors sequenced to close after gear lowering; inboard mainwheel doors bulged to accommodate larger trailing arm and tyres. Gear emergency lowering by free-fall. Goodrich wheels, tyres and brakes. Mainwheel tyres size 24×7.7–10 (20 ply) tubeless; nosewheels have size 19×5.25–10 (12 ply) tubeless tyres. Tyre pressure (all units) 22.40 bar (325 lb/sq in) for carrier operation; reduced for land operation. Hydraulic multidisc mainwheel brakes with Dunlop adaptive anti-skid system.

POWER PLANT: One 26.00 kN (5,845 lb st) nominal rating Rolls-Royce Turbomeca F405-RR-401 (navalised Adour Mk 871) non-afterburning turbofan; installed rating 24.59 kN (5,527 lb st). Air intakes and engine starting as described for BAE Systems Hawk. Fuel system similar to BAE Systems Hawk, but with revision for carrier operation. Total internal capacity of 1,635 litres (432 US gallons; 360 Imp gallons). Provision for carrying one 591 litre (156 US gallon; 130 Imp gallon) drop tank on each underwing pylon.

ACCOMMODATION: Similar to BAE Systems Hawk, except that ejection seats are of Martin-Baker Mk 14 NACES (Navy aircrew common ejection seat) zero/zero rocket-assisted type.

SYSTEMS: Air conditioning and pressurisation systems, using engine bleed air. Duplicated hydraulic systems, each 207 bar (3,000 lb/sq in), for actuation of control jacks, slats, flaps, airbrakes, landing gear, arrester hook and anti-skid wheel brakes. No. 1 system has flow rate of 36.4 litres (9.6 US gallons; 8.0 Imp gallons)/min, No. 2 system a rate of 22.7 litres (6.0 US gallons; 5.0 Imp gallons)/min. Reservoirs nitrogen pressurised at 2.75 to 5.50 bar (40 to 80 lb/sq in). Hydraulic accumulator for emergency operation of wheel brakes. Pop-up Dowty Aerospace ram air turbine in upper rear fuselage provides emergency hydraulic power for flying controls in event of engine or No. 2 pump failure. No pneumatic system. DC electrical power from single brushless generator, with two static inverters to provide AC power and two batteries for standby power. Onboard oxygen generating system (OBOGS).

AVIONICS: Avionics and cockpit displays optimised for carrier-compatible operations.

Comms: Rockwell Collins AN/ARN-182 UHF/VHF. Honeywell APX-100 IFF.

Flight: AN/ARN-144 VOR/ILS by Rockwell Collins. Honeywell AN/APN-194 radio altimeter. Sierra AN/ARN-136A Tacan. BAE Systems yaw damper computer. T-45C version with digital avionics (aircraft No. 84 onwards) has revised navigation package comprising mission data input device (MDID); Litton LN-100G ring laser gyro and Rockwell Collins five-channel GPS linked by 12-state Kalman filter.

Instrumentation: US Navy AN/USN-2 standard attitude and heading reference system (SAHRS). Smiths Industries Mini-HUD (front cockpit). Racal Acoustics avionics management system, and Teledyne caution/warning system. Digital avionics from 84th production aircraft onwards: two 127 × 127 mm (5 × 5 in) Elbit monochrome multifunction screens in both cockpits. MIL-STD-1553B databus and Smiths HUD.

Mission: Electrodynamics airborne data recorder.

ARMAMENT: No built-in armament, but weapons delivery capability is incorporated. Single pylon under each wing for carriage of practice multiple bomb rack, rocket pods or auxiliary fuel tank. Provision for carrying single stores pod on fuselage centreline. CAI Industries weapon-aiming sight in rear cockpit.

DIMENSIONS, EXTERNAL:

Wing span	9.39 m (30 ft 9¾ in)
Wing chord: at root	2.87 m (9 ft 5 in)
at tip	0.89 m (2 ft 11 in)
Wing aspect ratio	5.0
Length, overall, incl nose probe	11.98 m (39 ft 4 in)
Height overall	4.11 m (13 ft 6 in)
Tailplane span	4.59 m (15 ft 0¾ in)
Wheel track (c/l of shock-struts)	3.90 m (12 ft 9½ in)
Wheelbase	4.31 m (14 ft 1¾ in)

AREAS:

Wings, gross	17.66 m² (190.1 sq ft)
Ailerons (total)	1.05 m² (11.30 sq ft)
Trailing-edge flaps (total)	2.50 m² (26.91 sq ft)
Airbrakes (total)	0.88 m² (9.47 sq ft)
Fin	2.61 m² (28.10 sq ft)
Rudder, incl tab	0.58 m² (6.24 sq ft)
Tailplane	4.43 m² (47.64 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	4,261 kg (9,394 lb)
Internal fuel: early production	1,312 kg (2,893 lb)
enhanced capacity	1,433 kg (3,159 lb)
Normal T-O weight	5,783 kg (12,750 lb)
Max T-O weight	6,123 kg (13,500 lb)
Max wing loading	346.7 kg/m² (71.02 lb/sq ft)
Max installed power loading	249 kg/kN (2.44 lb/lb st)

PERFORMANCE:

Design limit diving speed at 1,000 m (3,280 ft)	575 kt (1,065 km/h; 662 mph)
Max true Mach No. in dive	1.04
Max level speed at 2,440 m (8,000 ft)	543 kt (1,006 km/h; 625 mph)
Max level Mach No. at 9,150 m (30,000 ft)	0.84
Carrier launch speed	121 kt (224 km/h; 139 mph)
Approach speed (typical)	125 kt (232 km/h; 144 mph)
Max rate of climb at S/L	2,440 m (8,000 ft)/min
Time to 9,150 m (30,000 ft), clean	7 min 40 s
Service ceiling	12,950 m (42,500 ft)
T-O to 15 m (50 ft)	1,100 m (3,610 ft)
Landing from 15 m (50 ft)	1,009 m (3,310 ft)
Ferry range	700 n miles (1,296 km; 805 miles)
g limits	+7.33/−3

BWB

BLENDED WING-BODY AIRLINERS

During the 1990s, several companies and organisations investigated the possibilities of the flying wing as a next-generation, efficient, high-capacity airliner. Their initiatives were tracked in *Jane's All the World's Aircraft* under the heading UHCA/VLCT in the International section until 2002, when known activity was reduced to the Boeing BWB. Increased interest has resulted in four programmes being concentrated below.

BLENDED WING-BODY

TYPE: New-concept airliner.

PROGRAMME: In mid-1990s, shortly before absorption by Boeing, McDonnell Douglas released details of the BWB-l-l (blended wing-body) study, giving the most comprehensive analysis yet of the flying wing's advantages for very large transport aircraft. This work continued after merger with Boeing, with at least half-a-dozen BWB derivatives under consideration at the beginning of 2002, ranging in passenger capacity from 180 to 570. An earlier BWB incarnation, able to carry 800 passengers over a 7,000 n mile (12,964 km; 8,055 mile) range, gave predicted benefits that included a 12.5 per cent reduction in T-O weight and 12.3 per cent less empty weight; 27.5 per cent reduction in fuel burn; 27.0 per cent reduction in installed thrust; and 20.6 per cent better lift:drag. These gains achieved by increasing wing area by 27.9 per cent (reducing loading by 33.6 per cent) and having a 19.2 per cent greater span.

Tests of a radio-controlled 5.5 m (18 ft) span scale BWB-l-l were undertaken by Stanford University at El Mirage dry lake, California, in July 1997 as part of a USD2.3 million programme to evaluate flight control laws for a flying wing. Data generated by these trials were of poor quality, but a series of tethered wind tunnel tests of a 3.7 m (12 ft 2 in) span free flight model conducted by NASA in 2005 yielded useful results.

In co-operation with NASA, Boeing initiated development of a 14 per cent scale vehicle known as the BWB-LSV (blended wing body–low speed vehicle) in the late 1990s. Powered by three Williams J24-8 turbojet engines, this featured a 10.67 m (35 ft) wing span and weighed approximately 1,361 kg (3,000 lb). Construction began in 2000, at which time it was still known as the BWB-LSV, but it was subsequently assigned the experimental **X-48A** designation shortly before the end of 2001. Production and assembly of the X-48A was expected to have been completed by the end of 2002, with a lengthy series of ground testing planned for most of 2003, leading up to flight trials in 2004. In the event, the X-48A was quietly cancelled, among the reasons cited being difficulties encountered with the flight control system and budgetary considerations on the part of NASA.

Despite this setback, Boeing still wished to demonstrate BWB flight control systems and next approached Cranfield Aerospace of the UK in 2003 with a request to construct two examples of a smaller 8.5 per cent scale remotely piloted test vehicle. Given the designation **X-48B** on 15 June 2005, this is to undergo a joint trials programme in the USA for Boeing, NASA and the US Air Force Research Laboratory.

The X-48B is approximately 7.0 m (23 ft) long, with a span of 6.2 m (20 ft 4 in) and a wing area of 9.29 m² (100 sq ft). Weight has been reported as 237 kg (523 lb), with estimated performance figures including a max speed of 118 kt (218 km/h; 135 mph), a max altitude of 3,050 m (10,000 ft) and about 40 minutes' endurance. Power is provided by three 0.22 kN (50 lb st) model aircraft microjet engines and the X-48B features a total of 20 control surfaces on the wing trailing-edge, of which the outer ailerons are split surfaces,

Stuttgart University/IF BWB-Demonstratormodell *(Paul Jackson)* 1040493

Boeing X-48B prepared for 2007 flight trials *(NASA)* 1040466

with the ability to function as drag rudders and speed brakes. In event of an emergency landing being necessary, a recovery parachute and airbag are installed, as is a spin recovery parachute for use in departure from controlled flight during a planned series of high AoA stall tests.

Cranfield Aerospace was also responsible for the supply of a control vehicle, but software for flight control was developed by Boeing's Phantom Works. Flight testing is to take place at NASA's Dryden Research Center at Edwards AFB, California and will be undertaken by the second X-48B; ground checkout of this was under way at Dryden in late 2006, with a series of five flights scheduled for early 2007. Previously, some 250 hours of wind tunnel testing was completed by the first X-48B at NASA's Langley, Virginia, facility between 7 April and mid-May 2006, with this craft then being transferred to Dryden to serve as a back-up vehicle for the flight test programme. Investigation of stall characteristics, spin and tumble, asymmetric thrust and ground effects are among the test objectives, in addition to studies of dynamic interaction between control surfaces, wing aerodynamics and inlet conditions.

One potential application considered by Boeing is a BWB tanker for multipoint aerial refuelling. Equipped with three 'smart' booms, two hose/drogue refuelling points and automated refuelling capabilities, BWB tanker would be able to accommodate simultaneous air-to-air refuelling of multiple conventional aircraft or UAVs. Fuel carried in wing tanks; maximum payload space would be available for up to 23 conventional pallets and 40 troops.

As a C2ISR (command, control, intelligence, surveillance, reconnaissance) platform, the BWB would provide increased loiter time, large interior space suitable for battle management control rooms, and ample exterior locations for conformal phased-array antennas for broadband communications with no increase in radar signature. These capabilities make the BWB additionally suitable as a long-range standoff weapons platform.

Other possible military derivatives could include a version to satisfy a future USAF cargo aircraft requirement.

Another organisation known to be conducting investigations into the Blended Wing Body configuration is the **Hamburg University** of Applied Sciences in Germany. This has conceived a design meant to represent a notional 900-seat airliner known as the AC 20.30 that could enter service in 2030. Project has involved construction of a radio-controlled 1:30 scale model, which flew for the first time at Itzehoe on 16 December 2003 and which undertook extensive wind tunnel testing at Dresden in September 2005 to provide data for additional flight trials.

Also in Germany, as part of EC's five-year EUR160 million Lufo III air transport technology development project, **BWB-Demonstratormodell** developed by Department of Conceptual Aircraft Design at **Stuttgart University** and Institut für Flugzeugbau, with assistance from Institut für Flugmechanik und Flugregelung and Steinbeis Transferzentrum Aerodynamik, Flugzeug- und Leichtbau. Single-jet model aircraft shown at ILA, Berlin, May 2006.

BWB configuration is also being investigated as a means of reducing the sound impact of aircraft in a study led by Cambridge University in the UK and Massachusetts Institute of Technology. Silent Aircraft Initiative **SAX-40** is funded by the **Cambridge-MIT Institute** (CMI); launched in 2003 with a grant from CMI of GBP2.3 million; first public

Hamburg University AC 20.30 flying scale model *(Paul Jackson)* 1040488

announcement 6 November 2006; includes teams involved in different aspects of aircraft design for a multidisciplinary approach; core personnel are 40 CMI researchers. Project has received significant collaborations from all parts of the civil aerospace/aviation industry including British Airways, BAA, Boeing, Brüel & Kjær, Civil Aviation Authority, Cranfield University, DHL, easyJet, Eurocontrol, HACAN Clearskies, Lochard, London Luton Airport, Marshall of Cambridge Aerospace, National Air Traffic Services (NATS), Nottingham East Midlands Airport, Royal Aeronautical Society and Rolls-Royce.

Noise reduction measures concentrate on take-off, climbout and approach phases of flight. On departure, this is achieved by engines embedded within the fuselage with intakes above the wings to shield much of the engine noise from listeners on the ground; novel, ultra-high bypass engines with a variable-area exit nozzle which can operate for low noise with low-speed exhaust jets at take-off and during climb, and then be optimised for minimum fuel burn in cruise; thrust, nozzle settings and climb rate optimised for low noise, subject to meeting legal requirements; long engine exhaust ducts to provide space for extensive acoustic liners.

On approach, the airframe on a conventional aircraft is as noisy as the engines. SAX-40 approach noise is reduced by an airframe design that enables the aircraft to approach at lower speed and so land further down the runway; low-noise fairings on the landing gear; advanced aerofoil trailing-edge treatment; a deployable drooped leading-edge on the wings and vectored thrust, which are used to enable low-speed flight without noise penalty; absence of flaps and slats; engines having a low idle thrust and able to respond rapidly if a go-around is necessary.

SAX-40 is a 215-seat (three-class) 'all-lifting' design, producing lift on centrebody as well as wings; makes use of a novel centrebody shape with leading edge carving; this balances aerodynamic forces without the need for tail surfaces, and enables an optimal wing design with an elliptical lift distribution and low cruise drag. Performance includes 149 passenger-miles per Imperial gallon of fuel (compared with about 120 for the best current aircraft in this range and size). This is equivalent to the Toyota Prius Hybrid car carrying two passengers. Noise of 63 dBA outside airport perimeter—some 25dB quieter than current aircraft.

SAX-40 low-noise, high efficiency aircraft by Cambridge University and MIT 1040472

Notional engines are 'Granta-3401'. Single core driving three high-capacity, low-speed fans. Distributed propulsion system is designed to ingest centrebody boundary layer, which reduces the fuel burn. Multiple small fan design is easier to embed in the airframe and leads to reduced weight and nacelle drag; also enhances boundary layer ingestion, thereby improving fuel efficiency, and the low fan tip speeds produce low noise. Ultra-high bypass ratio 18.3 at take-off for low jet noise, 12.3 at top of climb for good efficiency.

Several possible Boeing BWB derivatives have emerged as candidates for production, including the **BWB-250**, with accommodation for about 260 passengers, and the **BWB-450** with room for about 480 passengers.

Estimated data below refer to the 800-seat Boeing BWB-1-1 proposal powered by three 275 kN (61,900 lb st) turbofans and CMI SAX-40 with three 'Granta-3401' engines.

DIMENSIONS, EXTERNAL:

Wing span: excl winglets, BWB-1	85 m (280 ft)
incl winglets: BWB-1	88 m (289 ft)
SAX-40	67.54 m (221 ft 7 in)
Wing aspect ratio: BWB-1	5.1
SAX-40	5.5
Length overall, BWB-1	49 m (161 ft)
Height overall, BWB-1	15 m (50 ft)

AREAS:

Wings: trap, BWB-1	728 m² (7,840 sq ft)
gross: BWB-1	1,423 m² (15,325 sq ft)
SAX-40	835.9 m² (8,998 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, BWB-1	167,750 kg (369,800 lb)
Weight empty, equipped: BWB-1	186,900 kg (412,000 lb)
SAX-40	94,190 kg (207,660 lb)
Max payload: BWB-1	104,800 kg (231,000 lb)
SAX-40	23,405 kg (51,600 lb)
Max fuel weight: BWB-1	122,500 kg (270,000 lb)
SAX-40	33,252 kg (73,310 lb)
Max T-O weight: BWB-1	373,300 kg (823,000 lb)
SAX-40	150,840 kg (332,550 lb)
Max zero-fuel weight, BWB-1	291,650 kg (643,000 lb)
Fuel burn over 7,000 n miles with 800 passengers, BWB-1	96,820 kg (213,450 lb)
Max wing loading: BWB-1	513 kg/m² (105 lb/sq ft)
SAX-40	180.4 kg/m² (36.96 lb/sq ft)
Max power loading, BWB-1	452 kg/kN (4.4 lb/lb st)

PERFORMANCE:

Normal cruising speed: BWB-1	M0.85
SAX-40	M0.8
Max approach speed, BWB-1	150 kt (278 km/h; 173 mph) EAS
Initial cruising altitude: BWB-1	10,665 m (35,000 ft)
SAX-40	12,190 m (40,000 ft)
T-O field length, BWB-1	3,353 m (11,000 ft)
Range: with 800 passengers, BWB-1	7,000 n miles (12,964 km; 8,055 miles)
with 215 passengers, SAX-40	5,000 n miles (9,260 km; 5,753 miles)

DIRGANTARA/AERONIMBUS

DIRGANTARA/AERONIMBUS

Dirgantara: see Indonesia
AeroNimbus: see Malaysia

Companies collaborating from 2005 on NMX-1 new small passenger jet for Asia/Middle East market.

DIRGANTARA/AERONIMBUS NMX-1

TYPE: Light business jet.

PROGRAMME: Launched 7 January 2005 with plans for Dirgantara to design and build prototype and produce detail parts at Bandung; final assembly and certification by AeroNimbus in Malaysia. First flight then targeted for late 2006; however, according to reports at Asian Aerospace show in Singapore in February 2006, one of AeroNimbus' Southeast Asian investors had withdrawn and replacement(s) were being sought. Previously, Dirgantara had completed NMX preliminary design and wind tunnel testing by end of 2005, but then suspended detailed design work pending arrival of replacement funding. Assuming this to materialise soon, maiden flight could be retargeted for 2008. Eventually, AeroNimbus plans production of up to 36 a year at three separate plants.

COSTS: Dirgantara design and development contract valued at USD50 million; estimated unit price USD2.2 to 2.5 million (2005).

POWER PLANT: Twin Pratt & Whitney Canada turbojets/fans.

ACCOMMODATION: Pilot(s) and six passengers.

DIMENSIONS, EXTERNAL:

Length overall (approx)	16.0 m (52 ft 6 in)

WEIGHTS AND LOADINGS:

Max T-O weight	approx 2,000 kg (4,409 lb)

PERFORMANCE (estimated):

Cruising speed	M0.8
T-O and landing run	800 m (2,625 ft)

EADS

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Decision to merge Aerospatiale Matra of France and DASA of Germany was announced on 14 October 1999; previously mooted amalgamation of Spain's CASA with DASA was reconfirmed on 2 December 1999, increasing size of prospective company to 90 sites. Officially formed 10 July 2000, immediately becoming world's third-largest aerospace company. Asset distribution comprises 30.80 per cent stock flotation; 30.29 per cent directly, plus 2.75 per cent indirectly DaimlerChrysler; 5.53 per cent SEPI (Spanish state holding company); 30.29 per cent SOGEADE (Lagardière and French government jointly); and 0.34 per cent directly by French government.

EADS has five major operating divisions:

Airbus (International)
Military Transport Aircraft (Spain)
Eurocopter (International)
Defence & Security Systems Comprising EADS Military Aircraft (Germany), EADS Services, Missiles, EADS Systems & Defence Electronics and EADS Telecom
Space Company controls Socata and Eurocopter (100 per cent); also holds 80 per cent of Airbus, 56 per cent of Airbus Military Company and 51 per cent of EADS PZL in Poland; and has significant shares in Dassault (45.8 per cent), Eurofighter (43 per cent), ATR (50 per cent) and missile and space programmes. Aircraft produced by EADS are described in their

appropriate national sections with the exception of the Mako, which is first to bear the EADS name.

Wholly owned subsidiaries include EADS Socata, EADS EFW and EADS Sogerma Services.

Additionally, ATR is jointly owned with Alenia Aeronautica. EADS Russia founded 25 March 2004 as joint programme (subject to Russian law) principally concerned with research and production for Airbus.

Corporate headquarters established in Netherlands and EADS is subject to Dutch company law. Turnover in 2004 totalled EUR31,761 million; orders€44,117 million; backlog at 1 January 2005 EUR114,288 million. Workforce 110,662 total; by division is approximately 38 per cent Airbus, 26 per cent Aeronautics, 20 per cent Systems and Defence Electronics, 11 per cent Space and 4 per cent Military Transport Aircraft; remaining 1 per cent are HQ staff. By 2012, EADS work distribution planned to be 60 per cent commercial, 30 per cent military and 10 per cent space.

The first aircraft — Mako advanced jet trainer — to have an EADS appellation appears to have made little progress towards first flight in recent years.

EADS/JAXA

JAPAN AEROSPACE EXPLORATION AGENCY

PARTICIPATING COMPANIES:

EADS: see France

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JAXA was created on 1 October 2003 by amalgamation of Japan's National Aerospace Laboratory (NAL), Institute of Space and Astronautical Science (ISAS) and National Space Development Agency (NASDA). Current projects include the Stratospheric Platform (SPF), a programme to develop a series of unmanned, geostationary stratospheric airships for telecommunications and other purposes, for which a low-altitude, subscale (67,8 m; 222,4 ft long) NiCT prototype was test-flown in 2004. It is also developing a next-generation supersonic transport, the NEXST-1, on which it was joined by EADS France in June 2005.

Low-altitude test airship for the SPF 1133972

EADS/JAXA NEXST-1

TYPE: Supersonic airliner.

PROGRAMME: Continues towards development of future supersonic transport for service entry in 2015 to 2020 time frame. Design begun as indigenous project in 1997 by National Aerospace Laboratory of Japan; first test flight attempted in 2002, using subscale model launched by solid-fuel booster rocket, but failed when model detached prematurely and crashed. Agreement signed with EADS 14 June 2005 for three-year, USD5,4 million joint development research into 300-passenger SST able to fly from New York to Tokyo in 6 hours.

Subscale test model of the EADS/JAXA NEXST-1 1151054

Second rocket-boosted test flight, with 11,5 m (37,7 ft) long unpowered model, made from Woomera Test Range in Australia 10 October 2005, was successful. Model separated from rocket at about 18,000 m (59,050 ft) and glide-flew at M1,9 to M2,0 for 15 minutes 22 seconds before descending by parachute.

Putative alternative 4-engined SST design 1151004

NEXST-1 test model, launched 10 October 2005 1151053

EUROCOPTER

EUROCOPTER SAS (AN EADS COMPANY)

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PRESIDENT AND CEO: Lutz Bertling
DIRECTOR OF COMMUNICATIONS: Xavier Poupardin
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Eurocopter SA formed 16 January 1992 by merger of Aerospatiale and MBB (DASA) helicopter divisions. Share capital then held on two levels: Eurocopter Holding owned 60 per cent by Aerospatiale and 40 per cent by DASA; capital of Eurocopter SA held 75 per cent by Eurocopter Holding and 25 per cent by Aerospatiale. However, on 30 May 1997, the separate elements of Eurocopter were merged into a single management structure. Former Eurocopter France, Eurocopter International and Eurocopter Participations became a single entity (Eurocopter France, trading as Eurocopter), with Eurocopter Deutschland (in Germany) as a wholly owned subsidiary. Following formation of EADS, Eurocopter reconstituted on 18 September 2000 as simplified stock company (SAS) within EADS Aeronautics group. EADS CASA acquired 5 per cent share in December 2003, in return for relinquishing its share of Eurocopter España.

Eurocopter products cover 75 to 80 per cent of the range of helicopters in terms of size and capacity, but company intends to expand this to 95 per cent; aim set back by forced withdrawal from Euromil, particularly with co-operative development of Russian Mil Mi-38, but forthcoming EC 175 will fill market gap between EC 145 and EC 225. Orders in 2005 were 401: 44 Colibris, 193 Ecureuil/Fennec/EC 130s (variants not specified), 87 EC 135s, 20 BK 117/EC 145s, 25 Dauphin/Panther/EC 155s, 14 Super Puma/Cougar/EC 225/EC 725s, six Tigres and 12 NH90s. In 2006, delivered 381 helicopters and received orders for 615, valued at EUR3.52 billion: 59 Colibris, 257 Ecureuil/Fennec/EC 130s, 107 EC 135s, 80 Bk 117/EC 145s, 40 Dauphin/Panther/EC 155s, 29 Super Puma variants and 43 NH90s. By late 2006, Eurocopter fleet totalled more than 9,500 helicopters with 2,500 customers in 139 countries, these having flown more than 60 million hours.

Main production centres in France, Germany and Spain. Additionally, Eurocopter subsidiaries employ some 1,680 persons and deliver about 150 aircraft per year; managed by Eurocopter Subsidiaries and Participations division (ownership percentage in parentheses): American Eurocopter (370 personnel; 60 per cent); Eurocopter Canada (134 personnel; 100 per cent); Hélibras (Brazil; 260 personnel; 76.5 per cent); Eurocopter Romania (55 personnel; 51 per cent); and McAlpine (UK; 132 personnel; 10 per cent); are all first-tier subsidiaries responsible for distribution, service and industrial work, including assembly and component manufacture (Canada and Hélibras), customisation (American, Canada, Hélibras and McAlpine) and repair and overhaul. Second-tier subsidiaries (distribution and service) comprise Eurocopter South East Asia (Singapore; 75), Eurocopter Mexico (100), Eurocopter Chile (100), Eurocopter South Africa (100), Australian Aerospace (Australia; 100), and Euroheli (Japan; 10) (with Eurocopter Japan in co-ordinating role. Service subsidiaries are Eurocopter Philippines (70), Eurocopter Malaysia (100) and COHC GAMEC (China; 21).

On 7 August 2003, American Eurocopter, with HQ at Grand Prairie, Texas, broke ground for a new, USD12 million plant at Columbus, Mississippi, for final assembly of up to 30 AStar/Ecureuils per year, plus manufacture of some AS 350, AS 355 and EC 120 components; FAA production approval obtained September 2005. Australian facility at Brisbane began assembly of 18 Tigers in April 2003 and assembly of EC 120s in June 2003. Tiger deliveries began 2005. In 2005, established EC 120 assembly line in China and announced launch of EC 175 development programme jointly with AVIC II. South Korea nominated Eurocopter as partner in KHP programme for 8-tonne helicopter in December 2005; Eurocopter assigned 30 per cent share in development and 20 per cent in production, plus 50 per cent of exports.

EUROCOPTER

Address as above.

Company headquarters and main production centre at Marignane (Marseille); works at La Courneuve (Paris). In 2005, these employed 5,650 and 750 personnel, respectively.

EUROCOPTER DEUTSCHLAND

Industriestrasse 4, Postfach 1353, D-86609 Donauwörth, Germany
Tel: (+49 906) 710
Fax: (+49 906) 71 40 11
CHAIRMAN: Friedrich Dörhöfer
MEDIA RELATIONS EXECUTIVE: Christina Gotzhein

Industrial concern in charge of production and support of products originating in German part of Eurocopter. Wholly owned subsidiary with plants at Donauwörth (3,464 personnel in 2005), Kassel (80) and Ottobrunn (655).

Current programmes are EC 135, BK 117C-1, EC 145 and Tiger; NH90 (industrialisation); also maintenance/upgrade work for CH-53G, Lynx and Sea King. Research and development programmes concentrate on noise abatement, fly-by-light technologies, all-weather capability of helicopters and optimisation of in-flight comfort and safety. Eurocopter Deutschland closely co-operates with other industrial partners in the aerospace industry as well as the German and French aerospace institutions DLR and ONERA, respectively.

Eurocopter Deutschland, the Federal Ministry of Defence and German Aerospace Research Establishment are jointly providing DM40 million to 50 million funding for development of **Helicopter Simulator for Technology, Operations and Research (HeSTOR)**, based on EC 135, to replace BO 105-based Advanced Technology Testing Helicopter System (ATTHeS) which was lost in an accident on 19 May 1995.

EUROCOPTER ESPAÑA SA

Carretera del Barrio de la Fortuna 10, E-28044 Cuatro Vientos, Madrid
Tel: (+34 91) 379 72 00
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PUBLIC RELATIONS EXECUTIVE: Francisco Salido

Established 28 September 2000, replacing former subsidiary Helicopteros España (HESA). Works at Quatro Vientos responsible for engineering, production and customer support, on par with French and German divisions. Owned 60 per cent Eurocopter and 40 per cent EADS CASA until 18 December 2003 announcement of CASA's buy-out in return for 5 per cent share of Eurocopter. Personnel total 250. Announced 12 May 2005 that Eurocopter will invest EUR60 million over 10 years to build 450-personnel plant at Albacete.

Additionally, Eurocopter has entered into two alliances with manufacturers in Asia in order to develop specific products. These are regarded by the company as wholly Eurocopter aircraft.

EUROCOPTER/CATIC/ST AERO

PARTICIPATING COMPANIES
Eurocopter: International
CATIC: China
Singapore Technologies Aerospace: Singapore

This partnership formed to develop the EC 120 Colibri, production of which is now fully under way. Shares are Eurocopter 61 per cent (and programme leader), CATIC/HAMC 24 per cent and ST Aero 15 per cent.

EUROCOPTER/KAWASAKI

PARTICIPATING COMPANIES
Eurocopter: International
Kawasaki: Japan

Companies formed a partnership on 25 February 1977 to develop the BK 117 multipurpose helicopter. Low-rate production continues in both Germany and Japan. An upgraded version, the EC 145, was certified in December 2000.

EUROCOPTER 665 TIGER/TIGRE

TYPE: Attack helicopter.
PROGRAMME:

DEVELOPMENT MILESTONES

Requirement issued	1984
Design began	18 Sep 85
Programme launched	8 Dec 87
Official go-ahead	30 Nov 89
Rolled out	4 Feb 91
First flight	27 Apr 91
Production go-ahead	30 Jun 95
First flight, production	2 Aug 02
First delivery (Australia)	15 Dec 04

France and Germany agreed in 1984 to develop a common combat helicopter; Eurocopter Tiger GmbH formed 18 September 1985 to manage development and manufacture for French and German armies; was not a full member of Eurocopter because it was working on a single government contract; executive authority for programme is DFHB (Deutsch Französisches Hubschrauberbüro) in Koblenz; procurement agency is German government BWB (Bundesamt für Wehrtechnik und Beschaffung).

Original 1984 MoU amended 13 November 1987; FSD approved 8 December 1987; main development contract awarded 30 November 1989, when name Tiger (Germany)/Tigre (France) adopted; five development aircraft built, including three unarmed aerodynamic prototypes, used also for core avionics testing (PT1, 2 and 3), one (PT4) in HAP (initially called Gerfaut) configuration and one (PT5) as UHT prototype; PT1 rolled out 4 February 1991; first flight 27 April 1991; fifth prototype flew on 21 February 1996, at which time the first four aircraft had accumulated 1,090 flying hours; further details below; total of 2,869 hours flown by five prototypes up to June 2001. Germany confirmed purchase of full 212 required, 1994, having considered cut to 138, but later reconsidered.

Industrialisation phase brought forward by two years to strengthen export prospects and Franco-German MoU signed 30 June 1995; timetable then was first deliveries in 1999 to France (approximately 10) and for export, but France announced spending moratorium in November 1995, postponing authorisation of further funding commitments until signature of a FFr2.5 billion (DM733.6 million) production investment contract on 20 June 1997. Deliveries then expected in 2001, but further delayed to July 2003 (for HAP; 2011 for HAC) by May 1996 defence plan, which envisaged procurement of only 25 Tigres in 2000–2002 budgets.

On 20 May 1998, France and Germany signed a commitment to order an initial joint batch of 160 Tigers. However, planned late 1998 placing of contracts was delayed by requirement of new German government to conduct a defence review; options included delaying ISD; or reducing numbers; or even cancelling UHT and procuring French HAP version. Production contract was finally signed on 18 June 1999 for the full 160 aircraft; first deliveries in 2002. HAP deliveries to include two in 2003, eight in 2004 and 10 per year in 2005–10; first production aircraft (9826) flew in Germany, 2 August 2002. First deliveries to France (FMATA (c/n 2001) on 16 March 2005 (official ceremony 18 March) and to Germany 7405 (c/n 1005) on 6 April 2005, although nominal initial recipient was Australian Army, which accepted first two at Oakey, Queensland, on 15 December 2004

Eurocopter Tiger UHT 1153746

First Australian-built Eurocopter Tiger 1153747

(following acceptance by Australian Aerospace at Brisbane on 23 November 2004); however, official acceptance by Australian Army was 18 July 2005. Production of the first batch of 320 engines (plus 12 spares) began during 2000, and will continue through 2011. June 1999 contract also formalised German contract change from PAH2 to UHT and French change from HAP to HAP-F (*Finalisé*).

Spain became third member of Tiger programme in 2003 and integrated in airframe, engine, avionics and weapons development and manufacturing programmes. Spanish Army (and France) to receive HAD version of Tigre, for which development contract signed 8 December 2004.

Joint team at Marignane is flight testing basic helicopter, updating avionics during trials, and testing HAP variant; similar team at Ottobrunn is qualifying basic avionics, Euromep mission equipment package, and integrating weapons system. Rotor downwash problems resulted in trial forward positioning of horizontal stabiliser; by mid-1994 definitive solution adopted of reversion to original position, but halving area. By January 1998, the design had been frozen, and the development programme was more than 90 per cent complete. Development of HAD version involves Spanish participation from 2003 onwards.

First export order for Tiger confirmed 14 August 2001, when Australia announced selection to meet AIR 87 requirement. MoU on co-operation and exchange of information, to lead to production and delivery, signed by Eurocopter and Australian Defence Science and Technology Organisation on 12 July 2002.

CURRENT VERSIONS (general): Original partners require three versions in two basic configurations with about 80 per cent commonality: **U-Tiger** is basis of the UHT and HAC, both with mast-mounted sight and Trigat missiles; **HCP** (*Hélicoptère de Combat Polyvalent*) is basis of the HAP (roof sight and turreted gun). Other variants proposed to meet export requirements.

Tigre HAP: *Hélicoptère d'Appui et de Protection;* name Gerfaut dropped late 1993; escort and fire support version for French Army; armed with 30 mm Giat AM-30781 automatic cannon in undernose turret, with 150 to 450 rounds of ammunition; four Mistral air-to-air missiles and two pods each with twenty-two 68 mm unguided TDA rockets delivering armour-piercing darts, mounted on stub-wings, or 12-round rocket pod instead of each pair of Mistrals, making total of 68 rockets; roof-mounted sight, with TV, FLIR, laser range-finder and direct view optics sensors; image intensifiers integrated in helmets; and extended self-defence system. HAP configuration was approved by late 1998, permitting type qualification in December 2002 and official military (DGA) certification on 19 March 2004, followed by OCCAR (European arms procurement agency) certification on 30 March. Deliveries from Marignane began 16 March 2005; final (37th) aircraft due in 2008.

UHT: *Unterstützungshubschrauber Tiger* (previously designated UHU); German Army multirole 'utility' or multirole anti-tank and fire-support helicopter; replaces dedicated anti-tank PAH-2 Tiger; final assembly at Donauwörth. Type qualification due December 2002, but not achieved until 17 August 2004, with OCCAR approval next day; this approval for Step 1 configuration with Stinger, cannon, HOT 3 and TriGAT. Step 2, for operational training in France, adds passive missile warning; Step 3, in mid-2006, for operational regiment, includes encrypted communications. Underwing pylons for HOT 3 or (from 2006) Trigat missiles, Stinger self-defence missiles, unguided rockets, gun pod and extended self-defence system; mast-mounted TV/FLIR/laser ranger sight for gunner; nose-mounted FLIR for piloting. A mid-life upgrade for the UHT may integrate the Mauser 30 mm gun in a chin turret which traverses ±140° in azimuth and from +20 to −45° in elevation.

Tigre HAC: *Hélicoptère Anti-Char*; anti-tank variant originally required by, but not yet ordered for French Army; final assembly at Donauwörth. Type qualification due in third quarter of 2011; same weapon options (except Mistral AAM in place of Stinger), mast-mounted sight and pilot FLIR system as UHT. A mid-life upgrade to the HCP could see addition of a mast-mounted automatic air surveillance and warning system, in the form of DAV pulse Doppler radar, together with HUMS and an IR jammer.

Export: A basic export version combining features of French and German versions; offered (unsuccessfully) to UK and Netherlands.

Eurocopter Tigre HAP PS1 *(Paul Jackson)* 1153745

ARH Tiger (HCP): Hybrid Tiger variant to meet Australian Army Air 87 Requirement. Based on French HAP, with undernose Giat 30-781 30 mm cannon, roof-mounted sight and provision for underwing 70 mm rocket pods, but with added anti-tank capability. Australia also requires integration of the AGM-114 Hellfire ATM. Maximum mission weight of 6,100 to 6,300 kg (13,448 to 13,889 lb). A$1,300 million (US$674 million) contract for 22 signed 21 December 2001. First four from European production; fuselage sections of first aircraft joined 11 February 2003; first flight (F-ZVLH/A38-001) 20 February 2004 at Marignane.

HCP Tiger (HCP): Export version based on French Army HAP with the same undernose gun turret and roof-mounted sight, HOT 3 and Trigat missiles; Hellfire optional. Strix roof sight (direct view optics optional) and additional laser designator plus video signal interfacing for Trigat operation. Either Mistral or Stinger air-to-air missiles. A mid-life upgrade to the HCP could see addition of a DAV mast-mounted air surveillance radar (pulse Doppler type) or a mast-mounted MMW radar for automatic ground and air surveillance. No gun pod option.

Tigre HAD: *Hélicoptère d'Appui-Destruction*. Multirole version for anti-tank, combat support, reconnaissance and escort roles; development cost estimated as EUR152 million (2002). Purchased by Spain. Uprated (MTR390-E) engines, increased MTOW to 6 tonne class, roof sight for Trigat ATMs. Additional weapons include 30 mm cannon, Mistral AAMs and 70 mm unguided rockets. HAD adopted by France in 2003, with final 43 of order for 80 Tigres to be delivered from 2010 onwards. Programme launched by instruction to proceed (ITP) on 8 December 2004, following agreement by participating countries signed 26 October 2004 empowering OCCAR to place development contracts on their behalf. OCCAR; formal contract signed 30 November 2005.

Tiger T800: LHTEC T800 or CTS800 engines proposed as an engine option for the Tiger. Turkey is sales prospect, as Army has reservations about growth potential of MTR390.

CURRENT VERSIONS (specific): **PT1/F-ZWWW:** Aerodynamic prototype; basic avionics; first flight 27 April 1991. Successively fitted with aerodynamic mockups of mast-mounted and roof-mounted sights, nose-mounted gun and weapon containers. Relegated to ground fatigue testing and static display in early 1996 on completion of flight programme. Flown 502 hours.

PT2/F-ZWWY: HAP aerodynamic configuration; full core avionics; rolled out 9 November 1992; first flight 22 April 1993. Used for radar cross-section and detectability tests. Retrofit with HAP systems completed in November 1996; redesignated PT2R. Mistral launch trials at Landes ranges 14/15 December 1998; technical assessment by French Army at Valence between 17 May and 3 June 1999; rocket qualification, June 1999. Used for HAP version qualification (redesignated PT2R2) at Landes test centre between 4 April and 12 May 2000. Redesignated PT2X in 2001 to serve as multimission demonstrator, adding LFK/SAGEM sighting system for HOT 3 anti-tank missiles in addition to original Mistral missiles and rockets. Deck landing trials, May 2002, aboard FS *Siroco*, an amphibious landing ship. Demonstrated autorotation at 5,700 kg (12,566 lb) 27 April 2004.

PT3/9823: Full core avionics (including navigation and autopilot); first flight (as F-ZWWT) 19 November 1993. Retrofit with UHT systems began in February 1997; redesignated PT3R; Euromep C (see Avionics) from late 1997. HOT launches with mast sight at extreme range in night and smoke conditions, June 1999; hot weather trials at Bateen AB in Abu Dhabi September 1999. Moved back to France for HAC development.

PT4/F-ZWWU: HAP aerodynamic configuration and avionics (including roof sight, HUD and Topowl helmet sight; first Tiger with live weapons system); first flight 15 December 1994. Sighting system trials early 1995; Giat cannon trials (15 ground-based tests) completed at Toulon, April 1995; full testing began at CEV Cazaux, 21 September 1995 and, by late November, had demonstrated airborne cannon firing and launch of Mistral AAM (without seeker); by 1 January 1997 had fired eight Mistrals, 3,000 cannon rounds and 50 rockets; 1997 trials included two more Mistrals, rockets and tests of gun controls. Painted in three-tone disruptive camouflage. Winter trials in Sweden, early 1997 with skid/skis landing gear. Flown 296 hours to 1 December 1997; crashed during night low-level evaluation by Australian Army 17 February 1998.

PT5/9825: Full UHT avionics; first flight 21 February 1996. Undertook German Army weapon trials (Stinger, HOT 2 and 12.7 mm podded gun) in 1997 including the firing of six HOT 2s using Euromep Osiris mast-mounted sight. Retrofitted as PT5R with production-standard weapon system; first flight 8 October 1999. Weapon trials continued into 2004, including HOT, Trigat, 70 mm rocket and 12.7 mm machine gun.

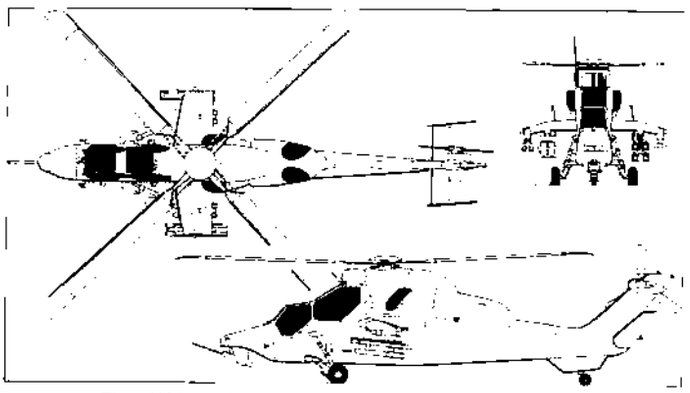
PT6 and PT7: Static test airframes for fatigue and crash-resistance trials.

PS1/F-ZVLJ: Pre-series HAP built at Marignane on production tooling; laid down in third quarter of 1998; first flight 21 December 2000. Tasks include validation of production methods and planned production configuration including 6.4 tonne MTOW extension. Operated by French Army aviation trials centre (GamStaT) at Valence.

UHT S01/9826: First true production aircraft; planned to fly on 1 March 2002, but not rolled out until 22 March; first flight 2 August 2002; used for six-month techeval/opeval trials, replacing PT5R. Pilot's visual system trials.

UHT S02/9812: Electromagnetic compatibility trials at WTD 81, Greding; weapons qualification.

UHT S03/9813: To WTD 61, Manching, for instructor training (with S04).



Eurocopter Tigre HCP combat escort and fire support helicopter
(Paul Jackson) 0504769

HAP S01: First production French Tiger, first flight (F-ZKDB) 26 March 2003; then briefly to CEV trials centre 1 April 2004; then French Army

CUSTOMERS: Firm orders by early 2004 totalled 206: France and Germany 80 each; Australia 22 and Spain 24.

Original requirement was for 427 (France 75 HAP and 140 HAC, Germany 212 PAH-2); UHU (later UHT) version substituted for PAH-2s in 1993; French order amended by 1994 to 115 HAP and 100 HAC but may be reduced further; in mid-2001 French Army expressed preference for multirole Hélicoptère d'Appui-Destruction (HAD) version in place of two subvariants now on order. Germany committed to 212, of which 112 to be funded between 2001 and 2009; initial commitment of 20 May 1998 confirmed 80 each by France (70 HAP, 10 HAC) and Germany (80 UHT), as agreed by Franco-German Security Council on 9 December 1996. By 2002, official German sources suggesting full requirement only 110 and Eurocopter resigned to total of 240 between two launch partners. Confirmed in 2003 that France's initial order for 80 Tigres now to be 40 HAPs and 40 HADs (no HACs), although this change was not due for formal embodiment in contracts until 2006. First operational squardon (April 2006) to be formed within 5 Combat Helicopter Regiment (5 RHC) at Pau, gaining IOC mid-2007. Further French order in 2011 for 20 Tigres satisfies current defence plan. Second regiment will be at Etain.

Germany's Tigers are required to equip four 48-aircraft regiments, each supporting an Army division, first being 1 Staffel of 36 Regiment at Fritzlar and second at Roth.

Joint training school at le Luc opened 1 July 2003 as the Ecole Franco-Allemand, or EFA with a Thomson Training and Simulation/STN Atlas aircrew training system, including six-axis motion simulators and wide-angle visual systems. Training course lasts 28 weeks for a crew chief, or 19 weeks for a pilot. Fleet of 14 German and 14 French Tigers assigned by 2006, with eleven simulators; deliveries began 2005. In October 2000 there were reports that the German MoD was considering reducing its Tiger buy to 100 helicopters.

Australia selected Tiger for AIR 87 requirement on 14 August 2001; contract signed 21 December 2001 for 22 helicopters, of which final 18 assembled by Australian Aerospace at Brisbane, from where deliveries due between July 2005 and April 2008. First French-built components arrived at Brisbane 31 March 2003 and assembly work began on 10 April. Four complete French aircraft deliverable in pairs, December 2004 and early 2005, initial Marignane-built helicopter having flown on 20 February 2004 (temporarily as F-ZVLH). First two French Tigers delivered to Australian Aerospace on 23 November 2004 and nominally accepted by Australian Army on 15 December 2004. First Australian - assembled Tiger (A38-005) flew at Brisbane 21 December 2004. Following familiarisation flying at Oakey, Tiger formally accepted by Australian Army on 18 July 2005. First operational squadron forms at Darwin in June 2007.

Spanish government approval for €1,353 million purchase of 24 Tigers given 5 September 2003, price including logistic support and initial weaponry. Programme involves Spanish participation in Tiger through Eurocopter España; Spain designated sole source of all tailbooms and will assemble chosen HAD version; other Spanish firms to participate in overall Tiger programme, including engine (ITP), avionics (INDRA) and Trigat missile (LFK, INDRA, SENER and IZAR). Initial six HAP Tigers delivered in 2004–05, but earmarked for later conversion to HADs. Development of HAD configuration and integration of Spanish companies in Tiger programme to take four years before production begins of 18 HADs in Spain for 2007–11 delivery. HAD development contract signed 8 December 2004.

COSTS: Tiger current development cost, shared equally by France and Germany, reported DM2.2 billion. Production tooling cost FFr2.6 billion (US$500 million) (1996). Unit cost (1996) for UH estimated as US$11 million, including launchers and all government-furnished equipment. Initial batch of 160 assigned FFr21.5 billion, of which FFr13 billion for 80 German helicopters and FFr8.5 billion for 80 French (1998). Australian programme unit cost US$30.6 million (2001).

DESIGN FEATURES: Robust, tandem-seat design with pylon-mounted armament, representing current combat helicopter style. FEL (fibre elastomer) main rotor designed for simplicity, manoeuvrability and damage tolerance; has infinite life except for inspection of elastomeric elements at more than 2,500-hour intervals; hub consists of titanium centrepiece (including duct for mast-mounted sight) with composites starplates bolted above and below; flap and lead/lag motions of blades allowed by elastic bending of neck region and pitch change by elastic part of elastomeric bearings; lead/lag damping by solid-state viscoelastic damper struts faired into trailing-edge of each blade root; equivalent flapping hinge offset of 10.5 per cent gives high control power; SARIB passive vibration damping system between transmission and airframe; three-blade Spheriflex tail rotor has composites blades with fork roots; built-in ram air engine exhaust suppressors.

FLYING CONTROLS: Fully powered hydraulic flying controls by SAMM/Liebherr; Labinal/Electrométal servo trim; horizontal tail mounted beneath tail rotor; autopilot is part of basic avionics system (see under Avionics heading).

STRUCTURE: 80 per cent CFRP, block and sandwich and Kevlar sandwich; 6 per cent titanium and 11 per cent aluminium; airframe structure protected against lightning and EMP by embedded copper/bronze grid and copper bonding foil; stub-wings of aluminium spars with CFRP ribs and skins; titanium engine deck may be replaced by GFRP; airframe tolerates crash impacts at 10.5 m/s (34.4 ft/s) and meets MIL-STD-1290 crashworthiness standards; titanium main rotor hub centrepiece and tail rotor Spheriflex integral hub/mast; blade spars filament-wound; GFRP, CFRP skins and subsidiary spars and foam filling.

French plants building transmission, tail rotor, centre-fuselage (including engine installation), aerodynamics, fuel and electrical systems, weight control, maintainability, reliability and survivability; Eurocopter Deutschland responsible for main rotor, flight control and hydraulic systems, front and rear fuselage (including cockpits), prototype assembly, flight characteristics and performance, stress and vibration testing and simulation.

LANDING GEAR: Tailwheel type, non-retractable, with single wheel on each unit. Designed to absorb impacts of up to 6 m (20 ft)/s. Main gear by Messier-Bugatti, tail gear by Liebherr Aerotechnik.

POWER PLANT: Two MTU/Rolls-Royce/Turbomeca MTR 390 modular turboshaft engines mounted side by side above centre-fuselage, divided by armour plate 'keel' (engine first flown in Panther testbed 14 February 1991); power ratings are maximum T-O 958 kW (1,285 shp), super emergency 1,160 kW (1,556 shp), maximum continuous 873 kW (1,171 shp). MTR 390 Enhanced, with additional 14 per cent power, to be installed in 38th and subsequent French Tigres and all Spanish aircraft. LHTEC has proposed the T800-801 as a potential alternative power plant for export variants of the Tiger.

Self-sealing crashworthy fuel tanks, with explosion suppression and with non-return valves which minimise leakage in a crash; total capacity 1,360 litres (359 US gallons; 299 Imp gallons). Provision for two external tanks, one on each inboard pylon, each of approximately 350 litres (92 US gallons; 77 Imp gallons) capacity. Gearbox has specified 30 minutes' dry running capability (demonstrated 65 minutes, November 1994).

ACCOMMODATION: Crew of two in tandem, with pilot in front and weapons system operator at rear; full dual controls; both crew members can perform all tasks and weapon operation except that anti-tank missile firing only available to gunner. Armoured, impact-absorbing seats; stepped cockpits, with flat-plate windscreens and slightly curved non-glint transparencies.

SYSTEMS: Redundant hydraulic, electrical and fuel systems. Primary power generation by two 20 kVA alternators; DC power generation by two 300 A 28 V transformer/rectifiers and two 23 Ah Ni/Cd batteries.

Dual redundant AFCS provides four-axis command and stability augmentation. Basic AFCS modes: attitude hold, heading hold. Higher AFCS modes: Heading/acquire/hold, barometric altitude capture/hold, altitude acquire, airspeed hold, vertical speed acquire/hold, nav coupling, radar height hold, Doppler hover hold, line of sight acquisition/hold. Other AFCS functions: gun recoil force compensation, axis decoupling and tactical mode (follow-up trim on override of break-out forces).

AVIONICS: *Basic or core avionics* common to all three versions include bus/display system, com radio (French and German systems vary), autonomous nav system and radio/Doppler navaids, Thales TSC 2000 IFF Mk 12, NH 90-based ECM suite (including laser warning) and AFCS, all connected to and controlled through redundant MIL-STD-1553B data highway.

Flight: Navigation system, by Thales, Teldix and EADS, is fully redundant; system contains two Thales PIXYZ three-axis ring laser gyro units, two air data computers, two magnetic sensors, one Teldix/BAE Canada CMA 2012 Doppler radar, a radio altimeter and GPS providing data to Dornier EuroGrid digital map system; these sensors also provide signals for flight control, information display and guidance; integrated duplex AFCS by Thales and Nord Micro; AFCS computers produced by Thales, VDO-Luft and Litef.

Instrumentation: Colour liquid crystal flight displays showing symbology and imagery (two per cockpit for flight and weapon/systems information) by Thales and VDO-Luft; each crewman has central control/display unit for inputting all radio, electronic systems and navigation selections; digital map display system by Dornier and VDO-Luft (incorporating NH 90's Eurogrid map generation system); engine and systems data are fed into the databus for in-flight indication and subsequent maintenance analysis. BAE Systems Knighthelm fully integrated day and night helmet ordered for German Tigers; French Tigres have similar Thales Topowl helmet-mounted sights, with integrated night vision (image intensifiers), FLIR, video and synthetic raster symbology.

Mission: Euromep (European mission equipment package) includes SATEL Condor 2 pilot vision subsystem (PVS), air-to-air subsystem (Stinger or Mistral), mast-mounted sight and missile subsystem and Euromep management system all connected to separate MIL-STD-1553B data highway. Euromep Standard B avionics first flew February 1995 (PT5); Standard C testing began in late 1997 (PT3R). PVS has 40 × 30° instantaneous field of view (with ±110 × 35° total field of view) thermal imaging sensor steered by helmet position detector giving both crewmen day/night/bad weather vision, flight symbology and air-to-air aiming in helmet-mounted display; mast-mounted sight, gunner sight electronics and gunner's head-in target acquisition display and ATGW 3 subsystem connected by separate data highway; HOT 3 missile system also available. Thales armament control panel and fire-control computer.

TIGER WEAPON SYSTEM OPTIONS

Version	Primary weapon systems	Optional weapon systems
HAP	Turret-mounted 30 mm cannon Strix roof sight Helmet sight and clear sight (×2)	Two pods, 22 each 70 mm rockets plus two pods, 12 each submunitions rockets; or four Mistral AAMs; or four Mistral AAMs plus two pods, 22 each 70 mm rockets
HAC	Osiris roof sight Helmet sight/display (×2)	Eight HOT ATMs plus four Mistral AAMs; or eight Trigat ATMs plus four Mistral AAMs; or four Trigat ATMs plus four HOT ATMs plus four Mistral AAMs
UHT	Osiris roof sight Helmet sight/display (×2)	Four Stinger AAMs plus two 12.7 mm gun pods; or eight HOT or Trigat (or HOT/Trigat mix) ATMs; or two pods, 19 each 70 mm rockets
ARH	Turret-mounted 30 mm cannon Roof sight and laser designator/helmet sight Mistral AAM capability	Two Hellfire ATMs plus 26 off 70 mm rockets; or four Hellfire ATMs plus 33 off 70 mm rockets
HAD	Turret-mounted 30 mm cannon Roof sight Helmet sight/display (×2)	Four Mistral AAMs; or four pods of 68 mm or 70 mm rockets; or four Trigat ATMs

HAP combat support mission equipment package includes SFIM STRIX gyrostabilised roof-mounted sight (with IRCCD IR channel) above rear cockpit; includes direct view optics with folding sight tube, television and IR channels and laser ranger/designator.

Self-defence: EADS C-model EW suite (as in NH90) is one element in HAP's fully integrated avionics suite. This has an EADS laser warning receiver, EADS/LFK AN/AAR-60 missile launch warning device *(Lenkflugkörpersysteme)* and Thales EW processor and radar warning receiver. Also chaff and flare dispensers (with 32 cartridges, sequenced by a Saphir M system). UH is similar, but with option of fitting IR jammer.

ARMAMENT: See also accompanying table. Tiger has four outboard weapon stations for typical four HOT, four Trigat, two Mistral or Stinger launchers or pods of 12 or 22 rockets; optional 12.7 mm gun pod with 250 rounds or auxiliary fuel tank. HCP (HAP) options all include one 30 mm Giat AM-30781 automatic cannon with up to 450 rounds (traversing from +33 to −30° in elevation and through ±90° in azimuth). Hellfire ATM on Australian aircraft.

DIMENSIONS, EXTERNAL (UT: UHT and HAC, HCP: HAP, where different):

Main rotor diameter	13.00 m (42 ft 7¾ in)
Tail rotor diameter	2.70 m (8 ft 10¼ in)
Length overall, rotors turning	15.80 m (51 ft 10 in)
Length of fuselage: excl cannon	14.08 m (46 ft 2¾ in)
incl cannon	15.00 m (49 ft 2½ in)
Height: to top of rotor head	3.83 m (12 ft 6¾ in)
to top of tail rotor disc	4.32 m (14 ft 2 in)
to top of mast sight (UT only)	5.20 m (17 ft 0¾ in)
Width over weapon pylons	4.52 m (14 ft 10 in)
Wheel track	2.38 m (7 ft 9¾ in)
Wheelbase	7.65 m (25 ft 1 in)

AREAS:

Main rotor disc	132.70 m² (1,428.7 sq ft)
Tail rotor disc	5.72 m² (61.63 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: HCP	4,200 kg (9,259 lb)
UT	4,350 kg (9,590 lb)
Max useful load: HCP	1,800 kg (3,968 lb)
UT	1,650 kg (3,638 lb)
Fuel weight: internal	1,080 kg (2,381 lb)
external (two tanks)	555 kg (1,224 lb)
Max T-O weight: normal	5,925 kg (13,062 lb)
alternate	6,000 kg (13,227 lb)
Max disc loading (alternate mission T-O weight)	45.2 kg/m² (9.26 lb/sq ft)

PERFORMANCE (UT and HCP, as above):

Never-exceed speed (VNE):	
UHT, HAC	171 kt (298 km/h; 185 mph)
HCP, HAP	175 kt (322 km/h; 200 mph)
Max level speed: UT	140 kt (259 km/h; 161 mph)
HCP	150 kt (278 km/h; 173 mph)
Cruising speed	124 kt (230 km/h; 143 mph)
Max rate of climb at S/L: UHT	642 m (2,106 ft)/min
HAP	690 m (2,263 ft)/min
Vertical rate of climb at S/L: UHT	312 m (1,023 ft)/min
HAP	384 m (1,259 ft)/min
Hovering ceiling OGE: UHT	3,200 m (10,500 ft)
HAP	3,500 m (11,480 ft)
Range: on internal fuel	432 n miles (800 km; 497 miles)
with ferry tanks	691 n miles (1,280 km; 795 miles)
Endurance: operational mission	2 h 50 min
max internal fuel	3 h 25 min

EUROCOPTER HTH

TYPE: Heavy lift helicopter.

PROGRAMME: Offered in response to Franco-German heavy transport helicopter (HTH) requirement for which request for information issued in 2006. Proposed manufacture in Germany. International partners being sought ahead of expected 2010 launch decision; IOC in 2020.

CUSTOMERS: Anticipated Franco-German requirement for 200.

DESIGN FEATURES: Seven-blade main rotor; four-blade tail rotor. Service life 30 years or 15,000 hours; intended mission reliability rate of 97.5 per cent.

FLYING CONTROLS: Fly-by-wire.

STRUCTURE: Carbon fibre frames, beams and longerons; hybrid Nomex skins and bulkheads.

LANDING GEAR: Tricycle type. Twin wheels on each unit.

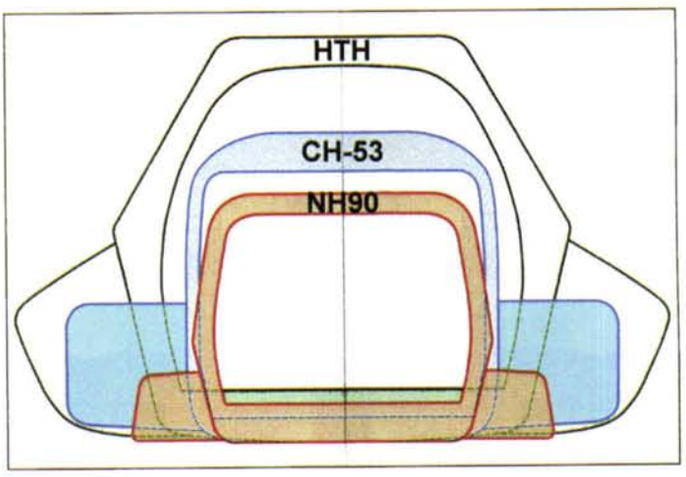
POWER PLANT: Three turboshafts, each 5,000 kW (6,705 shp).

ACCOMMODATION: Up to 66 combat-equipped troops. Internal dimensions accommodate German Wiesel scout car and French VAB armoured vehicle.

DIMENSIONS, EXTERNAL:

Fuselage: Length	24.20 m (79 ft 4¾ in)
Width at cabin	3.90 m (12 ft 9½ in)
Height overall	9.00 m (29 ft 6¼ in)

Artist's impression of proposed Eurocopter HTH 1159307



Eurocopter HTH hold cross-section compared to other transport helicopters 1159322

DIMENSIONS, INTERNAL:

Cabin: Length	9.10 m (29 ft 10¼ in)
Max width	3.10 m (10 ft 2 in)
Max height	2.75 m (9 ft 0¼ in)

WEIGHTS AND LOADINGS:

Max payload	13,000 kg (28,660 lb)
Max T-O weight	36,000 kg (79,366 lb)

EUROCOPTER SUPER PUMA Mk I AND COUGAR Mk I

Spanish military designations: HD.21 and HT.21
Swedish Air Force designation: Hkp 10

TYPE: Multirole medium helicopter.

PROGRAMME: First flight of AS 332 Super Puma (F-WZJA) 13 September 1978; six prototypes; deliveries began mid-1981; present version powered by Turbomeca Makila 1A1 introduced 1986; military versions renamed Cougar in 1990; first AS 332L (stretched fuselage) certified to French IFR Cat. II 7 July 1983 and delivered to Lufttransport of Norway; certified for flight into known icing 29 June 1983; FAA Cat. II certification with SFIM CDV 85 P4 four-axis AFCS and FAR Pt 25 Appendix C known icing clearance. Mk I continues in production as long as orders (mainly making good attrition) continue.

Some AS 332/532s built under licence by IPTN in Indonesia and TAI in Turkey; some assembled by CASA in Spain; and some equipped by F+W (now SF) in Switzerland. Super Puma/Cougar worldwide fleet had accumulated 2,662,000 hours by January 2004.

CURRENT VERSIONS: Designation suffixes: U: military unarmed utility, A: armed, S: anti-ship/submarine, C: military court (short) fuselage, L: long fuselage, military or civil.

AS 332L1 Super Puma: Standard Mk I civil version with long fuselage and airline interior for 20 passengers; UK CAA IFR certification 21 April 1992.

AS 532 Cougar 100: Simplified 9 tonne tactical transport; fixed landing gear reduces cruising speed by 5 kt (9 km/h; 6 mph); price reduced by 15 to 20 per cent. External tanks cannot be fitted. Two versions are proposed: **AS 532UB** Short fuselage version and **AS 532UE** stretched fuselage version.

AS 532UC Cougar: Military Mk I short fuselage unarmed utility; seats up to 21 troops and two crew; cabin floor reinforced for 1,500 kg/m² (307 lb/sq ft). Crashworthy self-sealing fuel tanks standard. Equipment includes IR suppressors, RWR, chaff dispensers, flare launcher and armoured protection for crew and troops.

AS 532UL Cougar: Military Mk I unarmed long fuselage version; cabin lengthened by 0.76 m (2 ft 6 in); extra fuel and two large windows in forward cabin plug; carries up to 25 troops and two crew. Crashworthy self-sealing fuel tanks standard. Equipment as per AS 532UC; sliding forward cabin doors can be fitted to allow carriage of forward-firing 7.62 mm machine guns.

AS 532AC Cougar: Armed AS 532UC (Mk I).

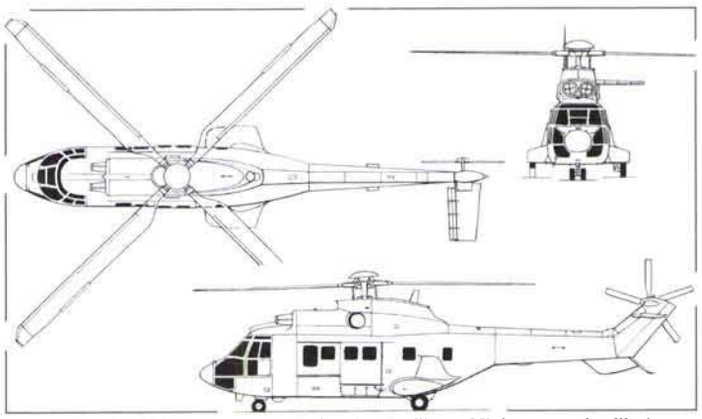
AS 532AL Cougar: Armed AS 532UL (Mk I).

AS 532SC Cougar: Naval short Mk I version with ASW/ASV equipment; folding tail rotor pylon and main rotor blades; deck harpoon landing aid. Crew of two plus up to two operators.

AS 532UL Horizon: Battlefield surveillance radar helicopter; flight trials of small Orphée radar under an AS 330B Puma started 1986; French Army wanted 20 AS 532 Cougar Mk II fitted with radar, dedicated ECM and datalink (Orchidée programme). First flight of

Eurocopter AS 332L1 Super Puma operated in China *(Patrick Penna)* 1040535

Military Eurocopter AS 532 Cougar Mk 1 *(Patrick Penna)* 1040536



Eurocopter AS 532UL Cougar (long-fuselage military Mk I unarmed utility) *(Dennis Punnett)* 0507158

full-scale AS 532/Orchidée June 1990; programme cancelled for budgetary reasons August 1990; prototype without datalink flew 24 missions in Gulf War February 1991 in Operation Horus.

Horizon programme (*Hélicoptère d'Observation Radar et d'Investigation sur Zone*) with more effective operational concept and reduced development costs replaced Orchidée; development contract awarded to Eurocopter October 1992 for two (later increased to four) AS 532UL Horizons with same radar capabilities and ECM as Orchidée, but in AS 532UL Cougar Mk I, with standard ECM and longer mission endurance. Antenna rotates at either 2° 24' or 8°/s; radar range 108 n miles (200 km; 124 miles) with helicopter cruising at 97 kt (180 km/h; 112 mph) at 4,000 m (13,120 ft); normal operational range is 81 n miles (150 km; 93 miles); target speed resolution is 2 m (6.6 ft)/s. Military features include jet efflux deflector/diluters, anti-icing systems, NVG-compatible cockpit lighting, weather radar, encrypted communications, INS/GPS and active/passive countermeasures. First flight Horizon with full radar 8 December 1992; first delivery 24 June 1996; second (plus a ground station) in December 1996; third delivered in 1997 and fourth (plus second ground station) in 1998.

AS 332L2 Super Puma Mk II: Stretched version with Spheriflex rotor heads, new cockpit, enlarged rotors and more powerful Makila 1A2 engines. *Described separately.*

AS 532U2/A2 Cougar Mk II: Stretched version with Spheriflex rotor heads, new cockpit, enlarged rotors and more powerful Makila 1A2 engines. *Described separately.*

CUSTOMERS: Total orders for AS 332/532 and EC 225/725 series stood at 652, from 85 customers in 47 countries, by December 2002. Sales in 2003 totalled eight. Combined sales of Super Puma/Cougar/EC 225 EC 725 totalled 15 in 2004 and 14 in 2005. Some 110 AS 332L1/L2 Super Pumas in civil offshore oil industry support operations; French military orders include six for French Air Force (three for nuclear test facilities in Pacific and three for government VIP flying); French Army (ALAT) has supplemented SA 330 Pumas with AS 532 Cougars; 22 delivered to *Force d'Action Rapide* between late 1988 and end 1991.

Export customers include Abu Dhabi (eight including two VIP of which five to be upgraded with Exocet, sonar and torpedoes under 1995 contract), Brazil (25 including six AS 532SCs, one AS 332M1 and eight ordered January 2001), Bulgaria (12 AS 532 AL Cougars ordered in January 2005 for delivery over a three-year period); Cameroon (one), Chile (army, two; navy, four AS 532SCs), China (six), Ecuador (eight including six army), Finland (three for border police), Gabon (two, Presidential Guard), Germany (three, border police), Greece (Ministry of Merchant Marine, four ordered August 1998 and first two delivered 21 December 1999; remaining pair March 2000), Greek Air Force (four plus two options in 2001 for delivery between 2001 and 2003); Indonesia (built under licence: see IPTN entry); Japan (three, army/VIP), Jordan (eight), South Korea (three army/VIP, one AS 332L1), Mexico (two VIP), Nepal (two, Royal Flight), Nigeria (two), Oman (two, Royal Flight), Panama (one VIP), Saudi Arabia (12 AS 532SCs), Singapore (36), Slovenian Army (two UIs delivered 2003), Spain (10 SAR HD.21s, four VIP HT.21s/HT.27s, 18 army tactical transport HT.21s plus 15 AS 532ULs ordered February 1996 and delivered from 1998), Sweden (12 SAR), Switzerland (15 AS 332Ms; plus 12 AS 532ULs ordered December 1998 for delivery from 2000; two to be built by Eurocopter and remainder subcontracted to RUAG Aerospace, which see), Togo (one), Turkey (30 AS 532ULs and 20 AS 532ALs in SAR configuration, including 28 assembled by TAI; first Turkish-built AS 532AL handed over 1 May 2000; deliveries to be completed by February 2003; first Turkish-built AS 532UL handed over 31 May 2000), Venezuela (six), Zaïre (one VIP). Competing for Taiwanese UH-1 and Greek UH-1/AB 205 replacement programmes, Bristow Helicopters acquired 31 examples of 19-passenger AS 332L for offshore oil support. AZAL of Azerbaijan ordered 22 AS 332L1s in 2003.

DESIGN FEATURES: Four-blade fully articulated main rotor turning clockwise seen from above; five-blade tail rotor on starboard side of tailboom; engines mounted above cabin have rear drive into main transmission at 23,840 rpm; main rotor turns at 265 rpm, tail rotor at 1,278 rpm; various lateral sponsons available housing partly retracted main landing gear and combinations of additional fuel or pop-out floats; optional air conditioning system housed in casing on port forward flank of cabin; all civil versions certified for IFR category A and B to FAR Pt 29.

FLYING CONTROLS: Dual fully powered hydraulic controls with full-time autostabilisation and yaw damping; machine remains flyable with autostabiliser switched off; cyclic trimming by stick friction adjustment; inverted slot on tailplane to maintain attitude-holding effect at low climb speeds; large ventral fin; saucer fairing on rotor head to smooth wake of hub; four-axis SFIM 155 autopilot standard.

STRUCTURE: Conventional light alloy airframe with some titanium; crashworthy fuel system, impact-absorbing landing gear and other features; main rotor blades of GFRP with CFRP stiffening and Moltoprene filler; elastomeric drag dampers.

LANDING GEAR: Retractable tricycle high energy absorbing design by Messier-Bugatti; all units retract rearward hydraulically, mainwheels into sponsons on sides of fuselage; dual-chamber oleo-pneumatic shock-absorbers; twin-wheel self-centring nose unit, tyre size 7.00–6 (8 ply) tubeless, pressure 7.00 bar (102 lb/sq in); single wheel on each main unit with tyre size 615×225–10 (12 ply) tubeless or 640×230–10, pressure 9.00 bar (130 lb/sq in); hydraulic differential disc brakes, controlled by foot pedals; lever-operated parking brake; emergency pop-out flotation units can be mounted on main landing gear fairings and forward fuselage.

POWER PLANT: Two Turbomeca Makila 1A1 turboshafts, each with maximum contingency rating of 1,400 kW (1,877 shp) and take-off rating of 1,357 kW (1,820 shp). Maximum continuous rating of 1,184 kW (1,588 shp). Air intakes protected by a grille against ingestion of ice, snow and foreign objects; Centrisep multipurpose intake optional for flight into sandy areas. Transmission rated at 2,238 kW (3,000 shp) for T-O.

AS 532UC/AC have five flexible fuel tanks under cabin floor, with total usable capacity of 1,497 litres (395 US gallons; 329 Imp gallons); AS 532SC has total basic capacity of 2,141 litres (565 US gallons; 471 Imp gallons); AS 332L1/532UE/532UL/532AL have a basic fuel system of six flexible tanks with total capacity of 2,020 litres (533 US gallons; 444 Imp gallons) in the 332 and 2,003 litres (529 US gallons; 440 Imp gallons) in the 532; provision for additional 2,375 litres (627 US gallons; 522 Imp gallons) in five auxiliary ferry tanks installed in cabin; two external auxiliary tanks with total capacity of 636 litres (168 US gallons; 140 Imp gallons) standard on AS 532SC, optional on other versions; AS 532UB Cougar 100 has capacity of 1,533 litres (405 US gallons; 337 Imp gallons). For long-range missions (mainly offshore) in AS 332L1, a special internal auxiliary tank can be fitted in cargo sling well, in addition to the two external tanks, to raise total usable fuel capacity to 2,977 litres (786 US gallons; 655 Imp gallons). Refuelling point on starboard side of cabin; fuel system designed to avoid leakage following a crash; self-sealing tanks standard on military versions, optional on other versions; other options include a fuel dumping system and pressure refuelling.

ACCOMMODATION: One pilot (VFR) or two pilots side by side (IFR) on flight deck, with jump seat for third crew member or paratroop dispatcher; provision for composite light alloy/Kevlar armour for crew protection on military models; door on each side of flight deck and internal doorway connecting flight deck to cabin; dual controls, co-pilot instrumentation and crashworthy flight deck and cabin floors; maximum accommodation for 21 troops in AS 532UC, 20 passengers in AS 332L1 and 25 troops in AS 532UL, 20 troops in AS 532UE; interiors available for VIP, air ambulance with six stretchers and 11 seated casualties/attendants; strengthened floor for cargo carrying, with lashing points; jettisonable sliding door on each side of main cabin or port side door with built-in steps and starboard side double door in VIP configuration; removable panel on underside of fuselage, at rear of main cabin, for longer loads; removable door with integral steps for access to baggage racks optional; hatch in floor below main rotor contains hook for slung loads up to 4,500 kg (9,920 lb) on internally mounted cargo sling; cabin and flight deck heated, ventilated and soundproofed; demisting, de-icing, washers and wipers for pilots' windscreens.

SYSTEMS: Two independent hydraulic systems, supplied by self-regulating pumps driven by main gearbox. Each system supplies one set of powered flying controls; left-hand system also supplies autopilot, landing gear, rotor brake and wheel brakes; hydraulically actuated systems can be operated on ground from main gearbox (when a special disconnect system is installed to permit running of port engine with rotors stationary), or by external power through ground power receptacle. Emergency landing gear lowering by standby pump.

Three-phase 200 V AC electrical power supplied by two 20 kVA 400 Hz alternators, driven by port side intermediate shaft from main gearbox and available on ground under same conditions as hydraulic ancillary systems; two 28.5 V DC transformer-rectifiers; main battery used for self-starting and emergency power in flight.

AVIONICS: *Comms:* Optional equipment includes VHF, UHF, tactical HF and HF/SSB radio and intercom.

Radar: Offshore models have nose-mounted radar; search and rescue version has nose-mounted RDR 1400 or chin-mounted 1500 search radar (as on Swedish Hkp 10s); naval ASW and ASV versions can have nose-mounted Thales Ocean Master radar, linked to a tactical table in the cabin.

Flight: ADF, VOR/ILS, radio altimeter, GPS, VLF Omega, Decca navigator and flight log, Doppler, SFIM 155 autopilot, with provision for coupling to self-contained navigation and landing systems; search and rescue version has Doppler, and Thales Nadir or Decca self-contained navigation system (Nadir Mk 2 in French Army and Greek versions), including navigation computer with SAR patterns, polar indicator, roller map display, hover indicator, route mileage indicator and groundspeed and drift indicator; SFIM CDV 155 autopilot coupler contains automatic nav track including search patterns, transitions and hover; multifunction video display shows radar and route images, SAR patterns and hover indication; Swedish Hkp 10s have Thales RAMS flight management system including BAE Systems AHRS, Decca Doppler and GPS. Optional Honeywell Mk XXII EGPWS and HP899 TCAS.

Instrumentation: Full IFR instrumentation optional.

Mission: Naval ASW versions have Thomson Marconi HS 312 acoustics suite; upgraded FLASH version currently available.

EQUIPMENT: Optional fixed rescue hoist (capacity 275 kg; 606 lb) starboard side and electrical back-up hoist; equipment for naval missions can include sonar, MAD and sonobuoys.

ARMAMENT (optional): Typical alternatives for army/air force missions are two 20 mm guns or two 7.62 mm machine guns or two 68 mm rocket launchers. Armament for naval missions includes two AM 39 Exocet missiles or two lightweight torpedoes.

DIMENSIONS, EXTERNAL:

Main rotor diameter	15.60 m (51 ft 2¼ in)
Tail rotor diameter	3.05 m (10 ft 0 in)
Main rotor blade chord	0.60 m (1 ft 11½ in)

Length: overall, rotors turning ..... 18.70 m (61 ft 4¼ in)
fuselage, incl tail rotor:
AS 532UC/AC/SC/UB ..... 15.53 m (50 ft 11½ in)
AS 332L1/532AL/UL/UE ..... 16.29 m (53 ft 5½ in)
tail and rotors folded (AS 532SC) ..... 12.95 m (42 ft 5¾ in)
Width, blades folded:
AS 532UB/UC/AC/AL/UL/332L1 ..... 3.79 m (12 ft 5¼ in)
AS 532SC ..... 3.86 m (13 ft 3 in)
Width over sponsons:
AS 332L1/AS 532AL/UL/UC/AC ..... 3.38 m (11 ft 1 in)
AS 532SC ..... 3.56 m (11 ft 8¼ in)
Fuselage max width ..... 2.00 m (6 ft 6 in)
Height: overall ..... 4.92 m (16 ft 1¾ in)
blades and tail pylon folded:
AS 532UE/UC/AC/SC ..... 4.80 m (15 ft 9 in)
to top of rotor head ..... 4.60 m (15 ft 1 in)
Tailplane half-span ..... 2.11 m (6 ft 11 in)
Wheel track ..... 3.00 m (9 ft 10 in)
Wheelbase: AS 532UC/AC/SC ..... 4.49 m (14 ft 8¾ in)
AS 332L1/532AL/UL/UE ..... 5.25 m (17 ft 2¾ in)
Passenger cabin doors, each: Height ..... 1.35 m (4 ft 5 in)
Width ..... 1.30 m (4 ft 3¼ in)
Floor hatch, rear of cabin: Length ..... 0.98 m (3 ft 2¾ in)
Width ..... 0.70 m (2 ft 3½ in)

DIMENSIONS, INTERNAL:

Cabin:
Length: AS 532UC/AC/SC ..... 6.05 m (19 ft 10½ in)
AS 332L1/532AL/UL/UE ..... 6.81 m (22 ft 4 in)
Max width ..... 1.80 m (5 ft 10¾ in)
Max height ..... 1.55 m (5 ft 1 in)
Floor area: AS 532UC/AC/SC ..... 7.80 m² (84.0 sq ft)
AS 332L1/532AL/UL/UE ..... 9.18 m² (98.8 sq ft)
Usable volume:
AS 532UC/AC/SC ..... 11.4 m³ (403 cu ft)
AS 332L1/532AL/UL/UE ..... 13.3 m³ (470 cu ft)

AREAS:

Main rotor disc ..... 191.13 m² (2,057.3 sq ft)
Tail rotor disc ..... 7.31 m² (78.64 sq ft)

WEIGHTS AND LOADINGS:

Weight empty (standard aircraft):
AS 532UC/AC ..... 4,330 kg (9,546 lb)
AS 532SC ..... 4,500 kg (9,920 lb)
AS 332L1/532AL/UL ..... 4,460 kg (9,832 lb)
AS 332UE ..... 4,485 kg (9,888 lb)
Max external payload ..... 4,500 kg (9,920 lb)
Max T-O weight:
internal load:
AS 532UC/AC/AL/UB/UL/SC/UB/UE ..... 9,000 kg (19,841 lb)
AS 332L1 ..... 8,600 kg (18,960 lb)
external slung load ..... 9,350 kg (20,615 lb)
Max disc loading, external load ..... 48.9 kg/m² (10.02 lb/sq ft)
Transmission loading at max T-O weight and power:
internal load:
AS 532UC/AC/AL/UB/UL/SC/UE ..... 4.03 kg/kW (6.61 lb/shp)
AS 332L1 ..... 3.85 kg/kW (6.32 lb/shp)
external load ..... 4.18 kg/kW (6.87 lb/shp)

PERFORMANCE:

Never-exceed speed (VNE) ..... 150 kt (278 km/h; 172 mph)
Cruising speed at S/L:
AS 532UC/AC/AL/UL/SC ..... 139 kt (257 km/h; 160 mph)
AS 532UB/UE ..... 134 kt (249 km/h; 155 mph)
AS 332L1 ..... 141 kt (261 km/h; 162 mph)
Max rate of climb at S/L:
AS 532UC/AC/AL/UL ..... 420 m (1,378 ft)/min
AS 532UB/UE ..... 432 m (1,417 ft)/min
AS 532SC ..... 372 m (1,220 ft)/min
AS 332L1 ..... 486 m (1,594 ft)/min
Service ceiling: AS 332L1 ..... 4,600 m (15,080 ft)
AS 532UC/AC/SC/AL/UL/UB/UE ..... 4,100 m (13,450 ft)
Hovering ceiling IGE:
AS 532AL/UL/AC/UC/SC/UB/UE ..... 2,800 m (9,180 ft)
AS 332L1 ..... 3,250 m (10,660 ft)
Hovering ceiling OGE:
AS 532AL/UL/AC/UC/SC/UB/UE ..... 1,650 m (5,420 ft)
AS 332L1 ..... 2,300 m (7,540 ft)
Range at S/L, standard tanks, no reserves:
AS 332L1 ..... 449 n miles (831 km; 516 miles)
AS 532UC/AC ..... 334 n miles (618 km; 384 miles)
AS532UB ..... 309 n miles (573 km; 356 miles)
AS 532SC ..... 492 n miles (911 km; 566 miles)
AS 532AL/UL ..... 455 n miles (842 km; 523 miles)
AS 332L1 ..... 470 n miles (870 km; 540 miles)
AS 532UE ..... 416 n miles (770 km; 478 miles)
Range with auxiliary internal tank:
AS 532UE ..... 486 n miles (900 km; 559 miles)
AS 532UB ..... 380 n miles (703 km; 437 miles)
Range at S/L with external (two 338 litre) and auxiliary (one 320 litre) tanks, no reserves:
AS 332L1 ..... 659 n miles (1,220 km; 758 miles)
AS 532UC/AC ..... 528 n miles (977 km; 607 miles)
AS 532AL/UL ..... 637 n miles (1,179 km; 733 miles)

EUROCOPTER SUPER PUMA Mk II, COUGAR Mk II, EC 225 and EC 725

Spanish Army designations: HU.21L

TYPE: Multirole medium helicopter.

PROGRAMME: Derived from Super Puma/Cougar Mk I (which see); first flight of development vehicle 6 February 1987; French certification 2 April 1992; UK BCAR 29 certification 16 November 1992; first delivery August 1993. Earlier AS 332L1 and 532U/A Cougar Mk I remain on production line.

Eurocopter EC 725 of French Air Force *(Patrick Penna)* 1040537

CURRENT VERSIONS: **AS 332L2 Super Puma Mk II**: Current production civil transport; innovations include Spheriflex rotor heads, super-emergency engine rating, EFIS flight deck and built-in health and usage monitoring system, duplex four-axis AFCS, and hydraulically powered standby electrics for 2 hours' operation after complete main generator failure. First delivery 28 August 1993.

AS 332L2 Super Puma Mk II VIP: Eight- to 15-passenger arrangement with attendant and fully equipped galley and lavatory; two four-seat lounges; fine materials and fittings throughout; range with eight passengers and attendant, 635 n miles (1,176 km; 730 miles).

AS 332L2 Super Puma Mk II 'Jigsaw': 'Project Jigsaw' launched by Bristow Helicopters in 2001, under contract to BP, to modify Super Puma G-JSAR for offshore SAR. Modifications include 'glass cockpit' and four-axis coupled autopilot for IFR/day/night approaches, search patterns, transitions and hover; additional radios (HF, VHF/FM Marine Band and UHF); Chelton Homer and Becker Homer; NightSun searchlight (30 million cd); Sky Shout loudspeaker; Iridium satellite telephone; A5-1 chin turret with FLIR; rescue hoist; and extensive medical equipment. Completed aircraft exhibited at Helitech, Duxford, UK, 23 to 25 September 2003.

AS 532U2 Cougar Mk II: Unarmed military tactical transport; longest member of Cougar family; carries 29 troops and two-man crew.

AS 532A2 Cougar Mk II: Armed version. First order (for four) by French Air Force for combat SAR, 1995; known as Cougar RESCO (REcherche et Sauvetage en COmbat); prototype (F-ZVMC) undertook maker's trials in 1998; was delivered to CEAM military test unit on 9 September 1999 for one year of evaluation; second aircraft, to determine operational fit, was due to be delivered in 2000. Potential equipment includes RWR, missile approach warner, chaff, flares, rescue hoist, two outboard 20 mm cannon, two door-mounted 12.7 mm machine guns, encrypted Personnel Locator System, third-generation NVG-compatible lighting, air-to-air refuelling capability. Nadir Mk 2 navigation computer, SFIM PA-165 four-axis digital autopilot, VOR, Tacan, DME, GPS, searchlight and FLIR. Alternative maximum T-O weight of 11,200 kg (24,692 lb) permits an 800 n mile (1,482 km; 920 mile), plus 30 min hover and 30 min reserve, unrefuelled radius of action to rescue two persons.

EC 225 Super Puma Mk II+: Growth version, announced June 1998, as competitor to Sikorsky S-92 in offshore support role; has military counterpart in **EC 725 Cougar Mk II+**. Cabin volume increased by 25 per cent to 20.0 m³ (706 cu ft) through increases of 35 cm (13¾ in) in height, 70 cm (2 ft 3½ in) in length and 25 cm (9¾ in) in width. Reinforced gearbox and 3,233 kW (2,411 shp) Makila 2A engines with FADEC produce 14 per cent power increase over earlier versions. Five-blade main rotor blades have composites spars and parabolic tips, diameter unchanged. MTOW increased to 10,400 kg (21,560 lb) for civil and 11,000 kg (24,251 lb) for military version (11,200 kg; 24,691 lb with external load). Max cruising speed 141 kt (261 km/h; 162 mph); range with central auxiliary fuel tanks 443 n miles (820 km; 510 miles). New integrated flight and display system (IFDS) using four 152 × 203 mm (6 × 8 in) multifunction LCDs plus four-axis autopilot. FAR/JAR-29 certification achieved July 2004 and first deliveries to French Air Force, December 2004; first customer delivery effected 22 December 2004 when Algerian Government received initial production EC 225 for its VIP transport unit. First prototype (No. 2338, F-ZVLR, converted from standard Mk II) made maiden flight 27 November 2000, at which time Eurocopter revealed an order for four from the French Air Force, including one earlier Mk 2 raised to this standard. JAR 29 certification expected by end 2003. Launch customer for EC 225 is CHC Helikopter, which ordered one (plus one AS332L2) in early 2001. French Air Force took delivery of initial aircraft 15 January 2001 for trials. First pre-production EC 725 (with Makila 1A4 engines) flew in September 2002. First fully equipped production example delivered December 2004 to EH1/67 'Pyrénées' at Cazaux, followed by three in 2005. Service entry eventually achieved on 10 May 2006 when four of six on order declared operational. Further order for 10 EC 725s for French special operations announced in late November 2002, with deliveries to be complete by end of 2006; these comprised two for Air Force (completing six required) and eight for Army special forces' support. Bristow Helicopters ordered two EC 225s, plus two options, on 12 January 2004. First production EC 225 flew 24 June 2004. EASA certification for flight into known icing conditions achieved in August 2005.

CUSTOMERS: By December 2004, total of 682 of Super Puma/Cougar family had been ordered, including 22 EC 225/725s. Combined sales of Super Puma/Cougar/EC 225/EC 725 totalled 15 in 2004 and 14 in 2005.

Production combined with Super Puma Mk I. Helikopter Service ordered four AS 332L2 Mk II in May 1992 and a further four in June 1997, latter delivered from 27 May 1998 onwards; RNethAF ordered 17 AS 532U2s October 1993 and deliveries began 1 April 1996 (with 400th AS 332/532) and last was received in October 1997; first of follow-on order for two for Bond Helicopters delivered 27 August 1998. Eventual 14 AS 532A2s required for combat SAR by French Air Force, first of four ordered delivered 9 September 1999; remainder to be delivered in three batches by 2015; these orders converted to EC 725 version late 2000. Saudi Arabia ordered 12 AS 532A2s in July 1996 under 'Al Fahd' contract for combat SAR, deliveries beginning in 1998; in-flight refuelling tests successfully completed during second half of 2000. VIP orders include Samsung (one AS 332L2), the German government (three AS 532U2s delivered from 4 November 1997 and operated by the Luftwaffe), and two AS 532L2s for Turkmenistan delivered in VVIP configuration in 2002. Three ordered for SAR by Hong Kong Government Flying Service for delivery mid-2001, the first being handed over 18 June 2001. Bond Offshore Helicopters Ltd of Aberdeen, Scotland, ordered six AS 332L2s on 10 December 2002, of which the first was delivered 19 May 2004. Recent customers include the Defence Agency of Japan, which

Eurocopter EC 225 operating in North Sea *(Gérard Deulin)* 1040542

Instrument panel of French Air Force EC 725 1040538

ordered in March 2005 for Imperial and VIP transport duties; the Japanese Coast Guard (two EC 225 for SAR duties); and CHC Helicopters, which ordered two in December 2005 for North Sea oil operations.

DESIGN FEATURES: Generally as for Mk I, but gross weight increased by 150 kg (331 lb) in 1993; composites plug in rear cabin area accommodates one extra row of seats and moves tail rotor rearwards; Spheriflex main and tail rotor heads with elastomeric spherical bearings and Kevlar retention bands; main rotor with longer blades having parabolic tips; enlarged composites sponsons can contain fuel, liferafts, air conditioning and pop-out floats.

FLYING CONTROLS: Fully powered hydraulically actuated with SFIM 165 four-axis digital AFCS and coupler.

STRUCTURE: Rear fuselage 55 cm (1 ft 9½ in) plug made of composites giving extra row of seats; large windows at rear of cabin; increased use of composites compared with Mk I; fuselage frames strengthened to retain same degree of crashworthiness.

LANDING GEAR: As Super Puma Mk I.

POWER PLANT: Two Turbomeca Makila 1A2 rear drive free turbines; maximum emergency power each (OEI 30 seconds) 1,573 kW (2,109 shp), 12 per cent higher than AS 332 Mk I; intermediate emergency power (OEI 2 minutes) 1,467 kW (1,967 shp); take-off power 1,376 kW (1,845 shp); maximum continuous power 1,236 kW (1,657 shp); protective intake grilles standard; optional Centrisep multipurpose intakes for dusty conditions. Transmission ratings: twin-engined maximum 2,410 kW (3,229 shp), maximum from single engine 1,666 kW (2,232 shp), maximum transient 20 seconds 2,651 kW (3,552 shp), maximum continuous 1,555 kW (2,084 shp); transmission has extended run-dry capability.

Standard fuel tankage under cabin floor 2,020 litres (535 US gallons; 444 Imp gallons); auxiliary tankage includes 324 litres (85.6 US gallons; 71.3 Imp gallons) in cargo hook well; sponson tanks each holding 325 litres (85.9 US gallons; 71.5 Imp gallons); 600 litres (159 US gallons; 132 Imp gallons) in cabin fuel tank; one to five internal ferry tanks each holding 475 litres (126 US gallons; 104.5 Imp gallons). Tankage (self-sealing tanks standard from 1997) AS 532A2 1,896 litres (500 US gallons; 417 Imp gallons); hook well tank 320 litres (84.5 US gallons; 70.4 Imp gallons); 325 litres (85.9 US gallons; 71.5 Imp gallons) in each sponson tank; crashproofing is standard in AS 532 and optional in 332; pressure refuelling optional. Military versions can be fitted with probe for in-flight refuelling.

ACCOMMODATION: Single pilot in DGAC Category B civil operation; single pilot plus licensed crewman in Category A VFR; two pilots in IFR; military operation one pilot in VFR, two in IFR; civil transport 24 passengers and attendant in airline interior for 220 n miles (408 km; 253 miles) or 19 passengers at 81 cm (32 in) seat pitch for 350 n miles (648 km; 403 miles); military capacity, squad chief plus 28 troops; SAR version four crew plus 15 survivors over radius of 285 n miles (527 km; 328 miles). VIP version for eight to 15 passengers plus attendant; ambulance version holds 12 stretchers and four seated casualties plus attendant.

AVIONICS: *Instrumentation:* Civil and military cockpits have Sextant Avionique four-tube EFIS integrated flight and display system (IFDS) with four 15 × 15 cm (6 × 6 in) screens; subsystems include smart multimode display (SMDS), automatic flight control system (AFCS) and flight data system (FDS); military cockpit compatible with night vision goggles; civil and military IFR system offered, plus military communications radio; SAR system includes radar and FLIR coupled to display system as well as navigation computer with Doppler and GPS sensors; can also be fitted with inertial nav sensor for combat SAR configuration at customer's request; SAR system can include automatic search pattern, transition and hover hold.

Flight: Optional Bendix/King Mark XXII EGPWS.

Radar: RNethAF AS 532U2s have been retrofitted with Honeywell weather radar.

EQUIPMENT: Pop-out floats, rescue winch (272 kg; 600 lb), external sling. Military equipment (U2/A2) includes IR suppressors, flare/chaff dispensers, RWR, MAWS and armoured protection for crew and troops.

ARMAMENT: Armament choice as for AS 532A Cougar Mk I except for Exocet. Special sliding doors on forward cabin windows allow forward firing 7.62 mm machine guns to be fitted.

DIMENSIONS, EXTERNAL:

Main rotor diameter	16.20 m (53 ft 1½ in)
Tail rotor diameter	3.15 m (10 ft 4 in)
Length overall: rotors turning	19.50 m (63 ft 11 in)
main rotor folded	16.79 m (55 ft 0½ in)
Width: fuselage	2.00 m (6 ft 6 in)
over sponsons	3.38 m (11 ft 1 in)
overall, main rotor folded	3.86 m (12 ft 8 in)
Height: overall, tail rotor turning	4.97 m (16 ft 4 in)
to top of rotor head	4.60 m (15 ft 1 in)
Tailplane span	2.12 m (6 ft 11½ in)
Wheel track	3.00 m (9 ft 10 in)
Wheelbase	5.25 m (17 ft 2¾ in)
Sliding cabin doors, each: Height	1.35 m (4 ft 5 in)
Width	1.30 m (4 ft 3¼ in)
Floor hatch: Length	0.98 m (3 ft 2¾ in)
Width	0.70 m (2 ft 3½ in)

DIMENSIONS, INTERNAL:

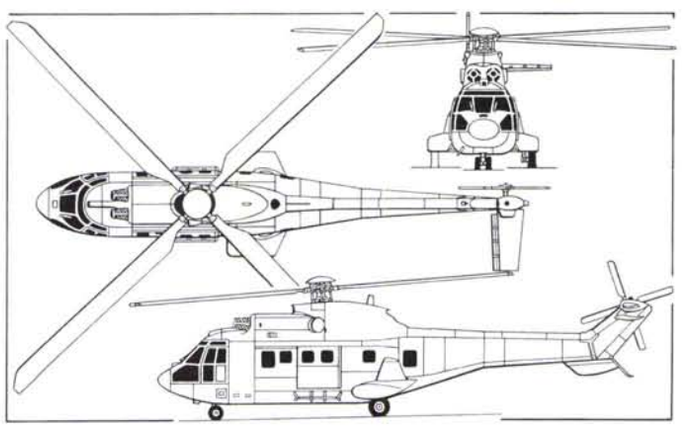
Cabin: Max length	7.87 m (25 ft 10 in)
Floor length	6.15 m (20 ft 2¼ in)
Max width	1.80 m (5 ft 10¾ in)
Max height	1.45 m (4 ft 9 in)
Volume	15.0 m³ (530 cu ft)

AREAS:

Main rotor disc	206.12 m² (2,218.7 sq ft)
Tail rotor disc	7.79 m² (83.88 sq ft)

WEIGHTS AND LOADINGS:

Manufacturer's weight empty: L2	4,686 kg (10,331 lb)
U2	4,945 kg (10,902 lb)
A2	5,012 kg (11,050 lb)
Useful load: L2	4,595 kg (10,130 lb)
U2	4,805 kg (10,593 lb)
A2	4,738 kg (10,445 lb)
EC 225	5,380 kg (11,861 lb)
EC 725	5,670 kg (12,500 lb)
Standard fuel weight: L2	1,596 kg (3,519 lb)
U2, crashworthy tanks	1,548 kg (3,412 lb)
Max normal T-O weight: L2	9,300 kg (20,502 lb)
U2	9,750 kg (21,495 lb)
EC 225, EC 725	11,000 kg (24,250 lb)
A2 Combat SAR	11,200 kg (24,692 lb)
Max slung load: A2/U2, EC 725	5,000 kg (11,023 lb)
L2	4,500 kg (9,920 lb)
Max flight weight with slung load:	
U2	10,500 kg (23,148 lb)
EC 225, EC 725	11,200 kg (24,692 lb)
Max disc loading, normal T-O weight:	
L2	45.1 kg/m² (9.24 lb/sq ft)
U2	47.3 kg/m² (9.69 lb/sq ft)
U2, alternate	54.3 kg/m² (11.13 lb/sq ft)



Eurocopter AS 332L2 Super Puma Mk II *(Mike Keep)* 1158934

Transmission loading at max T-O weight and power:
L2 ..... 3.85 kg/kW (6.34 lb/shp)
U2 with slung load ..... 4.35 kg/kW (7.16 lb/shp)
U2 alternate ..... 4.65 kg/kW (7.64 lb/shp)

PERFORMANCE:
Never-exceed speed (VNE):
L2/U2/EC 725 ..... 170 kt (315 km/h; 195 mph)
Fast cruising speed: L2 ..... 150 kt (277 km/h; 172 mph)
U2 ..... 147 kt (273 km/h; 170 mph)
EC 225 ..... 156 kt (289 km/h; 180 mph)
EC 725 ..... 160 kt (296 km/h; 184 mph)
Econ cruising speed: L2 ..... 136 kt (252 km/h; 157 mph)
U2 ..... 132 kt (244 km/h; 152 mph)
Rate of climb at 70 kt (130 km/h; 81 mph) at S/L:
L2 ..... 441 m (1,447 ft)/min
U2 ..... 384 m (1,260 ft)/min
Service ceiling (45.7 m; 150 ft/min climb), ISA:
L2 ..... 5,180 m (17,000 ft)
U2 ..... 4,100 m (13,450 ft)
Hovering ceiling IGE, normal T-O weight, ISA, T-O power: L2 ..... 3,120 m (10,240 ft)
U2 ..... 2,690 m (8,820 ft)
Hovering ceiling OGE, normal T-O weight, ISA, T-O power: L2 ..... 2,250 m (7,380 ft)
U2 ..... 1,900 m (6,240 ft)
Hovering ceiling OGE, slung load weight, ISA, T-O power: L2/U2 ..... 960 m (3,150 ft)
Range, no reserves, standard fuel, econ cruise:
L2 ..... 447 n miles (828 km; 514 miles)
U2 ..... 427 n miles (791 km; 491 miles)
Range, no reserves, max fuel, econ cruise:
L2 ..... 656 n miles (1,215 km; 755 miles)
U2 ..... 636 n miles (1,178 km; 732 miles)
EC 225, EC 725 ..... 783 n miles (1,450 km; 901 miles)
Ferry range:
EC 725 ..... 1,000 n miles (1,852 km; 1,150 miles)
Endurance, standard fuel, at 70 kt (130 km/h; 81 mph):
L2 ..... 4 h 54 min
U2 ..... 4 h 20 min
EC 725 ..... 6 h 30 min

EUROCOPTER AS 350 ECUREUIL/ASTAR and AS 550 FENNEC

Brazilian Air Force designations: CH-50 and TH-5 Esquilo
Brazilian Army designation: HA-1 Esquilo
Brazilian Navy designation: UH-12 Esquilo
UK forces designation: Squirrel HT. Mk 1 and HT. Mk 2

TYPE: Light utility helicopter.

PROGRAMME: First flight (F-WVKH) powered by Lycoming LTS101 turboshaft 27 June 1974; first flight second prototype (F-WVKI) powered by Turbomeca Arriel 1A February 1975; first production version was AS 350B powered by 478 kW (641 shp) Arriel 1B and certified 27 October 1977; LTS101 powered AStar sold only in USA. AS 350BA Ecureuil was powered by 478 kW (641 shp) Turbomeca Arriel 1B and fitted with large main rotor blades of AS 350B2 (see below); maximum T-O weight increased by 150 kg (331 lb); AS 350B upgraded to AS 350BA in field; replaced AS 350B during 1992; French VFR certification 1991; UK and US certifications 1992, Japanese 1993. Production of AS 350BA ended in 1998.

Delivery of the 2,000th AS 350/550 (F-WWPZ, later ZJ270 of UK Defence Helicopter Flying School) effected in July 1997. In February 2001, delivery effected of 3,000th of Ecureuil family (including AS 355/555), which also was first EC 130 upgraded version. On 28 November 2005 the 3,000th of AS 350/550 single-engine variants was delivered to the South African Police Authority.

Built at Marignane, France, and under licence by Helibrás in Brazil (which see). See also the CHAIC Z-11 entry in the Chinese section. Federal Aviation Administration approval was granted 29 September 2005 for manufacture of the AS350B2/B3 at Eurocopter's facility in Columbus, Mississippi.

CURRENT VERSIONS: **AS 350B2 Ecureuil:** Uprated engine and transmission; wide-chord new section main and tail rotor blades originally developed for AS 355 twin; certified 26 April 1989; known as **SuperStar** in North America; supplied to UK Ministry of Defence as **AS 350BB**, designated **Squirrel HT. Mk 1** with normal instrumentation and **Squirrel HT. Mk 2** with provision for pilot's NVGs.

AS 350B1, 350BA and 350B versions can be upgraded to 350B2.

AS 350B3 Ecureuil: Current variant; 632 kW (847 shp) Arriel 2B and wide-chord tail rotor; optimised for high-altitude operation; uprated transmission and digital engine control. First flight (F-WWPB) 4 March 1997; French VFR certification December 1997 after 150 hour test programme; first delivery, to Osterman Helicopter, January 1998; Australian and New Zealand certification achieved late 1998. By 1 June 2001, 180 AS 350B3s were in service with 120 customers, in 25 countries; 100th AS 350B3 delivered 14 December 1999 to Japanese customer and 400th on 18 December 2003 to Australian racing motorcyclist Mick Doohan.

AS 350D AStar: Version of 350B for North American market; improved LTS101 engine, with 6 per cent more power, offered early 1999.

AS 350 Firefighter: Conair system able to pick up water load in 30 seconds while hovering over water; demonstrated 1986; Isolair system certified September 1995.

AS 550A3 Fennec: Light attack version of AS 350B2 with 3-hour endurance; powered by 632 kW (847 shp), Arriel 2B; standard features include taller landing gear, sliding doors; NVG-compatible cockpit; reinforced airframe; provision for armoured seats and engine cowlings; can be armed with single 20 mm cannon or two rocket launchers.

EC 130: *Described separately.*

CUSTOMERS: Total 3,670 AS 350s, AS 355s and EC 130s ordered by at least 70 countries by June 2005, at which time combined flight time stood at more than 15 million flight hours.

Military customers include Singapore armed forces (10 AS 550B2 and 10 AS 550C2); Australia (RAAF 18 for training; RAN six utility); Danish Army (12 AS 550C2 with ESCO HeliTOW system ordered 1987, delivered 1990); French Army ALAT (originally expressed need for up to 100 to replace Alouette IIs); French CEV (flight test centre), and FBS Ltd, which ordered 38 AS 350BBs, with deliveries beginning November 1996 and service entry in April 1997. Of these, 26 are Squirrel HT. Mk 1s with Defence Helicopter Flying School at Shawbury and 12 are NVG-compatible HT. Mk 2s with 670 Squadron, Army Air Corps, at Middle Wallop; by June 2001 the fleet had amassed 100,000 hours. Other orders include 11 for Brazilian Navy for liaison and patrol work; 30 for Brazilian Air Force for training; 36 for Brazilian Army (16 for liaison and 20 for training and firefighting); six AS 350B3 for Chilean Army; eight for China (see also CHAIC Z-11) and 40 AS 350B2 options for US Customs Service (augmenting five B2s delivered from 21 October 1998 to supplement 19 earlier AStars); six AS 550C3; 13 AS 350B3 ordered by United Arab Emirates in 2000; and four AS 350B3 for the South African Police Air Wing, of which last two delivered in January 2002. Recent customers include the Helicopter Transportation Group of Norway, which ordered five AS350B3s, plus five options, in June 2005, and Orange County Police of California, which took delivery of an AS350B2 at the HAI convention on 6 February 2005. Orders in 1997–2003 were 102, 73, 95, 137, 103, 132 and 81. Deliveries in 2003 were 122. Combined Ecureuil/Fennec/EC 130 orders in 2004 and 2005 totalled 146 and 193, respectively.

COSTS: AS 350B3 US$1.4 million (2002).

DESIGN FEATURES: Conventional pod-and-boom design with power plant above cabin; fin, underfin and twin horizontal stabilising surfaces. Starflex bearingless glass fibre main rotor head; all versions now have lifting section composites main rotor blades. Main rotor turns at 394 rpm, tail rotor at 2,086 rpm.

FLYING CONTROLS: Single fully powered controls with accumulators to delay manual reversion following hydraulic failure until airspeed can be reduced; cyclic trim by adjustable stick friction; inverted aerofoil tailplane to adjust pitch attitude in climb, cruise and descent; saucer fairing on rotor head to smooth wake; swept fins above and below tail. Variety of autostabilisers and autopilots available (see Avionics).

STRUCTURE: Main rotor head of glass fibre and aramids; main rotor blades automatically manufactured in composites; self-sealing composites fuel tank in military versions.

LANDING GEAR: Steel tube skid type. Taller version standard on military aircraft. Emergency flotation gear optional.

POWER PLANT: AS 350B2 powered by one 546 kW (732 shp) Turbomeca Arriel 1D1 with transmission rated at 440 kW (590 shp) for T-O; AS 350B3/AS 550C3 powered by one 632 kW (847 shp) Turbomeca Arriel 2B turbine engine controlled by FADEC, with transmission rated at 500 kW (671 shp) for T-O; AS 350D powered by AlliedSignal LTS101 sold only in USA. Plastics fuel tank (self-sealing on AS 550) with capacity of 540 litres (143 US gallons; 119 Imp gallons). Optional 475 litre (125.5 US gallon; 104.5 Imp gallon) auxiliary tank in cabin.

Soloy offers conversion using Rolls-Royce 250-C30M turboshaft; see *Jane's Aircraft Upgrades*.

ACCOMMODATION: Two individual bucket seats at front of cabin and four-place rear bench standard, optional two-place front bench seat; optional ambulance layout; large forward-hinged door on each side of versions for civil use; optional sliding door at rear of cabin on

Against a flame-red background, Eurocopter AS 350B Ecureuil with appropriate registration F-HELL *(Patrick Penna)* 1040543

port side; (sliding doors standard on military version); baggage compartment aft of cabin, with full-width upward-hinged door on starboard side; top of baggage compartment reinforced to provide work platform on each side.

SYSTEMS: Hydraulic system includes four single-body servo units, operating at 40 bar (570 lb/sq in) pressure, and accumulators to delay reversion to manual control; electrical system includes a 4.5 kW engine-driven starter/generator, a 24 V 15 Ah Ni/Cd battery and a ground power receptacle; cabin air conditioning system optional.

AVIONICS: *Comms:* VHF/AM radios, HF/SSB transponder and ICS.

Flight: VOR/ILS, ADF, marker beacon receiver and DME. SFIM PA 85T31 (IFR), GPS; full-colour LCD VEMD (vehicle and engine multifunction display) on AS 350B3 and AS 550C3.

EQUIPMENT: Options include 907 kg (2,000 lb) capacity cargo sling (1,160 kg; 2,557 lb for AS 350B2/550, 1,400 kg; 3,086 lb on AS 350B3), 136 kg (300 lb) capacity electric hoist (optional 204 kg; 450 lb on AS 350B3), a TV camera for aerial filming, SX-16 searchlight, Wescam and FLIR observation systems, and a 735 litre (194 US gallon; 161 Imp gallon) Simplex agricultural spraytank and boom system.

ARMAMENT (AS 550C3): Provision for wide range of weapons, including 20 mm Giat M621 gun, FN Herstal TMP twin 7.62 mm and 12.7 mm machine gun pods, Thomson Brandt 68.12 launchers for twelve 68 mm rockets, Forges de Zeebrugge launchers for seven 2.75 in rockets, and ESCO HeliTOW anti-tank missile system.

DIMENSIONS, EXTERNAL:

Main rotor diameter	10.69 m (35 ft 0¾ in)
Main rotor blade chord	0.35 m (13¾ in)
Tail rotor diameter	1.86 m (6 ft 1¼ in)
Tail rotor blade chord: AS 350D	0.185 m (7¼ in)
AS 350B2/B3/550C3	0.205 m (8 in)
Length: overall, rotors turning	12.94 m (42 ft 5½ in)
fuselage	10.93 m (35 ft 10½ in)
Width: fuselage (max)	1.87 m (6 ft 1½ in)
overall, blades folded (horizontal stabiliser span)	2.53 m (8 ft 3¾ in)
Height overall: AS 350/B2/B3/D	3.14 m (10 ft 3½ in)
AS 550C3	3.34 m (10 ft 11½ in)
Tailplane span	2.53 m (8 ft 3½ in)
Skid track: AS 350/B2/B3/D	2.17 m (7 ft 1½ in)
AS 550C3	2.28 m (7 ft 5¾ in)
Cabin doors (civil versions, standard, each):	
Height	1.10 m (3 ft 7¼ in)
Width	0.80 m (2 ft 7½ in)

DIMENSIONS, INTERNAL:

Cabin: Length	2.42 m (7 ft 11¼ in)
Width at rear	1.65 m (5 ft 5 in)
Height	1.30 m (4 ft 3 in)
Floor area	2.60 m² (28.0 sq ft)
Baggage compartment volume	1.0 m³ (35 cu ft)

AREAS:

Main rotor disc	89.75 m² (966.1 sq ft)
Tail rotor disc	2.72 m² (29.25 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: AS 350B2	1,220 kg (2,690 lb)
AS 350B3	1,232 kg (2,917 lb)
AS 350D	1,123 kg (2,475 lb)
AS 550C3	1,220 kg (2,689 lb)
Max T-O weight:	
AS 350B2/B3/550C3	2,250 kg (4,960 lb)
AS 350D	1,950 kg (4,300 lb)
Max weight with slung load:	
AS 350B2	2,500 kg (5,511 lb)
AS 350B3/AS 550C3	2,800 kg (6,173 lb)
AS 350D	2,100 kg (4,630 lb)
Max disc loading:	
AS 350D with slung load	23.4 kg/m² (4.79 lb/sq ft)
AS 350B2/550 clean	25.1 kg/m² (5.13 lb/sq ft)
AS 350B2 with slung load	27.9 kg/m² (5.71 lb/sq ft)
AS 350B3/550C3 with slung load	30.6 kg/m² (6.28 lb/sq ft)
Transmission loading at max T-O weight and power:	
AS 350B2 clean	5.11 kg/kW (8.40 lb/shp)
AS 350B2 with slung load	5.68 kg/kW (9.34 lb/shp)
AS 350B3/550C3 clean	4.50 kg/kW (7.39 lb/shp)
AS 350B3/550C3 with slung load	5.50 kg/kW (9.04 lb/shp)

PERFORMANCE (AS 350D at normal T-O weight, AS 350B2/B3/550 at 2,200 kg; 4,850 lb):

Never-exceed speed (VNE) at S/L:	
AS 350/B2/B3/550	155 kt (287 km/h; 178 mph)
AS 350D	147 kt (272 km/h; 169 mph)
Max cruising speed at S/L:	
AS 350B2	134 kt (248 km/h; 154 mph)
AS 350B3	140 kt (259 km/h; 161 mph)
AS 350D	124 kt (230 km/h; 143 mph)
AS 550C3	133 kt (246 km/h; 153 mph)
Max rate of climb at S/L:	
AS 350B2	534 m (1,752 ft)/min
AS 350B3/550C3	618 m (2,028 ft)/min
Service ceiling: AS 350B2	4,800 m (15,750 ft)
AS 350B3/550C3	5,280 m (17,323 ft)
Hovering ceiling:	
IGE: AS 350B2	3,200 m (10,500 ft)
AS 350B3/550C3	4,260 m (13,976 ft)
OGE: AS 350B2	2,550 m (8,360 ft)
AS 350B3/550C3	3,630 m (11,909 ft)
Range with max fuel at recommended cruising speed, no reserves:	
AS 350B2	362 n miles (670 km; 417 miles)
AS 350B3	352 n miles (652 km; 405 miles)
AS 550C3	346 n miles (641 km; 398 miles)

EUROCOPTER EC 130B

TYPE: Light utility helicopter.

PROGRAMME: Derived from AS 350B3 Ecureuil; PT-1 prototype first flew (unannounced) June 1999 and registered F-WQEV in May 2000; second prototype (F-WQES) assisted in 200 hour test programme, including high-altitude testing in Albuquerque, USA, September 2000; JAA certification 14 December 2000; FAA certification 21 December 2000; revealed only in February 2001, when initial production aircraft (also 3,000th of Ecureuil family) handed over to Blue Hawaiian Helicopters at HeliExpo. Four preproduction helicopters delivered to launch customers in first half of 2001. 100th EC 130B (N130KL) delivered 25 November 2004 to Kendall-Jackson Wines Estates Ltd of Sonoma County, California.

CURRENT VERSIONS: **EC 130B4:** Initial production version.

CUSTOMERS: Announced orders include Blue Hawaiian (10 in 2001), Rocky Mountain Helicopters (10 in 2001), Mont Blanc Hélicoptères (two) and five to UK customers; deliveries started in June 2001 and totalled 10 in 2001, 30 in 2002 and 27 orders in 2003. Total 32 Dauphin/Panther/EC 155 ordered in 2004 and 25 in 2005. Recent customers include Helicoptershuttle.com, which took delivery of one in April 2005 for executive transport and sightseeing tour operations in the Fort Lauderdale, Florida area.

COSTS: USD1.6 million (2002).

DESIGN FEATURES: As for AS 355B3, but considerably modified external appearance, with windscreen side panels, doors and landing gear from EC 120, plus Fenestron based on EC 135, although symmetrical, carried by redesigned tailboom. Dual hydraulic system from AS 355N. Cabin width increased by 25 cm (10 in) to give additional 23 per cent internal space, accommodating seven or eight seats and enlarged (10 per cent) baggage compartment; optional air conditioning. Retains AS 355B3 engine and transmission, but automatic system (in conjunction with dual-channel FADEC, plus third, digital, back-up channel) matches rotor speed to flight conditions for noise reduction; 84.3 EPNdB flyover rating is 7 dB below ICAO limit and 0.5 dB under special Grand Canyon National Park restrictions achieved by use of unequally spaced Fenestron blades.

LANDING GEAR: Emergency flotation system available. Tailskid. Handling wheels.

POWER PLANT: One 543 kW (728 shp) Turbomeca Arriel 2B1 turboshaft with transmission rated at 632 kW (847 shp) for T-O, with FADEC. Fuel capacity 540 litres (143 US gallons; 119 Imp gallons) in single tank.

ACCOMMODATION: Pilot and up to seven passengers in transport role; or pilot and one or two stretcher patients plus two medical attendants in casualty evacuation configuration. Dual controls.

SYSTEMS: 4.5 kW 28 V DC starter-generator. 15 Ah battery; 28 V DC cabin outlet.

AVIONICS: *Comms:* Shadin 8800 T altitude encoder; Garmin GTX327 Mode C transponder and Garmin GMA340 ICS.

Flight: One Bendix/King KX 165A nav/com/glideslope; Garmin GNS 430 GPS; Kannad 406 AF-H ELT; Thales H321EHM ADI; Bendix/King KI 525 HSI; full-colour VEMD (Vehicle and Engine Multifunction Display).

DIMENSIONS, EXTERNAL:

Main rotor diameter	10.69 m (35 ft 0¾ in)
Length: overall, rotors turning	12.64 m (41 ft 5½ in)
fuselage	10.68 m (35 ft 0½ in)
Fuselage max width	2.03 m (6 ft 8 in)
Height: to top of fin	3.61 m (11 ft 10¼ in)
to top of rotor head	3.34 m (10 ft 11½ in)
Tailplane span	2.73 m (8 ft 11½ in)
Skid track	2.31 m (7 ft 7 in)
Cabin door: Height	1.18 m (3 ft 10½ in)
Max width: front	0.84 m (2 ft 9 in)
rear	0.92 m (3 ft 0¼ in)

DIMENSIONS, INTERNAL:

Cabin: Length	2.19 m (7 ft 2¼ in)
Max width	1.865 m (6 ft 1½ in)
Max height	1.28 m (4 ft 2½ in)
Volume	3.7 m³ (131 cu ft)
Baggage hold volume:	
front, port	0.29 m³ (10.2 cu ft)
front, starboard	0.25 m³ (8.8 cu ft)
rear	0.57 m³ (20.1 cu ft)

AREAS:

Main rotor disc	89.75 m² (966.1 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	1,379 kg (3,040 lb)
Max T-O weight: internal load	2,427 kg (5,351 lb)
external load	2,800 kg (6,173 lb)
Max disc loading:	
internal load	27.04 kg/m² (5.48 lb/sq ft)

Eurocopter EC 130B4 *(Patrick Penna)* 1040555

For details of the latest updates to ***Jane's All the World's Aircraft*** online and to discover the additional information available exclusively to online subscribers please visit
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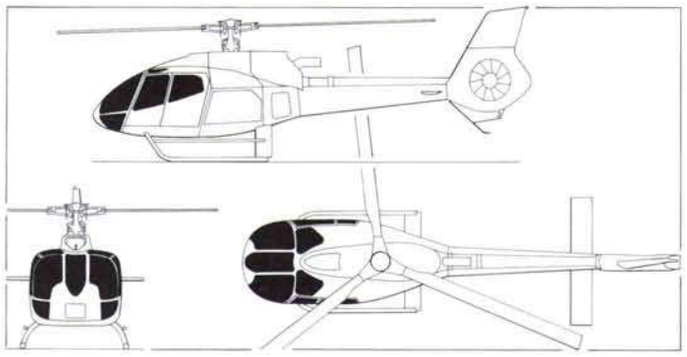


Eurocopter EC 130B (Turbomeca Arriel turboshaft) *(Paul Jackson)* 0062408

external load ..... 31.20 kg/m² (6.39 lb/sq ft)
Max power loading:
internal load ..... 4.47 kg/kW (7.35 lb/shp)
external load ..... 5.16 kg/kW (8.48 lb/shp)
PERFORMANCE (two occupants):
Never exceed speed (VNE) ..... 155 kt (287 km/h; 178 mph)
Max operating speed ..... 127 kt (235 km/h; 146 mph)
Max rate of climb at S/L ..... 698 m (2,290 ft)/min
Service ceiling ..... 7,010 m (23,000 ft)
Hovering ceiling: IGE ..... 5,875 m (19,280 ft)
OGE ..... 5,320 m (17,460 ft)
OPERATIONAL NOISE LEVELS (ICAO Annex 16 Ch 8):
Average ..... 86.8 EPNdB
Overflight ..... 84.3 EPNdB

EUROCOPTER AS 355 ECUREUIL 2/TWINSTAR and AS 555 FENNEC

Brazilian Air Force designations: CH-55 and VH-55 Esquilo
Brazilian Navy designation: UH-12B Esquilo
Royal Air Force name: Twin Squirrel

TYPE: Light utility helicopter.

PROGRAMME: Twin-engined version of AS 350. First flight of first prototype (F-WZLA) 28 September 1979; details of early production AS 355E/F versions in 1984–85 *Jane's*; AS 355F superseded by AS 355F1 in January 1984; AS 355F2 certified 10 December 1985; AS 355N powered by two Turbomeca TM 319 Arrius 1A certified in France in 1989, UK and USA in 1992; deliveries of this version began early 1992.

CURRENT VERSIONS: Current production AS 355 Ecureuil 2 and AS 555 Fennec are powered by two Turbomeca Arrius1A turboshafts.

AS 355N Ecureuil 2: Current civil production version, adaptable for passengers, cargo, police, ambulance, slung loads, carrying harbour pilots, working on high-tension cables and other missions; Category A OEI performance; known as **TwinStar** in USA.

Details refer to AS 355N, except where stated.

AS 555UN Fennec: Military utility version and French Army ALAT IFR pilot trainer.

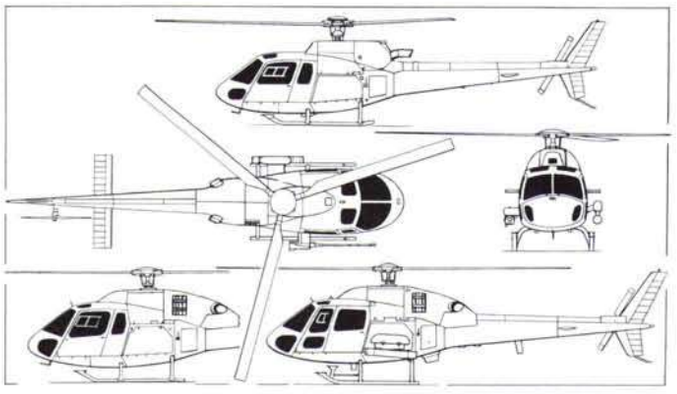
AS 555AN Fennec: Armed version; later machines adapted for centreline-mounted 20 mm gun and pylon-mounted rockets.

AS 555MN Fennec: Naval unarmed version. Can carry a 360° chin-mounted radar.

AS 555SN Fennec: Armed naval version for ASW and over-the-horizon targeting, operating from ships of 600 tonnes upwards; armament includes one lightweight homing torpedo or the cannon and rockets of land-based versions; avionics include Honeywell RDR-1500B 360° chin-mounted radar, Thales Nadir 10 navigation system, Thales RDN 85 Doppler and SFIM 85 T31 three-axis autopilot.

CUSTOMERS: Total 620 twin-engined Ecureuils in service at December 2003. French Air Force ordered 52 Fennecs, first eight as AS 355F1s powered by Rolls-Royce 250; flown by 67e Escadre d'Hélicoptères at Villacoublay and other units for communications and, with side-mounted Giat M61 20 mm gun pod, by ETOM 68 in Guyana; delivery of remaining 44 (AS 555AN powered by Arrius) began 19 January 1990; from 24th onwards, provision for centrally mounted 20 mm cannon and T-100 sight, plus Mistral missiles; French Army ordered 18 AS 555UNs for IFR training (delivery from February 1992); Brazilian Air Force has 13 AS 555s: 11 with armament, designated CH-55, and two VIP transports, designated VH-55; Brazilian Navy acquired 11 UH-12Bs; Brazilian AS 555s assembled by Helibrás in Brazil (which see); four more navies ordered eight AS 555s in 1992, two in 1993, four in 1994 and one in 1995. Two AS 355F1s, leased from OSS of Hayes, UK, supplied to the RAF's No. 32 (The Royal) Squadron at Northolt on 1 April 1996 for VIP transport; third subsequently added. Total of six AS 555Ns ordered by Malaysian Navy on 13 October 2001 to replace Westland Wasps with deliveries at end 2003. Orders in 1997–2003 totalled nine, 20, 10, 13, 17, four and 17. Total of seven delivered in 2003. Combined Ecureuil/Fennec/EC 130 orders in 2004 and 2005 totalled 146 and 193, respectively.

Eurocopter AS 355N Ecureuil in law-enforcement configuration *(Gérard Deulin)* 1040549



Eurocopter AS 555AN Fennec twin-turbine armed helicopter with side view (top) of single-engined AS 350B3 Ecureuil and scrap view (bottom) of AS 355N civil twin *(Dennis Punnett)* 1158933

DESIGN FEATURES: Starflex main rotor; two engine shafts drive into combiner gearbox containing freewheels; main rotor turns at 394 rpm and tail rotor at 2,086 rpm; otherwise substantially as AS 350.

FLYING CONTROLS: Powered, full dual flying controls without manual reversion; trim by adjustable stick friction; inverted aerofoil tailplane; swept fins above and below tailboom.

STRUCTURE: Light metal tailboom and central fuselage structure; thermoformed plastics for cabin structure.

LANDING GEAR: As for AS 350B2/550.

POWER PLANT: Two Turbomeca Arrius 1A turboshafts, each rated at 357 kW (479 shp) for take-off and 302 kW (406 shp) maximum continuous; 388 kW (520 shp) 30 minutes OEI emergency; 407 kW (547 shp) 2.5 minutes OEI emergency; full authority digital engine control (FADEC) allows automatic sequenced starting of both engines, automatic top temperature and torque limiting and preselection of lower limits for practice OEI operation. Transmission rating 511 kW (686 shp) for T-O. Two integral fuel tanks, with total usable capacity of 730 litres (193 US gallons; 160 Imp gallons), in body structure. Optional 475 litre (126 US gallon; 105 Imp gallon) auxiliary tank in cabin.

ACCOMMODATION: As for single-engined Ecureuil and Fennec.

SYSTEMS: As for AS 350B2/550, except two hydraulic pumps, reservoirs and tandem powered flying control units and electric generators.

Malaysian Navy Eurocopter AS 555SN *(Patrick Penna)* 1040553

AVIONICS: Options include a second VHF/AM and radio altimeter; provision for IFR system, SFIM 85 T31 three-axis autopilot and CDV 85 T3 nav coupler.

EQUIPMENT: Casualty installations, TV, FLIR, searchlight and 204 kg (450 lb) capacity winch available. Cargo hook optional; capacity 1,134 kg (2,500 lb). See also Current Version descriptions.

ARMAMENT (AS 555): Optional alternative weapons include TDA or Forges de Zeebrugge rocket packs, Matra or FN Herstal machine gun pods or a Giat M621 20 mm gun. Naval version carries one homing torpedo in ASW role, or SAR winch.

DIMENSIONS, EXTERNAL: As for AS 350B2/550C3, except:

Width: fuselage	1.87 m (6 ft 1½ in)
overall, blades folded	3.05 m (10 ft 0 in)
Tailplane span	3.05 m (10 ft 0 in)

DIMENSIONS, INTERNAL: As for AS 350B2/550C3

WEIGHTS AND LOADINGS:

Weight empty	1,437 kg (3,168 lb)
Max sling load	1,134 kg (2,500 lb)
Max T-O weight: internal load	2,600 kg (5,732 lb)
max sling load	2,600 kg (5,732 lb)
Max disc loading: internal load	29.0 kg/m² (5.93 lb/sq ft)
external load	29.0 kg/m² (5.93 lb/sq ft)
Transmission loading at max T-O weight and power:	
internal load	5.09 kg/kW (8.36 lb/shp)
external load	5.09 kg/kW (8.36 lb/shp)

PERFORMANCE (ISA):

Never-exceed speed (VNE)	150 kt (278 km/h; 172 mph)
Max cruising speed at S/L:	
AS 355N	120 kt (222 km/h; 138 mph)
AS 555UN/AN/MN/SN	118 kt (219 km/h; 136 mph)
Econ cruising speed	117 kt (217 km/h; 135 mph)
Max rate of climb at S/L	384 m (1,260 ft)/min
Rate of climb at S/L, OEI	156 m (512 ft)/min
Service ceiling	3,800 m (12,460 ft)
Service ceiling, OEI	1,450 m (4,760 ft)
Hovering ceiling: IGE	2,000 m (6,560 ft)
OGE	750 m (2,460 ft)
Radius, SAR, two survivors	70 n miles (129 km; 80.5 miles)
Range with max fuel at S/L, no reserves:	
AS 355N	385 n miles (713 km; 443 miles)
AS 355UN/AN	386 n miles (714 km; 444 miles)
AS 355MN/SN	350 n miles (648 km; 402 miles)
Endurance, no reserves:	
one torpedo, or cannon or rocket pods	2 h 20 min
cannon plus rockets	1 h 50 min

EUROCOPTER AS 365N DAUPHIN 2 and AS 565 PANTHER

US Coast Guard designation: HH-65A Dolphin

Israel Defence Force name: Dolpheen

TYPE: Light utility helicopter.

PROGRAMME: Certified for VFR in France November 1989; 500th Dauphin (all versions) delivered in November 1991 was 83rd AS 365N2. Dauphin family had flown 2.86 million flying hours by June 2001.

CURRENT VERSIONS: **AS 365N2 Dauphin 2:** Recent baseline version; now produced in parallel with AS 365N3.

Details below refer to N2 version.

AS 365N3 Dauphin: Improved hot-and-high version; technology for N3 and N4 versions developed by experimental DGV (Dauphin *Grande Vitesse*) F-WDFK; DGAC certification in October 1997 and first delivery to Noordzee Helikopter Vlaanderen of Belgium in early 1998. Turbomeca Arriel 2C engines offer maximum T-O weight up to 48°C (118°F), rather than N2's 36°C (97°F). FADEC as standard. Orders had reached 40 by mid-2000. Upgrade of AS 365N1 and 365N2 is offered by Eurocopter.

AS 365N4 Dauphin: Redesignated EC 155; see following entry.

AS 366G1 (HH-65A Dolphin): US Coast Guard version (99 built, plus two ex-trials aircraft bought for evaluation by Israel as Dolpheen); trial installation of 895 kW (1,200 shp) LHTEC T800 turboshaft ordered February 1990, but abandoned November 1991 when LTS101 performance promised to improve; re-engining with French Arriels also declined. For description see 1991–92 and earlier *Jane's*.

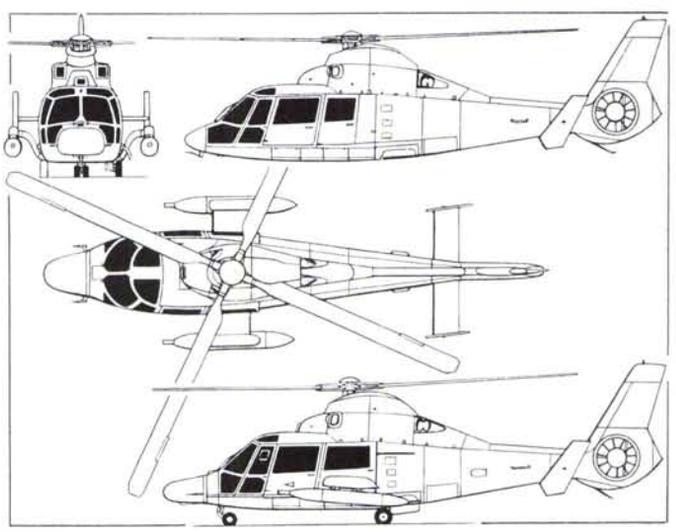
AS 565UB Panther: Army version; last described in 2001–02 edition.

AS 565SB Panther: Naval version; last described in 2001–02 edition.

Ambulance/EMS: Flight crew of two plus two or four stretchers along cabin sides loaded through rear doors; up to four seats can replace stretchers on one side; doctor sits in middle with equipment; rear doors open through 180° instead of sliding.

Offshore support: Pilot plus up to 12 passengers, autopilot and navigation systems, pop-out floats.

French Navy Eurocopter AS 365F 1040554



Military Panthers: Eurocopter AS 565AA with side view (top) of AS 365N2 Dauphin 2 *(Dennis Punnett)* 1158932

DTV5: *(Démonstrateur Technologie Véhicule)* Demonstrator of new Dauphin variant; new rotor of 13.50 m (44 ft 3½ in) diameter; Tigre transmission; and two 809 kW (1,085 shp) Turbomeca TM 333-2E1 turboshafts. Conversion of Dauphin N4 prototype, subsequently renamed Dolphin VHS (very high speed).

Dolphin FWB: Testbed for fly-by-wire technology used in NH 90.

CUSTOMERS: Total 684 AS 365/366/565 ordered for civil and military use by over 187 customers from 53 countries by January 2001; 599 then in service; totals include 50 produced as Harbin Z-9/9A in China and 101 in HH-65A Dolphin US Coast Guard versions; Chinese production by HAMC (which see) continuing. Dauphin and Panther orders in 1998–2003 totalled 28, 18, 18, 10, seven and 27. Total 32 Dauphin/Panther/EC 155 ordered in 2004 and 25 in 2005. Eurocopter has entered offset agreement with LOT of Slovak Republic to allow modification of AS 365s for East European customers; first sale announced 1998. Recent customers include the Mexican Navy, which ordered two Panthers, plus eight options, in 2003, for delivery in 2005, Greece (six AS 365N3s), and the Bulgarian Ministry of Defence, which ordered six AS565MBs on 28 January 2005 for delivery to the Bulgarian Navy over a three-year period.

DESIGN FEATURES: Progressively tapered rear fuselage with stabilising surfaces comprising horizontal tail with endplate fins, plus central fin; Fenestron anti-torque rotor; engines above cabin.

AS 365N2 and N3 have Starflex main rotor hub with four blades; 11-blade Fenestron; main rotor blades have quick disconnect pins for manual folding; ONERA OA 212

Eurocopter AS 365N3 *(Patrick Penna)* 1040550

(thickness/chord ratio 12 per cent) at root to OA 207 (thickness/chord ratio 7 per cent) at tip; adjustment tab near tip; leading-edge of tip swept at 45°; main rotor rpm 350; Fenestron rpm 3,665; rotor brake standard. AS 365N3 can be retrospectively fitted with EC 155's five-blade Spheriflex main rotor and 10-blade Fenestron rotor with unevenly spaced blades to reduce vibration.

FLYING CONTROLS: Hydraulic dual fully powered; cyclic trim by adjustable stick friction damper; fixed tailplane, with endplate fins offset 10° to port; IFR systems available.

STRUCTURE: Mainly light alloy; machined frames fore and aft of transmission support; main rotor blades have CFRP spar and skins with Nomex honeycomb filling; Fenestron duct and fin of CFRP and Nomex/Rohacell sandwich; nose and power plant fairings of GFRP/Nomex sandwich; centre and rear fuselage assemblies, flight deck floor, roof, walls and bottom skin of fuel tank bays of light alloy/Nomex sandwich.

LANDING GEAR: Hydraulically retractable tricycle type; twin-wheel self-centring nose unit retracts rearward; single wheel on each main unit; main legs retract into troughs in fuselage without cover doors; all three units have oleo-pneumatic shock-absorber; mainwheel tyres 15×6.00–6 or 380×150–6 (6 ply) tubeless, pressure 8.60 bar (125 lb/sq in); nosewheel tyres size 13×5.00–4, pressure 5.50 bar (80 lb/sq in); hydraulic disc brakes.

POWER PLANT: *AS 365N2:* Two Turbomeca Arriel 1C2 turboshafts, each rated at 551 kW (739 shp) for T-O and 471 kW (631 shp) maximum continuous, mounted side by side aft of transmission with stainless steel firewall between them. Transmission rating 965 kW (1,294 shp) for T-O and maximum continuous.

AS 365N3: Two FADEC-equipped Turbomeca Arriel 2C turboshafts, each rated at 635 kW (851 shp) for T-O, 597 kW (800 shp) maximum continuous and 729 kW (977 shp) for 30 seconds.

Standard fuel in four tanks under cabin floor and fifth tank in bottom of centre-fuselage; total capacity 1,135 litres (300 US gallons; 249.5 Imp gallons); provision for auxiliary tank in baggage compartment, with capacity of 180 litres (47.5 US gallons; 39.5 Imp gallons); or ferry tank in place of rear seats in cabin, capacity 475 litres (125.5 US gallons; 104.5 Imp gallons); refuelling point above landing gear door on port side. Oil capacity 14 litres (3.7 US gallons; 3.1 Imp gallons).

ACCOMMODATION: Standard accommodation for pilot and co-pilot or passenger in front, and two rows of four seats to rear; high-density seating for one pilot and 12 passengers; VIP configurations for four to six persons in addition to pilot; three forward-opening doors on each side; freight hold aft of cabin rear bulkhead, with door on starboard side; cabin heated and ventilated.

SYSTEMS: Air conditioning system optional. Duplicated hydraulic system, pressure 60 bar (870 lb/sq in). Electrical system includes two 4.8 kW starter/generators, one 24 V 27 Ah battery and two 250 VA 115 V 400 Hz inverters.

AVIONICS: *Comms:* Optional transponder.

Radar: Optional weather radar.

Flight: SFIM 155 duplex autopilot; optional VOR, ILS, ADF, DME, GPS and SFIM CDV 85 autopilot coupler. Optional Bendix/King Mark XXII EGPWS.

Instrumentation: Two-pilot IFR instrument panel; optional EFIS.

EQUIPMENT: Includes 1,600 kg (3,525 lb) capacity cargo hook, and 275 kg (606 lb) capacity hoist with 90 m (295 ft) cable.

DIMENSIONS, EXTERNAL (N2 and N3):

Main rotor diameter	11.94 m (39 ft 2 in)
Fenestron diameter	1.10 m (3 ft 7¼ in)
Main rotor blade chord: basic	0.385 m (1 ft 3¼ in)
outboard of tab	0.405 m (1 ft 4 in)
Length: overall, rotor turning	13.73 m (45 ft 0½ in)
fuselage	11.63 m (38 ft 2 in)
Width, rotor blades folded	3.25 m (10 ft 8 in)
Height: to top of rotor head	3.47 m (11 ft 4½ in)
overall (tip of fin)	4.06 m (13 ft 4 in)
Wheel track	1.90 m (6 ft 2¾ in)
Wheelbase	3.64 m (11 ft 11¼ in)
Main cabin door (fwd, each side):	
Height	1.16 m (3 ft 9½ in)
Width	1.14 m (3 ft 9 in)
Main cabin door (rear, each side):	
Height	1.16 m (3 ft 9½ in)
Width	0.87 m (2 ft 10¼ in)
Baggage compartment door (stbd):	
Height	0.51 m (1 ft 8 in)
Width	0.73 m (2 ft 4¾ in)

DIMENSIONS, INTERNAL:

Cabin: Length	2.30 m (7 ft 6½ in)
Max width	1.92 m (6 ft 3½ in)
Max height	1.16 m (3 ft 9¾ in)
Floor area	4.20 m² (45.2 sq ft)
Volume	5.0 m³ (176 cu ft)
Baggage compartment volume	1.6 m³ (56 cu ft)

AREAS:

Main rotor disc	111.97 m² (1,205.2 sq ft)
Fenestron disc	0.95 m² (10.23 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: N2	2,281 kg (5,028 lb)
N3	2,302 kg (5,075 lb)
Max T-O weight: N2	4,250 kg (9,369 lb)
N3	4,300 kg (9,480 lb)
Max disc loading: N2	37.9 kg/m² (7.78 lb/sq ft)
N3	38.4 kg/m² (7.87 lb/sq ft)
Transmission loading at max T-O weight and power:	
N2	4.40 kg/kW (7.24 lb/shp)

PERFORMANCE:

Never-exceed speed (VNE):	
N2 and N3	155 kt (287 km/h; 178 mph)
Max cruising speed:	
N2 and N3	150 kt (278 km/h; 173 mph)
Econ cruising speed: N2	137 kt (254 km/h; 158 mph)
N3	148 kt (274 km/h; 170 mph)
Max rate of climb at S/L: N2	408 m (1,339 ft)/min
Rate of climb at S/L, OEI: N2	78 m (256 ft)/min
N3	183 m (602 ft)/min
Service ceiling: N2	3,700 m (12,140 ft)
N3	4,700 m (15,420 ft)
Service ceiling, OEI: N2	1,200 m (3,940 ft)
N3	1,870 m (6,140 ft)
Hovering ceiling:	
IGE: N2	2,000 m (6,560 ft)
N3	2,620 m (8,600 ft)
OGE: N2	1,200 m (3,940 ft)
N3	1,150 m (3,780 ft)
Max range with standard fuel:	
N2	464 n miles (859 km; 534 miles)
N3	440 n miles (815 km; 506 miles)
Endurance with standard fuel: N2	4 h 18 min
N3	4 h 6 min

EUROCOPTER EC 155B

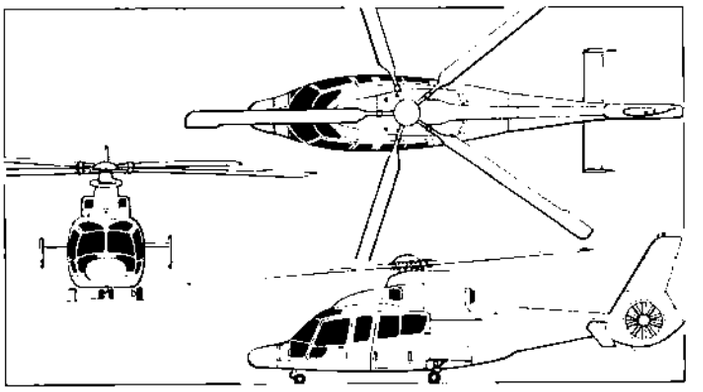
TYPE: Light utility helicopter.

PROGRAMME: Programme launched September 1996, as further development of Dauphin 2. Announced at 1997 Paris Air Show, when known as AS 365N4 Dauphin 2. First flight 17 June 1997 as conversion of DGV testbed F-WDFK (see AS 365N Dauphin 2 entry); 1,000 flying hours achieved by February 1998. New, EC 155 designation revealed at HAI convention, February 1998. First production EC 155 (F-WWOZ) flew 11 March 1998. JAR certification received 9 December 1998. FAR certification was due late 1999. Certification for single pilot in IFR issued 25 January 2000.

CURRENT VERSIONS: **EC 155B:** Baseline version; replaced in 2002; MTOW 4,800 kg (10,582 lb) and Arriel 2C1 engines.

EC 155B1: Upgraded version from 2002; *as described.* Features include new engine cowlings, new hydraulic cooling system, chip detectors, cargo fire protection, jettisonable cockpit doors; fixed cockpit footsteps and Thales AHV 16 radar altimeter display. Available

Eurocopter EC 155B *(Patrick Penna)* 1040551



Eurocopter EC 155B *(James Goulding)* 0130860

with standard Corporate, Offshore and Parapublic equipment packages. Increased MTOW of 4,920 kg (10,847 lb) approved at end of 2004.

EC 155B HTT: *Hélicoptère Tous Temps* (all-weather helicopter) Technology demonstrator (F-WQEZ), first flown 15 October 2002, for evaluation of helicopter navigation, ground collision avoidance and autopilot systems, aimed at relaxation of rules for rotary-wing IFR operations. Equipment includes a GPS/DGPS-based position-finding system which communicates with a ground station at Eurocopter's Marignane facility; four-axis autopilot, permitting steep approaches in zero visibility; and a mission computer with database-stored terrain maps which manages three-dimensional flight plans, coupled with ground collision avoidance system, to ensure safe terrain clearance during en route flight in zero visibility. Mission information is displayed on two large cockpit displays with three-dimensional mapping. Eurocopter expects that the technologies being evaluated in the HTT will be incorporated in its range of helicopters from 2005.

CUSTOMERS: Total of 63 delivered by January 2005, at which time total fleet time stood at 54,000 hours. Some 80 on order by mid-2006. Total of nine delivered in 2003. Total 32 Dauphin/Panther/EC 155 ordered in 2004 and 25 in 2005. First customer, German Border Guard (Bundesgrenzschutz; BGS), ordered 13 for delivery between 16 March 1999 and 2000 and further two in February 2002 for delivery in 2003. German Interior Ministry ordered two for Baden-Württemberg regional government in February 2000 for delivery in March 2001; Hong Kong Government Flying Service ordered five of which last delivered 17 December 2002; Shell Nigeria ordered six in 2000; first aircraft delivered on 26 September 2001. Swedish Helicopter Service ordered three in June 2001 for delivery between October and December 2002. Sales in 2001 including three for COHC (China), two for SFC (Vietnam) and three for SHS (Sweden). Further 13 purchased by BGS in February 2002. AZAL of Azerbaijan ordered four in 2003. Royal Thai Police ordered two on 6 February 2004, for delivery in VIP configuration by January 2005. Recent customers include Heli-Air Monaco/Monacair, which took delivery of one on 12 September 2005, and Bistow Helicopters which has selected the EC155 to support oil and gas platform crew change operations in the southern sectors of the north sea under a seven-year contract awarded by Shell Exploration and Production.

COSTS: Royal Thai Police order for two valued at USD25 million (2004).

DESIGN FEATURES: Compared to earlier Dauphin models, has bulged sliding cabin doors, redesigned cabin windows and 40 per cent larger cabin area. Five-blade Spheriflex main rotor and 10-blade Fenestron rotor with unevenly spaced blades to reduce noise.

FLYING CONTROLS: As AS 365N.

STRUCTURE: As AS 365N.

LANDING GEAR: As AS 365N.

POWER PLANT: Two FADEC-equipped Turbomeca Arriel 2C2 turboshafts, each rated at 697 kW (935 shp) for T-O, 645 kW (865 hp) max continuous power and 780 kW (1,046 shp) for 30 seconds. Standard fuel in six tanks, total capacity 1,257 litres (332 US gallons; 277 Imp gallons); provision for auxiliary tank in baggage compartment, with capacity for 180 litres (47.6 US gallons; 39.6 Imp gallons); or ferry tank in place of rear seats in cabin, capacity 460 litres (121.5 US gallons; 101 Imp gallons); refuelling point above landing gear door on port side. Oil capacity 14 litres (3.7 US gallons; 3.1 Imp gallons).

ACCOMMODATION: Standard accommodation for pilot and co-pilot or passenger in front, and three rows of four seats to rear; high-density seating for one pilot and up to 14 passengers; VIP configurations for between four and eight persons in addition to pilot; 12 cabin seats in offshore version; up to six stretchers in casevac role; one crew door and one large sliding door on each side; freight hold aft of cabin rear bulkhead, with door on both sides. Option of hinged cabin door on VIP versions.

SYSTEMS: Electrical system includes two starter/generators, each 160 A, 28 V DC and 43 Ah Ni/Cd battery. Duplicated hydraulic system. Optional 10 kVA alternator.

AVIONICS: *Comms: Corporate:* Twin Collins 422A VHF/AM; Collins TDR 94D transponder; NAT AA20-431 passenger address system; Team BA 1920 passenger interphone. Kannad 406AF ELT. Optional Maritime NPX 138, Collins HF 9100 HF/SSB and Collins TDR 94D transponder; Racal CPT 609 ELT. *Offshore:* Twin Collins 422A; TRD 94D; NPX 138 standard; AA20-431; BA 1920; Kannad 406. Optional second TDR 94D and CPT 609. *Parapublic:* Twin Collins 422A; TDR 94D; AA20-431; BA 1920; Kannad 406. Optional NPX 138, HF 9100, CPT 609.

Radar: Corporate: Telephonics RDR 2000 with VRU. *Offshore:* Telephonics RDR 1400C standard; RDR 2000 optional replacement. *Parapublic:* RDR 1400C.

Flight. Corporate: Universal UNS-1D flight management system. Twin Collins VIR 432 VOR/ILS; Collins DME 442; Collins ADF 462. Optional Honeywell CAS 66A TCAS, Euroavionics Euronav 3 moving map, Racal V 694 voice alerting system. *Offshore:* UNS-1D; Twin Collins VIR 432; DME 442; ADF 462. Optional Trimble TNL 2101 (replacing UNS-1D), Bendix CAS 66A TCAS, Euronav 3, V 694. *Parapublic:* UNS-1D; Twin VIR 432; DME 442; ADF 462. Optional CAS 66A, Euronav 3, V 694.

Instrumentation: As AS 365N, but optional eighth MFD available (152 × 203 mm; 6 × 8 in) for mission equipment display.

Mission: German Border Guard aircraft to have Hellas obstacle warning system.

EQUIPMENT: Standard role packages, included in equipped weight, comprise:

Corporate: Air conditioning, hinged cabin doors, fin and belly strobe lights, retractable passenger steps both sides, improved soundproofing and carpets.

Offshore: Windscreen washer, high-intensity lights, emergency flotation gear, strobe lights, liferaft stowage and improved soundproofing.

Parapublic: Air Equipment SAR hoist (272 kg; 600 lb, 90 m; 295 ft), Spectrolab SX-16 searchlight to port, strobe lights, loudhailer and siren, rappelling rope stays, improved soundproofing and 12 cabin seats.

DIMENSIONS, EXTERNAL:

Main rotor diameter	12.60 m (41 ft 4 in)
Fenestron diameter	1.10 m (3 ft 7¼ in)
Main rotor blade chord: basic	0.385 m (1 ft 3¼ in)
outboard of tab	0.405 m (1 ft 4 in)
Length: overall, rotor turning	14.30 m (46 ft 11 in)
fuselage	12.71 m (41 ft 8½ in)
Tailplane span; and width, rotor blades folded	3.48 m (11 ft 5 in)
Height: to top of rotor head	3.64 m (11 ft 11¼ in)
overall (tip of fin)	4.35 m (14 ft 3¼ in)
Wheel track	1.90 m (6 ft 2¾ in)
Wheelbase	3.91 m (12 ft 10 in)
Cockpit door (each side): Height	1.34 m (4 ft 4¾ in)
Width	1.19 m (3 ft 10¾ in)
Baggage compartment door (stbd):	
Height	0.69 m (2 ft 3¼ in)
Width	0.73 m (2 ft 4¾ in)

DIMENSIONS, INTERNAL:

Cabin: Length	**2.55 m (8 ft 4½ in)**
Max width	**2.10 m (6 ft 10¾ in)**
Max height	**1.34 m (4 ft 4¾ in)**
Floor area	**5.09 m² (54.8 sq ft)**
Volume	**6.7 m³ (237 cu ft)**
Baggage compartment: Floor area	2.95 m² (31.8 sq ft)
Volume	2.5 m³ (88 cu ft)

AREAS:

Main rotor disc	124.69 m² (1,342.1 sq ft)
Fenestron disc	0.95 m² (10.23 sq ft)

WEIGHTS AND LOADINGS:

Weight: empty	2,615 kg (5,765 lb)
equipped: Corporate	3,153 kg (6,951 lb)
Offshore	3,027 kg (6,673 lb)
Parapublic	2,876 kg (6,340 lb)
Max underslung load	1,600 kg (3,527 lb)
Max T-O weight	4,920 kg (10,847 lb)
Max disc loading	39.45 kg/m² (8.08 lb/sq ft)

PERFORMANCE:

Never-exceed speed (VNE)	175 kt (324 km/h; 201 mph)
Max cruising speed at S/L	144 kt (267 km/h; 166 mph)
Econ cruising speed at FL60	146 kt (270 km/h; 168 mph)
Max rate of climb at S/L	354 m (1,161 ft)/min
Service ceiling	4,570 m (15,000 ft)
Hovering ceiling: IGE	2,290 m (7,520 ft)
OGE at 4,400 kg (9,700 lb)	2,365 m (7,760 ft)
Max range with standard fuel, no reserves:	
standard tanks	424 n miles (785 km; 487 miles)
one auxiliary tank	488 n miles (903 km; 561 miles)
Endurance: standard tanks	4 h 0 min
one auxiliary tank	4 h 35 min

EUROCOPTER EC 135 and EC 635

TYPE: Light utility helicopter.

PROGRAMME: First flight on 15 October 1988 of technology prototype, D-HBOX, previously known as BO 108, powered by two Rolls-Royce 250-C20R turboshafts with conventional tail rotor; new all-composites bearingless tail rotor tested during 1990; Eurocopter announced in January 1991 that BO 108 was to succeed BO 105; first flight of second prototype (D-HBEC) powered by two Turbomeca TM 319-1B Arrius, 5 June 1991; production main and tail rotors flight tested during 1992 in preparation for certification programme; design revised late 1992 to increase maximum seating to seven; advanced Fenestron adopted.

Two preproduction prototypes D-HECX and D-HECY made first flights respectively 15 February and 16 April 1994 powered by Turbomeca Arrius 2B and P&WC PW206B intended as production alternatives; third preproduction prototype (D-HECZ) made first flight 28 November 1994, powered by Arrius 2B, and subsequently made type's US debut at HeliExpo '95 in Las Vegas in January 1995; total flight time of first three preproduction EC 135s was nearly 1,600 hours by end 1996, by which time all three preproduction prototypes had been retired. VFR certification to JAR 27 16 June 1996 and to FAR Pt 27 with Category A provisions and for both engine options, 31 July 1996; IFR certification awarded jointly by DGAC (France) and LBA (Germany) on 9 December 1998, while that for CAA attained late 2000; LBA (JAA) single pilot IFR certification achieved 2 December 1999; certified in 17 countries by June 2000; first two production aircraft delivered to Deutsche Rettungsflugwacht on 31 July 1996.

In November 2003 an agreement was signed with Eurocopter Romania for assembly of EC 135s at its Brasov, Romania facility. Other orders resulted in agreements for assembly lines in Spain (Albacete) and Switzerland. Increased MTOW of 2,910 kg (6,415 lb) — previously 2,835 kg (6,250 lb) certified on 21 February 2006 and available from September 2006, in conjunction with reduction of empty weight from 1,490 kg (3,284 lb) to 1,455 kg (3,208 lb).

CURRENT VERSIONS: **EC 135P1**: Pratt & Whitney engine version (PW206B). First two (D-HQQQ and D-HYYY; c/ns 0005 and 0006) delivered on 31 July 1996 to Deutsche Rettungsflugwacht.

EC 135P2: Introduced August 2001. PW206B2 engine with improved contingency ratings.

EC 135T1: Turbomeca engine version. First (0010/N4037A) delivered to USA in November 1996. Early helicopters had 435 kW (583 shp) Arrius 2B engines, later replaced by 500 kW (670 shp) Arrius 2B1. Uprated Arrius 2B1A engine certified April 2001.

EC 135T2: Deliveries from September 2002. Arrius 2B2 engines.

EC 135 ACT/FHS: Active control technology and flying helicopter simulator; German fly-by-light trials programme; first flight of modified production EC 135 (D-HECV) from Eurocopter's Ottobrunn facility 28 January 2002.

EC 135 APH: Advanced Police Helicopter. Unified mission fit offered by McAlpine Helicopters of UK, 1997; allows simple outfitting with sensors and equipment, according to tasking, using underfuselage pod; typical equipment, including loudspeakers, searchlights, microwave downlink and multisensor turret, can be fitted externally; TV and video equipment carried internally. Pod reduces maximum speed by 5 kt (9 km/h; 6 mph).

EC 635: Military version; mockup was conversion of first preproduction EC 135 (D-HECX). Offered (unsuccessfully) to South Africa and unveiled at Aerospace Africa Air Show on 28 April 1998. First customer was Portuguese Army, which ordered nine EC 635T1s on 22 October 1999 for delivery from June 2001. However, these retrospectively

Spanish Civil Guard Eurocopter EC 135 *(Eric Raz)* 1040552

cancelled on 14 August 2002, following delay in post-delivery modifications; six sold to Jordan and delivered from July 2003 onwards; Jordan ordered four more in January 2006.

CUSTOMERS: Announced customers include Boeing Executive Flight Operations (two in mid-2002) plus one option, Bond, UK (15), Czech Police Aviation Department (eight, for delivery between 2003 and 2008), Deutsche Rettungsflugwacht (German Air Rescue; two); EuropAvia, Switzerland; MFL, France; Helicap of Paris, France (14 EMS versions); Basque Police, Spain; Bavarian Police, Germany (9 with PW206 engines); Sultan of Pahang, Malaysia; OAMTC Austrian Automobile Club (five, delivered from 10 August 1997 followed by order for 11 on 27 September 2000 for delivery between December 2000 and early 2002, and three ordered in June 2003); DAO, Argentina; Laidlaw, UK; Hood, UK; Manichi Press, Japan; Elifriulia, Italy; Proeteus, France; Air Service 51, France; Center for Emergency Medicine of Pittsburgh, Pennsylvania (one); Norsk Luftambulanse (six); Petroleum Helicopters Inc (three); Temsco of Ketchikan, Alaska (one); TexAir of Houston, Texas (one); ADAC, Germany (12 for EMS); Osterman; Swedish Police (seven, first aircraft handed over 10 August 2001) Haier, China (one in VIP configuration); Helicap, France (two, in EMS configuration) of which first delivered 12 September 2002); Helicsa, Spain (six, in EMS configuration); Romanian Ministry of the Interior (five, of which the first three were delivered in December 2003); the Irish Air Corps, which took delivery of the first of two on 27 September 2005; CJ Systems Aviation Group of the US which ordered 10 in February 2005 to support its air medical services; and Petroleum Helicopters Inc, which ordered 10 with 10 options, on 6 February 2005.

Law enforcement users include Mecklenburg-West Pomerania, Germany (two), Rheinland-Palatinate, Germany (one, delivered 10 July 2002, plus two options), Saxony Police (one), Abu Dhabi Police (one), Chile Police (one), Greek Police (two), Travis County Police Department, USA (one), plus UK police forces (seven). German Army ordered 15 at cost of DM95 million in August 1997 for delivery in 2000 to replace Alouette II in training role of which the first was delivered on 13 September 2000. German Border Guard (Bundesgrenzshutz; BGS) ordered nine (subsequently increased to 11) in December 1997; first three delivered 21 September 2000, with eight in service by end of 2001. Swiss Air Force ordered 18 EC 635s and two VIP EC 135s in April 2006, of which 16 to be assembled locally by RUAG from 2007.

Eurocopter expects to win 700 sales out of a world market for 1,350 during the period 1998 to 2007. More than 550 on order by mid-2006. 100th delivered (to Bavarian Police) on 16 June 1999, and 250th to Spanish operator CoyotAir on 25 October 2002, 300th to UK distributor McAlpine Helicopter Ltd, for North Midlands Police, in September 2003 and 400th to Transporters Aéreos Pegaso of Mexico City in April 2005; 500th to Austrian ÖAMTC motoring club in August 2006; some two-thirds with Turbomeca engines. Orders in 1999–2005 have comprised 30, 40, 38, 48, 55, 67 and 87.

COSTS: Operating cost 25 per cent lower than BO 105; development programme funded by Eurocopter Deutschland and Eurocopter Canada, suppliers, and German Ministries of Economics and Research and Technology. Czech contract for eight valued at €36 million (2003).

DESIGN FEATURES: Designed to FAR Pt 27 including Category A and European JAR 27; pod-and-boom configuration, with Fenestron; forward flight stability by two horizontal and four vertical (fin, underfin and two endplates) surfaces; four-blade FVW bearingless main rotor, single-piece rotor head/mast; rotor rpm are variable; composites blades mounted on controlled flexibility composites arms giving flap, lag and pitch-change freedom; control demands transmitted from rods to root of blade by rigid CFRP pitch cuffs; main rotor blades have DM-H3 and –4 aerofoils with non-linear twist and tapered transonic tips; main rotor axis tilted forward 5°.

Airframe drag 30 per cent lower than BO 105 by clean and compact external shape; cabin height retained by shallow two-stage transmission; vibration reduced by ARIS mounting between transmission and fuselage; all dynamically loaded components to have 3,500 hours MTBR or be maintained on-condition. Fenestron has 10 asymmetrically spaced blades.

Second BO 108 prototype had EFIS-based IFR system; fuselage stretched 15 cm (5.9 in) and interior cabin width extended by 10 cm (3.9 in); main rotor diameter extended to 10.20 m (33 ft 5½ in); for EC 135, tail rotor replaced in 1992 by New Generation Fenestron with 11 fixed flow-straightening vanes in fan efflux designed to avoid momentum losses and improve fan figure of merit; vanes are swept relative to radius and fan has different number of blades to avoid shocks and reduce noise; fan blade tip speed is only 185 m (607 ft)/s; maximum T-O weight increased to 2,720 kg (5,997 lb).

Military Eurocopter EC 635 with rocket pods *(Wolfgang Obrusnik)* 1040556

FLYING CONTROLS: Conventional hydraulic fully powered controls with integrated electrical SAS servos; objective is single-pilot IFR with cost-effective stability augmentation. Electric cyclic trim system.

STRUCTURE: Fibre-reinforced composites main rotor blades; single-piece rotor head/mast. Airframe mainly Kevlar/CFRP sandwich composites, except aluminium alloy sidewalls, pod lower module and cabin floor, tailboom and around cargo area; some titanium in engine bay; composites tailplane.

LANDING GEAR: Skid type; ground handling wheels can be fitted.

POWER PLANT: Choice of turboshaft engines. Turbomeca-engined aircraft have two Arrius 2B2s, each giving 473 kW (634 shp) at T-O, 442 kW (592 shp) maximum continuous, 528 kW (708 shp) OEI continuous, 580 kW (777 shp) for 2 minutes with OEI and 609 kW (816 shp) for 30 seconds. Alternative power plant is two Pratt & Whitney Canada PW206B2s, each giving 498 kW (667 shp) at T-O, 457 kW (612 shp) maximum continuous, 528 kW (708 shp) OEI continuous, 580 kW (777 shp) for 2 minutes with OEI and 609 kW (816 shp) for 30 seconds. Both types of engine have FADEC. Combined transmission rating 640 kW (858 shp) maximum T-O, 567 kW (760 shp) maximum continuous, 368 kW (493 shp) OEI continuous, 513 kW (687 shp) for 2 minutes with OEI and 526 kW (705 shp) for 30 seconds.

Fuel capacity of first 249 aircraft 673 litres (178 US gallons; 148 Imp gallons) of which 663 litres (175 US gallons; 146 Imp gallons) are usable. Capacity 700 litres (185 US gallons; 154 Imp gallons) from No. 250. Additional long-range tank optional, usable capacity 198.5 litres (52.4 US gallons; 43.7 Imp gallons). Optional self-sealing fuel tanks. Oil capacity 8 litres (2.0 US gallons; 1.75 Imp gallons).

ACCOMMODATION: Seven persons, including one or two pilots, in standard version, or six persons in VIP version; optional max capacity of eight. Four-point harnesses for front seats; three-point harnesses for remaining seats. Forward-hinged doors for two front occupants; sliding doors for five persons in cabin. Rear of pod has clamshell doors for bulky items/cargo; flights permissible with clamshell doors removed; optional window in each rear door. Unobstructed cabin interior. EMS variant can accommodate one pilot with two stretcher cases and two seated medical staff/attendants; alternative layouts for one, one, three, or two, one, three, or two, two, two.

SYSTEMS: Redundant 28 V DC electrical supply systems to JAR/FAR 27 standards; two 160 A 28 V starter/generators and 24 V 17 Ah Ni/Cd batteries in Arrius 2B variant, two 200 A 28 V starter/generators and 24 V 25 Ah Ni/Cd batteries in PW206B variant. Fully redundant dual hydraulic systems. NATO standard external power connector.

AVIONICS: Bendix/King Gold Crown and Thales equipment. Total of 10 standard avionics and equipment packages available.

Radar: Provision for integrated weather radar.

Flight: Air data computer; SFIM automatic flight control system (AFCS); GPS. Honeywell combined solid-state flight data and cockpit voice recorder tested on EC 135 late 1998. BGS aircraft have EADS-Dornier Hellas obstacle warning system. Optional Bendix/King Mark XXII EGPWS available for EC 135 APH.

Instrumentation: Liquid crystal dual-screen (Thales SMD45) vehicle and engine management displays with AN equipment.

Mission: Optional FLIR and NVGs for military, police and ambulance roles. BGS EC 135s are first to be equipped with Hellas laser obstacle warning system.

EQUIPMENT: Options include cargo hook, external loudspeakers and searchlights, rescue winch (230 kg; 507 lb) with 50 m (164 ft) cable, emergency floats, sand filter, wire-strike protection system and light armour protection.

ARMAMENT: By 2003, approved to carry FN Herstal HMP 400 12.7 mm machine gun, Giat NC621 20 mm gun or 12-round 70 mm rocket launcher on pylons.

DIMENSIONS, EXTERNAL:

Main rotor diameter	10.20 m (33 ft 5½ in)
Fenestron diameter	1.00 m (3 ft 3¼ in)
Length: overall, rotor turning	12.16 m (39 ft 10¾ in)
fuselage: incl boom	10.20 m (33 ft 6½ in)
excl boom	5.87 m (19 ft 3 in)
Height: overall	3.51 m (11 ft 6 in)
to top of rotor head	3.35 m (11 ft 0 in)
Width:	
without rotor blades (tailplane span)	2.65 m (8 ft 8¼ in)
fuselage (max)	1.56 m (5 ft 1½ in)
Skid length	3.20 m (10 ft 6 in)
Skid track	2.00 m (6 ft 6¾ in)
Ground clearance: fuselage	0.40 m (1 ft 3¾ in)
tailboom underfin	0.66 m (2 ft 2 in)

DIMENSIONS, INTERNAL:

Cabin and cockpit:	
Length: normal	3.06 m (10 ft 0½ in)
with EMS floor extension	4.11 m (13 ft 5¾ in)
Max width	1.50 m (4 ft 11 in)
Max height	1.26 m (4 ft 1½ in)
Floor area	4.3 m² (46 sq ft)
Volume: EC 135	4.8 m³ (170 cu ft)
EC 635	4.6 m³ (162 cu ft)
Baggage compartment: Length	1.05 m (3 ft 5¼ in)
Max width	1.23 m (4 ft 0½ in)
Max height	0.70 m (2 ft 3½ in)
Floor area	1.20 m² (12.9 sq ft)
Volume	1.1 m³ (39 cu ft)

AREAS:

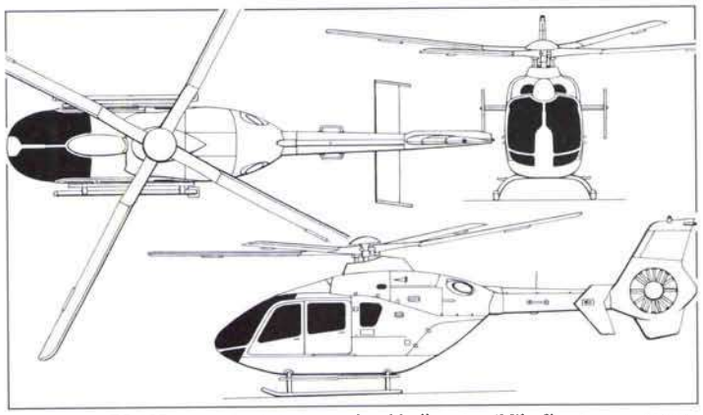
Main rotor disc	81.71 m² (879.5 sq ft)
Fenestron disc	2.84 m² (30.52 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: EC 135	1,455 kg (3,208 lb)
EC 635	1,530 kg (3,373 lb)
Max fuel: standard (No. 250 on)	560 kg (1,235 lb)
with long-range tank	720 kg (1,587 lb)
Max external load	1,360 kg (2,998 lb)
Max T-O weight	2,910 kg (6,415 lb)
Max disc loading	35.6 kg/m² (7.29 lb/sq ft)
Transmission loading at max T-O weight and power	4.73 kg/kW (7.77 lb/shp)

PERFORMANCE (A: Arrius 2B2, B: PW206B2, at normal MTOW):

Never-exceed speed (VNE):	
A, B	140 kt (259 km/h; 161 mph)
Max cruising speed: A, B	138 kt (256 km/h; 159 mph)
Econ cruising speed: A	129 kt (239 km/h; 148 mph)
B	124 kt (230 km/h; 143 mph)
Max rate of climb at S/L: A, B	457 m (1,500 ft)/min
Rate of climb at S/L, OEI: A, B	65 m (215 ft)/min
Max certified altitude: A, B	3,050 m (10,000 ft)
Service ceiling, OEI: A	3,050 m (10,000 ft)
B	2,925 m (9,600 ft)
Max certified hovering ceiling, IGE:	
A, B	3,050 m (10,000 ft)
Hovering ceiling, OGE: A, B	1,830 m (6,000 ft)
Range at S/L, standard fuel (700 litres):	
A	335 n miles (620 km; 385 miles)
B	342 n miles (635 km; 394 miles)
Ferry range with long-range tank:	
A	440 n miles (814 km; 506 miles)
B	450 n miles (833 km; 517 miles)
Endurance at S/L, standard fuel (700 litres):	
A	3 h 23 min
B	3 h 35 min



Eurocopter EC 135 seven-seat, twin-engined helicopter *(Mike Keep)* 0507504

EUROCOPTER EC 120 B COLIBRI

English name: Hummingbird
Spanish Air Force designation: HE.25
Chinese designation: HC120

TYPE: Light utility helicopter.

PROGRAMME: Definition phase of original P120L launched 15 February 1990; subsequently redesigned with 500 kg (1,102 lb) lower gross weight and new engine and rotor; development contract signed October 1992; redesignated EC 120, January 1993; design definition completed mid-1993; assembly of first of two prototypes began at Eurocopter France at Marignane in early 1995; first flight (F-WWPA) 9 June 1995; second prototype (F-WWPD) flown 17 July 1996; certification to JAR 27 was achieved on 16 June 1997 (following Arrius 2F engine approval by DGAC on 22 January 1997); FAR Pt 27 certification on 28 January 1998; operations in cold weather certified late 1998; first production EC 120 (c/n 1005) flew 5 December 1997 before delivery to Japanese distributor Nosaki on 23 January 1998 for eventual use (as JA120B) by Nosaki Sangyo, Osaka.

Eurocopter has 61 per cent share and responsible for instrument panel, landing gear, seats, rotor system, transmission, final assembly, flight test and certification; CATIC (China National Aero-Technology Import & Export Corporation in the form of Hafei Aviation Industry Company; 24 per cent) for cabin structure and doors, engine cowlings, pod central and intermediate structure and fuel system; and Singapore Technologies Aerospace (15 per cent) for tailboom, fin, horizontal stabiliser, Fenestron, general doors and instrument pedestal. Joint design team working in Eurocopter France at Marignane. Global support system, with 13 product centres, being initiated. Australian assembly centre established as part of offsets for 2001 purchase of Tiger attack helicopters by Australian Army, with first two Australian-assembled EC 120 BSS completed in 2003. Agreement signed with AVIC II of China in November 2003 for establishment of production line at Harbin with target output of 20 per year.

CUSTOMERS: Delivery of 400th EC 120 (N288JK of Sacramento County Sheriff's Department) effected in September 2006. Recent customers include the Spanish Air Force, which ordered 15 in 1999 for basic training; deliveries began 26 July 2000 and were completed in July 2001; and Air Logistics, which took delivery of six in 2001 for offshore operations in the Gulf of Mexico. Three ordered for Indonesian Navy and 12 for Indonesian Air Force; deliveries began June 2001. 100th aircraft handed over 19 April 2000 to a German customer; 200th to a Swedish customer on 29 March 2001; 300th to Australian customer 8 November 2002. Selected 5 October 2004 by US Department of Homeland Security for US Border Patrol, with firm order for 55, plus five options. Orders in 1999–2005 were 36, 61, 81, 38, 38, 35 and 44. Total market estimated at 1,600 to 2,000 during production life.

COSTS: USD840,000 (1999). US Border Patrol order for 55, plus five options, valued at USD75 million (2004).

DESIGN FEATURES: Pod-and-boom layout; horizontal stabilisers, fin and underfin for directional stability; anti-torque Fenestron. Three-blade main rotor on Spheriflex hub rotating clockwise (nominal rotor speed 406 rpm) integrated with main shaft and transmission; two-stage reduction gear; rotor brake; eight asymmetrically positioned bladed New Generation Fenestron (nominal tail rotor speed 4,567 rpm). External noise almost 7 dB below ICAO limits. Single level cabin floor. Engine mounted to left of main rotor mast to improve balance by counteracting main rotor downwash.

FLYING CONTROLS: Control forces on collective and cyclic reduced by three electrically actuated hydraulic servos operating at 37 bar (537 lb/sq in). Tab on each main rotor blade trailing-edge at three-quarter span.

STRUCTURE: Main rotor blades have carbon fibre rib with foam filler and glass fibre skin, plus stainless steel attachment bushes and leading-edge. Titanium alloy Spheriflex head and shaft made as single composites assembly; metal centre-fuselage; light alloy skid landing gear; crashworthy seats and fuel system. Light alloy tail rotor shaft.

LANDING GEAR: 'Moustache' configuration of fixed skids, having sweptback forward supports and full-width boarding step. Optional 1.50 m (4 ft 11 in) skis for snow operations.

POWER PLANT: One Turbomeca TM 319 Arrius 2F engine selected for first 300 EC 120s; rating 376 kW (504 shp) for T-O, 335 kW (449 shp) max continuous. Transmission rating 330 kW (442 shp). Fuel capacity 416 litres (109.9 US gallons; 91.5 Imp gallons) in two tanks (one located beneath cabin floor and one above baggage compartment); usable fuel 406 litres (107 US gallons; 89.3 Imp gallons).

ACCOMMODATION: Pilot and four passengers (or pilot, patient and paramedic in HEMS configuration); two front seats and one rear bench seat. Large door, front, starboard; hinged front and rear sliding door, port. Compartment below engine on same level as cabin floor, accessible from cabin, by external side door and rear door. Seating conforms to new FAR Pt 27 requirements for 30 *g* vertical and 18 *g* horizontal deceleration. Dual controls optional. Accommodation ventilated and heated; air conditioning optional.

SYSTEMS: VEMD (vehicle and engine multifunction display), fitted as standard, is a fully duplex three-module processing system using two glass screens to monitor performance and maintenance requirements. Electrical system includes 4.5 kW 28 V DC starter/generator and Ni/Cd battery.

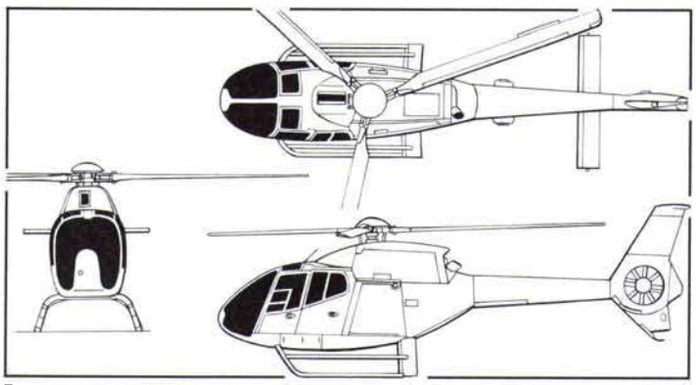
AVIONICS: To customer's requirements. Six standard packages available for passenger transport (two), law enforcement, training (two) and utility.

Comms: Bendix/King: KX 165 nav/com/glideslope and secondary KY 196A VHF, Jolet JE2 NG ELT, Bendix/King KT 76A transponder and Team SIB 120 interphone in typical passenger configuration.

Flight: Trimble TNL 2101 GPS with moving map in typical passenger configuration.

Instrumentation: Standard fit of VEMD, ASI, NR/NF dual indicator and altimeter.

Eurocopter EC 120 Colibri *(Patrick Penna)* 1040567



Eurocopter EC 120 B Colibri single-engined light helicopter *(James Goulding)*
0099566

EQUIPMENT: Optional Aerazur emergency flotation bags, and cable cutters. Optional pilot-controllable swivelling landing light. Optional windscreen wipers.

DIMENSIONS, EXTERNAL:

Main rotor diameter	10.00 m (32 ft 9¾ in)
Main rotor blade chord	0.26 m (10¼ in)
Fenestron diameter	0.75 m (2 ft 5½ in)
Fenestron blade chord	0.06 m (2¼ in)
Length overall, rotors turning	11.52 m (37 ft 9½ in)
Fuselage: Length	9.60 m (31 ft 6 in)
Max width of cabin	1.50 m (4 ft 11 in)
Max depth, excl skids:	
to engine cowling	1.67 m (5 ft 5¾ in)
to rotor head	2.52 m (8 ft 3¼ in)
Tailplane span	2.60 m (8 ft 6¼ in)
Height: overall	3.40 m (11 ft 1¾ in)
to top of rotor head	3.08 m (10 ft 1¼ in)
to top of engine cowling	2.23 m (7 ft 3¾ in)
Skid track	2.07 m (6 ft 9½ in)
Height of skids	0.56 m (1 ft 10 in)
Height of boarding step	0.50 m (1 ft 7¾ in)
Large door, starboard: Width	1.15 m (3 ft 9¼ in)
Height	1.16 m (3 ft 9¾ in)
Front door, port: Width	0.81 m (2 ft 8 in)
Height	1.16 m (3 ft 9¾ in)
Sliding door, port: Width	0.90 m (2 ft 11½ in)
Height	1.16 m (3 ft 9¾ in)

DIMENSIONS, INTERNAL:

Cabin: Length	2.30 m (7 ft 6½ in)
Max width	1.35 m (4 ft 5¼ in)
Max height	1.25 m (4 ft 1¼ in)
Floor area	3.0 m² (32.29 sq ft)
Volume	2.14 m³ (75.6 cu ft)
Baggage compartment: Length	1.31 m (4 ft 3½ in)
Max width	0.72 m (2 ft 4¼ in)
Max height	1.02 m (3 ft 4¼ in)
Volume	0.8 m³ (28.25 cu ft)

AREAS:

Main rotor disc	78.54 m² (845.4 sq ft)
Fenestron disc	0.44 m² (4.73 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: standard	960 kg (2,116 lb)
typical passenger fit	1,007 kg (2,220 lb)
typical law enforcement fit	985 kg (2,172 lb)
advanced training fit	1,021 kg (2,251 lb)
Max sling load	700 kg (1,543 lb)
Max useful load	755 kg (1,664 lb)
Max T-O weight: internal load	1,715 kg (3,781 lb)
external load	1,800 kg (3,968 lb)
Max disc loading:	
internal load	21.8 kg/m² (4.47 lb/sq ft)
external load	22.9 kg/m² (4.69 lb/sq ft)
Transmission loading at max T-O weight and power:	
internal load	5.20 kg/kW (8.54 lb/shp)
external load	5.45 kg/kW (8.96 lb/shp)

PERFORMANCE (at 1,715 kg; 3,781 lb):

Never-exceed speed (VNE)	150 kt (278 km/h; 173 mph)
Cruising speed: max	122 kt (226 km/h; 140 mph)
econ	103 kt (191 km/h; 119 mph)
Max rate of climb at S/L	366 m (1,200 ft)/min
Service ceiling	5,180 m (17,000 ft)
Hovering ceiling: IGE	2,820 m (9,260 ft)
OGE	2,320 m (7,620 ft)
Range, no reserves	393 n miles (727 km; 452 miles)
Endurance, no reserves	4 h 32 min

EUROCOPTER BK 117

TYPE: Light utility helicopter.

PROGRAMME: Developed jointly by partners; four prototypes, first flight 13 June 1979; one preproduction aircraft, first flight 6 March 1981; first flights of production aircraft 24 December 1981 (JQ1001 in Japan) and 23 April 1982 (in Germany); certified in Germany and Japan 9 and 17 December 1982 respectively, followed by US FAA 29 March 1983 (FAR Pt 29, Categories A and B, including Amendments 29-1 to 29-16); deliveries began early 1983. See 1991–92 and previous editions for earlier A series and B-1. BK 117 fleet reached 1,274,000 flying hours by January 2001, at which time 416 delivered and 379 remaining in service.

In October 2001, Eurocopter announced plans for transfer of production from Donauwörth to Trento, Italy, where seven to be produced annually by Avionline (jointly owned by Aerosud Elicotteri and Helicopters Italia); marketing and delivery remain unchanged. By late 2006 none appeared to have been built in Italy.

Eurocopter BK 117 C-1 *(Daniel Bauchere)* 1040571

CURRENT VERSIONS: **BK 117 B-2:** Production completed in 1998.

BK 117 C-1: Turbomeca Arriel 1E2 engines first flown in converted BK 117A/B (F-WMBB) 6 April 1990; German LBA certification 17 January 1992; US FAA certification 7 December 1992; first delivery (to USA) December 1992. French DGAC certification 15 July 1993. Performance similar to that of BK 117 B-2; better hot-and-high performance.

Production BK 117 C-1 additionally features higher transmission and engine OEI ratings, new tail rotor blades and variable rotor speed to improve tail rotor thrust and reduce external noise, and torque matching system to reduce pilot workload.

Prototype C-1 (D-HECD) built 1992; exports began, to USA, December 1992. German LBA certification achieved 28 April 1994, followed by US FAA certification 29 September 1994, Italian RAI certification 24 November 1994, and UK CAA certification 28 July 1995.

Japanese (Kawasaki-built) version, which includes both re-engine and above improvements, was approved 8 June 1995 by Japanese CAB.

Details below apply to BK 117 C-1 version.

BK-117 C-2: Described separately as EC 145.

NBK-117: Designation of aircraft built by IPTN (now Dirgantara) under November 1982 agreement with MBB. Three only; no longer produced.

BK 117 P5: Advanced technology demonstrator in Japan; fly-by-wire control system.

EC-Futura BK117: Technology demonstrator, first flown July 1999 at Ottobrunn, used as part of All Weather Rescue Helicopter programme.

EC 145: See separate entry.

CUSTOMERS: Total of 440 (including prototypes) built by MBB/Eurocopter up to December 2004; no further examples recorded in following two years. Orders 1997–2003 were seven, five, three, seven, two, three and six. Customers include TsENTROSPAS of Russia (two, delivered 1998 and December 2000), Greek Fire Brigade (two, delivered June 2001), Telmex of Mexico (2001), First Security Bank of USA (October 2002), Virginia State Police (2002) and Italian EMS operators Aeroveneta, (2000) and Alidaunia (2001). Kawasaki production had reached 132 by late 2002; 133rd registered in mid-2006.

DESIGN FEATURES: Pod-and-boom configuration, latter mounted high for cabin access via rear freight doors; tail rotor mounted at fintip; large auxiliary fins at tip of each horizontal stabiliser; engines above cabin.

System Bölkow four-blade main rotor head, almost identical to that of BO 105; main rotor blades similar to but larger than those of BO 105, with NACA 23012/23010 (modified) section; optional two-blade folding. Two-blade semi-rigid tail rotor with MBB-S102E performance/noise optimised blade section; rotor rpm 383 (main), 2,169 (tail).

FLYING CONTROLS: Equipped as standard for single-pilot VFR operation; dual controls and dual VFR instrumentation optional; rotor brake and yaw CSAS standard on German-built versions, optional on Kawasaki aircraft; options include IFR instrumentation, two-axis (pitch/roll) CSAS and Honeywell SPZ-7100 dual digital AFCS. Mast moment indicator discourages excessive cyclic control inputs.

STRUCTURE: Main rotor has one-piece titanium hub with pitch-change bearings; fail-safe GFRP blades with stainless steel anti-erosion strip. Tail rotor, mounted on port side of central fin, has GFRP blades of high-impact resistance. Main fuselage pod and tailboom are aluminium alloy with single-curvature sheets and (on fuselage) bonded aluminium sandwich panels; secondary fuselage components are compound curvature shells of Kevlar sandwich. Engine deck, to which tailboom is integrally attached, forms cargo compartment roof and is of titanium adjacent engine bays. Detachable tailcone carries main fin/tail rotor support, and horizontal stabiliser with offset endplate fins.

Eurocopter responsible for rotor systems, tailboom, tail unit, skid landing gear, hydraulic system, engine firewall and cowlings, powered controls and systems integration; Kawasaki for fuselage, transmission, fuel and electrical systems, and standard equipment. Components single-sourced and exchanged for separate assembly lines at Donauwörth and Gifu; some components and accessories interchangeable with those of BO 105 (which see), from which hydraulic-powered control system is also adapted.

LANDING GEAR: Non-retractable tubular skid type, of aluminium construction. Skids are detachable from cross-tubes. Ground handling wheels standard. Emergency flotation gear, settling protectors and snow skids optional.

POWER PLANT: BK 117 B-2 has two Honeywell LTS 101-750B-1 turboshafts, each rated at 410 kW (550 shp) for take-off and maximum continuous power, 441 kW (592 shp) for 30 minutes with OEI. BK 117 C-1 has two Turbomeca Arriel 1E2 turboshafts each rated at 550 kW (738 shp) for take-off, 516 kW (692 shp) maximum continuous and 574 kW (770 shp) for 2½ minutes OEI.

Kawasaki KB 03 main transmission rated at 736 kW (986 shp) for twin-engine T-O, 632 kW (848 shp) maximum continuous; for single-engine operation, 550 kW (738 shp) allowed for 2½ minutes, 404 kW (542 shp) for maximum continuous (see also BK 117 C-1 improvements).

Fuel in four flexible bladder tanks (forward and aft main tanks, with two supply tanks between), in compartments under cabin floor. Two independent fuel feed systems for engines and common main fuel tank. Total standard fuel capacity 697 litres (184 US gallons; 153 Imp gallons), of which 685 litres (181 US gallons; 151 Imp gallons) are usable; single or twin internal auxiliary fuel tanks, each of 200 litres (52.8 US gallons; 44.0 Imp gallons) capacity, and two external auxiliary fuel tanks, each of 150 litres (39.6 US gallons; 33.0 Imp gallons), optional.

ACCOMMODATION: Pilot and up to six (executive version), seven (Eurocopter standard version) or nine passengers (Kawasaki version). High-density layouts available for up to 10 passengers in addition to pilot. Level floor throughout cockpit, cabin and cargo compartment. Jettisonable forward-hinged door on each side of cockpit, pilot's door having an openable window. Jettisonable rearward-sliding passenger door on each side of cabin, lockable in open position. Fixed steps on each side. Two hinged, clamshell doors at rear of cabin, providing straight-in access to cargo compartment. Rear cabin window on each side.

Aircraft can be equipped for offshore support, medical evacuation (one or two stretchers side by side and up to six attendants), firefighting, search and rescue, law enforcement, cargo transport or other operations.

SYSTEMS: Ram air and electrical ventilation system. Fully redundant tandem hydraulic boost system (one operating and one standby), pressure 103.5 bar (1,500 lb/sq in), for flight controls. System flow rate 8.1 litres (2.14 US gallons; 1.78 Imp gallons)/min. Bootstrap/oil reservoir, pressure 1.70 bar (25 lb/sq in). Main DC electrical power from two 150 A 28 V (200 A 28 V for C-1) starter/generators (one on each engine) and a 24 V 25 Ah Ni/Cd battery. AC power provided by inverter; second AC inverter optional; emergency busbar provides direct battery power to essential services, external DC power receptacle.

AVIONICS: *Comms:* VHF-AM/FM, UHF and HF radios to customer's requirements.

Flight: Long-range navaids optional.

Radar: Multirole radar optional.

Instrumentation: Basic instrumentation for single-pilot VFR operation includes airspeed indicator with two electrically heated pitot tubes and static ports, two hydraulic pressure indicators, encoding altimeter, instantaneous vertical speed indicator, 4 in artificial horizon, 3 in standby artificial horizon, HSI, (4 in and 3 in artificial horizons and HSI optional on Kawasaki-built aircraft), gyro magnetic heading system, magnetic compass, ambient air temperature thermometer and clock.

EQUIPMENT: Standard basic equipment includes rotor brake, annunciator panel, two master caution lights, rotor rpm/engine fail warning control unit, fuel quantity indicator and low-level sensor, outside air temperature indicator, engine and transmission oil pressure and temperature indicators, two exhaust temperature indicators, dual torque indicator, triple tachometer, two N1 tachometers, full internal and external lighting, ground handling wheels, pilot's windscreen wiper, floor covering, interior panelling and sound insulation, ashtrays, map/document case, tiedown rings in cabin and cargo compartment, engine compartment fire warning indicator, engine fire extinguishing system, portable fire extinguisher, first aid kit, and single-colour exterior paint scheme.

Optional equipment includes long-range fuel tanks, high-density seating arrangement, bleed air heating system, crashworthy seats, emergency flotation gear, settling protectors, snow skids, main rotor blade folding kit, dual pilot operation kit, stretcher installation, external cargo hook for 1,500 kg (3,307 lb) maximum load, rescue hoist (90 m; 295 ft cable, maximum load 270 kg; 595 lb, variable winch speed), Spectrolab SX 16 remotely controlled searchlight, external loudspeaker, sand filter and kits for rescue, law enforcement, firefighting and VIP transport.

Active anti-vibration system certified in Japan in mid-1997; available as option or for retrofit.

DIMENSIONS, EXTERNAL:

Main rotor diameter	11.00 m (36 ft 1 in)
Tail rotor diameter	1.96 m (6 ft 5 in)
Tail rotor blade chord	0.22 m (8¾ in)
Length: overall, both rotors turning	13.01 m (42 ft 8¼ in)
fuselage, tail rotor blades vertical	9.93 m (32 ft 7 in)
Fuselage: Max width	1.60 m (5 ft 3 in)
Height: overall, both rotors turning	3.85 m (12 ft 7½ in)
to top of main rotor head	3.36 m (11 ft 0¼ in)
Tailplane span (over endplate fins)	2.71 m (8 ft 10¾ in)
Ground clearance: tail rotor	1.89 m (6 ft 2½ in)
fuselage	0.35 m (1 ft 1¾ in)
Skid track	2.50 m (8 ft 2½ in)

DIMENSIONS, INTERNAL:

Combined cabin and cargo compartment:	
Max length	3.02 m (9 ft 11 in)
Width: max	1.59 m (5 ft 2½ in)
min	1.27 m (4 ft 2 in)
Height: max	1.28 m (4 ft 2½ in)
min	0.99 m (3 ft 3 in)
Useful floor area	3.70 m² (39.8 sq ft)
Volume	5.0 m³ (177 cu ft)
Cabin only: Length	2.56 m (8 ft 4¾ in)

AREAS:

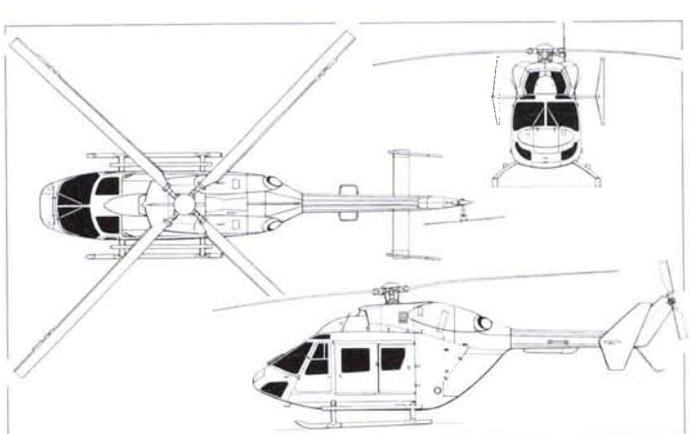
Main rotor blades (each)	1.76 m² (18.94 sq ft)
Tail rotor blades (each): B-2	0.098 m² (1.05 sq ft)
C-1	0.108 m² (1.16 sq ft)
Main rotor disc	95.03 m² (1,022.9 sq ft)
Tail rotor disc	3.00 m² (32.24 sq ft)

WEIGHTS AND LOADINGS:

Basic weight empty: B-2	1,745 kg (3,846 lb)
C-1	1,764 kg (3,890 lb)
Fuel: standard usable	558 kg (1,230 lb)
incl first auxiliary tank	718 kg (1,583 lb)
Max T-O weight: internal payload	3,350 kg (7,385 lb)
external payload	3,500 kg (7,716 lb)
Max disc loading:	
internal payload	35.25 kg/m² (7.22 lb/sq ft)
external payload	36.8 kg/m² (7.54 lb/sq ft)
Transmission loading at max T-O weight and power:	
internal payload	4.55 kg/kW (7.48 lb/shp)
external payload	4.76 kg/kW (7.83 lb/shp)

PERFORMANCE (main values for BK 117 C-1; A: at gross weight of 3,000 kg; 6,614 lb, B: at 3,200 kg; 7,055 lb, C: at 3,350 kg; 7,385 lb):

Never-exceed speed (VNE) at S/L:	
A	150 kt (277 km/h; 172 mph)
B, C	140 kt (259 km/h; 161 mph)
Max cruising speed: A	135 kt (250 km/h; 155 mph)
B	134 kt (248 km/h; 154 mph)
C	133 kt (246 km/h; 153 mph)
Econ cruising speed: A	127 kt (235 km/h; 146 mph)
B	126 kt (233 km/h; 145 mph)
C	125 kt (231 km/h; 144 mph)
Max rate of climb at S/L: A	655 m (2,150 ft)/min
B	587 m (1,925 ft)/min
C	538 m (1,765 ft)/min
Max certified altitude: A, B, C	4,575 m (15,000 ft)
Service ceiling: A, B	5,480 m (18,000 ft)
C	5,090 m (16,700 ft)
Hovering ceiling IGE (zero wind):	
A	3,690 m (12,100 ft)
B	3,050 m (10,000 ft)
C	2,530 m (8,300 ft)
Hovering ceiling IGE (20 kt; 37 km/h; 23 mph) crosswind: A	3,200 m (10,500 ft)
B	2,530 m (8,300 ft)
C	1,920 m (6,300 ft)
Hovering ceiling OGE: A	3,520 m (11,550 ft)
B	3,000 m (9,840 ft)
C	1,480 m (4,860 ft)
Range: C	292 n miles (540 km; 336 miles)
Endurance: B, C	2 h 50 min



Eurocopter BK 117 B-2 twin-turboshaft multipurpose helicopter *(Dennis Punnett)* 0507163

EUROCOPTER EC 145

Japanese designation: BK 117C-2

US Army designation: UH-72A Lakota

TYPE: Light utility helicopter.

PROGRAMME: Incorporation of EC 135 technology into BK 117 (see separate entry for Eurocopter BK 117) began in 1997; named EC 145 in late 1999, but retains engineering designation **BK 117C-2** and is marketed in Japan as such. First flight of German aircraft (D-HMBK) (unannounced) 12 June 1999; first flight of Japanese prototype 15 March 2000; third prototype (D-HMBL) joined programme 14 April 2000; fourth (D-HMBM) on 27 October 2000. Kawasaki builds tail section; Eurocopter responsible for forward section. Certification by LBA received 12 December 2000; commercial launch at Paris Air Show, June 2001; FAA certification awarded 14 February 2002, coincident with type's formal 'introduction' at HeliExpo, Orlando, Florida.

CUSTOMERS: Launch customer was French Sécurité Civile, which ordered 32 in December 1997 for delivery between 2001 and 2006 to replace Alouette III; two preproduction examples delivered May 2001 for familiarisation; first production example (F-ZBPA) formally handed over at Nimes-Garons 24 April 2002; initial batch of 15 received by mid-2003, with final delivery taking place on 19 May 2005. Second customer is French Gendarmerie, with firm order for eight placed in 1999; deliveries began 2002 and initial batch of five received by mid-2003. ADAC (German Automobile Club) ordered two in June 2001 to become civilian launch customer; delivery in 2002. Eight ordered in 2001, including four for Rega HEMS in Switzerland, delivered from 21 November 2002. Two for Hesse Police (Germany) delivered from April 2002. 50th production EC145 (F-ZBPY) delivered to Sécurité Civile on 31 March 2004. Total 13 BK 117/EC 145s delivered in 2004 and 20 EC 145s in 2005. Recent customers include SOS Helicopter Gottland AB of Sweden, which took delivery of one for EMS operation in October 2005.

CURRENT VERSIONS: **EC 145:** *As described.*

UH-72A Lakota: Described separately.

COSTS: Sécurité Civile contract valued at USD170 million. Flyaway cost unofficially reported as USD4.9 million (2000).

DESIGN FEATURES: Fuselage redesigned forward of engines; new nose, based on EC 135, provides improved visibility. Main rotor blades are same diameter as BK 117, but have EC 135 profile. Redesigned tail rotor. Optimised for SAR and emergency roles.

STRUCTURE: As BK 117.

LANDING GEAR: As BK 117.

POWER PLANT: Two Turbomeca Arriel 1E2 turboshafts, each rated at 550 kW (738 shp) for take-off, 516 kW (692 shp) maximum continuous and 574 kW (770 shp) for 2½ minutes' OEI. Main transmission rated at 776 kW (1,040 shp) for twin-engine T-O, 632 kW (848 shp) maximum continuous; for single-engine operation 551 kW (739 shp) allowed for 2½ minutes, 404 kW (542 shp) for maximum continuous. Standard fuel contained in main tank, usable capacity 741.5 litres (195.7 US gallons; 163.1 Imp gallons) and left and right

Eurocopter EC 145 of French Sécurité Civil *(Patrick Penna)* 1040569

German emergency medical service Eurocopter EC 145 *(Wolfgang Obrusnik)* 1153694

supply tanks, usable capacities 59 litres (15.6 US gallons; 13.0 Imp gallons) and 67 litres (17.7 US gallons; 14.7 Imp gallons respectively, for total capacity of 867.5 litres (229.0 US gallons; 190.8 Imp gallons). Optional long-range tanks increase usable capacity to 1,086 litres (287 US gallons; 239 Imp gallons).

ACCOMMODATION: Compared with BK 117, cabin is more spacious through removal of centre post and door supports.

SYSTEMS: As BK 117.

AVIONICS: Standard packages available for single/dual pilot IFR (*as described*), single pilot VFR and single pilot IFR.

Comms: Twin Becker ACU 5100 control panels and VCS 40A VHF-AM, IC 3100 intercom, MST 67A Mode S transponder, Artex C-406-2 ELT. Optional second IC 3100 and C406-2.

Radar: Optional Telephonics RDR 1400C weather radar and SMD 45 display.

Flight: Bendix/King KRA 405B radar altimeter; DMS 44A DME, twin VNS 41A VOR/ILS. Optional second KRA 405B, Chelton DFS 43A direction finder, Freeflight 2101 GPS and dual Canadian Marconi CMA 3000 management system.

Instrumentation: Four SMD 45 LCD displays (two primary, two navigation).

EQUIPMENT: As BK 117.

DIMENSIONS, EXTERNAL: As BK 117C-1, except:

Main rotor diameter	11.0 m (36 ft 1 in)
Tail rotor diameter	1.96 m (6 ft 5¼ in)
Length: overall, both rotors turning	13.03 m (42 ft 9 in)
fuselage, tail rotor blades vertical	10.19 m (33 ft 5¼ in)
Fuselage max width	1.84 m (6 ft 0½ in)
Height: overall, both rotors turning	3.96 m (13 ft 0 in)
to top of main rotor head	3.45 m (11 ft 3¾ in)
Tailplane span (over endplate fins)	3.12 m (10 ft 2¾ in)
Ground clearance: tail rotor	2.00 m (6 ft 6¾ in)
fuselage	0.45 m (1 ft 5¾ in)
Skid track	2.40 m (7 ft 10½ in)

DIMENSIONS, INTERNAL:

Cabin: Length: excl cockpit	3.42 m (11 ft 2½ in)
incl cockpit	4.55 m (14 ft 11¼ in)
Max width	1.40 m (4 ft 7 in)
Max height	1.22 m (4 ft 0 in)
Floor area: excl cockpit	4.72 m² (50.8 sq ft)
total	5.43 m² (58.5 sq ft)
Volume (total)	6.8 m³ (240 cu ft)

AREAS:

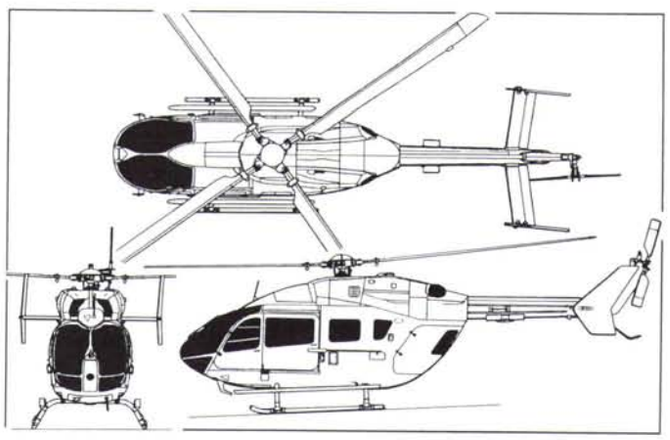
Main rotor disc	95.03 m² (1,022.9 sq ft)
Tail rotor disc	3.02 m² (32.48 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	1,792 kg (3,951 lb)
Max usable fuel: standard	694 kg (1,530 lb)
optional	869 kg (1,916 lb)
Max T-O weight, internal or external payload	3,585 kg (7,903 lb)
Max underslung load	1,500 kg (3,307 lb)
Max disc loading	37.7 kg/m² (7.73 lb/sq ft)
Transmission loading at max T-O weight and power	4.88 kg/kW (8.02 lb/shp)

PERFORMANCE (A: at gross weight of 2,200 kg; 4,850 lb, B: at 2,700 kg; 5,952 lb, C: at 3,000 kg; 6,614 lb; D: at 3,585 kg; 7,903 lb):

Never-exceed speed (VNE):	
A, B, C	150 kt (278 km/h; 173 mph)
D	145 kt (268 km/h; 166 mph)



Eurocopter EC 145/Kawasaki BK 117C-2 *(Paul Jackson)* 1158931

Max cruising speed: A	138 kt (256 km/h; 159 mph)
B	137 kt (254 km/h; 158 mph)
C	136 kt (252 km/h; 156 mph)
D	133 kt (246 km/h; 153 mph)
Normal cruising speed: A	127 kt (235 km/h; 146 mph)
B	129 kt (239 km/h; 148 mph)
C	130 kt (241 km/h; 150 mph)
D	131 kt (243 km/h; 151 mph)
Max rate of climb: A	978 m (3,210 ft)/min
B	780 m (2,560 ft)/min
C	674 m (2,210 ft)/min
D	488 m (1,660 ft)/min
Service ceiling: A, B, C	5,485 m (18,000 ft)
D	5,240 m (17,200 ft)
Hovering ceiling IGE: A, B	5,485 m (18,000 ft)
C	4,695 m (15,400 ft)
D	2,925 m (9,600 ft)
Hovering ceiling OGE: A	5,485 m (18,000 ft)
B	5,120 m (16,800 ft)
C	4,345 m (14,250 ft)
D	370 m (1,215 ft)
Range at normal cruising speed, no reserves:	
standard fuel:	
B	380 n miles (705 km; 438 miles)
C	378 n miles (700 km; 435 miles)
D	367 n miles (680 km; 422 miles)
optional fuel:	
C	472 n miles (875 km; 543 miles)
D	461 n miles (855 km; 531 miles)

Endurance at 65 kt (120 km/h; 75 mph), no reserves:
standard fuel:
B ..... 3 h 55 min
C ..... 3 h 50 min
D ..... 3 h 35 min
optional fuel:
C ..... 4 h 50 min
D ..... 4 h 30 min

EUROCOPTER UH-72A LAKOTA

TYPE: Light utility helicopter.

PROGRAMME: Light Utility Helicopter (LUH) programme formally launched in September 2004, with release by US Army of technical requirements in a capability development document. Resulting LUH intended to replace UH-1H Iroquois and OH-58A/C Kiowa and will not be deployed to combat theatres; majority expected to remain within continental USA, serving with regular force elements and the Army National Guard. EADS North America offered version of EC 145 (known by company as UH-145) and faced competition from AgustaWestland AB139, Bell 412EP and MD Helicopters Explorer. Civilian UH-145 demonstrator (N145UH) prepared at Grand Prairie, Texas to participate in fly-off undertaken by US Army at Fort Rucker, Alabama in early March 2006.

EADS North America is prime contractor, with American Eurocopter given responsibility for assembly and production; teaming arrangement concluded with Sikorsky (for contractor logistical support) and WestWind Technologies (systems integration, engineering and programme management support) by the end of January 2006; subsequently, Thales USA (avionics suite), Wulfsberg Electronics (navigation and communications systems), NORDAM Group (windscreen and windows) and Armor Holdings (crew and passenger seating) had all joined the EADS North America team by April 2006.

Eurocopter UH-145 announced as winning contender at the end of June 2006, at which time EADS North America received contract valued at USD43.1 million to cover initial batch of eight helicopters; US Army designation UH-72A assigned on 5 September 2006. Objections from AgustaWestland and MD Helicopters then necessitated review of competition by US Government Accounting Office (GAO) and caused slight delay; GAO investigation completed by 24 October 2006 and rejected protests by losing contenders.

In anticipation of winning fly-off, Eurocopter had already begun production of first two helicopters, which were due for delivery to the US Army before the end of 2006, with up to 20 to follow in 2007 and increasing to 50 per year thereafter. Formal hand-over of first ('07-2001') took place on 11 December 2006, when name of Lakota (native American people) also announced. Initial production (of up to 50 helicopters) will be undertaken in Europe, with American Eurocopter facility at Columbus, Mississippi serving as assembly centre at start of programme, but gradually making transition to production of complete helicopter with exception of rotor blades; Arriel 1E2 turboshaft engine supplied by Turbomeca factory in Grand Prairie.

CUSTOMERS: US Army has total stated requirement for 322, with option on additional 30, of which 42 under contract by late 2006.

COSTS: Initial procurement contract covering eight UH-72As valued at USD43.1 million awarded June 2006. Second batch of 34 helicopters included in 31 October 2006 contract valued at USD170.6 million, which also covered supply of a training aid and support services.

Specification generally as for EC 145, except the following.

POWER PLANT: Two Turbomeca Arriel 1E2 turboshafts, each rated at 550 kW (738 shp) for take-off.

ACCOMMODATION: Two pilots and up to eight passengers.

AVIONICS: Thales responsible for avionics, which based on Meghas suite with 'glass cockpit' featuring active matrix liquid crystal displays (AMLCDs). Navigation/communications equipment by Wulfsberg Electronics includes navigation and air traffic communications, dual VHF communications transceivers, dual VHF navigation receivers with VOR, ILS and marker beacon, DME transceiver, RT-5000 wideband receiver and dual P-2000 tactical communications transceivers.

PERFORMANCE:
Never-exceed speed (VNE) ..... 145 kt (268 km/h; 166 mph)
Hovering ceiling IGE ..... 3,445 m (11,300 ft)
Hovering ceiling OGE ..... 2,745 m (9,000 ft)
Range ..... 370 n miles (685 km; 425 miles)

Demonstrator Eurocopter UH-145 (UH-72A) military utility helicopter 1040467

EUROCOPTER/HAI

EUROCOPTER/HAI

PARTICIPATING COMPANIES:
Eurocopter: see under International
HAI: see under China
New joint venture to develop 6-7 tonne light helicopter previously known as Chinese 'Z-X', now identified as EC 175 in Europe and Z-15 in China.

EUROCOPTER EC 175/HAI Z-15

Chinese name: Zhishengji-15 (Vertical take-off aircraft 15)

TYPE: Multirole medium helicopter.

PROGRAMME: Initial framework agreement of October 2004, EC 175 announced at HAI Convention in Anaheim, California, on 6 February 2005; joint (50/50), five-year development by Eurocopter and AVIC II of China launched with contract signature on 5 December 2005; first Chinese partnership with Eurocopter in which China has equal work-share status, although Eurocopter will retain technical leadership and overall control of development. Joint project office opened in Marignane January 2006; commitment of EUR200 million (USD240 million) by each partner announced March 2006. Three flying prototypes to be built: PT1 and PT3 in France and PT2 in China. First flight, in France, targeted for June 2009; European certification and production start in each country in 2011 (final assembly lines at Marignane and Harbin); service entry 2012.

Artist's impression of Eurocopter EC 175 1153727

CUSTOMERS: Market for helicopters in EC 175/Z-15 class estimated at 800 over 20-year period.

DESIGN FEATURES: Size-wise, fits into Eurocopter product line between EC 155 Dauphin and EC 225 Super Puma/Cougar. Announced features include state-of-the-art avionics; five-blade Spheriflex main rotor; high-energy-absorbing aircraft; single-pilot operation; 16-passenger capacity. Typical missions to include transport, search and rescue and police use; military variants also possible.

STRUCTURE: Chinese team responsible for landing gear, power plant, main rotor, intermediate and tail rotor gearboxes and fuel system; Eurocopter for main gearbox, tail rotor, doors and transparencies, avionics and electrical and hydraulic systems.

POWER PLANT: Pratt & Whitney Canada PT6 turboshaft.

ACCOMMODATION: One (for VFR) or two (IFR) pilots; seating for up to 16 passengers.

DIMENSIONS, EXTERNAL:

Not yet released

WEIGHTS AND LOADINGS:

Max T-O weight ..... 6,000-7,000 kg (13,227-15,432 lb) class

PERFORMANCE (estimated):

Max level speed ..... 150 kt (277 km/h; 172 mph)

Range ..... approx 200 n miles (370 km; 230 miles)

EUROFIGHTER

EUROFIGHTER JAGDFLUGZEUG GMBH

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Eurofighter GmbH formed to manage EFA (European Fighter Aircraft) programme June 1986, followed shortly after by Eurojet Turbo GmbH to manage engine programme. Eurofighter GmbH is owned by Alenia (Italy), BAE Systems (UK) and EADS (formerly CASA; Spain and DASA; Germany); development workshares are 21, 33 and 46 per cent, respectively. Eurojet Turbo participants are Fiat Aviazione (Italy), ITP (Spain), MTU-München (Germany) and Rolls-Royce (UK). Radar is provided by the Euroradar consortium of BAE Systems (UK), FIAR (Italy), EADS (Germany) and ENOSA (Spain). NETMA (NATO Eurofighter and Tornado Management Agency) supervises the programme on behalf of the customer air forces.

All four participating countries agreed on 22 December 1997 to proceed with production and signed the appropriate authorisation on 30 January 1998. The aircraft was formally named Typhoon on 2 September 1998 although, initially, that title was only used for marketing outside Europe. However, on 23 July 2002, Typhoon name was formally adopted by RAF.

On 4 November 1999, (then) four partners announced impending formation of Eurofighter International (EFI) as dedicated sales organisation with target of securing half of available market for 800 combat aircraft over following 30 years. Relations with NETMA remain unchanged. First export commitment issued by Greece on 7 March 2000, but first firm order placed by Austria.

Former subsidiary marketing organisation, Eurofighter International, was disbanded in 2002. Deliveries to customer air forces began following formal type acceptance on 30 June 2003.

Eurofighter Typhoon production at Warton 1159308

RAF No. 3 Squadron Eurofighter Typhoon F. Mk 2 1159311

PROGRAMME:

DEVELOPMENT MILESTONES

Requirement issued	Dec 83
Official go-ahead	23 Nov 88
First order (multinational)	22 Dec 97
First prototype material cut	May 98
Rolled out (unofficially)	mid-92
First flight	27 Mar 94
Public debut	11 Jun 95
First flight, pre-production	5 Apr 02
Production go-ahead	30 Jan 98
Certification	30 Jun 03
First flight, production	13 Feb 03
First delivery (Luftwaffe)	17 Feb 03
Entered service (multinational)	30 Jun 03

Began with outline staff target for common combat aircraft issued December 1983 by air chiefs of staff of France, Germany, Italy, Spain and UK; initial feasibility study launched July 1984; France withdrew July 1985, shareholdings then being readjusted to 33 per cent each to UK and Germany, 21 per cent Italy and 13 per cent Spain; project definition phase completed September 1986; definitive ESR-D (European Staff Requirement—Development) issued September 1987, giving military requirements in greater detail; definition refinement and risk reduction stage completed December 1987; main engine and weapons system development contracts signed 23 November 1988.

After various political delays were overcome, first (instrumented) production aircraft flew (in Italy) on 5 April 2002; initial 'delivery' was 'presentation' of first full production aircraft GT001/9831 to Luftwaffe at manufacturer's German plant, the aircraft not flying until 13 February 2003, following which, on 17 February, it was delivered to a Luftwaffe technical school for ground crew familiarisation. Also by 17 February, a full production (two-seat) aircraft had flown in each of the four participating countries. On 30 June 2003 Type Acceptance certificate was issued and aircraft was formally handed over to participating air arms at national ceremonies.

In December 2002, unofficial reports claimed UK was attempting to bring forward the ground attack enhancements scheduled for Tranche 3 into the second international production batch, allowing the RAF to cut back or eliminate its final batch of 88 aircraft. Statements throughout 2003 strengthened this impression and agreement on Tranche 2 had not been reached by scheduled date of end-2003. Eventually signed 17 December 2004.

Four partner air forces initially agreed to name their aircraft Eurofighter (or EF2000), using Typhoon name for export marketing. However, on 23 July 2002, RAF also adopted Typhoon during a ceremony at Farnborough Air Show. Delivery of 100th Eurofighter (BS022/ZJ931 for RAF) effected 29 September 2006.

Typhoon is participating in several fighter competitions, as detailed in the adjacent table.

No formal roll-out: DA1 and DA2 remained unflown for some 18 months after completion for exhaustive cross-checking of flight control system (FCS). First flight eventually achieved on 27 March 1994, but FCS development resulted in later aircraft flying out of sequence, DA6 being fourth to fly (31 August 1996), by which time earlier aircraft had completed 241 sorties. DA5 flew Eurofighter's 500th sortie (almost 450 hours total airborne time) on 21 October 1997; the 750th sortie (over 630 hours) was flown in June 1998 and the 1,000th in May 1999. Total 1,135 sorties and 931 hours by fourth quarter of

EUROFIGHTER TYPHOON

Spanish Air Force designations: C.16 and CE.16

Royal Air Force designations: Typhoon T. Mk 1, T. Mk 1A and F. Mk 2

TYPE: Multirole fighter.

German Eurofighter EF2000 carrying four Paveway, two IRIS-T, four Sidewinders and three 1,000-litre tanks 1159310

1999: 1,000th hour flown February 2000. Some 90 per cent of flight envelope had been explored by April 1999.

Defensive aids subsystem development contract awarded to Euro-DASS 13 March 1992, but Germany and Spain initially declined to participate; production contract allocated June 2001. 'A' version of ECR 90 radar first flew in nose of modified BAe One-Eleven testbed (ZE433) at Bedford, 8 January 1993; 'C' version is first ECR 90 packaged to fit Eurofighter; flown in One-Eleven from July 1996. First development standard radar delivered to DASA in June 1996; flight testing (in DA5) began 24 February 1997. Radar named Captor in 2000; first production unit delivered in February 2001. Electronically-scanned Captor-E scheduled for Tranche 3 aircraft; to begin flight trials in 2007.

Major airframe fatigue test (AFT) fuselage at Ottobrunn achieved 6,000 hours in May 1995 and target of 18,000 hours (equivalent to 6,000 hours of service use) on 4 September 1998.

Production version of EJ200 engine certified 8 March 2001. Thrust vectoring nozzles for EJ200 had undergone 78 hours of bench testing by mid-2000. Study launched by ITP of Spain in 1994, using private funding. Trial system demonstrated 23° 30' vector angle and 110°/s slew rate; advantages of installation for regular use would include 3 per cent reduction in cruise drag, 7 per cent improvement in sustained turn rate, 7 per cent increase in installed thrust, 25 per cent reduction of take-off run and 3 per cent reduction of mission fuel burn.

Three production Tranches subdivided into Batches and Blocks, each of increased capability: Refer to table.

EUROFIGHTER PRODUCTION BLOCKS

Tranche 1			
	Batch 1		
		Block 1	Basic standard for training; radar; no defensive aids, Cannon, AIM-9L, AIM-120B, ASRAAM; external fuel tanks
		Block 1B/1C	Variations of the above
	Batch 2		
		Block 2	Full IOC. Adds IRIS-T. Initial sensor fusion (Captor, IFF and MIDS datalink); initial defensive aids (RWR/ESM, chaff/flare, basic ECM). Basic autopilot and microwave landing; basic direct voice input. Type acceptance 13 December 2004
		Block 2B	Full air-to-air and carefree handling. Type acceptance 15 December 2005
		Block 5	FOC standard. Austere air-to-ground (employed only by UK). Total sensor fusion; full defensive aids and missile approach warning; full direct voice; PIRATE (not Germany); towed radar decoy (not Germany); laser warning (UK only). Litening pod; GBU-10, GBU-16, Paveway II, AIM-120C-5
		Block 5A	Austrian two-seat
Tranche 2			
	Batch 3		
		Block 8	From 2007. New computers. Includes Austrian single-seat
		Block 8A	Unspecified
		Block 8B	Unspecified
	Batch 4		
		Block 10	Future Capability Package. Production Enhancement 1. Additional air-to-ground weapons
		Block 10B	Unspecified
		Block 15	Meteor missile
Tranche 3			
	Batch 5		
		Block 20	Under formulation. Possible developed engine and electronically-scanned radar
	Batch 6?		
		Block 25	Unspecified

Trials of air-to-surface weapons intensified in 2006; several combinations flown by trials aircraft. First drop of any-surface weapon achieved 4 May 2006 by Spanish C.16-20 releasing GBU-16s.

In April 2002, industrial partners completed a 12-month study into further development of Eurofighter to maintain operational effectiveness beyond 2040. Options addressed (some previously mooted unofficially) included electronically scanned radar, two-dimensional thrust vectoring, extended range and signature reduction. These to be applicable to Tranche 2 and 3 aircraft. Germany and UK seeking to add long-range attack capability in Tranche 3; BAE Systems announced completion in May 2002 of wind tunnel trials of conformal fuel tanks offering 25 per cent extension of range and mockup shown at Farnborough in July 2002.

RAF Eurofighter Typhoon equipped with six Paveway II LGBs, two Sidewinders and one 1,000-litre tank 1159309

Italian Eurofighter two-seat trainer 1159312

CURRENT VERSIONS (general): **Single-seater:** Standard version. Known to RAF as **Typhoon F. Mk 2** and to Spanish Air force as **C.16**. Also abbreviated to **EF2000**.

Two-seater: Combat-capable conversion trainer. Slightly reduced internal fuel capacity. Known to RAF as **Typhoon T. Mk 1** (first 12 flying aircraft: IPA1/ZJ699 and ZJ800 to ZJ810), **T. Mk 1A** (ZJ811 and subsequent) and to Spanish Air Force as **CE.16**. Also known as **EF2000B** or **EF2000T**.

CURRENT VERSIONS (specific): **DA1/9829:** (DASA-built at Ottobrunn; airframe No. 01; Luftwaffe serial number 9829.) By road to Manching 11 May 1992; first flight, 27 March 1994, using Phase 0 software; planned transfer to Warton for handling and envelope expansion trials (wearing UK serial number ZH586) cancelled; remained at Manching.

Transferred to Getafe, Spain, 8 April 2003 and reserialled XC.16-02. First Eurofighter flight with IRIS-T (dummy) AAMs 27 August 2003. Final flight December 2005; retired.

DA2/ZH588: (BAE at Warton; airframe No. 02.) First engine run 30 August 1992, first flight 6 April 1994; assigned to envelope expansion,'carefree' handling and load trials; nine sorties to June 1994, when stood-down for FCS upgrade; reflown 17 May 1995 with Phase 2 version of flight software and made Eurofighter's world public debut (Paris, 11 June 1995, static) and UK debut (Fairford 22 July 1995, flying).

'Carefree handling' trials completed by mid-2002; DASS decoy trials.

DA3/MMX602: (Alenia at Turin/Caselle; airframe No. 04.) First with EJ200 power plants (series -01A) for engine trials (originally scheduled from March 1993 but postponed) and gun/weapon release trials. Initial flight 4 June 1995 on Phase 1 software (20° AoA and +6 g limits).

DA4/ZH590: (BAE; airframe No. 03.) First two-seat and first with full avionics (including ECR 90) for radar development, and 'carefree' handling trials. Rolled out 4 May 1994; first flight 14 March 1997; 14 sorties up to end of first phase of trials on 8 September 1997.

DASS ESM trials 2002.

DA5/9830: (DASA.) Construction begun 2 November 1992; maiden flight 24 February 1997; first with ECR 90 radar; autopilot and weapons trials, DS-X radar software standard upgraded to DS-C1 in June 1997, at which time first EJ200-03A engines fitted.

DA6/XCE.16-01: (EADS CASA at Seville.) Second two-seat; performance (including 'carefree' handling), environmental systems, MIDS integration and helmet integration trials.

First flight 31 August 1996; high-temperature trials at Morón, Spain, from 20 July 1998; trials of LCSS (see Systems) cooled aircrew clothing, June 1999; environmental trials (with DA1), including ground tests at Boscombe Down, completed May 2000. Direct voice input trials begun 2001. Refuelling trials with Spanish KC-130H Hercules mid-2002. Suffered double flame-out of 03A-standard engines on 21 November 2002 and abandoned by crew. Total 324 hours in over 340 sorties. Spanish testing resumed in April 2003 upon transfer of DA1 from Germany.

DA7: (Alenia.) Nav/com, performance and weapons integration trials. First flight 27 January 1997. First firing of AIM-9L Sidewinder 15 December 1997; first AIM-120 AMRAAM jettison two days later; first (1,000 litre) external wing tank jettison 17 June 1988.

Further eight ground testing part-airframes and five instrumented production aircraft.

IPA1/ZJ699: (UK.) Two-seat; first production Eurofighter Typhoon. Production numbers PT001/BTT1. Final assembly began 8 September 2000; delivery was due in late 2001; however, first flight postponed to 15 April 2002; first supersonic flight by a production aircraft, 26 April 2002; short lay-up after six sorties for addition of refuelling probe, flight test instrumentation and paint. Defensive aids trials. First Paveway II releases in UK announced July 2006. Planned 414 sorties to FOC.

IPA2/MMX614: (Italy.) Two-seat; PT002; air-to-surface weapon and sensor fusion trials. Final assembly began 3 November 2000. First flight 5 April 2002. Planned 301 sorties to FOC.

IPA3/9803: (Germany.) Two-seat; PT003; air-to-surface weapon integration. Rolled out 2 March 2002. First flight 8 April 2002; 100th flight 17 February 2004. Planned 408 sorties to FOC.

IPA4/C.16-20: (Spain.) Single-seat; PS001; AAM and gun trials; environmental system trials. Planned 170 sorties to FOC. First components delivered March 2003; first flight 27 February 2004 as initial production single-seat Eurofighter. Transferred to Vidsel, Sweden, for cold weather trials 9 December 2004. These completed 8 March 2005. Aircraft then to Morón, Spain, for hot weather trials, 2005.

IPA5/ZJ700: (UK.) Single-seat; PS002; air-to-air and -surface weapons trials. Planned 223 sorties to FOC. First flight 7 June 2004.

Early production aircraft:

GT001/9831: (to become 3001) (Germany.) Rolled out 14 November 2002; 'presented' to Luftwaffe 9 December 2002; first flight 13 February 2003; delivered to Air Force Technical School No. 1 at Kaufbeuren for ground training 17 February 2003.

IT001/CSX55092: (Italy.) First flight 14 February 2003. Initially assigned to EMC clearance.

BT001/ZJ800: (UK.) First flight 14 February 2003. To QinetiQ at Boscombe Down for EMC clearance.

BT005/ZJ804: First Instrumented Service Production Aircraft. First flight 11 May 2004.

ST001/CE.16-01: (Spain.) First flight 17 February 2003.

GS001/3006: (Germany.) First single-seat. Rolled out 14 July 2004. To JG 73 4 July 2005.

GS002/9839: (to become 3007) (Germany.) Second single-seat and first non-

Eurofighter EF2000 two-seat version in Spanish service

1159313

instrumented aircraft to fly, on 22 October 2004. To TSLw 1, Kaufbeuren 14 Feb 2005.

GS003/3008: To JG 73 24 June 2005.

GS004/3009: To JG 73 8 April 2005 as first single-seat in service.

IS001/ISPA2/CSX7235: (Italy). First single-seat; second Instrumented Service Production Aircraft. First flight 9 July 2004.

BS001/ZJ910: (UK). First single-seat.

SS001/C.16-20: (Spain). First single-seat. Delivered 29 December 2004.

CUSTOMERS: Originally declared requirements for 765 (UK and Germany 250 each; Italy 165 and Spain 100). In January 1994, Spain announced firm requirement for 87; Germany revised needs to 180 (including at least 40 fighter-bombers post-2012) under January 1996 work-share agreement. Final total is 620 aircraft, including 1,382 engines; plus options on 90 and 183, respectively (see accompanying table). MoUs 6 and 7 (production and logistical support) of 3 December 1997 and Production Investment contract of 10 December followed on 22 December 1997 by political agreement of all four nations to fund production phase.

Production contract (Supplement 1) for all 620 aircraft (plus 90 options) signed 30 January 1998; Supplement 2 agreement of 18 September 1998 authorised first 148 of these on fixed-price terms, together with 363 engines. UK parliament told in early 2002 that all four participating countries were reviewing aircraft delivery schedule.

Deliveries to air forces to have begun in June 2002 with RAF and Italy; this delayed one year to 30 June 2003, at which time 28 aircraft (eight German, five Italian, four Spanish and 11 UK) were earmarked for delivery before end of 2003, this not being achieved. Delivery of 50th effected 29 June 2005 and 89 delivered by July 2006. Hours by this time totalled 14,000, including 4,500 of testing.

RAF acceptance of BT001/ZJ800 rescheduled to December 2002, but not effected until 30 June 2003. First RAF unit, under Wg Cdr David Chan, is Operational Evaluation Unit (OEU, also known as No. 17 (Reserve) Squadron) at BAE Warton, where first 16 pilots converted using four aircraft in 1,300 flying hours; formation date of September 2002 delayed to 1 July 2003; first public showing of No. 17 Squadron aircraft (ZJ802 'AB') at Royal International Air Tattoo, Fairford, 18–20 July 2003 (had first flown only on 16th). RAF aircraft issued with Release to Service on 13 May 2004, allowing operational test and OCU syllabus validation flying to begin. Coningsby formally received OEU on 19 May 2005 (previously scheduled for January 2004) and formed No. 29 (Reserve) Squadron as an OCU, these with four and five aircraft, respectively (those of No. 29 being delivered from April 2004 onwards, before official formation and transfer of unit to Coningsby on 1 July 2005). Coningsby also to host two operational squadrons: No. 3 formed 31 March 2006 and No. 11 in March 2007. Deliveries of Tranche 2 aircraft to No. 6 Squadron at Leuchars begin 2008, two more units to follow at that base, while establishment of two at Leeming remains uncertain. First flight of Typhoon in No. 29 Squadron markings undertaken at Warton on 20 May 2004. First for No. 11 Squadron (ZJ931) delivered Coningsby on 9 October 2006. First of seven combat squadrons were to have been air defence tasked; remainder to comprise three air defence, two multirole and one offensive support. However, by 2003, RAF was seeking all seven in multirole task by 2011, with Tranche 1 aircraft relegated to training and trials.

RAF announced in May 2000 that no ammunition would be procured for Eurofighter's cannon, despite installation of Mauser in Tranche 1 aircraft. Decision reversed in 2006. Rafael Litening III targeting pods selected 2005.

German acceptances of squadron aircraft (all two-seat) began 4 August 2003; first production single-seat (GS002/3007) handed over 14 February and delivered to ground training school on 24 February 2005; and first to JG 73 (3009) on 8 April 2005. Air defence wing JG 73 at Laage began formal conversion 1 October 2003 under auspices of manufacturer at Manching; initial instructor training completed 2 April 2004; unit moved with five aircraft to Laage on 30 April 2004; received first IRIS-T missiles 5 December 2005.

German Eurofighter trainer of JG 73

1159314

Second wing is JG 74 at Neuberg to which first aircraft delivered on 25 July 2006; third wing is attack unit JG 31 at Nörvenich (from 2007); fourth is air defence JG 71 at Wittmund (from 2009); fifth is JG 33 at Büchel (2012–2015) in attack role; final German delivery in 2014, but further two squadrons (single- or two-seat to be decided) may be obtained for air-to-ground operations.

Italian re-equipment begins with 4° Stormo at Grosseto (9° Gruppo and 20° Gruppo), other bases being Cameri (53° Stormo) and Trapani (37° Stormo). Initial acceptance (IT001) for technical training at Cameri 20 February 2004. First squadron aircraft (IT002/MM55093) accepted by 4° Stormo on 16 March 2004; first air force assigned (second built) single-seat (MM7270) delivered 19 April 2005. Assigned QRA duties from 16 December 2005.

Deliveries to Spanish Air Force began 5 September 2003 upon hand-over of first aircraft, CE.16-01, although initial pilot training continued with manufacturer at Getafe until April 2004; formal acceptance ceremony on 9 October 2003. First (OCU) squadron is Escuadron 113 of Ala 11 at Morón de la Frontera, to where initial three aircraft were delivered on 27 May 2004. Single-seat deliveries began 29 December 2004. Escuadron 111 formed 2006; 112 to follow in 2009; while 141 and 142 to be based at Albacete with Ala 14, forming 2012 and 2015, respectively.

Other details in accompanying table.

Export orders also being solicited; various programmes, requirements and requests for proposals detailed separately. First firm order from Austria; deliveries scheduled from 1 June 2007. Eurofighter predicts export of 400 Typhoons between 2005 and 2030, worth in excess of GBP35 billion (2000).

Contract for Eurofighter ground support system signed 24 May 2000. UK has four training rigs, numbered ZJ695 to ZJ698. Aircrew Synthetic Training Aids programme contract, worth EUR1,07 billion, signed 27 April 2001, including 18 full mission simulators and nine cockpit trainers, deliverable from March 2004 to all four participants.

COSTS: Development EUR18 billion; production (620 aircraft) EUR36 billion at 2004 prices (2006). UK unit cost officially GBP49.1 million in 2004 but increased without clarification to GBP64.8 million, which figure is disputed by Eurofighter. UK Tranche 1 unit cost GBP45.45 million; global Tranche 2 averaged GBP40 million when awarded.

DESIGN FEATURES: Agile fighter; subsonic instability exceeds 35 per cent (as achieved by Grumman X-29 research aircraft). Collaborative design by BAE, DASA, Alenia and EADS CASA, incorporating some design and technology (including low detectability) from BAe EAP programme. No official requirement for thrust vectoring (TV), supercruise or high order of 'stealthiness'; however, TV nozzle for Eurofighter is under private development; supercruise was 'inadvertently' demonstrated at high altitude in 1997; and RAF has confirmed that aircraft meets low-observables specification.

Low-wing, low-aspect ratio tailless delta with 53° leading-edge sweepback; underfuselage box with side-by-side engine air intakes, each with fixed upper wedge/ramp and vari-cowl (variable position lower cowl lip) with Dowty actuators.

Wing section NACA66 (mod); taper ratio 2.15; dihedral 1°. Foreplane section RAE 104.

Intended service life, 6,000 hours or 25 years. Integrated structural health-and-usage monitoring system (first in any combat aircraft) calculates structural fatigue at 20 positions on the airframe 16 times per second during flight. Maintainability features include 10 mmh/fh and single engine change by four engineers in 45 minutes. Operational turn-round by six ground crew in 25 minutes. Germany, and possibly UK, will contract-out maintenance on 'power by the hour' arrangement with private industry.

FLYING CONTROLS: Two-segment automatic slats on wing leading-edges, inboard and outboard flaperons on trailing-edges; all-moving foreplanes below windscreen; rudder; hydraulically actuated airbrake aft of canopy, forming part of dorsal spine; Liebherr primary flight control actuators. Full-authority quadruplex ACT (active control technology) digital fly-by-wire flight control system (team leader was DASA; Bodenseewerk and ENOSA flight control computer) combines with mission adaptive configuring and aircraft's instability in pitch to provide required 'carefree' handling, gust alleviation and high sustained manoeuvrability throughout flight envelope; pitch control provided by symmetric operation of foreplanes and wing flaperons; roll control primarily by differential operation of flaperons; yaw control by rudder. Cross-feeds between controls to optimise performance and handling qualities provide artificial longitudinal stability; yaw control via rudder; no manual reversion.

STRUCTURE: Fuselage, wings (including inboard flaperons), wing-fuselage fairings, fin and rudder mainly of CFC (carbon fibre composites) except for foreplanes, outboard flaperons and exhaust nozzle fairings (titanium); nose radome and fintip (GFRP); leading-edge slats, wingtip pods, fin base, fin leading-edge, rudder trailing-edge, cockpit side strake and canopy-to-airbrake fairing (aluminium-lithium alloy); and canopy surround (aluminium). CFC constitutes 70 per cent of surface area, with metal 15 per cent, GFRP 12 per cent and other materials 3 per cent.

Individual wing composed of 438 kg (966 lb) carbon fibre, 174 kg (384 lb) aluminium, 179 kg (395 lb) titanium, 33 kg (73 lb) fasteners, 17 kg (37 lb) miscellaneous items and 24 kg (53 lb) tip pod, while installations and equipment add further 120 kg (265 lb) and 154 kg (340 lb), respectively.

Single-seat Eurofighter in German service *(Jamie Hunter)* 1194935

Manufacture includes such advanced techniques as superplastic forming and diffusion bonding; EADS CASA-led joint structures team. On development aircraft (only) UK responsible for front fuselage, foreplanes, starboard leading-edge slats and flaperons; Germany the centre-fuselage and fin, Italy the port wing, port leading-edge and flaperons, and stages 2 and 3 of rear fuselage; Spain the rear fuselage stage 1; and Spain and UK the starboard wing; no duplication of tooling.

Work-share on production aircraft involves UK for front fuselage, canards, windscreen, canopy, dorsal fairing inboard flaperons, fin and rear fuselage stage 1; Germany for centre-fuselage; Italy for port wing, outboard flaperons and rear fuselage stages 2 and 3; and Spain for starboard wing and leading-edge slats. Assembly at Caselle (Italy), Getafe (Spain), Manching (Germany) and Warton (UK).

LANDING GEAR: Dowty Aerospace retractable tricycle type with SICAMB mainwheels and Magnaghi/OMA nose gear; Dunlop Aviation wheels, brakes and braking system; Ultra Electronics landing gear computer. Single-wheel main units retract inward into fuselage; nosewheel unit forward. Nosewheel steering is subfunction of DFCS. Tyre sizes 28×9.5R15 main; 18×7.75R6 nose. Elektro Metall braking parachute at base of fin.

POWER PLANT: Two Eurojet EJ200 advanced technology turbofans (each of approximately 60 kN; 13,490 lb st dry and 90 kN; 20,250 lb nominal thrust with afterburning), mounted side by side in rear fuselage with ventral intakes. EJ200-01A initially; -1C for early flight tests; -03A first flown June 1997 (DA5); -03B followed in late 1998; and 03Z in December 1999. Staged EJ200 improvements available (but not funded) to 103 kN (23,155 lb st) (designated EJ 230) and then 117 kN (26,300 lb st). MTU FADEC. Lucas Aerospace fuel management system; Aeroquip GmbH fuel ducts; Autoflug sensors; Teldix flowmeters; VDO computer and gauges; Smiths fuel measurement system. First two development aircraft originally powered by two Turbo-Union RB199-122 (Mk 104E) afterburning turbofans (each more than 71.2 kN; 16,000 lb st). Both were retrofitted with EJ200s in 1998.

Internal fuel capacity classified, but believed to total approximately 5,700 litres (1,506 US gallons; 1,254 Imp gallons) in two fuselage tanks and two integral wing tanks. Two-seat trainer lacks forward transfer tank, but partly offsets loss of capacity with auxiliary tank in the enlarged spine. Pressure refuelling point below fuselage, immediately behind air intake. Provision for in-flight refuelling and up to three suspended, external fuel tanks: two 1,000 litre (264 US gallon; 220 Imp gallon) or 2,000 litre (528 US gallon; 440 Imp gallon) underwing, plus one 1,000 litre (264 US gallon; 220 Imp gallon) centreline tank. Only the smaller tanks are rated for supersonic flight.

In early 1998, UK was reported to be designing upper fuselage conformal tanks to increase combat radius to 1,500 n miles (2,778 km; 1,726 miles); work subcontracted to GKN Engage in Australia. Wind tunnel trials of conformal tanks completed May 2002, size 1,500 litres (396 US gallons; 330 Imp gallons) each, providing for additional total of 2,400 kg (5,291 lb) of fuel, for 25 per cent range increase. Conformal tanks can be installed or removed in 75 minutes. Tranche 2 aircraft have structural and piping modifications to accept conformal tanks.

ACCOMMODATION: Pilot(s) on Martin-Baker Mk 16A zero/zero ejection seat(s). Single-piece Aerospace Composite windscreen and single-piece, rear-hinged canopy on both versions. Optional liquid-cooled vest for pilot. Helmet-mounted display. Anti-*g* trousers augmented by pressure breathing system. Two equipment/baggage stowage bays, each 0.01 m³ (0.35 cu ft), above air intakes, port and starboard.

SYSTEMS: Responsibility for systems delegated to Eurofighter GmbH; participants are UK for electrics, Spain for environmental control and Germany for hydraulics.

Flight control system combines stability and control augmentation; good handling characteristics; high agility; and carefree handling, while incorporating safety features such as low-speed automatic recovery, emergency *g* override, *g* onset limitation, disorientation recovery capability and automatic reversion. System is controlled by four computers and features primary and secondary actuation. FCS features automatic revision through various back-up modes and is integrated with other systems through avionics (STANAG 3910) and utilities control (STANAG 3838) databusses. FCS software updated to Phase 2 in late 1995; Phase 2A 'carefree' handling throughout the subsonic flight envelope, including 25° AoA and over +6 *g* (cleared by DA2 in January 1998); Phase 2B allows carriage of heavy stores and comprises 2B1 (flown April 1999) for 28° AoA and +7.25 *g*, and 2B2 for 30–35° and 9 *g* (first flown 7 July 2000). Phase 3 is IOC standard in 2001 (9 *g* envelope), DA2, DA4 and DA6 receiving Phase 3R1 in that year; Phase 4 covers air-to-surface weapons; and full combat capability Phase 5. FCS incorporates auto-recovery mode ('panic button') for immediate return to straight-and-level flight in emergency. Ada language, apart from time-critical subroutines in Assembler.

Electrical system has Lucas Aerospace as leading supplier and is designed to minimise risk of total power loss by using high level of redundancy and by system positioning. Engine start, systems test, avionics activation and alignment, need no external power. Elements include ZF accessories drive gearbox, two AC and two DC engine-driven Hamilton Sundstrand generators, Honeywell APU in forward port wingroot, Varta battery in corresponding starboard position, two Ferranti Technologies transformer/rectifier units and power converter from same company.

Environmental control system (ECS), with Normalair Garrett as leading supplier, provides conditioned and partly conditioned air to cockpit canopy seal, anti- and de-misting, pilot's anti-*g* clothing, radar, FLIR, avionics and general equipment. Main oxygen provided by molecular sieve generation system (MSOGS). Precooler (at base of fin), heat exchanger, cold air unit and MSOG all located in aircraft's spine. Liquid cooling subsystem (LCSS) connects aircrew vest to ECS.

Hydraulic system (Magnaghi as leading supplier) comprises two independent circuits supplying power to flight control system (Dowty Boulton Paul actuators), landing gear (including nosewheel steering and brakes), port and starboard utilities, gun, canopy, airbrake and refuelling probe.

Utilities control system is integrated within overall system architecture and provides for continuous monitoring and fault detection, comprising front computer, fuel computer, secondary power system computer, landing gear computer and maintenance data panel. Integrated monitoring and recording system constantly checks status of all other systems, airframe and engine, to provide rapid, onboard fault diagnosis; functions include crash-survivable memory, bulk storage device, video-voice recording, mission data loading and portable data store, maintenance data panel, portable maintenance data store and air-to-ground relay of data.

EUROFIGHTER ORDERS

	Austria		Germany		Italy		Spain		UK		Summary		Total
Block	**S**	**T**	**S**	**T**	**S**	**T**	**S**	**T**	**S**	**T**	**S**	**T**	
IPA				1		1	1		1	1	2	3	5
1				8		6		5		12		31	31[1]
2			13	1	8	1	5	1	17	1	43	4	47
2B			8	4	6	1	4	1	11	3	29	9	38
5			5	2	4	1	1	1	6	1	16	5	21
5A											6		6
Tranche 1[2]	**6**		**26**	**16**	**18**	**10**	**11**	**8**	**35**	**18**	**96**	**52**	**148**
Tranche 2[3]	**12**		**60**	**10**	**44**	**3**	**28**	**6**	**85**	**6**	**229**	**25**	**254**
Tranche 3[4]			**61**	**7**	**44**	**2**	**33**	**1**	**75**	**13**	**213**	**23**	**236**
Totals	**18**		**147**	**33**	**106**	**15**	**72**	**15**	**195**	**37**	**538**	**100**	**638**

Notes: S is single-seat; T is two-seat

German aircraft numbered 9803 (IPA3), then 3001 onwards for both single- and two-seat versions; temporary flight test and evaluation serial numbers from 9831 onwards. RAF Tranche 1 are ZJ700 and ZJ910 to ZJ945 for single-seat, and ZJ699 and ZJ800 to ZJ815 for 17 of two-seat aircraft. Italian two-seat begin MM55092 to '097, then 55128, while two-seat MM7235, then MM7270 onwards. Spanish two-seat are CE.16-01 to '15; single-seat from C.16-20 onwards. Austrian aircraft (all single-seat) coded 7L-WA to 7L-WR. Conversion of 15 early aircraft to Block 5 in 'R2' retrofit programme began in November 2006, with priority to Block 2B aircraft

[1] Including one (17th from international production) for static testing, designated TR001
[2] Plus 363 engines and 147 radars
[3] Plus 519 engines and 236 radars
[4] Plus 500 engines and 236 radars

EUROFIGHTER TYPHOON EXPORT ORDERS AND PROSPECTS

Nation	Requirement	Timeframe	Status
Requests for proposals (RFP)			
Austria	18		Tenders for 24 fighters invited 10 October 2001. Proposals received from Eurofighter, F-16 and Gripen 23 January 2002 Selection announced 2 July 2002, but suspended 9 September 2002 following fall of government Competition reopened 28 February 2003; parliamentary decision 11 June 2003; contract signed 1 July 2003; presidential approval given 21 August 2003 and contract became effective 22 August for 18 single-seat aircraft to be delivered in 2007 (four) and 2008 (14). Initial acceptance due 1 June 2007
Greece	60 plus 30 option		Selection confirmed April 1999 EF Office Athens opened July 1999. Intentions confirmed March 2000. Order delayed by financial constraints, April 2001 and competition re-opened in 2004
South Korea	40	Deliveries 2004–2007	EF Office Seoul opened April 1998 RFP received June 1999 Proposal submitted 8 September 1999 Flight evaluation expected early 2000 Final RFP submitted 28 June 2000 Flight Evaluation Team December 2000
Norway	48–60	Deliveries 2010	EF Office Oslo opened March 1999 RFP received 15 February 1999 Proposal submitted 1 June 1999 Offsets proposal submitted 1 December 1999 Competition suspended 2000, but industrial participation agreement signed 28 January 2003 and several Norweigan companies received subcontracts Response to proposals submitted by Eurofighter in March 2006
Saudi Arabia	possible 72	Decision after 2000	Early discussions under way in 1999 Commitment to purchase announced 21 December 2005. Initial 24 from RAF production
Requests for information (RFI)			
Australia	60	Decision after 2000	Discussions under way in 1999 F-35 JSF selected
Czech Republic	Possible 36	Long-term requirement	RFI received June 1999 RFI response September 1999 Gripen selected
India			Request expected 2006
Japan			Request 2006
Netherlands	60–70	Decision 2005 Deliveries 2010	RFI received June 1999 RFI response October 1999
Poland	60	Long-term requirement	RFI received June 1999 RFI response July 1999 F-16 selected
Singapore	20		RFI response submitted late 1999 Evaluation late 2001 Shortlisted 10 October 2003 (with Rafale and F-15) Flight evaluation July 2004 Eliminated April 2005

AVIONICS: BAE Systems has overall team leadership for avionics development and integration. All avionics, flight control and utilities control systems integrated through STANAG 3910 databus highways with appropriate redundancy levels, using fibre optics and microprocessors. Some functions activated by direct voice input, with 100 word vocabulary.

Comms: Rohde & Schwarz or Elmer VHF/UHF communications, both secure and non-secure. BAE video and voice recorder. EADS and Cossor IFF; BAE antennas.

Radar: Euroradar ECR 90 Captor coherent, multimode, pulse-Doppler radar.

Flight: Smiths mission data loader and radar altimeter. Litton laser INS/GPS; Marconi SpA microwave landing system, plus ILS and differential global navigation satellite system; BAE Systems TERPROM and ground proximity warning; Tacan; provision for terrain reference navigation; Elmer SpA crash survival memory unit.

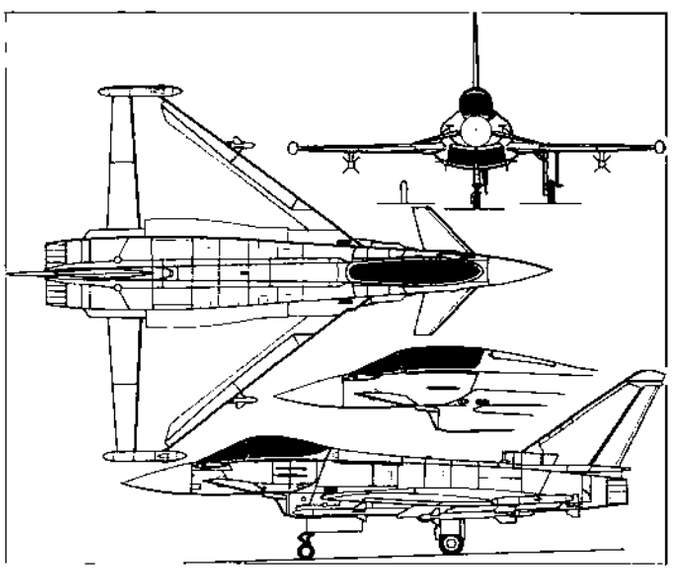
Instrumentation: Special attention given to reducing pilot workload. New cockpit techniques simplify safe and effective operation to limits of flight envelope while monitoring and managing aircraft and its operational systems, and detecting/identifying/attacking desired targets while remaining safe from enemy defences. This achieved through high level of system integration and automation, including HOTAS controls; BAE wide-angle (30° azimuth; 25° elevation) HUD able to display, in addition to other symbology, FLIR pictures from PIRATE sensor mounted externally to port side of cockpit; helmet-mounted sight (HMS), with helmet tracking system and Smiths Aerospace direct voice input (DVI), with 200-word vocabulary, for appropriate functions; and three Smiths Industries multifunction head-down colour CRT displays (MHDD) and Smiths glareshield standby displays. EADS, EDS Defence and CANAVA digital map generator; Teldix cockpit interface unit.

Mission: Alenia and Computing Devices nav/attack computers. Eurofirst (FIAR consortium) PIRATE (Passive Infra-Red Airborne Tracking Equipment) port side of windscreen. Secure MIDS datalink. (UK requirement for MIDS reconfirmed in November 2003.) RAF aircraft to have optional reconnaissance capability with a long-range electro-optical pod, for which SR(A) 1368 was issued in 1995.

Self-defence: Advanced integrated defensive aids subsystem (DASS), contracted to Euro-DASS consortium, led by BAE Systems and including Indra (Spain) and Elettronica (Italy); includes RWR and active jamming pod at each wingtip, laser warning receiver (each side, adjacent to windscreen), missile approach warning (wing leading-edges, inboard, and at rear base of fin), Elettronica Aster/GAMESA/CelsiusTech expendables (flares in flap actuator fairings; chaff in aileron actuator fairings) and towed radar decoys. (Germany initially did not join Euro-DASS, but is now to adopt standard equipment, with contract awarded October 2001). Two BAE Systems radar decoys in the starboard wingtip pod, each on a 100 m (320 ft) fibre optic cable. Italy considering Cross Eye ECM system as alternative to towed decoy. Spain also declined to join Euro-DASS, but is now participating; UK and Spain are only nations to have LWR. Initial contract for 103 systems placed June 2001; to be augmented by German requirement and addition of EADS to consortium. Saab Avitronics BOL 510 countermeasures dispensers in all Tranche 2 aircraft, including Austria.

EQUIPMENT: Hella lighting; Logic anti-collision beacons.

ARMAMENT: Total of 13 external stores stations: five (including one wet) under fuselage and four (including one wet) under each wing. Internally mounted 27 mm Mauser gun on starboard side with 150 rounds.



Eurofighter Typhoon with scrap view of two-seat version *(Paul Jackson)*

1159817

Planned weapons (with maximum load in parentheses) include:

Air-to-air: Meteor (six), AIM-120 AMRAAM (six), ERAAM (six), FMRAAM (six), AIM-9L Sidewinder (six), ASRAAM (six) and IRIS-T (six).

Air-to-air surface: ALARM (six), Penguin (four), Harpoon (four), Brimstone (18), Taurus, Storm Shadow, GBU-10 (four), GBU-16 (four), Paveway III (three), CRV-7 (four pods of 19 rockets each), 500 lb bombs (12) and reduced quantity of larger weapons up to 2,000 lb Mk 84 (four).

Typical weapon combinations for specific roles could include the following:

Air superiority: Six BVRAAMs, two SRAAMs, internal cannon, plus two 2,000 litre and one 1,000 litre external fuel tanks.

Interdiction/Strike: Two cruise missiles; four BVRAAMs, internal cannon plus two 2,000 litre and one 1,000 litre tanks.

Defence suppression: Six ARMs, four BVRAAMs, two SRAAMs, internal cannon and centreline 1,000 litre tank.

Multirole: Two Paveway LGBs, two ARMs, three BVRAAMs, two SRAAMs, internal cannon, laser designation pod and two 2,000 litre and one 1,000 litre tanks

Close air support: Eighteen Brimstones, four BVRAAMs, two SRAAMs, internal cannon and one 1,000 litre centreline tank

Maritime attack: Six ASMs, four BVRAAMs, two SRAAMs, internal cannon and one 1,000 litre centreline tank.

Phased introduction of weapons (as envisaged before final determination of Tranche 2) is shown in an accompanying table.

DIMENSIONS, EXTERNAL:
- **Wing span over ECM pods** 11.28 m (37 ft 0 in)
- **Wing aspect ratio** 2.5
- **Length: fuselage** 14.89 m (48 ft 10¼ in)
- **overall** 15.96 m (52 ft 4¼ in)
- Height overall 5.28 m (17 ft 4 in)
- Wheelbase 4.07 m (13 ft 4¾ in)

AREAS:
- Wings, gross 51.2 m² (551.1 sq ft)
- Foreplanes (total) 2.40 m² (25.83 sq ft)

WEIGHTS AND LOADINGS (approx):
- Weight empty 11,150 kg (24,582 lb)
- Internal fuel load 4,500 kg (9,920 lb)
- External stores load (weapons and/or fuel):
  - normal 6,500 kg (14,330 lb)
  - overload 7,500 kg (16,535 lb)
- **Max T-O weight: interceptor** 16,000 kg (35,274 lb)
  - attack 21,000 kg (46,297 lb)
  - overload 23,500 kg (51,809 lb)
- Max wing loading: interceptor 312.5 kg/m² (64.01 lb/sq ft)
  - attack 410.2 kg/m² (84.01 lb/sq ft)
  - overload 459.0 kg/m² (94.01 lb/sq ft)
- Max power loading: interceptor 89 kg/kN (0.87 lb/lb st)
  - attack 117 kg/kN (1.14 lb/lb st)
  - overload 130 kg/kN (1.28 lb/lb st)

PERFORMANCE (approx):
- Acceleration at low level, 200 kt to M1.0 30 s
- Max level speed M2.0
- Time to 10,670 m (35,000 ft)/M1.5 up to 2 min 30 s
- **Service ceiling** 16,765 m (55,000 ft)
- **Runway requirement** 700 m (2,300 ft)
- **T-O run, air combat mission** 300 m (985 ft)
- **Combat radius, single-seat:**
  - ground attack, lo-lo-lo 325 n miles (601 km; 374 miles)
  - ground attack, hi-lo-hi with three LGBs, designator pod and seven AAMs 750 n miles (1,389 km; 863 miles)
  - air defence with 3 hour CAP 100 n miles (185 km; 115 miles)
  - air defence with 10 minute loiter 750 n miles (1,389 km; 863 miles)
- g limits with full internal fuel and four AIM-120s +9/−3

EUROFIGHTER TYPHOON WEAPONS INTEGRATION
(as envisaged before Tranche 2 agreement)

Type	Mission	Manufacturer	Features	Max load	Tranche 1 IOC/FOC	Tranche 2 EOC 1	Tranche 2 EOC 2
27 mm cannon	Short range defence	Mauser	Internally mounted, 150 rounds linkless system	1	X		
Meteor	Beyond Visual Range Air-to-Air Missile (BVRAAM)	EADS, MBDA, Saab	Ramjet propulsion Active radar seeker	6			X
AIM-120A/B AMRAAM	Advanced Medium Range AAM	Raytheon	Active radar seeker	6	X		
AIM-120C 5 AMRAAM	Advanced Medium Range AAM	Raytheon	Active radar seeker	6			X
ERAAM	Extended Range AAM	Raytheon	Dual pulse rocket motor	6	superseded by METEOR		
FMRAAM	Future Medium Range AAM	Raytheon	Liquid fuel ramjet propulsion	6	superseded by METEOR		
AIM-9L/I AIM-9L/I-1	Short range AAM	Raytheon, Ford Aerospace, Bodenseewerkgerätetechnik (BGT)		6	X		
ASRAAM	Advanced Short Range AAM	MBDA	Focal-plane array seeker	6	X		
IRIS-T	Advanced Short Range AAM	BGT	Infrared imaging seeker Thrust vector control	4 (option for 6)	X	X	
ALARM	Anti-radiation Missile	MBDA	Loiter capability	(6) currently are only 4 planned in Tranche 2			X
Penguin	Anti-ship Missile	Kongsberg Defence & Aerospace	Mk 3 version range 50 km	4			
Harpoon	Anti-ship Missile	Boeing	Low level flight, active radar seeker	4			
Brimstone	Anti-tank Missile	MBDA	Millimetric wave seeker	(18) currently are only 6 planned in Tranche 2			X
Taurus	Cruise Missile	EADS/Celsius/Bofors Missiles	Terrain-following, range 150–350 km	2			X
Storm Shadow	Cruise Missile	MBDA	Terprom terrain-following, range 350+ km	2			X
Paveway II (UK), GBU-10/16	Laser Guided bomb	Portsmouth Aviation Raytheon	Mk 83 (GBU 16)/Mk 84 (GBU 10) Mk 13/20 (PWII UK) bomb with laser guidance	(4) up to 5 (2000 lbs bombs) 7 (1000 lbs bombs) are planned depending on LDP position	X PW II initial capability X GBU 10/16	X PW II full capability	
Enhanced Paveway II (UK)	GPS and Laser Guided bomb			7		X	
GBU 32 JDAM	GPS Guided bomb	Boeing	Mk 83 bomb	5		X	
Lightning	Laser Designator Pod	Zeiss		1		partially	full
Paveway III (UK), GBU 24	Laser Guided bomb	Raytheon	Mk 84/BLU 109 bombs with advanced laser guidance	(3) up to 5 are planned depending on LDP position			X
BL755	Cluster bomb	Hunting Engineering	147 bomblets	6			
Bombs 500–2000 lb	Unguided bombs			(12) up to 5 (2000 lbs) 7 (1000 lbs) are possible			
Rockets CRV-7	Unguided rockets	Bristol Aerospace, Canada	19 rockets per pod	4			

Notes: Introduction indicated by 'X'. EOC = enhanced operational capability

EUROTILT

EUROPEAN TILTROTOR PROGRAMME

PARTICIPATING COMPANIES

AgustaWestland: Italy/UK

Eurocopter: International

TYPE: Multimission tiltrotor.

PROGRAMME: Beginning in 1987, the European Commission sponsored feasibility and definition studies for a tiltrotor transport, then known as EuroFAR.

By 1999, 33 companies from nine European countries had joined with Eurocopter to apply for EC funding, initially to build a test rig for a proposed 10,000 kg (22,046 lb), 12/19-seat tiltrotor, provisionally known as Eurotilt.

Meanwhile, in July 1999, Agusta announced the 10-tonne, 20-seat Erica Tiltrotor and was seeking €90 million of funding from EU's 5th Framework research programme to build a ground test vehicle (GTV).

AgustaWestland concept for a European tiltrotor 1151731

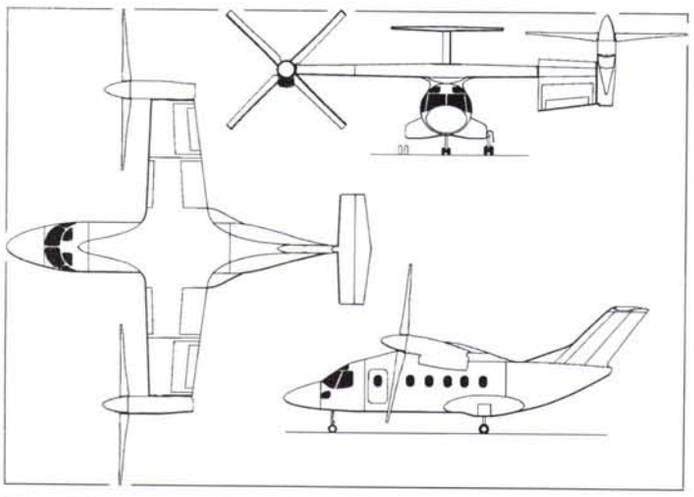
In October 1999, European Commission rejected separate funding of competing European tiltrotors and urged merger of Erica with Eurotilt.

Common research project, known as 2Gether (second-generation European tilting highly efficient rotorcraft), submitted to European Commission on 31 March 2000 by Eurocopter, Westland and Agusta (since merged as AgustaWestland).

European Commission rejected 2Gether as too costly and insufficiently innovative. New development proposal submitted in March 2001: cost €40 million to €60 million, with industry providing half; features tilting outer wing, as proposed by Agusta; early research devoted to overcoming additional technical difficulties of this configuration; flight demonstration could begin in 2007–08. Study team also to include Mecaer and Teleavio of Italy; Gamesa and Sener of Spain; UK's FHL; ZF of Germany; ONERA, DLR, NLR and CIRA research institutes; Israel Aircraft Industries; and Pratt & Whitney Canada. These joined by Flight Science and Technology Laboratory at Liverpool University, UK, which inaugurated in June 2001 a flight simulator to be used in developing a control system for Eurocopter's Eurotilt submission.

Various research efforts merged into RHILP (Rotorcraft Handling qualities, Interaction and Load Prediction) project, combining Eurocopter (in France) and Eurocopter Deutschland, plus research organisations CIRA (Italy), DLR (Germany), NLR (Netherlands), ONERA (France) and University of Liverpool (UK). Three year evaluation and risk-minimisation project began March 2000 and so far embraces four work packages: WP1 for handling qualities definition, employing moving base simulator at Liverpool (first four with Bell XV-15 parameters, but progressing to Eurotilt in August 2002); WP2 analysing specific flight phenomena using 1:7 scale model at Eurocopter, Marignane; WP3 for loads alleviation; and WP4 use of Marignane's SPHERE simulator for piloted simulation tests. RHILP is only one of several Critical Technology Projects envisaged up to 2005 and its results will be incorporated in HOST flight mechanics software configured to represent Eurotilt.

By 2003, AgustaWestland Erica had evolved with smaller, but highly twisted four-blade proprotors of 7.4 m (24 ft) diameter, enabling the aircraft to take-off and land in aeroplane mode. This rotor design is optimised for speeds up to 350 kt (648 km/h; 403 mph), compared with 275 kt (509 km/h; 316 mph) for current tiltrotors. Performance and handling will be further enhanced by allowing the outboard wing panels to be tilted independently of the engine/proprotor pods at their tips, with the related benefits of a wider transition corridor between helicopter and aeroplane and improved autorotation characteristics. Pods will remain firmly coupled to each other, however. Capacity will be 19 passengers, or 22 plus 2.2 tonnes of luggage in STOL mode only.



Agusta Erica; current studies are based on the tilting outboard wing (independent of proprotor angle) envisaged by this design. Prop rotation (viewed from rear) is port, anticlockwise; starboard, clockwise, producing an 'upwards past the fuselage' airflow in forward flight *(Paul Jackson)* 1151697

Most recent timetable calls for ground testing of complete wing and engine nacelle in 2009 and prototype first flight in 2015.

GAP

GULF AIRCRAFT PARTNERSHIP

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GAP was established in November 2005 by Farnborough Aircraft Corporation Ltd of the UK (FACL, which see) and Gulf Aircraft Maintenance Corporation (GAMCO) and simultaneously launched the Kestrel JP100 business turboprop at the Dubai Air Show. While the aircraft then shown in documents strongly resembled the AIR Epic LT, a legal case opened in January 2005 revealed that AIR and the UK-based FACL had entered into a secret agreement in September 2003 under which AIR was to assist with design, development, construction and certification of the slightly larger Farnborough F1. FACL engineers worked in the US, the 2006 dispute being based around the contribution of this team to the final Epic LT and F1 configurations.

Pending resolution of this dispute, FACL was said in January 2006 to have suspended the agreement with GAMCO while remaining in contact. Following arbitration in May 2006, AIR was precluded from using the wing developed jointly for the Epic LT and Farnborough F1 on the jet version of the former aircraft. The latter made its maiden flight in the US in July 2006, returning to the UK in the following month for cabin outfitting before being flown to Abu Dhabi for a promotional tour of the Persian Gulf region. MoU with GAMCO reportedly renewed in late 2006.

GAP KESTREL JP100

Engineering designation: Farnborough F1C3

TYPE: Business turboprop.

PROGRAMME: Launched by Farnborough-Aircraft.com Ltd 14 October 1999, at which time initial wind tunnel testing had been completed. Further wind tunnel testing verified laminar wing design and performance of Fowler flap system. Assets of original company acquired by FACL mid-2002; investment to complete development apparently in place by late 2004, at which time more than 65,000 hours of development work completed and parts manufacture said to be under way, with maiden flight then predicted during first half of 2005. Prototype subsequently completed in Oregon by workforce of British and US engineers, undergoing revision of original design; registered N352F on 15 September 2005 and made maiden flight at Bend, Oregon, on 29 July 2006. Flown back to UK 28 August 2006 prior to outfitting and promotional tour in Persian Gulf area. Will then begin certification to EASA CS-23 and FAR Pt 23.

CUSTOMERS: Intended for air taxi operators providing on-demand point-to-point travel from small airfields. Initial market estimated to be 250 per year from 2007.

Prototype GAP Kestrel JP100/Farnborough F1 during early test flying in US

1158836

GAP Kestrel JP100/Farnborough F1

1158837

COSTS: Predicted unit cost, equipped USD2.2 million (2003).

DESIGN FEATURES: Designed with heavy reliance on computational fluid dynamics, backed up by wind tunnel tests. Design goals include ability to operate from small airstrips, carrying five passengers at more than 325 kt (602 km/h; 374 mph) over a range of 1,000 n miles (1,852 km; 1,150 miles) with NBAA IFR reserves. Sidestick controls; low-rpm propeller for low noise.

Wing aerofoil proprietary High-Lift, Laminar Flow sections: HLLF29155 at root, HLLF13130 at tip.

In comparison with original F1, Kestrel version has progressive wing leading-edge sweepback with additional span in place of winglets; horn-balanced rudder; plain flaps; two-piece windscreen; and circular cabin windows.

FLYING CONTROLS: Unpowered sidestick connected to conventional controls; 30 per cent chord Fowler flaps occupy approximately two-thirds span. Novel Fowler mechanism retracts almost entirely into wing.

STRUCTURE: Primarily carbon composites; fuselage of carbon fibre skins with foam core, moulded in two vertically split halves; two-spar carbon fibre wing with aluminium alloy landing gear pick-up ribs, flap tracks and aileron attachments.

LANDING GEAR: Retractable tricycle type; trailing-link main units retract inwards, nosewheel rearwards.

POWER PLANT: One Pratt & Whitney PT6A-67B turboprop, flat rated at 746 kW (1,000 shp). Integral, gravity-fed fuel tank in each wing, combined capacity 965 litres (255 US gallons; 212 Imp gallons).

ACCOMMODATION: Pilot and five or six passengers in pressurised cabin (four-person club seating in prototype), maximum pressure differential 0.55 bar (8.0 lb/sq in) maintaining sea level cabin altitude to 5,790 m (19,000 ft). Three cabin windows on each side; drop-down airstair door on starboard side aft of wing; overwing emergency exit on starboard side. Lavatory at rear of cabin. Alternative configurations for commuter, medevac and cargo applications.

SYSTEMS: Hydraulic system for landing gear actuation. Electrical power (28 V DC) provided by 200 A starter/generator and 120 A alternator; 40 Ah main battery for engine start and systems power in event of engine failure. Wing leading-edges de-iced electrically. Environmental control system and supplemental oxygen system.

AVIONICS: 'Glass cockpit' compatible with existing and planned ATC procedures and GPS-based en-route navigation and airfield approach systems. Weather radar in wingtip pod.

DIMENSIONS, EXTERNAL:

Wing span	13.11 m (43 ft 0 in)
Length overall	11.40 m (37 ft 4¾ in)
Height overall	3.84 m (12 ft 7¼ in)

DIMENSIONS, INTERNAL:

Cabin (firewall to pressure bulkhead):	
Length	5.36 m (17 ft 7 in)
Max width	1.52 m (5 ft 0 in)
Max height	1.40 m (4 ft 7 in)

WEIGHTS AND LOADINGS:

Weight empty	1,818 kg (4,007 lb)
Max T-O weight	2,835 kg (6,250 lb)
Max power loading	3.80 kg/kW (6.25 lb/shp)

PERFORMANCE:

Max cruising speed	352 kt (652 km/h; 405 mph)
Econ cruising speed	249 kt (461 km/h; 287 mph)
Stalling speed, flaps down	61 kt (113 km/h; 71 mph)
Max rate of climb at S/L	more than 1,219 m (4,000 ft)/min
Time to FL250	9 min
Service ceiling	9,450 m (31,000 ft)
T-O to 15 m (50 ft)	492 m (1,612 ft)
Range: with max fuel	1,618 n miles (2,996 km; 1,861 miles)
with four occupants, IFR:	
NBAA reserves	1,427 n miles (2,642 km; 1,642 miles)
no reserves	1,567 n miles (2,902 km; 1,810 miles)
Ferry range	1,997 n miles (3,698 km; 2,298 miles)

IBIS

IBIS AEROSPACE LTD

PARTICIPATING COMPANIES

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AIDC: see Taiwan

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Ibis Aerospace Ltd is a 50-50 joint venture company created by an agreement of 15 March 1997 under which Aero Vodochody and AIDC-developed the Ae 270 Spirit single-turboprop utility aircraft. By early 2005, three prototypes and two production conforming aircraft had flown, and although certification has been achieved of a basic variant, full-scale manufacture had not been authorised by early 2007.

IBIS Ae 270 SPIRIT

TYPE: Light utility turboprop.

PROGRAMME: Announced by Aero Vodochody of Czech Republic in early 1990, originally as L-270; configuration modified 1991; originally planned in two versions (Ae 270 U and Ae 270 MP), but revised late 1993 and name Ibis introduced; design frozen 1995. Chief designer Jan Mikula. Three flying prototypes (Nos. 1, 3 and 5), plus one each for static and fatigue testing (Nos. 2 and 4, respectively); to be certified under FAR Pt 23 (Normal category) and be suitable for FAR Pt 135 single-pilot IFR. Wings for first prototype (Ae 270 P) received from Taiwan August 1999. Roll-out delayed by late arrival of some components, but took place on 10 December 1999; first flight (OK-EMA) 25 July 2000 and to VZLU test centre 23 October 2000. Third prototype (second flying, OK-SAR) rolled out 2 November 2001; first flight 23 December 2001 (not announced until 11 January 2002) followed by fifth prototype (third flying, first production conforming, OK-LIB) on 24 January 2003, although 'official' first flight was not until 25 February 2003. Sixth prototype (fourth flying, OK-INA) first flown 22 September 2003, and made the type's US debut at the NBAA Convention in Orlando 6 October 2003. Second production conforming aircraft (OK-EVA) flew 24 February 2004.

Certification of Ae 270 P originally expected mid-2002, followed by Ae 270 HP in fourth quarter; first deliveries (Ae 270 P) anticipated in October 2002, with Ae 270 HP deliveries commencing in early 2003. This not achieved, and at NBAA Convention at Orlando, Florida, in September 2002, Ibis announced suspension of Ae 270 P in order to concentrate

Ibis Ae 270P Spirit utility turboprop

1037993

Ibis Aerospace Ae 270 W *(Mike Keep)*

1154678

resources on Ae 270 HP. EASA certification granted 12 December 2005 following a flight test programme involving two prototypes and a preproduction aircraft which jointly logged 1,416 hours, 40 minutes. FAA certification 24 February 2006.

In 2004, AIDC withdrew from production of wing and announced cessation of Ae 270 funding. Ibis was attempting in mid-2005 to interest original partners, and others, in funding development of a redesigned aircraft to be known as **Ae 270B**, with 200 kg (441 lb) reduction in empty weight, achieved by changes to wing, empennage and systems; this to restore target 260 kt (482 km/h; 299 mph) cruising speed and 400 kg (882 lb) payload.

In early 2007, Ae 270B was in suspension, awaiting additional funding. Ibis, in cooperation with Aero Vodochody and Taiwan's AIDC, were studying an interim version, then undesignated, which would upgrade performance of current certified aircraft. Most significant change would be to wing's planform and size, although several systems changes and additional fuel capacity are also envisaged. Version is intermediate step more significant programme of changes for Ae 270B. If decision is made to produce interim aircraft, it would be available in 2007-2008.

CURRENT VERSIONS: **Ae 270 P**: Basic pressurised version, with 634 kW (850 shp) flat rated P&WC PT6A-42A engine, Honeywell avionics and retractable gear.

Ae 270 HP: High-performance version, announced 7 October 2000 at NBAA Convention in New Orleans; PT6A-66A engine offering improved speed, climb and altitude performance and greater fuel efficiency. Aircraft 05 is prototype for this version, which is the first to be certified. *As described.*

Ae 270 W: Non-pressurised model (previously called Ae 270 U), with fixed landing gear, Walter M 601F engine and Czech avionics. Plans for this version in abeyance in 2001.

Ae 270 FP and FW: Wheeled-float versions of P and W. Not currently promoted.

CUSTOMERS: Initial orders announced at Paris Air Show, June 2001, involved 51 aircraft for six regional distributors (four in USA, one each in Australia and South Africa). Firm orders for 76 by October 2004.

COSTS: USD2.195 million (2004).

DESIGN FEATURES: Sized between Socata TBM 700 and Pilatus PC-12. High-aspect ratio low wing, circular cabin windows, sweptback vertical tail. Fence added to upper surface of wings, approx 1.12 m (3 ft 8 in) outboard, by 2003.

Medium-speed aerofoil section (thickness/chord ratio 17 per cent at root, 12 per cent at tip); leading-edge sweepback 7° 42'; dihedral 6°; incidence 3°; twist 3°.

FLYING CONTROLS: Conventional and manual. Elevators trimmed mechanically, ailerons and rudder electromechanically; trim tab in rudder. Wide-span single-slotted Fowler flaps (70 per cent of trailing-edge; positions 0, 20 and 36°) actuated hydraulically. Autopilot optional. Control surface movements: ailerons +22,5°/–13,5°; elevators +30°/–15°; rudder ±25°.

STRUCTURE: All-metal semi-monocoque, with fail-safe structural elements in fuselage and two-spar wings. Fuselage of conventionally formed sheet metal bulkheads, stringers and skin; wings (built by AIDC) have formed sheet metal ribs, stringers and chemically milled skin. Production in Czech Republic (including engine compartment by Moravan, cabin floor panels by LZ and rear fuselage, fin and rudder by EV-AT) except for wings and landing gear, produced in Taiwan by AIDC; final assembly by Aero Vodochody. Other suppliers include: Chelton-Systems (EFIS display), De Crane Aircraft Seating (crew and cabin seats); Gumotex Breclav (de-icer boots), Honeywell (air conditioning and pressurisation components), Intertechnique (fuel gauges), Jihlavan (hydraulic system), Mikrotechna Modrany (instrumentation), Moravan (wheels and brakes), PPG Industries (windows) SimCom (pilot and technical training), Southstar Aircraft Interiors (interior completion), and UNIS (automated electronic monitoring systems).

LANDING GEAR: Retractable tricycle type by Technometra Radotin, with Moravan wheels and brakes; steerable nosewheel (60° by brakes, 15° by rudder pedals). Bulged nosewheel doors inward retraction for mainwheels, rearward for nosewheel. Oleo-pneumatic shock-absorbers in all units; hydraulic disc brakes on mainwheels. Dunlop tubeless tyres: size 6.50–10, pressure 6.90 bar (100 lb/sq in) on mainwheels, size 6.00–6, pressure 3.80 bar (55 lb/sq in) on nosewheel. Minimum ground turning radius (based on nosewheel) 4.00 m (13 ft 1½ in).

POWER PLANT: One 634 kW (850 shp) (flat rated) Pratt & Whitney Canada PT6A-66A turboprop, driving a Hartzell HC-E4N-3P/D9511FASK/D-630-3 four-blade, constant-speed, feathering and reversing propeller.

Integral fuel tank in each wing centre-section, combined usable capacity 1,152 litres (304 US gallons; 334 Imp gallons). Gravity refuelling point in top of each wing. Oil capacity 5.7 litres (1.5 US gallons; 1.25 Imp gallons) in Ae 270 P.

ACCOMMODATION: Flight crew of two standard, but to be certified for single-pilot operation. Main cabin suitable for up to eight passengers or 1,200 kg (2,645 lb) of cargo, or combinations of both. Six/seven-seat business or four-seat club layouts permit inclusion of lavatory. Medevac configuration provides accommodation for two stretcher cases and two medical attendants. Forward-opening crew door at front on port side; upward-opening passenger/cargo door on port side aft of wing with optional airstair door inset; downward-opening door extension, immediately to rear to provide freight loading aperture; overwing emergency exit on starboard side. Baggage door on starboard side at rear. Cockpit and cabin air conditioning, pressurisation and windscreen heating standard.

SYSTEMS: Electrical power provided by 28 V 250 A DC engine-driven starter/generator and 24 V 42 Ah lead-acid battery; 28 V DC external power connector. Standby generator optional. Hydraulic system, pressure 150 bar (2,175 lb/sq in), for actuation of flaps, mainwheel brakes and landing gear extension/retraction; flow rate 11 litres (2.9 US gallons; 2.4 Imp gallons)/min. Landing gear and mainwheel brakes also controllable by separate emergency hand-operated valves and parking brake.

Honeywell air conditioning and pressurisation system maintains differential of 0.30 bar (4.4 lb/sq in) up to altitude 7,500 m (24,600 ft). Gumotex pneumatic (engine bleed air) de-icing of wing and tailplane leading-edges; electric de-icing of windscreens, propeller blades; hot air de-icing of engine air intake; stall warning sensor and pitot tube standard on both models. Eros emergency oxygen system for crew and passengers.

AVIONICS: Standard flight, navigation and engine instrumentation (VFR or IFR) to comply with FAR Pt 23.

Honeywell APEX integrated avionics system will be offered as an option in the future, comprising three-tube active matrix liquid crystal display EFIS, EICAS, digital autopilot and FMS, Mode S transponder and weather radar. Other options will include TCAS, EGPWS, DME and Honeywell Flight Information Service.

Radar: Weather radar optional.

Flight: IFR package standard for business versions, including VOR/ILS, ADF, Trimble GPS, Bendix King KFC 325 autopilot and Ryan 9900BX TCAS.

Instrumentation: Chelton Systems FlightLogic synthetic vision EFIS optional.

DIMENSIONS, EXTERNAL:

Wing span	14.13 m (46 ft 4¼ in)
Wing chord: at root	1.88 m (6 ft 2 in)
at tip	1.04 m (3 ft 5 in)
Wing aspect ratio	9.1
Length overall	12.23 m (40 ft 1½ in)
Fuselage: Length	12.23 m (40 ft 1½ in)
Max width	1.60 m (5 ft 3 in)
Max depth	1.75 m (5 ft 9 in)
Height overall	4.78 m (15 ft 8¼ in)
Elevator span	5.40 m (17 ft 8½ in)
Wheel track	2.83 m (9 ft 3½ in)
Wheelbase	3.53 m (11 ft 7 in)
Propeller diameter:	2.44 m (8 ft 0 in)
Propeller ground clearance:	
Hartzell	0.41 m (1 ft 4¾ in)
McCauley	0.44 m (1 ft 5¼ in)
Passenger/cargo door (port, rear):	
Height	1.30 m (4 ft 3¼ in)
Width	1.25 m (4 ft 1¼ in)
Height to sill	1.30 m (4 ft 3¼ in)
Crew door (port, fwd): Height	1.20 m (3 ft 11¼ in)
Width	0.70 m (2 ft 3½ in)
Height to sill	1.30 m (4 ft 3¼ in)
Emergency exit (stbd, overwing):	
Height	0.71 m (2 ft 4 in)
Width	0.50 m (1 ft 7¾ in)

DIMENSIONS, INTERNAL:

Cabin: Length: excl flight deck	4.98 m (16 ft 4 in)
incl flight deck	5.50 m (18 ft 0½ in)
Max width	1.45 m (4 ft 9 in)
Max height	1.36 m (4 ft 5½ in)
Volume	7.5 m³ (265 cu ft)
Baggage compartment volume	0.73 m³ (25.8 cu ft)

AREAS:

Wings, gross	21.00 m² (226.0 sq ft)
Ailerons (total)	1.00 m² (10.76 sq ft)

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Trailing-edge flaps (total) ..... 4.22 m² (45.42 sq ft)
Spoilers (total) ..... 0.325 m² (3.50 sq ft)
Fin, incl dorsal fin ..... 1.96 m² (21.10 sq ft)
Rudder, incl tab ..... 1.11 m² (11.95 sq ft)
Tailplane ..... 2.975 m² (32.02 sq ft)
Elevators (total) ..... 1.885 m² (20.29 sq ft)

WEIGHTS AND LOADINGS (Ae 270 HP):
Empty weight ..... 2,436 kg (5,370 lb)
Weight empty, equipped ..... 2,710 kg (5,974 lb)
Max fuel weight ..... 1,034 kg (2,280 lb)
Max T-O weight ..... 3,800 kg (8,377 lb)
Max ramp weight ..... 3,820 kg (8,422 lb)
Max landing weight ..... 3,700 kg (8,157 lb)
Max baggage weight ..... 60 kg (132 lb)
Max zero-fuel weight ..... 3,500 kg (7,716 lb)
Max wing loading ..... 181.0 kg/m² (37.06 lb/sq ft)
Max power loading ..... 6.00 kg/kW (9.86 lb/shp)

PERFORMANCE (Ae 270 HP):
Max cruising speed: at S/L ..... 220 kt (407 km/h; 253 mph)
at FL 200 ..... 270 kt (500 km/h; 311 mph)
Stalling speed, engine idling:
flaps up ..... 85 kt (158 km/h; 98 mph)
flaps down ..... 66 kt (123 km/h; 76 mph)
Max rate of climb at S/L ..... 521 m (1,710 ft)/min
Max certified altitude ..... 7,925 m (26,000 ft)
T-O run ..... 270 m (890 ft)
T-O to 15 m (50 ft) ..... 550 m (1,805 ft)
Landing from 15 m (50 ft) ..... 500 m (1,640 ft)
Landing run ..... 167 m (1,545 ft)
Range with max fuel at FL 300:
30 min reserves ..... 1,610 n miles (2,981 km; 1,852 miles)
NBAA IFR reserves ..... 1,420 n miles (2,629 km; 1,634 miles)

ILYUSHIN/IRKUT/HAL

ILYUSHIN/IRKUT/HAL

PARTICIPATING COMPANIES

Ilyushin: see Russian Federation
Irkut: see Russian Federation
HAL: see India

PROGRAMME DIRECTOR: Aleksandr Kuleshov (Irkut)

e-mail: irta@irkut.com

Agreement announced between these three companies in June 2001 for joint design, development and co-production of a multirole transport aircraft (MTA), now known also as IRTA-21. It will be funded 50 per cent by HAL, 40 per cent by Irkut and 10 per cent by Ilyushin with total planned investment in the region of USD380 million. Production lines in both countries are planned. Under agreement of January 2002, both HAL and Russian partners are to transfer conceptual draft for series production and technology information during the design, development and productionisation planning stages. Further joint accord signed 16 November 2005. HAL will create infrastructure for design, development and manufacturing programme and commercial production in India; similar facilities in Russia will be established by Ilyushin and Irkut.

ILYUSHIN/IRKUT/HAL IRTA-21

TYPE: Medium transport/multirole.

PROGRAMME: This Indian requirement for a multirole transport aircraft (MTA) became the subject of a joint venture between HAL and Ilyushin (Russian designation Il-214) following the opening of negotiations in March 1999; joint agreement signed later in the same year; MoU in late 2000 followed in June 2001 by joint design, development and co-production agreement involving these two companies plus Irkut. Aircraft redesignated in 2003 as IRTA-21 (Indo-Russian Transport Aircraft, 21st century).

Configuration now differs considerably from the original design of 1996. Programme is included in Russian government's aeronautical development plan for 2001–15. Engineering concept and feasibility study completed by early 2004; preliminary design then begun; static and life cycle tests due for 2006; first flight in 2008; tactical transport version targeted to enter service in 2009.

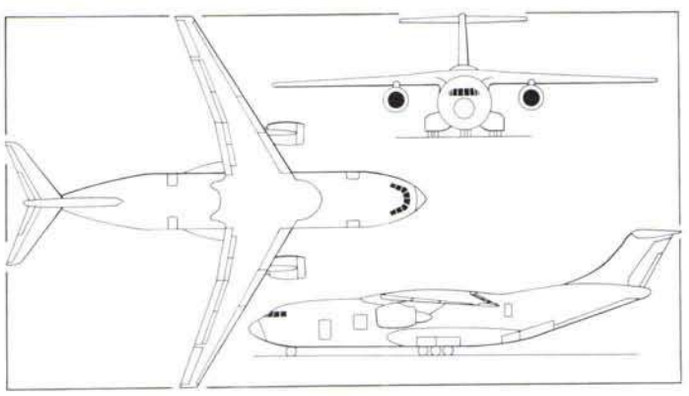
CURRENT VERSIONS: **Airliner:** With cabin windows and seating for 94 to 104.

Tactical transport: Military version with rear-loading ramp; provision for 82 troops or 74 paratroops; or 60 casualties in medevac configuration; or containerised, palleted or bulk cargo.

Commercial freighter: With rear-loading ramp.

CUSTOMERS: Required by Indian and Russian air forces; manufacture by HAL and Irkut. Initial Indian Air Force commitment for 45; estimated Russian requirement for up to 100.

Artist's impression of Ilyushin/Irkut/HAL IRTA-21 1159034



Russia and India's new multirole transport aircraft, the IRTA-21
(Paul Jackson) 0062411

COSTS: Development funding of USD190 million each planned by Russia and India, according to joint agreement signed on 16 November 2005. Unit cost USD25 million to USD29 million. Target price is 20 per cent less than for comparable aircraft.

DESIGN FEATURES: Sweptback high-wing monoplane with all-swept T tail; twin, underslung podded engines; upswept rear fuselage with rear-loading ramp. Intended to replace ageing An-12, An-26 and An-32. Operable from unpaved airfields with surface density 7.5 kg/m² (1.5 lb/sq ft).

FLYING CONTROLS: Digital fly-by-wire. Fowler-type flaps.

STRUCTURE: Aluminium alloy and composites.

LANDING GEAR: Tricycle type; retractable. Two four-wheel main bogies retracting upwards into sponsons on fuselage hips; twin nosewheels.

POWER PLANT: Two 103 kN (23,150 lb st) class turbofans. Options include CFM56, Aviadvigatel PS-12 (under development), Rolls-Royce BR715, PW6000 or IAE V2500.

ACCOMMODATION: See Current Versions above.

AVIONICS: Integrated suite includes flight and navigation complex, flight deck information and control, com radios and sighting system. Six multifunction displays; two HUDs.

Following details all provisional:

DIMENSIONS, EXTERNAL:
Wing span ..... 32.25 m (105 ft 9¾ in)
Length overall ..... 35.20 m (115 ft 5¾ in)
Height overall ..... 11.00 m (36 ft 1 in)

DIMENSIONS, INTERNAL:
Cargo hold:
Length: excl ramp ..... 13.85 m (45 ft 5¼ in)
incl ramp ..... 18.85 m (61 ft 10¼ in)
Max width at floor ..... 3.45 m (11 ft 3¾ in)
Max height ..... 3.40 m (11 ft 1¾ in)

WEIGHTS AND LOADINGS (design):
Max cargo payload ..... 18,500 kg (40,785 lb)
Max fuel weight ..... 13,650 kg (30,093 lb)
Max T-O weight ..... 55,000 kg (121,250 lb)
Max landing weight ..... 49,000 kg (108,026 lb)

PERFORMANCE (estimated):
Max level speed ..... 469 kt (870 km/h; 540 mph)
Normal cruising speed ..... 432 kt (800 km/h; 497 mph)
Airdropping speed ..... 135 kt (250 km/h; 155 mph)
Normal operating altitude ..... 13,000 m (42,650 ft)
T-O run at S/L ..... 1,300 m (4,265 ft)
Landing from 15 m (50 ft) ..... 1,350 m (4,430 ft)
Range: airliner with max payload ..... 1,889 n miles (3,500 km; 2,174 miles)
tactical transport:
with 4,500 kg (9,920 lb) payload ..... 3,239 n miles (6,000 km; 3,728 miles)
with max payload ..... 1,349 n miles (2,500 km; 1,553 miles)

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NHINDUSTRIES

NHINDUSTRIES SARL

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EADS Eurocopter: International
EADS Eurocopter Deutschland: Germany
Stork Fokker AESP: Netherlands

NHIndustries (NATO Helicopter Industries) established August 1992 to manage design and development of NH90 and is also responsible for production, logistic support, marketing and sales; in October 1995, workshares were slightly amended to Agusta 28.2 per cent, Eurocopter Deutschland 23.7 per cent, Eurocopter France 41.6 per cent, Fokker Aircraft 6.5 per cent, NFT (Norway) joined in 1994 as risk-sharing partner of Eurocopter France. Further amendment occurred on 21 June 2001, when Portugal joined programme and allocated 1.2 per cent share to OGMA. Netherlands activities transferred to Fokker Aerostructures BV following bankruptcy of the former Fokker Aircraft. Industrial ownership (and production share) is now EADS 61.7 per cent, Finmeccanica (AgustaWestland) 31.6 per cent, Stork Fokker 5.5 per cent and Portuguese industry (as Eurocopter and AgustaWestland subcontractor) 1.2 per cent.

Joint agency NAHEMA (NATO Helicopter Management Agency) formed February 1992 by the four governments, within NATO framework, to manage programme; now additionally represents Portuguese government; NAHEMA located alongside NH Industries in Aix-en-Provence.

NHINDUSTRIES NH90

Australian military designation: MRH90
Swedish military designation: Hkp 14
TYPE: Multirole medium helicopter.
PROGRAMME:

DEVELOPMENT MILESTONES

Requirement issued	83–84
Design began	Dec 86
Official go-ahead	26 Apr 90
First order (multinational)	30 Jun 00
Rolled out	29 Sep 95
First flight	18 Dec 95
Official first flight	15 Feb 96
Public debut	May 96
First flight, production	4 May 04
First delivery (planned)	06

Initial studies by NIAG (NATO Industrial Advisory Group) SG14 in 1983–84; September 1985 MoU between defence ministers of France, Germany, Italy, Netherlands and UK (USA and Canada having already withdrawn) preceded 14 month feasibility/predefinition study for new naval/army NH90 (NATO helicopter for the 1990s); initial design phase approved December 1986; second MoU in September 1987 led to predefinition phase and completion of weapons system definition in 1988; UK withdrew from programme April 1987; German workshare reduced early 1990, Italian participation renegotiated later 1990; French and German launch decision 26 April 1990; two ministerial MoUs in December 1990 and June 1991 cover design and development responsibilities; intercompany agreement signed March 1992; design and development contract signed 1 September 1992; five prototypes and GTV (ground test vehicle) completed, with three prototypes produced in France, TTH in Germany and NFH in Italy; assembly of first prototype began at Marignane, October 1993; first flight 18 December 1995. All five prototypes flying by December 1999.

Development suspended May 1994; restarted July 1994, but all new-development items subject to rigorous cost examination; preference for off-the-shelf components. Programme doubts dispelled by inclusion of NH90 in French defence plan adopted in June 1996, which required first NFH delivery to Aéronavale in 2004 (not achieved) and first TTH to ALAT in 2011. Bid for production investment and Lot 1 manufacture submitted 5 October 1997; four nations signed political authorisation for first production batch of 154 (amended later to 151) helicopters on 19 May 1998; pricing proposals submitted by NHI to NAHEMA on 15 July 1998; industrial contract due in mid-1999 to permit first deliveries in 2003 for Netherlands Navy, but was delayed and latter date rescheduled to 2007.

In September 1999, Germany revealed a cut of 24 in its total order and then planned to receive first TTH in April 2004 and NFH in 2007, instead of withdrawing current Westland Lynx in 2003; however, delivery of first TTH subsequently slipped to early 2006. Italian deliveries (both versions) planned to begin in April 2004, continuing until 2017–18, but start of deliveries delayed until 2006. NH90 built on parallel production lines in France, Germany and Italy, with peak rate of 40 helicopters per year anticipated. Aircraft for Finland, Norway and Sweden will be completed on fourth assembly line at Patria's Jamsa site. Netherlands confirmed in November 1998 that its helicopters would be built in Italy; German NFHs built in France. Further, in 1998, a basic NH90 variant was proposed to which 'Kits on Option' could be added to produce specific variants at lower cost than purpose-build.

Rescheduled production contract signature, at Berlin Air Show, 8 June 2000, replaced by MoU committing to 243, plus 55 options and minimum buy of 366 from stated requirements for 595. Production investment and production contract finally signed in Paris on 30 June

NHIndustries NH90 of German Army

Maiden flight of Italian Army's first NH90

1153794

NHIndustries NH90 prototype PT2 visiting Netherlands *(R Neth Navy)* 1153792

2000 on these terms and quoting cost for 298 as €6.6 billion, with industrial participants providing 25 per cent of production investment. Portuguese contract signed at Paris Air Show on 21 June 2001 added fifth member to consortium and 10 aircraft to previous figures, for new totals of 253 firm, 376 minimum purchase and 605 stated requirement. This further increased by 52 in September 2001 on selection of NH90 for Nordic Standard Helicopter Project, programme offsets including production by Saab of 200 forward fuselages.

On 6 October 1998, NAHEMA contracted NHI to undertake additional work and national customisation, involving integration of T700 engine to meet Italian requirement; design of rear ramp installation for TTH version; and reinforcement for carriage of stores up to 700 kg (1,543 lb). Associated national requirements include study of command post version; cannon pod; sand filter; radiometer; second VHF/FM radio for TTH; and sonobuoy data relay, Tacan and rear ramp for NFH. Total value of €58.23 million slightly amends national workshares, Italy formally confirmed T700 engine selection in June 2000; Germany and Netherlands simultaneously confirmed RTM322, which earlier selected by France.

First five aircraft had flown more than 2,500 hours by end of November 2003. Flight envelope expanded by early 2002 to 190 kt (352 km/h; 219 mph), 6,096 m (20,000 ft) altitude and T-O weight of 10,600 kg (23,369 lb). The aircraft has also demonstrated fast rolling landings at 50 kt (93 km/h; 58 mph) and landings on slopes of up to 12°. Flight test activity in 2003 mainly dedicated to mission system qualification. Initial production aircraft (TTH for German Army, TGEA01, temporarily serialled 9891) first flew at Donauwörth 4 May 2004 and made public debut at ILA, Berlin, 11 May; first production examples for Finland and Italy both made maiden flights 15 September 2004, with first 'high cabin' aircraft for Sweden following suit on 18 March 2005. First Italian Navy NFH made initial flight from Vergiate on 15 December 2005. By end of 2005, over 3,600 flight hours had been accumulated, including just over 3,000 by five development machines, with balance accounted for by early production helicopters.

CURRENT VERSIONS (general): **NFH: (NATO Frigate Helicopter)** Naval version, primarily for autonomous ASW and ASVW; additional applications include OTH targeting, vertrep, SAR, transport and anti-air warfare support; designed for all weather/severe ship motion environment; fully integrated mission system for crew of three (optionally four); ECM, anti radar and IR protection systems. Italy considering a unique sensor fit from FIAR/Honeywell consortium, Agusta, with its EH101 and S-61 experience, is responsible for NFH development and integration. In late 2005, it emerged that software development for Navy mission systems was running behind schedule, with possible 18-month delay in service entry.

TTH: (Tactical Transport Helicopter) Land-based army/air force version, primarily for tactical transport, airmobile operations and SAR with up to 20 armed troops or 2.5 tonnes of supplies; additional applications include tactical support, special EW, airborne command post, VIP transport and training; defensive weapons suite; rear-loading ramp/door, loading winch and rolling strips to be provided for French, Italian and German armies to accommodate light armoured anti-tank missile vehicle; 4-tonne external underslung load hook; high manoeuvrability and survivability for NOE operation near front line. Eurocopter Deutschland is responsible for development of the TTH.

C-SAR: Combat search and rescue version, yet to be fully defined, but probably equipped with refuelling probe, 'bolt-on' armour on lower fuselage, two external fuel tanks, flotation gear, secure datalink, integrated countermeasures, FLIR and four FIM-92 Stinger self-defence AAMs.

'Kits on Option': To accommodate differing budgetary and operational requirements, a baseline configuration has been agreed, to which specific packages can be added. French shipborne utility version combining troop seats and ramp could replace Super Frelon. This version could also form basis of dedicated VIP variant, and even of a civil variant. Eurocopter France is responsible for development of the basic helicopter.

Netherlands NFH: All 20 equipped with common core avionics, FCS, 360° radar, FLIR, ESM, ECM and sonics, but only 12 with full mission system; rest for night special operations insertion and maritime transport duties. To serve aboard eight M-type frigates, four LCF frigates, two LPDs and two AORs; delivery to begin in 2007.

MH90: Version proposed to satisfy Canadian requirement for up to 28 maritime helicopters to replace CH-124 Sea King; NHIndustries teamed with Thales and Lockheed Martin Canada to bid, with latter acting as prime contractor. Sikorsky S-92 eventually selected.

MRH90: Designation allocated to Australian helicopters for delivery from 2007 to 2009.

Civil Version: In latter half of 2004, it was revealed that consideration is being given to developing civil version of NH90 for offshore oil platform support and government/VIP airlift. NHIndustries confirmed that civilian helicopter operators have shown interest in NH90, but by mid-2005 it appeared unlikely to move ahead with development of a civil NH90 in the immediate future.

CURRENT VERSIONS (specific): **PT1/F-ZWTH:** Prototype; common basic configuration; assembled at Marignane; rolled out 29 September 1995; first flight 18 December 1995 with RTM 322 engines; formal debut (official first flight) 15 February 1996; public debut at Berlin, May 1996; tactical (green) colours; with 160 hours logged, PT1 flew to Agusta's Cascina Costa plant on 29 July 1997 for installation of Alfa Romeo Avio/GE T700-T6E engines before an 18-month test programme funded by Italy; first flew as such on 13 March 1998; had amassed 205 hours with these engines by August 2000, including sea trials with French 'La Fayette' class frigate *Courbet*, making 62 deck landings in two days (22/23 July 1998). Flown with Italian serial MMX612. Total 365 hours by 31 August 2000, when scheduled flight activities were completed. Employed as static demonstration and marketing airframe.

PT2/F-ZWTI: Common basic configuration; rolled out November 1996 at Marignane; first flight 19 March 1997; naval (light grey) colours; first with fly-by-wire controls. Initially flew for 5 hours with mechanical back-up flight controls, then first flew with analogue FBW on 2 July 1997; digital FBW installed early 1998 (retaining mechanical backup) and first flown on 15 May. PT2 also first with automatic electric blade folding intended for NFH, and due to receive IR exhaust suppressors. External load tests in fourth quarter of 2002.

NHIndustries NH90 tactical helicopter *(Paul Jackson)* 1153791

PT3/F-ZWTJ: Common basic configuration; first with core avionics system with AFCS, navigation, communications, IFF and full 'glass' cockpit; retains mechanical control back-up; first flight at Marignane 27 November 1998. Core avionics trials with production-standard LCDs; replaced PT2 in extending flight envelope. De-icing system tests began 13 April 2001, lasting 20 hours. Became first helicopter in world to fly with full quadruplex FBW control system, December 2003; now representative of production standard NH90. Engaged on high altitude performance testing at Latacunga, Ecuador, from 13 September to 5 October 2005.

PT4/9890: TTH configuration; first flight 31 May 1999, at Ottobrunn. First NH90 to be fitted with C-model prototype of DaimlerChrysler Aerospace electronic warfare suite as one element in a fully integrated avionics suite, with LCD cockpit displays, FLIR, helmet sight, tactical control system, secure communications, and radar (with digital mapping). Cleared operation of rear loading ramp and doors open in flight up to 140 kt (259 km/h; 161 mph) Night flights with FLIR and rescue hoist demonstration Cold weather trials at Iqaluit, Canada, January-February 2003 Undertook operational evaluation with French Army 17 to 30 September 2005.

PT5/MMX613: NFH mission system; first flight at Cascina Costa 22 December 1999. Performed flotation system test. Accomplished initial NH90 deck operating campaign aboard replenishment tanker *Etna*, 2–8 May 2001, with 77 landings and 42 decklock engagements, all in FBW mode Third series of deck trials, May 2003 (first with deck hook).

GTV: Ground test vehicle at Cascina Costa. Instrumented to monitor 300 parameters. First run 28 September 1995; 539 hours accumulated by June 2000.

CUSTOMERS: See table. Requirements originally estimated as 726 (France 220, Germany 272, Italy 214 and Netherlands 20); reduced to 647 in July 1996, then to 642 in 1998 and 595 in late 1999 These comprise Germany 181 TTH and 38 NFH (= 219); France 133 TTH and 27 NFH (= 160); Italy 150 TTH and 46 NFH (= 196); and Netherlands 20 NFH. Additionally, over 600 export orders are anticipated; NHI is competing for orders from Chile, Malaysia, Poland and Saudi Arabia, amongst others. Selected for Nordic Standard Helicopter Project: Finland (**NH90-TTT**) and Norway announced decision on 13 September 2001, with Sweden following on 18 September. Greece ordered 20 NH90 (with 14 on option) on 29 August 2003. Oman ordered 20 TTHs on 24 July 2004 for delivery by 2008. Australia added 12, designated **MRH90**, on 31 August 2004, although contract not finalised until 2 June 2005; first four to be completed at Marignane, with remaining eight assembled in Australia Initial delivery in 2007, with first locally assembled MRH90 due for completion September 2008. Further order appears possible, with up to 28 helicopters required to replace S-70A Black Hawk in Army service New Zealand announced selection of NH90 on 31 March 2005 and will obtain from eight to 10 helicopters. On 20 May 2005, Spain revealed plans for an initial purchase of 45 NH90s. Most recent customer is Belgium, which revealed intent to purchase 10 on 9 December 2005; at that time, total of 357 NH90s on firm order, with at least another 63 awaiting contract finalisation and 120 more subject to option

NH90 ORDERS

Customer	TTH	NFH	Total	First flight and location
Australia (Army)	12		**12**	
Finland (Air Force)	20		**20**	15 Sep 04 M 13 Jul 05 H
France (Navy)		**27**	**27**	M
Germany (Air Force)	30		**30**	D
(Army)	50		**50**	4 May 04 D
Greece (Army)	20		**20**	13 Jul 05 M
Italy (Navy)	10	**46**	**56**	15 Dec 05 V (NFH)
(Army)	60		**60**	15 Sep 04 V
Netherlands (Navy)		20	**20**	V
Norway (Air Force)		14	**14**	H
Oman (Air Force)	20		**20**	
Portugal (Army)	10		**10**	
Sweden (Helicopter Wing)	13	5	**18**	18 Mar 05 H
Totals	**245**	**112**	**357**	

Notes: German Air Force total includes 23 for combat SAR
First aircraft for Finland built at Marignane; second at Halli; third at Vergiate; remainder at Halli.
Locations are D = Donauworth, Germany; H = Halli, Finland; M = Marigane, France; V = Vergiate, Italy
Firm contracts still to be concluded with Belgium (10 NH90s); New Zealand (8-10) and Spain (45)

COSTS: Development cost EUR1,376.15 million (EUR 9.6 billion) (January 1988 values) agreed September 1992, provided by governments and industry: EUR421.83 million French government plus EUR161.24 million Eurocopter France; EUR256 41 million Germany plus EUR74 59 million Eurocopter Deutschland; EUR89.44 million Netherlands plus EUR2.64 million Fokker; and EUR370 million by Italian government. Additional development, agreed October 1995, adds EUR58.23 million. By January 1997, an estimated 75 per cent of R&D costs had been disbursed. Projected flyaway prices (1995) are EUR90 million for TTH and EUR145 million for NFH, but further 15 per cent cut demanded by French military procurement office in February 1996. Initial batch of French NFHs have 2000 unit cost of EUR200 million, including spares and tax; NHI quotes EUR115 million, pre-tax Netherlands paying NLG1 7 billion (USD510 million) giving a unit price of USD25.5 million per aircraft. Cost of 10 TTH for Portugal quoted as EUR200 million.

DESIGN FEATURES: Compact external dimensions with large cabin (larger and slightly higher than Sikorsky Black Hawk). Low vulnerability/detectability, with aerodynamic and low-observables design, reduced maintenance requirements, and day/night operability within temperature range of –40 to +50°C. Specification requires fewer than 250 failures per 1,000 flight hours; 97.5 per cent mission reliability rate; 87 per cent availability; MTBF better than 4 hours; and under 2 5 mmh/fh (excluding engines). Service life of 10,000 hours over 30 years

Titanium Spheriflex main rotor hub with elastomeric spherical thrust bearings; four blades with advanced aerofoils and curved tips; main rotor turns anticlockwise at 256.6 rpm with 219 m (719 ft)/s tip speed; bearingless tail rotor with four blades of similar design and construction; tail rotor with cross-beam hub turns at 1,235.4 rpm with 207 m (679 ft)/s tip speed; automatic electronic folding of main rotor blades and tail pylon in NFH; manual blade folding (automatic optional) in TTH. Large unobstructed internal volume.

FLYING CONTROLS: Quadruplex fly-by-wire controls eliminate cross-coupling between control axes NH90 is the world's first FBW transport helicopter. Flight control system developed by Eurocopter France; optimised for NOE flight and minimal vulnerability to small arms damage.

STRUCTURE: All-composites fuselage; fail-safe design of structure, rotating parts and systems for high safety levels. First set of main and tail rotor blades completed for ground testing May 1994; blades have multibox structure and glass and carbon fibre skin; leading-edge box and roved parts of blade prefabricated to reduce time in main mould; resin used reduces material ageing in damp and hot regions; blades designed and manufactured using CATIA CAD/CAM.

Eurocopter France builds rotor, rear gearbox, auxiliary gearbox, fairings and produces wiring, electrical system and air conditioning. Eurocopter Deutschland builds front and centre fuselage and fuel system. Agusta responsible for rear fuselage, main gearbox, hydraulic system and rear ramp; Stork Aerospace for tailboom (first completed unit delivered mid-2003), sliding doors, landing gear and fairings and intermediate gearbox. Assembly lines in France, Germany (TTH only), Italy and Finland (Patria) for the Nordic helicopters Portuguese industries supply Agusta and Eurocopter with cabin steps, some electrical wiring and engine supports. Saab awarded contract in February 2002 for supply of 200 NH90 forward fuselage sections.

LANDING GEAR: Retractable crashworthy tricycle gear by DAF Special Products with twin-wheel nose unit (tyre size 6.00–6; 10 ply) and single-wheel main units (tyre size 615×225–10; 12 ply); all units retract rearwards; four-balloon emergency flotation gear effective up to Sea State 3. NFH has harpoon-type deck haul-down gear.

POWER PLANT: Two engines; required power from each engine during normal operation at S/L is 1,788 kW (2,398 shp) for 30 minutes, 1,662 kW (2,229 shp) maximum continuous, OEI maximum contingency (2½ minutes) 1,855 kW (2,488 shp), emergency (30 seconds) 2,158 kW (2,895 shp) and continuous (1 h) 1,802 kW (2,417 shp). Engine RFP issued April 1992. Decided on 25 January 1994 that NFH and TTH will be developed and qualified with 1,566 kW (2,100 shp) RTM 322-01/9 made by European consortium of Turbomeca, Rolls-Royce, MTU and Piaggio; during development, the 1,521 kW (2,040 shp) GE T700-T6E1 is being qualified by Alfa Romeo and GE to meet Italian military requirements. In June 2001, US$1 billion contract signed by Eurocopter for supply of production RTM 322-01/9 engines, including initial tranche of 254 power plants for installation in aircraft for France, Germany and Netherlands; same engine also specified for Australian and Omani NH90s. Engine control by FADEC.

Transmission rating 2,925 kW (3,922 shp) with both engines, 2,170 kW (2,910 shp) for 30 seconds OEI. Modular main gearbox features integrated lubrication system with innovative integral monitoring and diagnostic system and, like the two accessory gearboxes, can run dry for 30 minutes.

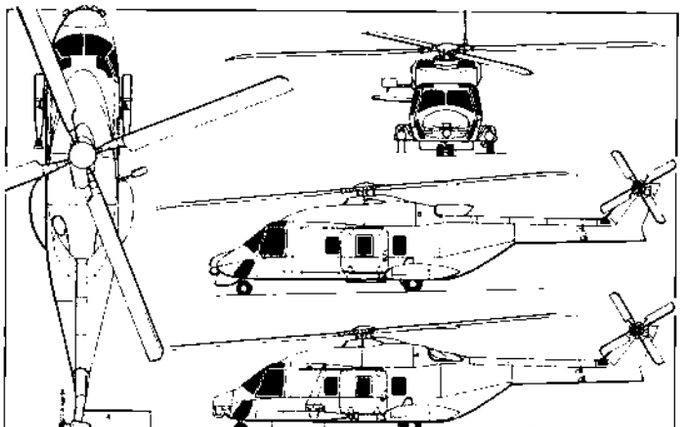
Fuel system has eight Uniroyal crash-resistant self-sealing cells and AFG management system Total internal capacity approx 2,500 litres (660 US gallons; 550 Imp gallons). Provision for pressure refuelling and hover refuelling. Provision for two external tanks (modified from Alpha Jet) each of 310 litres (82 US gallons; 68 Imp gallons) plus four ferry tanks in cabin.

ACCOMMODATION: Minimum crew one pilot VFR and IFR; NFH crew, pilot, co-pilot/TACCO on flight deck and one system operator in cabin; optionally, two pilots on flight deck and one TACCO, one SENSO in cabin; TTH, two pilots or one pilot and one crewman on flight deck and 14 to 20 equipped troops or 12 stretchers or one 2 tonne tactical vehicle in cabin. Sogerma crew seats and Autoflug composites passenger seats withstand 22 *g* or 11 m (35 ft)/s vertical descent crash loading. Swedish helicopters have 'high cabin', allowing more room for treatment of patients during SAR missions; for ASW mission, Swedish NH90 will have one operator console permanently installed and capability to add a second within two hours.

SYSTEMS: Full redundancy for all vital systems; hydraulic system has two Vickers mechanically driven and one electrohydraulic and one electric pumps; redundant flight control hydraulic system has two main separated and independent circuits; independent utilities system provides hydraulic power for landing gear and ancillary operations; electrically driven pump as back-up in event of one circuit failing; other circuit permanently supplied in parallel by a utility system pump. Electrical system by Thales has two Saft batteries and three 40 kVA Auxilec AC generators (two driven by main gearbox, one by remote accessory gearbox) feeding DC busses through transformer-rectifiers; 70 kW Microturbo Saphyr 100 APU for electrical engine starting, environmental control on ground and emergency use in flight; Kollmorgen-Artus emergency DC generator (driven by remote accessory gearbox); fire detection and suppression in engine bays, APU and cabin. Microtecnica air conditioning system (with two identical independent units) operating in three zones: cockpit, cabin (both vapour cycle) and main avionics bays (filtered external air). Anti-icing of main blades (standard on TTH, optional on NFH) by heated leading-edge mat (heating carbon coating and not metal parts). Anti-icing system also on tail rotor blades and horizontal stabiliser, and air intakes. Ice protection system effective in maximum conditions defined by DEF-STAN 000–970. Dunlop Aerospace Ice Protection and Composites selected in mid-2002 to design, develop and produce anti-iced engine air intakes for NH90, with serial production starting in 2003.

AVIONICS: Core avionic system based on dual MIL-STD-1553B data highways (one for the core avionics system, one for the mission system) allows integration of aircraft and mission equipment through several computers. Eurocopter France responsible for basic avionics; Eurocopter Deutschland for TTH avionics; Agusta-Westland for NFH mission system.

Comms: Integrated management of communications and identification systems. Two V/UHF; V/UHF DF/homer; HF SSB and Thales TSC 2000 IFF. Elmer intercom.



NHIndustries NH90 NFH, with additional side view (upper) of TTH *(Mike Keep)*

Radar: NFH has Thales ENR 360° track-while-scan surveillance radar with target recognition capability; TTH has Honeywell weather radar. Telephonics APS-143B(V)3 Ocean Eye multimode surveillance radar chosen for Swedish helicopters.

Flight: Twin INS with embedded GPS and Doppler ground speed sensor; twin air data computers; provision for radio altimeter and MLS. SFIM/Alenia flight control computer and Thales/BAE Systems microwave landing system.

Instrumentation: NVG compatible. Five 200 mm (8 in) square Thales LCDs in cockpit of NFH; up to three more in cabin; four (fifth optional) in TTH. TTH has digital map. Central warning system, two remote frequency indicators and conventional analogue back-up instruments. Provision for Thales Topowl binocular helmet-mounted display and sight.

Mission: NFH: Alenia or Thales FLASH dipping sonar, high focal-length tactical FLIR, IFF interrogator, Link 11 datalink including ship-to-air umbilical, ESM and telebrief; electronic warfare subsystem, SAGEM OLOSP electro optical multisensor turret; French NFH has single SAGEM IRIS Thermal imager; Nordic helicopters will operate with two or three sensors, depending on specific mission requirement, but probably including some or all of day TV, IR camera and laser rangefinder. Dedicated video/audio network distributes tactical information to all crew members. TTH: FLIR. Modular tactical mission system (TMS) for Swedish NH90 being developed by Saab under terms of agreement signed with NH Industries on 1 February 2002; sensors include Galileo Avionica FLIR, Thales FLASH-S dipping sonar and radar. Delay in TMS development revealed in mid-2005 expected to result in delivery of operational helicopters to Swedish armed forces being up to two years later than originally planned.

Self-defence: Provision for MAWS, RWR, LWR, Matra chaff/flares and IR jammer. TTH has self-protection suite with passive threat warning system known as EWS (electronic warfare suite) with EADS laser warning receiver, LFK AN/AAR-60 MILDS (missile launch detection system) and Thales EW processor and radar warning receiver. Active elements of self-protection suite include MBDA Saphir-M chaff/flare dispenser system and IR jammer. Norway selected ITT Avionics AN/ALQ-211 SIRFC in first quarter 2002. Swedish NH90 self-protection EW suite developed jointly by Saab Avionics of Sweden and Avitronics of South Africa. Includes radar, missile and laser warning capabilities and countermeasures dispensing equipment.

EQUIPMENT: Rosemount windscreen washers/wipers; Siren 5 tonne cargo hook and rescue hoist. NFH has Magnaghi 5 ton deck restraint harpoon and automatic main rotor blade and tail folding.

ARMAMENT: TTH can have area suppression and self-defence armament; NFH to carry air-to-surface missiles weighing up to 400 kg (882 lb) and anti-submarine torpedoes (including Murène 90); air-to-air missiles optional. Italian NFH will carry Marte Mk 2/S.

DIMENSIONS, EXTERNAL:

Main rotor diameter	16.30 m (53 ft 5½ in)
Main rotor blade chord	0.65 m (2 ft 1½ in)
Tail rotor diameter	3.20 m (10 ft 6 in)
Tail rotor blade chord	0.32 m (1 ft 0½ in)
Length: overall, rotors turning	19.565 m (64 ft 2¼ in)
fuselage (NFH)	16.09 m (52 ft 8¼ in)
folded (NFH)	13.50 m (44 ft 3½ in)
Height: folded (NFH)	4.16 m (13 ft 7¾ in)
overall, tail rotor turning	5.31 m (17 ft 5 in)
Width: max (incl tailplane):	
NFH clean	4.515 m (14 ft 9¾ in)
NFH with torpedoes	4.625 m (15 ft 2 in)
over mainwheel fairings	3.63 m (11 ft 11 in)
over torpedoes (NFH)	3.85 m (12 ft 7½ in)
fuselage max	2.60 m (8 ft 6¼ in)
folded (NFH)	3.63 m (11 ft 11 in)
Tailplane half-span (stbd)	2.79 m (9 ft 1¾ in)
Wheel track	3.20 m (10 ft 6 in)
Wheelbase	6.08 m (19 ft 11½ in)
Rear-loading ramp: Length	1.58 m (5 ft 2¼ in)
Width	1.78 m (5 ft 10 in)
Cabin door: Width	1.60 m (5 ft 3 in)
Height	1.50 m (4 ft 11 in)

DIMENSIONS, INTERNAL:

Cabin: Length: excl rear ramp	4.80 m (15 ft 9 in)
incl rear ramp	6.17 m (20 ft 3 in)
Min usable width	2.00 m (6 ft 6¾ in)
Min usable height: standard	1.58 m (5 ft 2¼ in)
'high cabin'	1.82 m (5 ft 11¾ in)
Volume: standard	15.2 m³ (537 cu ft)
'high cabin'	17.5 m³ (618 cu ft)

AREAS:

Main rotor disc	208.67 m² (2,246.1 sq ft)
Tail rotor disc	8.04 m² (86.57 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: basic: NFH	6,288 kg (13,863 lb)
TTH	5,945 kg (13,106 lb)
equipped: TTH	6,200 kg (13,669 lb)
Standard fuel: NFH (usable)	2,036 kg (4,489 lb)
Max payload: TTH	2,500 kg (5,511 lb)
T-O weight, TTH, NFH:	
typical mission	10,000 kg (22,046 lb)
max	10,600 kg (23,369 lb)
Max disc loading	50.8 kg/m² (10.40 lb/sq ft)
Transmission loading at max T-O weight and power	3.62 kg/kW (5.96 lb/shp)

PERFORMANCE (TTH at 1,000 m; 3,280 ft ISA +15° C, NFH at S/L, ISA +10° C, except where stated):

Max cruising speed:	
NFH	157 kt (290 km/h; 180 mph)
TTH	165 kt (305 km/h; 190 mph)
Econ cruising speed: NFH	132 kt (245 km/h; 152 mph)
TTH	140 kt (260 km/h; 162 mph)
Max rate of climb at S/L: NFH	528 m (1,732 ft)/min
TTH	522 m (1,713 ft)/min
Rate of climb at S/L, OEI: NFH	61 m (200 ft)/min
TTH	45 m (148 ft)/min
Hovering ceiling: IGE: NFH	3,140 m (10,300 ft)
TTH	2,960 m (9,720 ft)
OGE: NFH	2,515 m (8,260 ft)
TTH	2,355 m (7,720 ft)
Mission loiter: NFH, 50 n miles (93 km; 58 miles) from base, 20 min reserves	3 h 20 min
Range: max operational:	
NFH	491 n miles (910 km; 565 miles)
TTH	430 n miles (796 km; 494 miles)
ferry: NFH	658 n miles (1,220 km; 758 miles)
TTH	648 n miles (1,200 km; 745 miles)
Radius of action:	
TTH with 2,000 kg; 4,409 lb payload, 30 min reserves	162 n miles (300 km; 186 miles)
Max endurance: NFH	4 h 45 min
TTH	4 h 35 min

Iran

AII

AVIATION INDUSTRIES OF IRAN

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AII was formed in April 1993. It is affiliated to the Industrial Development and Renovation Organisation (IDRO) of the Iranian Ministry of Industries and Mining to produce, repair and maintain various types of aircraft. Following the AVA-101 glider (designed and built by Paravan Pars, flown in 1995 and now in service with Iran Civil Aviation Training Services), it flew its first powered aircraft, the AVA-202 two-seat trainer, in mid-1997.

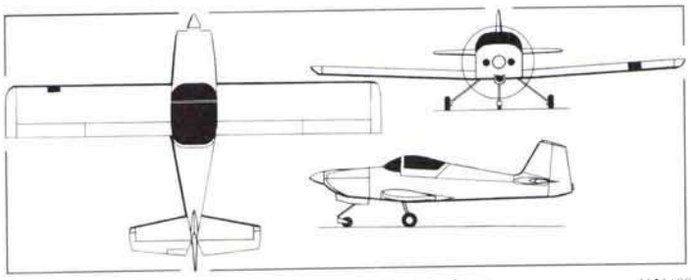
In 1998 the company began construction of its own 75 ha (185.3 acre) airport facility at Azadi, some 65 n miles (120 km; 75 miles) from Tehran; this was completed in 2000. An aeroclub and sales centre have been established at this location for pilot training and customer demonstrations.

Under the designation AVA-303, AII is undertaking licensed assembly of the Polish PZL M18B Dromader agricultural aircraft to supplement those already purchased directly from PZL. By the end of 2002 the first set of Polish-supplied components had been received and assembled. The programme is expected to yield 12 to 15 aircraft for the Iranian Ministry of Agriculture, built at a new production line to be located at Azadi.

Other programmes stated to be current in October 2004 included a small helicopter (AVA-505) and a new 19-seat transport (AVA-606), both now to be joint ventures, while the AVA-404 designation will be applied to a foreign type to be produced under licence.

AII's AVA designations appear to be assigned for purposes of unification and export marketing; some of the aircraft are known by different designations within Iran, having been produced by companies affiliated to AII.

AVA-202 trainer/sportplane *(Paul Jackson)* 1159077



Aviation Industries of Iran AVA-202 trainer *(Paul Jackson)* 1121600

AII AVA-202

TYPE: Primary prop trainer/sportplane.

PROGRAMME: Intended for domestic market to avoid dependence on foreign imports; prototype (originally known as IR-02) made first flight on 3 June 1997; second had been built by 3 January 1999 when one was lost in a fatal accident while testing an emergency parachute. Series production launched in 2000. Iranian certification to JAR-VLA (Normal category) standard was awarded on 16 August 2000. Made its public debut (fourth aircraft shown) at the Iran International Air Show in October/November 2002. Four completed by early 2003; no later total provided by mid-2006.

CUSTOMERS: Four ordered by a flying school in Iran; 10 on option for a government institute.

DESIGN FEATURES: Similar configuration to US Van's RV-6A, but with greater wing span; meets JAR 22 and JAR-VLA standards. Intended for pilot training, general aviation, surveillance and recreational flying.

NASA aerofoil sections: 63_3-215 (wing), 63_3-015 (horizontal tail) and 63-010 (vertical tail).

FLYING CONTROLS: Conventional and manual. Balanced ailerons; horn-balanced elevators. Trim tab in port elevator. Electrically actuated single-slotted flaps.

STRUCTURE: Mainly aluminium alloy; steel alloys in some areas. Single-spar wings. Glass fibre engine cowling and wingtip fairings.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring steel tube cantilever mainwheel legs with 5.00-5 tyres; trailing link, castoring nosewheel on spring steel tube cantilever leg with shimmy damper; tyre size 10X3.50-4. Hydraulic mainwheel disc brakes. Streamlined composites fairings over all three wheels.

POWER PLANT: One Textron Lycoming O-320-B2B flat-four engine (119 kW; 160 hp at 2,700 rpm), driving a Sensenich M 74 DM two-blade, fixed-pitch metal propeller. Optional 112 kW (150 hp) Lycoming O-320-E2D. Integral fuel tank in each wing, combined capacity 120 litres (31.7 US gallons; 26.4 Imp gallons).

ACCOMMODATION: Two seats side by side. Dual controls. Wraparound windscreen; one-piece rearward-sliding canopy. Cabin heated and ventilated. Rear baggage compartment with internal access.

SYSTEMS: 12 V electrical system.

AVIONICS: To customer requirements; can include Bendix/King KX 155 VHF nav/com radio, ELT, and ADF/VOR/GPS.

DIMENSIONS, EXTERNAL:

Wing span	8.74 m (28 ft 8 in)
Wing chord, constant	1.24 m (4 ft 0¾ in)
Wing aspect ratio	7.0
Length overall	6.02 m (19 ft 9 in)
Height overall	2.04 m (6 ft 8¼ in)
Propeller diameter	1.88 m (6 ft 2 in)

AREAS:

Wings, gross	10.87 m² (117.0 sq ft)
Vertical tail surfaces (total)	1.04 m² (11.19 sq ft)
Horizontal tail surfaces (total)	2.40 m² (25.83 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	500 kg (1,102 lb)
Max T-O and landing weight	750 kg (1,653 lb)
Max wing loading	69.0 kg/m² (14.13 lb/sq ft)
Max power loading	6.29 kg/kW (10.33 lb/hp)

PERFORMANCE:

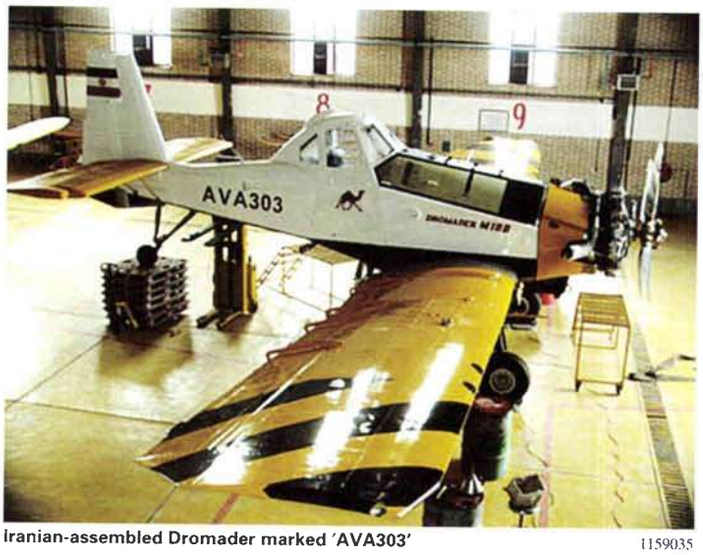
Max level speed at S/L	140 kt (259 km/h; 161 mph)
Max cruising speed, 75% power	135 kt (250 km/h; 155 mph)
Stalling speed, flaps down	45 kt (84 km/h; 52 mph)
Max rate of climb at S/L	457 m (1,500 ft)/min
Service ceiling	6,400 m (21,000 ft)
T-O run	250 m (820 ft)
Range with max fuel	540 n miles (1,000 km; 621 miles)

AII AVA-303

TYPE: Agricultural sprayer.

PROGRAMME: Assembly and eventual licensed manufacture of PZL M-18B Dromader (which see), to supplement aircraft previously imported from Poland; first set of Polish-supplied components (for EP-AVA, c/n 303-1, delivered 23 September 2002) had been assembled by end of 2002. New assembly line located at Azadi airport facility. Company reported expanded production by early 2005, though no specific details given. Earlier plans to introduce some design changes will not now be implemented.

CUSTOMERS: Iranian Ministry of Agriculture. Programme may yield 12 to 15 new aircraft, depending upon requirement.



Iranian-assembled Dromader marked 'AVA303' 1159035

AII AVA-404

In design stage 1996 as twin-turboprop light transport, but not proceeded with. Designation re-allocated to a new six-seat design, which company now says will be a foreign type manufactured under licence. This had not been identified by mid-2006.

AII AVA-606

TYPE: Twin-turboprop light transport.

PROGRAMME: The 19-seat transport project announced by AII in 2002 now has the designation AVA-606. According to the company in October 2004, this is to be a joint venture programme, negotiations with different companies being under way at that time. Three months later, at the Iran Air Show, it exhibited a model of a 19/32-seat passenger transport bearing the designation **A-209M** and the name of the Austrian-registered company Mukhamedov Flugzeugbau GmbH. AII would not comment further beyond saying that it was close to an agreement with a partner on the concept. No details of the aircraft were forthcoming, and no further news had emerged by mid-2006.

Further details of the A-209M, then credited to the Aero-M design bureau, appeared in *Jane's All the World's Aircraft* between 1997 and 1999.

AIO

AVIATION INDUSTRIES ORGANISATION OF THE ISLAMIC REPUBLIC OF IRAN

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AIO, a subdivision of the Iranian Ministry of Defence, is the policy maker, co-ordinator and planner for the manufacturing, overhaul, repair and support of aircraft by Iran's aviation industry. Created to counter problems arising from the Gulf wars and subsequent economic sanctions, its primary concern has been in supplying spares for aircraft in service and obtaining the technologies required for manufacturing various types of aircraft for the Iranian armed forces. However, it has now assumed a much greater role in aircraft development and production, including civil programmes such as the Ir.An-140.

According to Jane's sources in December 2001, the Iranian government was to consider a bill calling for the establishment of an Aerospace Organisation of the Defence and Armed Forces Logistics Ministry, into which all aerospace manufacturing and research units, as well as Iranian MoD factories, would be merged. No later information regarding this proposal had emerged by mid-2006.

Earlier proposals for a co-production programme involving the Ilyushin Il-114 lapsed, but talks between Iranian officials and the Tupolev JSC have continued concerning possible Iranian participation (including local assembly) in the Tu-204 and manufacture of up to 100 Tu-334s over a 15-year period.

SUBSIDIARIES:

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MANAGING DIRECTOR: Abbas Fallah

IHSRC Bell 214ST *(Robert Hewson)* 1121644

Otherwise known as Hevapeimasazi, or **HESA**, this state-owned company is controlled jointly by the Iranian Ministry of Defence and Ministry of Industries and Mining, and is the main aircraft production centre of the AIO, with divisions responsible for trainers, helicopters, the Ir.An-140 transport and UAVs. Programmes include the HT-80, a proposed replacement for (but based on) the Pilatus PC-7 Turbo-Trainer.

Esfahan factory construction initiated 1975 by Bell Helicopter Textron for production of Bell 214, but suspended 1978 after Islamic revolution when only 11 per cent completed. Reactivated 1983; began piston engine manufacture 1988 and Northrop F-5B overhaul 1989. Helicopter (Bell AH-1J and other) and hovercraft overhaul started 1993; first production piston engine completed in 1996.

Following a February 1996 agreement, a factory was set up, with Ukrainian government assistance, for licensed assembly of the Antonov An-140 twin-turboprop transport, now known by the Iranian designation Ir.An-140 Faraz. A similar agreement with MAPO organisation, for manufacture of 60 Motor-Sich TV7-117VMA turboprop engines, was announced at the 1997 Paris Air Show and valued at USD180 million. These engines were said to be for installation on 'Ukrainian- and Russian-built' airliners.

Qods Aviation Industries (QAI)
PO Box 13445-873, 4 Km Karaj Road, Tehran
Tel: (+98 21) 450 33 06
Fax: (+98 21) 450 33 07
e-mail: mohajer@isiran.com

Established 1984 to design, develop and manufacture surveillance/reconnaissance and attack RPV/UAVs and aerial targets (see *Jane's Unmanned Aerial Vehicles and Targets*). Subsidiary of IAMI/HESA. Also manufactures parachutes and parafoils for UAV/target/ultralights recovery, sky-diving and various other applications. Factory area 40,000 m² (430,550 sq ft); 1998 workforce (latest known figure) approximately 400.

Iran Aircraft Industries (IACI)
PO Box 14155-1449, Tehran
Tel: (+98 21) 603 56 06
Fax: (+98 21) 600 00 75
e-mail: karhava@isiran.com
MANAGING DIRECTOR: Nasser Marzebani
AERO-ENGINE PROGRAMMES MANAGER: Eng Amiri

Established by Northrop Corporation in 1970; first Iranian aviation company to obtain ISO 9002 certification. Known locally as **SAHA**, factory has overhauled, maintained and repaired

approximately 4,000 aircraft and aero-engines. Like IAMI/HESA, it is controlled by the Ministry of Defence. It occupies a 45,000 ha (111,195 acre) site, and had a 2004 workforce of about 2,500. It is designated to produce the Tu-204, and the Tu-334 and its D-436 engines, if these programmes come to fruition. Earlier aircraft projects included the Fajr (Dawn) piston-engined trainer described briefly in earlier editions of *Jane's All the World's Aircraft*.

Turbine Engine Manufacturing (TEM)

Manufactures engine components at a 100,000 m² (1.08 million sq ft) site with shop floor area of 33,000 m² (355,200 sq ft). Also has well-equipped research laboratories and active design team. Producer of Tolloue 4 and 5 small jet engines, unveiled in late 1999 as power plants for UAVs and aerial targets.

Iran Helicopter Support and Renewal Company (IHSRC)

PO Box 13185-1688, Mehrabad Airport Road, Meraj Avenue, Tehran
Tel: (+98 21) 600 34 14
Fax: (+98 21) 601 58 62
e-mail: panha@isiran.com
MANAGING DIRECTOR: Ahmad Dadbin
DEPUTY MANAGING DIRECTOR: Abdollah Kheirollahi

Established 1969 with assistance of Agusta (Italy) and Bell Helicopter (USA); overhaul and maintenance of Agusta-Bell 205, 212, 214A/B/C; Bell 206/206L JetRanger/LongRanger and AH-1J/JT Cobra series; Boeing CH-47C Chinook; and Sikorsky SH-3D Sea King and RH-53D Sea Stallion. In 1999, it was stated that experience gained with extensive rebuild and refurbishment of AH-1J SeaCobras had given IHSRC (known locally as **PANHA**) the potential for full manufacture, if so required. Current upgrade programmes (see *Jane's Aircraft Upgrades*) include those for Bell 205 (Shabaviz) and AH-1J (Project 2091). PANHA has designed a 14-seat helicopter known as the Parian (fairy in English), possibly based on the Bell 214. By early 2005, this had attracted interest from the National Iranian Oil Company and others; PANHA stated capability to produce up to 20 per year, but no orders reported by mid-2006.

IACI (SAHA) SHAFAGH

English name: The light before dawn
Russian name: Rassvet

TYPE: Advanced jet trainer/light attack jet.

PROGRAMME: Existence revealed at Aero 2000 air show in Tehran; name also transliterated as Safak or Shafaq. Programme controlled by Tehran's Aviation University Complex (part of the Malek-Ashtar University of Technology). Design, to IRGC specifications, based on earlier (twin-engined) proposals from Russian OKB headed by Fatidin Mukhamedov, with characteristically unorthodox configuration. Wind tunnel testing of one-seventh scale model in Tehran followed by completion of full-size mockup. Integration of landing gear, hydraulic system and avionics under way in late 2002. Displayed in model form at Iran International Air Show in late 2002, at which time prototype roll-out targeted for 2008. No further details emerged at January 2005 Iranian air show. According to one report during that year, some design changes were under consideration, including an F-16 type 'chin' intake; design authority had passed to Malek-Ashtar University by 2005.

CUSTOMERS: Potentially, Russian Air Forces (to replace Aero L-39 C) and Iranian Air Force.

DESIGN FEATURES: Close-coupled configuration. Circular wing centre-section with pronounced LERX and tapered outer panels; twin outward-canted fins and rudders and (probably all-moving) tailplane halves.

POWER PLANT: One RD-33 turbofan (General Electric J79 turbojet in early design studies).

ACCOMMODATION: Crew of two in tandem; Russian (Zvezda K-36D ?) ejection seats.

AVIONICS: Row of three MFDs; HUD; HOTAS controls on centrally mounted column.

ARMAMENT: Seven external stores stations (one on centreline and three beneath each wing).

DIMENSIONS, EXTERNAL (approx):

Wing span	12 m (39.4 ft)
Length overall	14 m (45.9 ft)

Shafagh model displayed in January 2005 *(Robert Hewson)* 1121664

Cockpit of IACI Shafagh 1159037

IACI Shafagh full-size mockup 1159036

WEIGHTS AND LOADINGS (approx):

Weight empty	5,000 kg (11,023 lb)

PERFORMANCE (estimated):

Max level speed	M1.3

IAMI (HESA) HT-80

TYPE: Basic turboprop trainer.

PROGRAMME: Preceded by programme to reverse engineer Pilatus PC-7s under Iranian designation S-68, three prototypes of which completed by Malek-Ashtar University of Technology before being handed over to HESA for series production; latter had reportedly built five before suspending manufacture due to protest from Pilatus. Replaced by HT-80 project, for which in 2002–03 HESA was in conceptual ('pre-preliminary') design stage, as eventual successor to the Swiss trainer in IRIAF service. Roll-out of first example tentatively forecast for 2005 or 2006 at that time, though no further details had emerged by mid-2006. HESA may seek international partners (China one potential option).

CUSTOMERS: S-68s delivered to IRGC (two) and IRIAF.

DESIGN FEATURES: Generally similar to PC-7.

POWER PLANT: Studies in 2002 were based on Walter M601T (flat rated to 559 kW; 750 shp) or equivalent Motor-Sich turboprop, although P&WC PT6A said to be preferred. Four-blade propeller. Capability for 30 seconds of inverted flight.

ACCOMMODATION: Crew of two in tandem on stepped, SKS-94 lightweight ejection seats.

AVIONICS: Conventional (analogue) instrumentation.

Following data estimated and provisional:

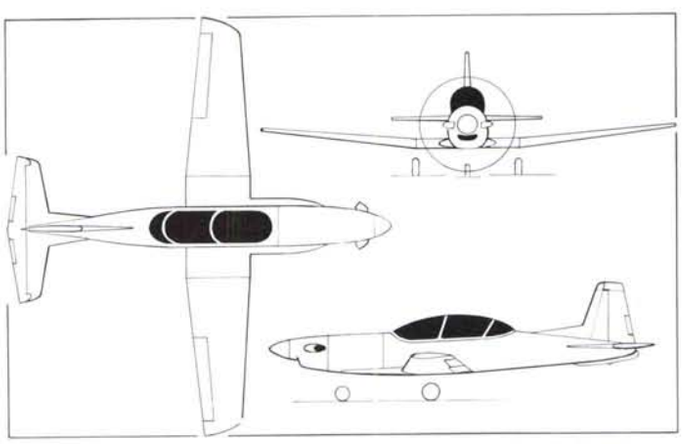
DIMENSIONS, EXTERNAL:

Wing span	10.40 m (34 ft 1½ in)
Length overall	9.78 m (32 ft 1 in)
Height overall	3.30 m (10 ft 10 in)
Tailplane span	3.60 m (11 ft 9¾ in)
Wheel track	2.60 m (8 ft 6¾ in)
Wheelbase	2.32 m (7 ft 7¼ in)

WEIGHTS AND LOADINGS (A: Aerobatic, U: Utility category):

Max T-O weight: A	1,900–2,068 kg (4,188–4,559 lb)
U	2,700–2,883 kg (5,952–6,356 lb)

HESA model of the HT-80 Iranian development of the PC-7 *(Robert Hewson)* 0530184



Provisional general arrangement of the proposed IAMI (HESA) HT-80 turboprop trainer *(James Goulding)* 0552825

Max landing weight: A ..... as MTOW
U ..... 2,565–2,733 kg (5,655–6,025 lb)
PERFORMANCE (estimated; A and U as above):
Max operating speed:
A ..... 240–324 kt (444–600 km/h; 276–372 mph)
U ..... 270 kt (500 km/h; 310 mph)
Max cruising speed at S/L:
A, U ..... 208–211 kt (385–391 km/h; 239–243 mph)
Stalling speed: A ..... 71 kt (132 km/h; 82 mph)
U ..... 83 kt (154 km/h; 96 mph)
Max rate of climb at S/L:
A ..... 702–798 m (2,303–2,618 ft)/min
U ..... 393 m (1,290 ft)/min
Max operating altitude: A, U ..... 7,620 m (25,000 ft)
T-O to 15 m (50 ft) at S/L: A ..... 320–425 m (1,050–1,395 ft)
U ..... 1,180 m (3,870 ft)
Landing from 15 m (50 ft) at S/L:
A ..... 480–550 m (1,575–1,805 ft)
U ..... 800 m (2,625 ft)
g limits: A ..... +7.0/–3.5
U ..... +4.5/–2.5

IAMI (HESA) Ir.An-140 FARAZ

English name: Elevation

TYPE: Twin-turboprop airliner.

PROGRAMME: Licence-built Antonov An-140. Selected by Iran in 1995, against competition from 12 other contenders; initial agreement leading to Iranian manufacture signed February 1996; first stage is assembly from imported KhGAPP CKD kits at rate of up to 12 per year (first two kits received by early 2000); long-term objective is gradual progress to local parts manufacture; Iranian engineers installed at Antonov from 1997. Similar agreement with TEM to assemble power plant. Contract announced late 1998 for initial quantity of 80 aircraft by second quarter 2009, for Iranian domestic (civil and military) use only, but possibility of additional 25 production for export to CIS states has been suggested. In May 1999, Iran Electronics and Leninets (St Petersburg) signed contract for Ir.An-140 avionics development. Assembly of first aircraft (c/n 90-01) began at Esfahan March 1999 and completed by September 2000; maiden flight achieved on 7 February 2001. Second aircraft (of initial batch of eight) rolled out 26 December 2002, maiden flight in March 2003. Iranian certification awarded 14 April 2003. First two aircraft (EP-SFD and 'SFE) handed over to Safiran on 10 October 2003 and began revenue services on 29 November 2004; third completed late 2003 but still unflown by March 2005, at which time two more awaiting acceptance and further three reportedly in final assembly. Fourth aircraft reported to have been completed by time of Dubai Air Show in November 2005, when agreement signed for supply of a further 40 An-140-100 kits, assembly of which scheduled to begin in second quarter of 2010.

Total of 14 originally scheduled for completion from CKD kits by end of 2004, but due to funding delays only three completed at that time. Revised plan called for additional four by March 2006 and next eight by March 2007, with annual output rate of 12 to be achieved in 2008. Offered for passenger (including VIP) civil transport, aeromedical (ambulance or flying hospital) use, cargo/passenger or parachutist carrying, photogrammetry, geosurvey, environmental research, fisheries protection and pollution control; military versions could include staff or personnel transport, coastal and maritime patrol, radar patrol/missile guidance, elint and crew training. MPA to be next version developed; HESA reports IRI Navy requirement for about 10; hoped to roll out first example in 2006.

CURRENT VERSIONS: **Ir.An-140:** First three Iranian-assembled aircraft. *Following description applies to this version.*

Ir.An-140-100: Iranian production switched to this version from fourth aircraft onwards. KhGAPP scheduled to deliver first four CKD kits in 2004; up to 10 supplied or earmarked by mid-2006.

Stretched version: Projected version with 3.80 m (12 ft 5½ in) longer fuselage seating up to 68 passengers; 2,237 kW (3,000 shp) engines, 22,400 kg (49,383 lb) MTOW and 917 n mile (1,700 km; 1,056 mile) range.

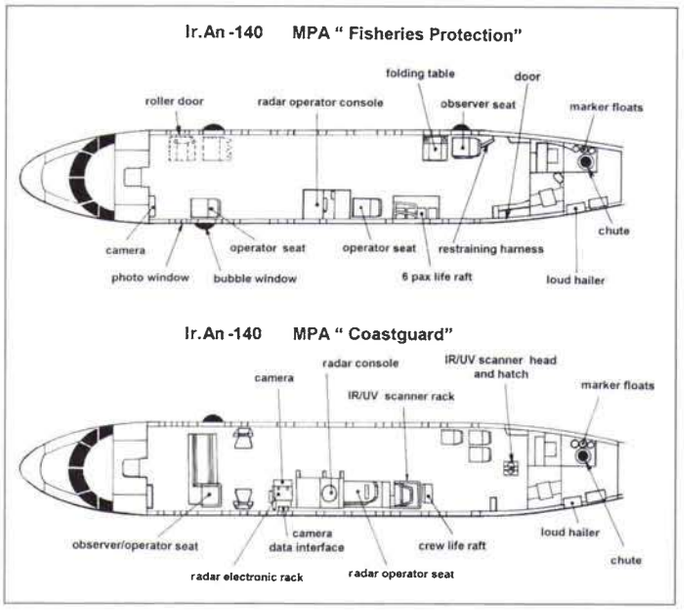
Ir.An-140MPA: Maritime patrol version; under collaborative design development with three other companies in 2002–03 (undisclosed, but thought to be KhGAPP, Antonov and Thales). Major changes (based on Ir.An-140-100 airframe) would be: bubble window each side of front fuselage; undernose FLIR turret; ventral search radar; underwing stations for weapons or auxiliary fuel tanks; MAD tailboom; and ESM suite. Internally, cabin configured for up to four systems operator positions. Roles could be extended to ASuV and/or ASW missions.

Ir.An-140T: Military transport; as TC but without rear ramp.

Ir.An-140TC: Tactical transport; under similar collaborative design development to MPA version; planned to be third version developed; rear fuselage redesigned to incorporate rear-loading ramp. Internal capacity for (typically) three 106 mm AA guns, three light vehicles or five LD3 containers; or up to 36 paratroops and a jumpmaster.

CUSTOMERS: Launch customers initially reported as Iran Air and Iran Asseman Airlines, of which latter signed order for 20 in October 1999, but Iran Air later declined to operate the type. Stated in October 2000 that 'orders' had been received for 127, but these revealed by early 2005 as letters of intent and total reduced to 112. Briefly operated in mid-2003 by Kish Air, first two then being delivered in October 2003 to Safiran Airlines, which has ordered six. Scheduled services with Safiran (Tehran to Gorgan) began 29 November 2004. Seventh aircraft, due to be delivered in 2006, will be first of four ordered by Arvand Air. Estimated Iranian market for 80. Likely also to be procured by Iranian Air Force and Navy (potential roles tactical transport, maritime patrol and EW). Africa regarded as most likely export market.

Production Ir.An-140 in the livery of Safiran Airways *(Robert Hewson)* 1121658



Interior arrangement of maritime Ir.An-140s *(James Goulding)* 1121599

COSTS: USD8.5 million unit price (2005); set-up of production line USD273 million.

POWER PLANT: Two TEM-assembled AI-30 Series 1 (Motor-Sich-built Klimov/ZMKB Progress TV3-117VMA-SBM1) turboprops, each flat-rated at 1,864 kW (2,500 shp) and driving an AV-140 six-blade propeller. First Iranian-assembled engine completed January 2005. Fuel capacity 5,460 litres (1,442 US gallons; 1,201 Imp gallons).

AVIONICS: Supplied initially by Avio Pribor; Thales (Sextant) suite under negotiation in 2002–03.

DIMENSIONS, EXTERNAL:
Wing span ..... 25.505 m (83 ft 8¼ in)
Wing aspect ratio 11.5
Length: overall ..... 22.605 m (74 ft 2 in)
fuselage ..... 22.46 m (73 ft 8¼ in)
Fuselage max diameter ..... 2.82 m (9 ft 3 in)
Height overall ..... 8.23 m (27 ft 0 in)
Elevator span ..... 9.385 m (30 ft 9½ in)
Wheel track (c/l of shock struts) ..... 3.18 m (10 ft 5¼ in)
Wheelbase ..... 8.125 m (26 ft 8 in)
Distance between propeller centres ..... 8.20 m (26 ft 10¾ in)
Propeller diameter ..... 3.72 m (12 ft 2½ in)
Passenger door (rear, port): Height ..... 1.68 m (5 ft 6¼ in)
Width ..... 0.915 m (3 ft 0 in)
Service door (rear, stbd): Height ..... 1.29 m (4 ft 2¾ in)
Width ..... 0.62 m (2 ft 0½ in)
Cargo door (fwd, stbd): Height ..... 1.29 m (4 ft 2¾ in)
Width ..... 0.985 m (3 ft 2¾ in)
Emergency exit (fwd, port): Height ..... 1.18 m (3 ft 10½ in)
Width ..... 0.51 m (1 ft 8 in)

DIMENSIONS, INTERNAL:
Passenger cabin:
Length:
excl galley/lavatory and baggage area ..... 11.60 m (38 ft 0¾ in)
incl galley/lavatory and baggage area ..... 14.51 m (47 ft 7¼ in)
Max width ..... 2.60 m (8 ft 6¼ in)
Width at floor ..... 2.28 m (7 ft 5¾ in)
Aisle width ..... 0.46 m (1 ft 6 in)
Max height ..... 1.90 m (6 ft 2¾ in)
Underfloor cargo hold: Length ..... 3.98 m (13 ft 0¾ in)
Width ..... 1.45 m (4 ft 9 in)
Max depth ..... 0.545 m (1 ft 9½ in)
Baggage/cargo compartment volume:
rear ..... 6.1 m^3 (215 cu ft)
underfloor ..... 3.0 m^3 (106 cu ft)
Overhead bins volume (total) ..... 2.3 m^3 (81 cu ft)

AREAS:
Wings, gross ..... 56.36 m^2 (606.6 sq ft)

WEIGHTS AND LOADINGS:
Weight empty ..... 11,800 kg (26,015 lb)
Max fuel weight ..... 4,370 kg (9,634 lb)
Max payload ..... 6,000 kg (13,228 lb)
Baggage/cargo compartment capacity:
rear ..... 1,040 kg (2,293 lb)
underfloor ..... 560 kg (1,235 lb)
Max T-O weight ..... 21,500 kg (47,399 lb)
Max landing weight ..... 21,000 kg (46,297 lb)
Max zero-fuel weight ..... 19,200 kg (42,329 lb)
Max wing loading ..... 381.5 kg/m^2 (78.13 lb/sq ft)
Max power loading ..... 5.64 kg/kW (9.26 lb/shp)

PERFORMANCE:
Max cruising speed at FL180 ..... 288 kt (533 km/h; 331 mph)
Max rate of climb at S/L ..... 420 m (1,378 ft)/min
Service ceiling ..... 7,600 m (24,940 ft)
Max operating altitude ..... 6,250 m (20,500 ft)
T-O distance, 10° flap ..... 1,350 m (4,430 ft)
Landing distance, 40° flap ..... 1,295 m (4,250 ft)
Range at optimum cruising speed, 45 min reserves:
with 52 passengers ..... 1,112 n miles (2,060 km; 1,280 miles)
with 46 passengers ..... 1,430 n miles (2,650 km; 1,646 miles)
with 34 passengers ..... 1,987 n miles (3,680 km; 2,286 miles)

Ferry range ..... 2,105 n miles (3,900 km; 2,423 miles)
Endurance ..... 6 h
OPERATIONAL NOISE LEVELS (estimated):
T-O, flyover ..... 85.0 EPNdB
Sideline ..... 82.5 EPNdB
Approach ..... 89.5 EPNdB

IAMI (HESA) SHAHED 278

TYPE: Light utility helicopter.

First production Shahed 278 at Iran Air Show, January 2005 *(Robert Hewson)*
1121592

PROGRAMME: Three prototypes, first of which made maiden flight late 1997 or early 1998; most-flown prototype had accumulated 200 hours by March 2001. Public debut at Iran International air show in October/November 2002 as HESA 278, having previously been reported as Panha 287. First production aircraft exhibited at Iran Air Show, Kish Island, in January 2005; second and third then undergoing static and fatigue testing, with fourth expected to fly 'soon'.

DESIGN FEATURES: Five-seater; intended for dual military/civil use, though designed primarily to meet military requirements. Locally redesigned Bell 206 JetRanger. Declared improvements include updated transmission; engine particle separator; composites airframe; new, high-efficiency tail rotor blades; new-design horizontal stabiliser; self-sealing fuel tanks; improved cabin comfort, sound insulation and optional air-conditioning; increased-area transparencies. Being marketed by 2005 for training, traffic observation, police and border patrol, rescue, medevac, aerial photography and private operation.

POWER PLANT: One 313 kW (420 shp) Rolls-Royce 250-C20B turboshaft. Fuel capacity 287 litres (75.8 US gallons; 63.1 Imp gallons) in self-sealing tanks.

ACCOMMODATION: Pilot and four passengers in 2+3 arrangement.

WEIGHTS AND LOADINGS:
Weight empty ..... 682 kg (1,504 lb)
Normal T-O weight ..... 1,451 kg (3,198 lb)

PERFORMANCE:
Max level speed: at S/L ..... 129 kt (240 km/h; 149 mph)
at FL50 ..... 124 kt (230 km/h; 142 mph)
Max rate of climb at S/L ..... 762 m (2,500 ft)/min
Service ceiling ..... 6,400 m (21,000 ft)
Hovering ceiling: IGE ..... 6,218 m (20,400 ft)
OGE ..... 4,865 m (15,960 ft)
Range ..... 183 n miles (340 km; 211 miles)

DORNA

H F DORNA COMPANY

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Web: www.hfdorna.com
MANAGING DIRECTOR: Yaghoob Antesary
CHIEF DESIGNER: Mohammad Hassan Karami

Company established March 1989 to specialise in aircraft design and development, and in composites materials technology. It has 3,000 m² (32,300 sq ft) of factory space and had a workforce of 60 in July 2005. Current product is two-seat Blue Bird. Dorna planned to open a private pilot flying training school, equipped with Blue Bird, during 2006. In 2005-06, it was seeking investors in a new light utility twin-turboprop design.

DORNA D-139 BLUE BIRD

TYPE: Two-seat lightplane.

PROGRAMME: Launched 1994; prototype manufacture started mid-1994; first flight was made on 27 July 1998; prototype had accumulated 600 hours' flying in 800 flights by end of November 2005. Certification to JAR 21 standards by the Iranian CAO was awarded on 2 December 2001, and initial production is under way. Improved version, characterised by forward-hinged doors, was scheduled for certification in early 2005; received amendment to Type Certificate for yoke or stick type control system.

CUSTOMERS: First five production aircraft sold to Iranian civil aeroclubs for pilot training; manufacture of these began in 2001. Stated orders for 14 and options for 30 more as at March 2006.

COSTS: Programme cost by November 1998 estimated at USD1.5 million excluding R&D; basic aircraft quoted at USD137,500 for new version (2006).

DESIGN FEATURES: Conventional low-wing, fixed-gear lightplane, designed for low-cost, easy-to-fly/maintain operation.

Several revisions of detail during early production including enlarged engine cowling for improved cooling (achieved in at least two stages of modification); tailplane leading-edge root extensions; enlarged rudder horn balance; fluted (bead) skin on rudder and ailerons. By 2004, all these features applied to new version having forward-hinged doors in place of previous 'gull wing' type. At least one aircraft of earlier version noted with flaps of reduced span.

Wings have constant chord, NACA 63-215 aerofoil section, 2° 30' dihedral from roots, 2° incidence and −2° twist.

FLYING CONTROLS: Conventional and manual; yoke or stick available optionally. Ailerons and elevators actuated by pushrods; rudder by cables; elevators have electric trim. Electrically actuated plain flaps.

STRUCTURE: All-composites. Two-spar wing, single-spar horizontal tail, monocoque fuselage.

LANDING GEAR: Non-retractable tricycle type, with Goodyear 5.00–5 tyres (6 ply on mainwheels, 4 ply on nosewheel). Fuselage-mounted cantilever self-sprung steel leg on each unit. Cleveland mainwheel brakes. Composites speed fairings on all three wheels.

Dorna Blue Bird cockpit details 1159039

POWER PLANT: One 84.6 kW (113.4 hp) Rotax 914 F3 flat-four engine driving an MT Propeller; three-blade MTV-6-A/172-08 variable-pitch propeller at 5,800 rpm. Fuel tank in each wing, combined capacity 120 litres (31.7 US gallons; 26.4 Imp gallons); gravity filling point on each tank. Oil capacity 3.0 litres (0.8 US gallon; 0.7 Imp gallon).

ACCOMMODATION: Two seats side by side, with baggage compartment aft of seats. Initially with narrow hardtop roof to cabin; access via upward-opening window each side, each with smaller non-opening window to rear. Later aircraft have full-height, forward-hinged door each side.

SYSTEMS: Electrical system: 12 V 20 A integral AC generator, 12 V 40 A external alternator and 35 Ah battery.

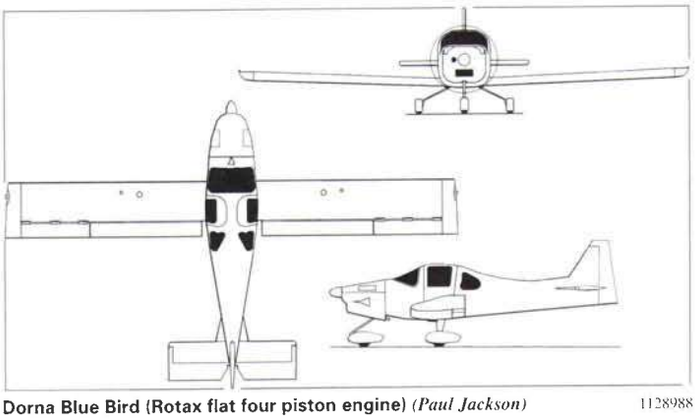
AVIONICS: *Comms:* Bendix/King KX 125 nav/com; KT 76A transponder.
Instrumentation: Conventional VFR.

DIMENSIONS, EXTERNAL:
Wing span ..... 9.45 m (31 ft 0 in)
Wing chord, constant ..... 1.17 m (3 ft 10 in)
Wing aspect ratio 8.1
Length overall ..... 6.17 m (20 ft 3 in)
Fuselage max width ..... 1.12 m (3 ft 8 in)
Height overall ..... 2.17 m (7 ft 1½ in)
Tailplane span ..... 2.70 m (8 ft 10¼ in)
Wheel track ..... 1.94 m (6 ft 4½ in)
Wheelbase ..... 1.51 m (4 ft 11½ in)
Propeller diameter ..... 1.72 m (5 ft 7¾ in)
Propeller ground clearance ..... 0.18 m (7 in)

DIMENSIONS, INTERNAL:
Cockpit: Length ..... 1.09 m (3 ft 7 in)
Max width ..... 1.02 m (3 ft 4¼ in)

Current versions of Dorna Blue Bird, showing larger doors 1159038

Dorna Blue Bird cockpit with optional control sticks 1159040



Dorna Blue Bird (Rotax flat four piston engine) *(Paul Jackson)* 1128988

AREAS:
- Wings, gross ..... 11.06 m² (119.0 sq ft)
- Ailerons (total) ..... 0.95 m² (10.23 sq ft)
- Trailing-edge flaps (total) ..... 1.54 m² (16.58 sq ft)
- Fin ..... 0.42 m² (4.52 sq ft)
- Rudder ..... 0.37 m² (3.98 sq ft)
- Tailplane ..... 0.84 m² (9.04 sq ft)
- Elevators (total) ..... 0.515 m² (5.54 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty, equipped ..... 490 kg (1,080 lb)
- Max fuel weight ..... 90 kg (198 lb)
- Max T-O and landing weight ..... 750 kg (1,653 lb)
- Max wing loading ..... 67.8 kg/m² (13.89 lb/sq ft)
- Max power loading ..... 8.87 kg/kW (14.58 lb/hp)

PERFORMANCE:
- Never-exceed speed (VNE) ..... 173 kt (321 km/h; 200 mph)
- Max level speed at FL140 ..... 152 kt (282 km/h; 175 mph)
- Max cruising speed at FL100 ..... 130 kt (241 km/h; 150 mph)
- Econ cruising speed at FL120 ..... 87 kt (161 km/h; 100 mph)
- Stalling speed at S/L, flaps down ..... 45 kt (83 km/h; 51 mph)
- Max rate of climb at S/L ..... 229 m (750 ft)/min
- Service ceiling ..... 4,265 m (14,000 ft)
- T-O run ..... 275 m (900 ft)
- Landing run ..... 244 m (800 ft)
- Range with max fuel ..... 590 n miles (1,094 km; 680 miles)

DORNA 12/19-SEAT TRANSPORT

TYPE: Twin-turboprop light transport.

PROGRAMME: In 'final stage of conceptual design' March 2005; offered to potential investors as sale or transfer of design; aimed at developing countries.

DESIGN FEATURES: Designed to EASA standards; operable in ISA +30°C (86°F) conditions; ability to take off and land using sandy or grass airstrips.

STRUCTURE: Composites.

LANDING GEAR: Tricycle type; fixed or retractable.

POWER PLANT: Two turboprops, of Eastern or Western origin; three-blade constant-speed propellers with reverse pitch.

ACCOMMODATION: Flight crew of two plus 12 to 19 passengers (three-abreast seating) or equivalent cargo. Crew door, passenger door and large rear cargo door.

SYSTEMS: Include air conditioning, heating and de-icing.

AVIONICS: To FAR Pt 135A standard; dual controls; full IFR autopilot optional.

Following data all provisional:

DIMENSIONS, EXTERNAL:
- Wing span ..... 19.51 m (64 ft)
- Length overall ..... 14.63 m (48 ft)
- Height overall ..... 5.49 m (18 ft)

DIMENSIONS, INTERNAL:
- Passenger cabin: Length ..... 6.10 m (20 ft)
  - Max width ..... 1.83 m (6 ft)
  - Max height ..... 1.68 m (5.5 ft)

WEIGHTS AND LOADINGS:
- Max cargo payload ..... 2,041 kg (4,500 lb)
- Max T-O weight ..... 7,257 kg (16,000 lb)

PERFORMANCE (estimated):
- Cruising speed at FL120 ..... 216 kt (400 km/h; 249 mph)
- Max rate of climb at S/L ..... 550 m (1,804 ft)/min
- Service ceiling, OEI ..... 3,050 m (10,000 ft)
- Range:
  - with 2,000 kg (4,409 lb) payload ..... 243 n miles (450 km; 279 miles)
  - with 900 kg (1,984 lb) payload ..... 647 n miles (1,200 km; 745 miles)

Dorna's projected 12/19-seat civil transport 1044760

FACI

FAJR AVIATION AND COMPOSITES INDUSTRY

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Tel: (+98 21) 465 94 61
Fax: (+98 21) 465 94 60
e-mail: faci@fajr-ind.com
Web: www.fajr-ind.com
GENERAL DIRECTOR: E Ghaleh

FACI established 1991 by Raht-Aseman Co (www.raht-air.com), which remains F-3 exclusive distribution agency, with objective of developing all-composites aircraft in Iran. Plant has 30,000 m² (323,000 sq ft) site at Mehrabad International Airport with 6,500 m² (69,965 sq ft) of hangar space and 3,600 m² (38,750 sq ft) of other covered space; total workforce is 130. Its first design, the F-3, entered production in 2001 and made its public debut in October 2002. Production continuing in 2006, now of improved F-3B.

FACI FAJR F-3

English name: Dawn

TYPE: Four-seat lightplane.

PROGRAMME: Design began 1992; construction of prototype started 1993; first flight 26 January 1995; further airframe for static testing; JAR 23-standard domestic type certificate awarded September 2000; construction of first production aircraft (now **Fajr F-3A**) began 2001; first deliveries 2002. Development plans so far announced include introduction of retractable landing gear (**Fajr F-3B**, certified in 2004) and some weight reduction measures to improve cruise performance.

CUSTOMERS: Domestic orders for 20 by January 2003. Five reportedly completed by that time, of which two then delivered; a sixth had been completed by November 2004. Ordered by Iranian Border Patrol, which is reported to have requirement for 10.

Fajr F-3 assembly line 1113677

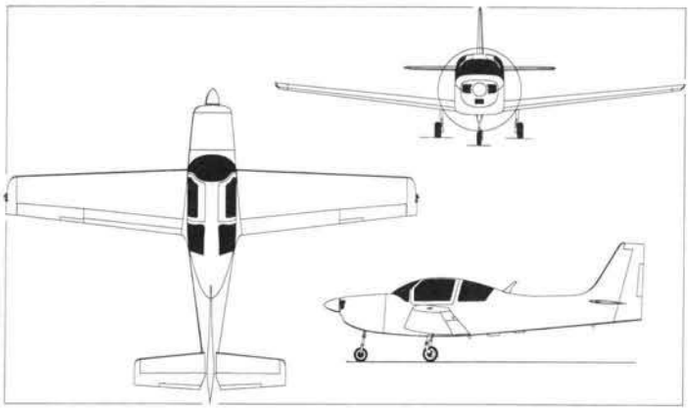
DESIGN FEATURES: Intended for pilot training and utility roles. Designed for low cost and easy maintenance.

Horstmann-Quast HQ-42E advanced laminar aerofoil section, with thickness/chord ratio of 16 per cent and 2° 17' sweepback. Dihedral 6° 30' from roots; twist –2° 30'; incidence 2° 18', Raked wingtips.

FLYING CONTROLS: Conventional and manual (push/pull rods). Horn-balanced ailerons, elevators and rudder, each with inset tab (ground-adjustable on ailerons, electrically actuated on elevators and rudder). Electrically actuated single-slotted Fowler flaps. Deflection angles: ailerons +22/–15°; elevators +30/–25°; rudder ±30°, flaps +15/–40°; rudder and elevator trim tabs ±25°.

STRUCTURE: All-composites; monocoque fuselage; high-stress parts of glass fibre airframe are reinforced with carbon fibre. Wings and horizontal tail, including control surfaces, are two-spar (I and C section) structures primarily of glass fibre/epoxy/foam sandwich shells. Two-piece monocoque fuselage of similar construction, with unidirectional carbon fibre reinforcement; embedded longerons; integral fin; Kevlar cowling.

LANDING GEAR: Tricycle-type; fixed on first few aircraft; now also retractable. Goodyear tyres; size 15×6.00-6 (main) and 5.00×5 (6 ply) (nose); pressures 4.41 bar (64 lb/sq in) and



General arrangement of the FACI F-3A 0110841

3.38 bar (49 lb/sq in) respectively. Nose gear is steerable (±18°) through a mechanical linkage to the rudder pedals. Parker Hannifin brakes are direct-operation, hydraulically actuated disc type. Minimum ground turning radius 2.75 m (9 ft 0¾ in).

POWER PLANT: One Textron Lycoming AEIO-540-L1B5D flat-six engine, flat rated at 201 kW (270 hp), driving a three-blade Hoffmann HOV 123K-KV-K200-AH constant-speed propeller. Fuel capacity 212 litres (56.0 US gallons; 46.6 Imp gallons) standard; 292 litres (77.1 US gallons; 64.2 Imp gallons) optional. Oil capacity 15.1 litres (4.0 US gallons; 3.3 Imp gallons).

ACCOMMODATION: Four persons, in pairs. Dual controls. Two upward-hinged window/doors of glass fibre. Cabin heated and ventilated.

SYSTEMS: 24 to 28 V DC electrical system powered by Gill 70 A 10 Ah alternator. Oxygen system.

AVIONICS: IFR or VFR, to customer's requirements. Options include Bendix/King VHF com, ADF and GPS.

DIMENSIONS, EXTERNAL:

Wing span	10.50 m (34 ft 5½ in)
Wing chord: at root	1.76 m (5 ft 9¼ in)
mean aerodynamic	1.40 m (4 ft 7 in)
at tip	0.94 m (3 ft 1 in)
Wing aspect ratio	7.9
Length overall	8.07 m (26 ft 5¾ in)
Height overall	3.05 m (10 ft 0 in)
Tailplane span	3.87 m (12 ft 8¼ in)
Wheel track	2.08 m (6 ft 10 in)
Wheelbase	1.78 m (5 ft 10 in)
Propeller diameter	2.10 m (6 ft 10¾ in)
Propeller ground clearance	0.175 m (7 in)

DIMENSIONS, INTERNAL:

Cabin: Length	2.18 m (7 ft 1¾ in)
Max width	1.25 m (4 ft 1¼ in)
Max height	1.53 m (5 ft 0¼ in)

AREAS:

Wings, gross	14.02 m² (150.9 sq ft)
Ailerons (total, incl tabs)	0.46 m² (4.95 sq ft)
Flaps (total)	0.95 m² (10.23 sq ft)
Fin	2.33 m² (25.08 sq ft)
Rudder (incl tab)	0.91 m² (9.80 sq ft)
Tailplane	2.95 m² (31.75 sq ft)
Elevators (total, incl tabs)	1.16 m² (12.49 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	1,100 kg (2,425 lb)
Max fuel weight: standard	141 kg (311 lb)
optional	204 kg (450 lb)
Max T-O and landing weight	1,580 kg (3,483 lb)
Max wing loading	112.7 kg/m² (23.08 lb/sq ft)
Max power loading	7.85 kg/kW (12.90 lb/hp)

PERFORMANCE (A: fixed gear, B: retractable gear):

Never-exceed speed (VNE): A, B	200 kt (370 km/h; 230 mph)
Max cruising speed: A	148 kt (274 km/h; 170 mph)
B	175 kt (324 km/h; 201 mph)
Cruising speed at 75% power: A	128 kt (237 km/h; 147 mph)
B	148 kt (274 km/h; 170 mph)
Stalling speed, power off:	
flaps up: A, B	67 kt (125 km/h; 78 mph)
flaps down: A, B	56 kt (104 km/h; 65 mph)
Max rate of climb at S/L: A	280 m (920 ft)/min
B	314 m (1,030 ft)/min
Service ceiling: A	5,180 m (17,000 ft)
B	5,790 m (19,000 ft)
T-O run: B	310 m (1,020 ft)
T-O to 15 m (50 ft): A, B	630 m (2,070 ft)
Landing from 15 m (50 ft): A, B	720 m (2,365 ft)
Landing run: B	330 m (1,085 ft)
Range, standard fuel: A	502 n miles (930 km; 577 miles)
B	702 n miles (1,300 km; 807 miles)
Endurance: A	4 h 30 min
B	6 h
g limits: A, B	+4.4/−1.76

IRGC

IRAN REVOLUTIONARY GUARD CORPS

Development of the Shahed 274 helicopter is reported to have been undertaken by the Pasdaran, or Revolutionary Guards.

IRGC SHAHED 274

TYPE: Light utility helicopter.

PROGRAMME: Sponsored (as X-5) by the Institute of Industrial Research and Development of the IRGC; reportedly due to have made its first flight in 1997. First aircraft (71-832) handed over to IRGC 16 September 1999. International public debut, in Tehran, 30 December 2000. At least two more (74-001 and '002) in service by end of 2001. Further public appearance in air show on Kish Island, October/November 2002. Current status still uncertain in 2006.

CUSTOMERS: Total of 20 (other sources suggest 30) were reportedly planned to be built by end of 2004, but no evidence of these seen by mid-2006.

DESIGN FEATURES: Two-blade main and tail rotors; fully enclosed cabin and tailboom; upper and lower vertical fins. Intended applications include observation, rescue and light cargo-carrying.

LANDING GEAR: Twin-skid type.

POWER PLANT: One 313 kW (420 shp) Rolls-Royce 250-C20B turboshaft.

ACCOMMODATION: Seats for five persons including pilot. Forward-opening crew door and passenger door each side; baggage door aft of latter on port side.

Following data provisional and unconfirmed.

DIMENSIONS, EXTERNAL:

Main rotor diameter	10 m (33 ft)
Fuselage length	9 m (30 ft)
Height overall	3 m (10 ft)

First photograph released of the Shahed 274 five-seat helicopter
(Aviation Industries Journal of Iran) 0095152

WEIGHTS AND LOADINGS:

Weight empty	1,000 kg (2,200 lb)
Max T-O weight	1,500 kg (3,300 lb)

PERFORMANCE:

Max level speed	97 kt (180 km/h; 112 mph)
Ceiling	5,200 m (17,060 ft)
Max range	324 n miles (600 km; 372 miles)

IRIAF

ISLAMIC REPUBLIC OF IRAN AIR FORCE (YA HOSSEIN PROJECT/OWJ INDUSTRIAL COMPLEX)

PO Box 13885-193, Mehrabad Airport, Tehran
Tel: (+98 21) 452 08 10
Tel/Fax: (+98 21) 452 08 53
CHIEF DESIGNER, TAZARVE: Mahmood Bayat

The Owj Industrial Complex, is an agency of the Iranian MoD and IRIAF established in the early 1990s. Its activities have included design and development of various aircraft components and subsystems in both metal and composites, plus assorted ground equipment. It is now understood to have overseen the abortive Azarakhsh fighter programme previously attributed to IAMI (HESA), its intended production centre, and is currently responsible for development of the Saeghe attack fighter.

The IRIAF's Ya Hossein Project has yielded the Tazarve jet trainer, which made its first flight in 2001 and its public debut at the end of 2002.

IRIAF (OWJ) AZARAKHSH

English name: Lightning

TYPE: Attack fighter.

Aircraft, and any news of progress, were absent from Iranian air show in November 2002. Reported in late 2003 that AIO had announced plans during that year to begin low-rate series production of up to 30, but aircraft again absent from second Iranian air show in January 2005. No evidence at that time that any more than six prototypes, at most, had been completed, and programme now generally believed to have been abandoned.

IRIAF (OWJ) SAEGHE

English name: Lightning

TYPE: Attack fighter.

PROGRAMME: Said to have been designed at Owj Industrial Complex, replacing abortive Azarakhsh programme. Modified Northrop F-5E, rebuilt in twin-finned configuration and probably incorporating experience gained in Project Simorgh work on building new fuselage sections to convert in-country F-5As into two-seat F-5Bs. Photo of model shown

Saeghe (foreground) in formation with an IRIAF F-5F during military exercises in August/September 2006 1165074

on Iranian Students' News Agency website in 2003. First Saeghe airframe reportedly about 70 per cent complete by November 2002 and expected to be completed within next six months. Reported by Iranian news agency as having made its maiden flight on 8 July 2004, although other sources give 30 May 2004 as true date. Name has also been transliterated as Sa'eqeh-80. Flight testing still in progress at end of 2005, attaining speeds approaching Mach 1.

IRIAF (YA HOSSEIN) TAZARVE

English name: Eagle

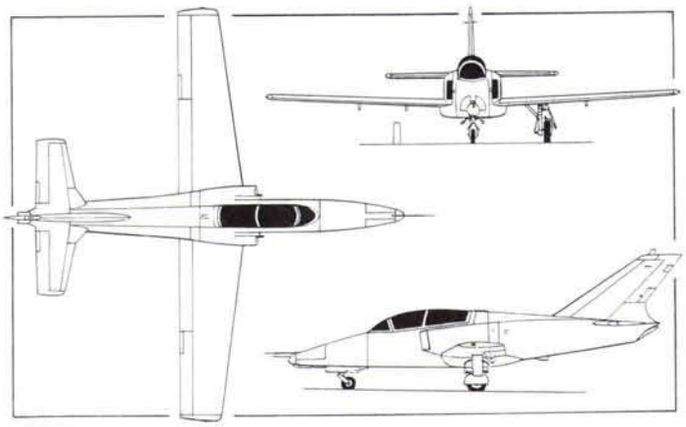
TYPE: Basic jet trainer.

PROGRAMME: First design studies early 1990s, leading to first prototype (named *Dorna*: crane), flown in or about 1995; substantially redesigned second prototype (*Tondar*: thunder) flown 1998, leading to further wing and fuselage refinements; Tazarve is third (and reportedly final) configuration, embodying further wing, fuselage and systems improvements; manufacture began 1998 and first flight said to have taken place in mid-2001; public debut October/November 2002 at airshow on Kish Island, in full IRIAF insignia and wearing unexplained code 778-2 on vertical fin. Designation JT2-2 has been linked with this aircraft. Fourth prototype under construction at that time and said to have flown by end of 2005; reports that this bears name **Ra'ad** and has slightly sweptback horizontal tail surfaces.

CUSTOMERS: Under development for IRIAF, which ordered five pre-series aircraft for delivery by 2005 and planned acquisition of 25 production examples thereafter.

DESIGN FEATURES: Intended to provide basic, advanced and lead-in fighter training, with secondary capability for light attack. Low/mid-mounted wings, lateral air intakes, conventional sweptback tail unit. Designed for 6,000 hour operational life.

Ya Hossein Tazarve in 2004 colour scheme 1113701



Provisional general arrangement of the IRIAF Tazarve *(Michael Badrocke)* 0567875

FLYING CONTROLS: Hydraulically boosted ailerons, elevators and rudder; hydraulic flaps with push/pull rod controls.

STRUCTURE: Mainly GFRP/nickel sandwich and carbon fibre. Wings, fuselage and tail sections built as single pieces and bolted together; wing and tail structures resin-bonded. All load-bearing elements of main structure are carbon fibre; parts such as fairings, panels and doors are of GFRP. Nickel layer is sandwiched within composites for protection against lightning strikes and static electricity. MIL-SPEC design criteria applied throughout.

LANDING GEAR: Ya Hossein tricycle type; retractable (nosewheel rearward, mainwheels inward into engine intake trunks).

POWER PLANT: One 12.68 kN (2,850 lb st) General Electric J85-GE-17 non-afterburning turbojet in prototypes; alternative such as Honeywell TFE731-2A turbofan being sought for production aircraft. Fuel capacity 704 kg (1,552 lb) in wing tanks and 300 litres (79.3 US gallons; 66.0 Imp gallons) in fuselage tanks. Provision for two 246 litre (65.0 US gallon; 54.1 Imp gallon) inboard and two 100 litre (26.4 US gallon; 22.0 Imp gallon) outboard underwing auxiliary tanks.

ACCOMMODATION: Crew of two in tandem on Martin-Baker Mk 15 ejection seats; rear seat elevated. Wraparound windscreen; one-piece framed canopy, with built-in MDC, opening sideways to starboard. Accommodation fully pressurised and air conditioned.

AVIONICS: *Comms:* Locally produced UHF/VHF radio.
Instrumentation: Includes VOR, ILS, DME, ADF and Tacan, sourced from inventory stores for aircraft such as F-4 and PC-7.

ARMAMENT: Four underwing attachment points for weapons, drop-tanks or other stores.

DIMENSIONS, EXTERNAL:

Wing span	8.04 m (26 ft 4½ in)
Length overall	10.70 m (35 ft 1¼ in)
Height overall	3.63 m (11 ft 11 in)

WEIGHTS AND LOADINGS:

Weight empty	2,550 kg (5,622 lb)
Max T-O weight	4,000 kg (8,818 lb)

PERFORMANCE:

Max level speed at 5,485 m (18,000 ft)	350 kt (648 km/h; 402 mph)
Stalling speed	85 kt (158 km/h; 98 mph)
Service ceiling	11,582 m (38,000 ft)
T-O run	600 m (1,970 ft)
Landing run	650 m (2,135 ft)
Max range: internal fuel	405 n miles (750 km; 466 miles)
internal and external fuel	600 n miles (1,111 km; 690 miles)
g limits	+8.0/–3.8

PARAVAR PARS

PARAVAR PARS COMPANY

PO Box 16353-433, Telo Road, 13 km Babaee Expressway, Tehran
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Fax: (+98 21) 731 41 30 and 734 96 39
e-mail: info@paravar-pars.com
Web: www.paravar-pars.com

Company began designing light aircraft in 1992 and first product was **P-72 Nasim** two-seat, all-composites sailplane, which also designated AVA-101 by AII. Became first Iranian company to obtain a sailplane type certification and first in aerospace with product organisation approval; currently (2005) preparing for design organisation approval. Designed and flew (April 2000) Saba motor glider and also produces other ultralight aircraft under licence:

Salar: Flex-wing trike, comprising wing built under licence from General Aircraft Company of Ukraine and tandem-seat pod licensed by Aquilair of France.

Pelican Sport 450: High-wing ultralight; to be produced in Iran as version of Ultravia Pelican of Canada.

Gyroplane: South African Chayair Sycamore two-seat autogyro (which see).

Salar flex-wing trike marketed by Paravar Pars 1121624

PARAVAR PARS SABA

TYPE: Motor glider.

PROGRAMME: Design began June 1997; prototype made maiden flight April 2000. Promotion continuing in 2006.

DESIGN FEATURES: Low/mid-wing monoplane with T tail.
Eppler wing sections: 654 at root, 434 at tip. Dihedral 2° 30'.

FLYING CONTROLS: Differential ailerons; Hütter two-plate upper and lower surface airbrakes; plain flaps; fixed incidence tailplane, with trim tab in port elevator. Adjustable rudder pedals.

STRUCTURE: Single-spar wings with shells of glass fibre and PVC foam sandwich, carbon fibre spar caps and glass fibre/foam sandwich shear web; detachable for transportation and storage. Metal airbrakes. Flaps and ailerons of GRP/PVC foam sandwich. Glass fibre fuselage and integral fin, of GRP/honeycomb sandwich, reinforced with four carbon fibre longerons.

LANDING GEAR: Tailwheel type; Mainwheel tyres 5.00-5, with Tost hydraulic disc brakes; fully castoring tailwheel.

POWER PLANT: *Saba A:* One 59.6 kW (79.9 hp) Rotax 912 flat four, driving a Hoffmann two-blade fixed-pitch propeller.

Paravar Pars Saba side-by-side motor glider 1121628

Saba B: One 84.6 kW (113.4 hp) Rotax 914 flat four, driving a Hoffmann two-blade constant-speed propeller.

Fuel in two rigid tanks in wings, combined capacity 80 litres (21.1 US gallons; 17.6 Imp gallons).

ACCOMMODATION: Two seats side by side. Dual controls standard. Two-piece, gull-wing canopy, opening upward; canopy emergency release standard.

AVIONICS: VFR instrumentaton standard.

DIMENSIONS, EXTERNAL:

Wing span	17.25 m (56 ft 7¼ in)
Wing aspect ratio	16.0
Length overall	7.66 m (25 ft 1½ in)
Height over tail	1.77 m (5 ft 9¾ in)

AREAS:

Wings, gross	18.54 m² (199.6 sq ft)
Vertical tail surfaces (total)	1.95 m² (20.99 sq ft)
Horizontal tail surfaces (total)	2.54 m² (27.34 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: both	542 kg (1,195 lb)
Max T-O weight: both	780 kg (1,719 lb)
Max wing loading: both	41.9 kg/m² (8.58 lb/sq ft)
Max power loading: A	13.09 kg/kW (21.51 lb/hp)
B	9.22 kg/kW (15.15 lb/hp)

PERFORMANCE:

Max cruising speed: A	127 kt (234 km/h; 146 mph)
B	135 kt (250 km/h; 155 mph)
Stalling speed: A	41 kt (75 km/h; 47 mph)
B	44 kt (80 km/h; 50 mph)
Max rate of climb at S/L: A	214 m (702 ft)/min
B	237 m (778 ft)/min
T-O to 15 m (50 ft): A	305 m (1,000 ft)
B	295 m (970 ft)
Range with max fuel: both	216 n miles (400 km; 248 miles)
g limits: both	+5.3/-2.65

Israel

IAI

ISRAEL AIRCRAFT INDUSTRIES LTD

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CHAIRMAN: Ori Orr
PRESIDENT AND CEO: Moshe Keret
EXECUTIVE VICE-PRESIDENT AND COO: Ovadia Harari
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DEPUTY CORPORATE VICE-PRESIDENT: Dr David Harari (Director, Research and Development)
DEPUTY CORPORATE VICE-PRESIDENT, MARKETING: Shimon Eckhaus
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Founded 1953 as Bedek Aviation; ceased being unit of Ministry of Defence and became government-owned corporation 1967; name changed to Israel Aircraft Industries 1 April 1967; number of divisions reduced from five to four February 1988 (Aircraft, Electronics, Technologies and Bedek Aviation). Further restructuring 1994 and now comprises four independent operating Groups: Commercial Aircraft, Military Aircraft, Bedek Aviation and Electronics. Covered floor space 680,000 m² (7.32 million sq ft); total workforce 14,500 in August 2001, of whom one-third are engineers or academics. IAI has ISO 9001 certification, and its products and technologies are fully backed by integrated logistic support, training and a complete after-sales service.

Approved as repair station and maintenance organisation by Israel Civil Aviation Administration, US Federal Aviation Administration, UK Civil Aviation Authority and Israel Air and Space Force. Products include aircraft of own design; in-house produced airframe systems and avionics; service, upgrading and retrofit packages for civil and military aircraft and helicopters; other activities include space technology, missile and ordnance development, and seaborne and ground equipment.

Sold Galaxy Aerospace to General Dynamics on 1 May 2001, this becoming part of Gulfstream. Renamed Israel Aerospace Industries on 6 November 2006.

IAI comprises four principal divisions:

BEDEK AVIATION GROUP: Provides total aircraft, engine and component repair, overhaul, retrofit, modification, conversion and support services to airlines and leasing companies. On 21 February 2002, IAI and Hindustan Aeronautics Limited of India signed a co-operation agreement for HAL to participate in Bedek's Boeing 737 freighter conversion programme.

MILITARY AIRCRAFT GROUP: Develops and manufactures unmanned air vehicles; integrates and upgrades military fixed-wing aircraft and helicopters; designs and manufactures helicopter structures, electrical harnesses and crash-attenuating aircraft seats.

ELECTRONICS GROUP: Specialises in electronics, electro-optical and inertial systems, and components for military and commercial applications.

COMMERCIAL AIRCRAFT GROUP: *Described separately.*

COMMERCIAL AIRCRAFT GROUP

Ben-Gurion International Airport, IL-70100 Tel-Aviv
Tel: (+972 3) 935 33 37 and 935 71 49
Fax: (+972 3) 935 42 26
GENERAL MANAGER: M Boness

Established 1994. Design, development, certification and manufacture of civil aircraft; hydraulic, electromechanical and pneumatic components; dynamic systems; and composites material structures (all backed by full computer-aided design, engineering and manufacturing processes).

Gulfstream 100 (formerly IAI Astra) and Gulfstream 200 (formerly IAI Galaxy) are built in Israel and delivered to US for outfitting and sale. Gulfstream 150 received joint Israeli and FAA certification on 7 November 2005.

URBANAERO

URBAN AERONAUTICS LTD

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CHAIRMAN: Ovadia Harari
PRESIDENT AND CEO: Dr Rafi Yoeli
VICE-PRESIDENT, MARKETING: Janina Frankel-Yoeli

Company formed in 2000 (previously known as Romeo Yankee Ltd), specifically to develop certified VTOL urban aerial vehicles. Currently has completed CityHawk technology demonstrator; has also begun to develop X-Hawk (civil and military variants), as well as unmanned derivatives. Purdy Corporation is a risk-sharing partner, responsible for developing the X-Hawk transmission system. Agreement with Bell Helicopter in August 2005 covered promotion of X-Hawk for US military requirements, plus systems integration and production, if ordered. In 2006, Bell trademarked Fancraft for the technology required for this class of air vehicle.

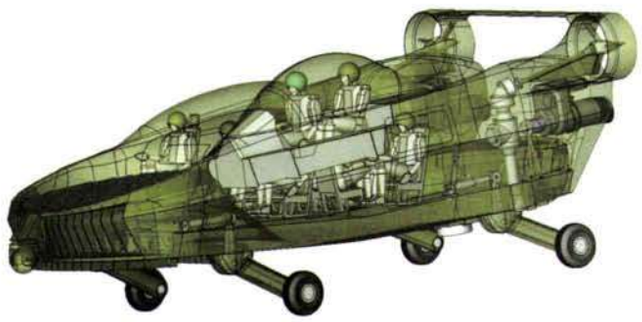
Mockup of Urban X-Hawk military version *(Paul Jackson)* 1159105

URBANAERO X-HAWK

TYPE: Lifting vehicle.

PROGRAMME: Commercial derivative of CityHawk.

CURRENT VERSIONS: Planned, FAA-certified (Powered Lift category) **commercial aerial utility** vehicle with modular payload bay and twin turboshaft engines; *as described.* Funding being sought for prototype construction. First phase three-axis wind tunnel testing in both hover and forward flight mode were completed successfully at the University of Arizona in Tucson in August 2005, using a one-tenth scale model; these indicated a maximum attainable speed of at least 130 kt (240 km/h; 149 mph) for the full-scale production X-Hawk. Two Honeywell LTS 101-B2 engines have been ordered for the first X-Hawk A. Design and construction of the latter's main lift rotors has been delegated to Aerocomposites Inc; Purdy Corporation is designing the transmission system; and UrbanAero planned to award contracts for the variable-pitch thruster assemblies, thruster shrouds, fuselage, stabiliser and landing gear in the first quarter of 2006. By May 2006, company was engaged in completing main lift fan production tooling, passing critical design review (CDR) and starting production of transmission system, initiating thruster design andestablishing a pilot simulation programme. A mockup of the 11-passenger military version was displayed at the Farnborough International Air Show in July 2006. Three versions, with



Internal details of military Urban X-Hawk 1159101

different power plants, are planned. First flight anticipated mid-2008, first delivery in late 2009.

Bell Helicopter promoting X-Hawk **armed version** for US armed forces as combat troop carrier; in 2006 Bell and the Vertical Lift Research Center of Excellence at Penn State University were seeking Office of Naval Research funding for further development. Mockup shown at Farnborough in July 2006 carried two M61 multibarrel cannon on fuselage sides and nose-mounted sensor turret. Bell XworX to build demonstrator to X-Hawk C standard.

CUSTOMERS: First order (for X-Hawk A) received from Herzlia Medical Centre, Israel.

COSTS: Begins at approximately USD2.2 million to USD5.8 million, depending on version (2006).

DESIGN FEATURES: VTOL vehicle. Two standard aeroplane propellers (with optional de-icing) in vertical ducts and two pusher fans, all connected to pair of turboshaft engines mounted in rear nacelles. Rearward deflection of thrust from ducts provides forward motion; pusher fans contribute additional speed and are available for manoeuvring at the hover. Potential civil applications include medical access and evacuation, powerline maintenance, bridge inspection and ship-to-shore taxi operation. All essential systems fully redundant.

FLYING CONTROLS: Designed to be able to sustain hover and come to safe landing even if one engine fails. Patented vane control system (VCS) comprises two vertical ducts, each with set of 100 vanes top and bottom (400 vanes per aircraft). Independent deflection of vanes, between top and bottom and between two ducts, provides manoeuvrability, including ability to 'dock' alongside buildings.

LANDING GEAR: Four levered suspension legs, each with small, steerable road wheel. Wheels powered, to enable road taxying at up to 10 kt (19 km/h; 12 mph).

POWER PLANT: Twin turboshafts, as follows:

X-Hawk A: 611 kW (820 shp) Honeywell LTS 101-B2, Pratt & Whitney Canada PW207 or Turbomeca Arrius 2K2.

X-Hawk B: 820 kW (1,100 shp) Arriel 2C2, PW210 or HTS 900.

X-Hawk C: 1,193 kW (1,600 shp) CTS 800-4N or MTR 390. Transmission rating 1,834 kW (2,460 shp).

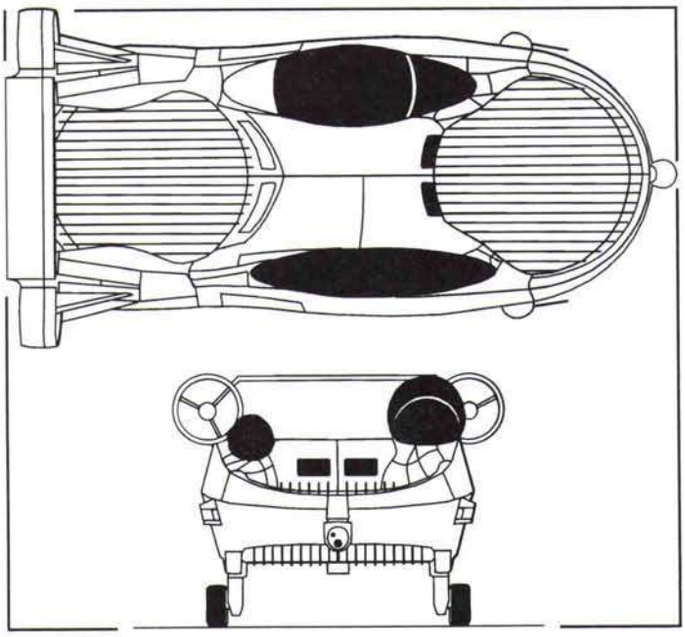
ACCOMMODATION: Four persons including pilot, in commercial version. Inboard-hinged, upward-opening canopy each side. Military version accommodates pilot and 11 troops: one passenger behind pilot under large port canopy; one beneath lower, starboard canopy; nine in cargo bay between ducts, with door each side .

Following data are provisional:

EQUIPMENT: Rocket-deployed recovery parachute optional.

DIMENSIONS, EXTERNAL:

Rotor diameter (each)	2.50 m (8 ft 2½ in)
Length overall (excl sensor turret)	8.10 m (26 ft 7 in)
Height overall	3.50 m (11 ft 5¾ in)



Urban X-Hawk military version *(Paul Jackson)* 1159103

Fuselage max width	3.40 m (11 ft 1¾ in)
DIMENSIONS, INTERNAL:	
Cabin volume (EMS configuration)	5.6 m³ (197.8 cu ft)
WEIGHTS AND LOADINGS:	
Weight empty: A	1,157 kg (2,550 lb)
C	1,678 kg (3,700 lb)
Max fuel weight: A	431 kg (950 lb)
Typical mission fuel weight: C	590 kg (1,300 lb)
Typical payload: A	340 kg (750 lb)
B	454 kg (1,000 lb)
C	771 kg (1,700 lb)
Useful load: A	771 kg (1,700 lb)
B	907 kg (2,000 lb)
C	1,361 kg (3,000 lb)
Max T-O weight: A	1,927 kg (4,250 lb)
B	2,154 kg (4,750 lb)
C	3,039 kg (6,700 lb)
PERFORMANCE (estimated):	
Max level speed: C	140 kt (259 km/h; 161 mph)
Max cruising speed: A	100 kt (185 km/h; 115 mph)
B	110 kt (204 km/h; 127 mph)
C	130 kt (241 km/h; 150 mph)
Hovering ceiling OGE, OEI: A	3,660 m (12,000 ft)
Range with typical mission fuel: C	330 n miles (611 km; 379 miles)
Operational radius with typical mission fuel, plus 30 min on site	140 n miles (259 km; 161 miles)
Endurance with typical payloads quoted above, 20 min reserves:	
A, B	1 h 30 min
C	2 h

Italy

AEROLAB

AEROLAB SAS

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Web: www.aerolab.it
PRESIDENT: Francesco Rizzi

Company founded in 2001 by Sig Rizzi, an airliner and sport aircraft pilot, to produce a related family of light aircraft with a vintage aspect.

AEROLAB CAMP

TYPE: Two-seat kitbuilt.

PROGRAMME: Prototype I-CAMB, in low-wing configuration, first flew December 2005 and transported to US for announcement at Sun 'n' Fun, April 2006. Parasol version then due to fly in mid-2006, followed by biplane at unspecified date. US LSA approval due in 2007, but initially available as kit meeting 51 per cent rule.

CURRENT VERSIONS: **LoCamp:** Low-wing version.

HiCamp: Parasol wing version.

BiCamp: Biplane version. Data not yet defined.

COSTS: Monoplane kit USD41,340 including Rotec engine and exhaust collector (2006).

DESIGN FEATURES: Inspired by (high wing) Pietenpol Air Camper. Open cockpit; vintage appearance. Common fuselage with pick-up points for all three wing configurations. Monoplanes have unswept constant-chord, wings, cantilever low wing; parasol wing braced to lower longerons by V struts; biplane wings have different thickness and narrower chord, with slight sweepback. Tailplane braced to fin and lower longerons by streamlined wire. Sweptback fin.

Design and construction to European JAR-VLA criteria, but not certified as such, being available in Europe as Experimental category equivalent.

Quoted build time 500 hours; further 100 hours for BiCamp.

Wing section NACA 4416; dihedral 2°; no twist; plain fin and rudder.

FLYING CONTROLS: Conventional and manual. Frise ailerons; horn-balanced elevators and rudder. Pitch trim by electrically variable-incidence tailplane. Actuation by pushrods, except rudder by cables. Flaps.

STRUCTURE: AN (American) materials throughout. Welded chromoly steel tube fuselage with wooden stringers, plywood frames and engine cowling. Wooden wing of laser-cut components, including hemlock spar cap and birch ply shear-webs, plus aluminium flap and aileron structure. Dacron airframe covering. Wing spars joined at centreline by steel plates and LoCamp wing to fuselage by steel pins (total four) at each forward and aft spar. HiCamp wing mounted on cabane.

LANDING GEAR: Tailwheel type; fixed. Faired-in side Vs hinged to lower longerons; half-axles, each with helical spring shock-absorber, attached to compression frame on prototype; compressed rubber suspension for production version. Mainwheels 6.00-6 with hydraulic brakes; solid, steerable tailwheel.

POWER PLANT: One piston engine driving a two-blade wooden propeller (Aust Performance on prototype). Engine options comprise 82.0 kW (110 hp) Rotec R2800 seven-cylinder radial and four-cylinder 59.7 kW (80 hp) Parma-Technik Mikron IIIC. In 2006, 90.2 kW (121 hp) four-cylinder LOM M132A was under evaluation.

Fuel in two wingroot tanks; combined capacity 78 litres (20.6 US gallons; 17.2 Imp gallons).

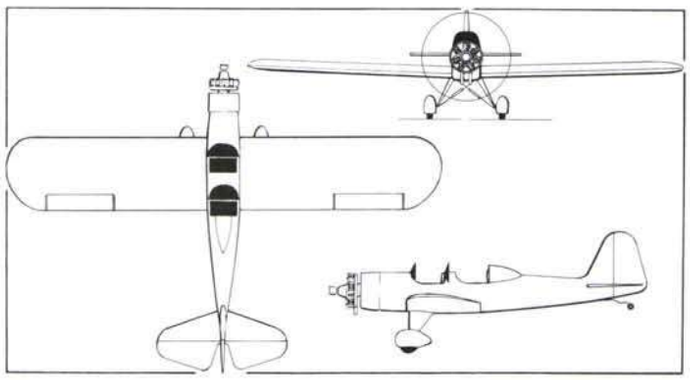
ACCOMMODATION: Two in tandem in individual open cockpits, each with windscreen. Dual controls, but flown solo from rear seat. Luggage lockers forward and aft of cockpit group.

DIMENSIONS, EXTERNAL (Hi/LoCamp, where different):

Wing span	9.10 m (29 ft 10¼ in)
Wing aspect ratio	6.1
Length overall	6.71 m (22 ft 0 in)
Height overall: Lo:	
propeller horizontal	1.95 m (6 ft 4¾ in)
propeller turning	2.51 m (8 ft 2¾ in)
Wheel track	1.68 m (5 ft 6¼ in)
Propeller diameter	1.83 m (6 ft 0 in)

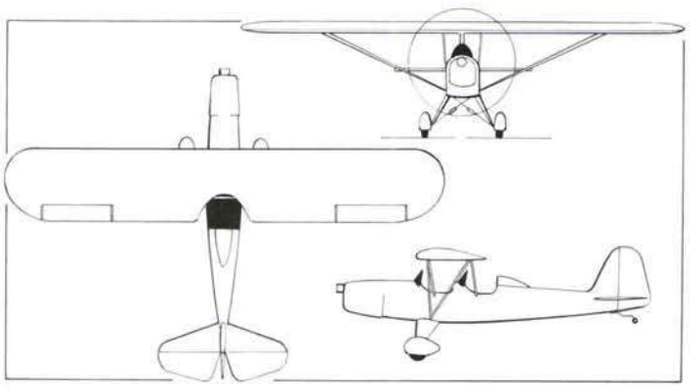
Prototype Aerolab LoCamp 1037978

Impression of Aerolab BiCamp 1037997



Aerolab LoCamp tandem-seat lightplane *(James Goulding)* 1158444

Aerolab HiCamp parasol lightplane 1158002



High wing Aerolab HiCamp *(James Goulding)* 1158443

AREAS:
Wings, gross ..... 13.50 m² (145.3 sq ft)
WEIGHTS AND LOADINGS (Rotec engine; Hi/LoCamp, where different):
Weight empty: Hi ..... 350 kg (772 lb)
Lo ..... 385 kg (849 lb)
Max baggage weight ..... 44 kg (97 lb)
Max T-O weight: Hi ..... 575 kg (1,267 lb)
Lo ..... 598 kg (1,320 lb)
Max wing loading: Hi ..... 42.6 kg/m² (8.72 lb/sq ft)
Lo ..... 44.4 kg/m² (9.08 lb/sq ft)
Max power loading, Rotec engine: Hi ..... 7.01 kg/kW (11.52 lb/hp)
Lo ..... 7.30 kg/kW (12.00 lb/hp)

PERFORMANCE (Rotec engine, Hi/LoCamp):
Never-exceed speed (VNE) ..... 114 kt (212 km/h; 132 mph)
Max level speed at S/L ..... 105 kt (195 km/h; 121 mph)
Cruising speed at 75% power ..... 92 kt (171 km/h; 106 mph)
Stalling speed: flaps up ..... 40 kt (73 km/h; 45 mph)
flaps down ..... 36 kt (66 km/h; 41 mph)
Max rate of climb at S/L ..... 244 m (800 ft)/min
Service ceiling ..... 3,660 m (12,000 ft)
T-O run ..... 250 m (820 ft)
Landing run ..... 200 m (655 ft)
Range with 30 min reserves ..... 216 n miles (400 km; 248 miles)
g limits ..... +4/–2

AERMACCHI

AERMACCHI SPA (A FINMECCANICA COMPANY)

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e-mail: info@aermacchi.it
Web: www.aermacchi.it
CHAIRMAN: Giorgio Brazzelli
CEO: Carmelo Cosentino
GENERAL MANAGER: Massimo Lucchesini

Original Macchi Company, founded on 1 May 1913 in Varese, produced famous line of high-speed flying-boats and seaplanes. After the Second World War, specialised in aircraft for military pilot training, including MB-308, MB-326 and the MB-339 family, designed by Ermanno Bazzocchi.

On 1 January 1997, Aermacchi acquired all training activities and programmes of SIAI-Marchetti, including the SF.260 and S.211 (but not SF.600 Canguro, which was obtained by VulcanAir) and support of earlier S.205s and S.208s remaining in service. Production was then transferred from Sesto Calende to the Aermacchi plants at Venegono. In January 1996, Aermacchi obtained production rights to the former Valmet L-90TP Redigo turboprop trainer, which was renamed M-290TP Redigo.

Finmeccanica obtained control of the company by increasing its 27.4 per cent shareholding to 99 per cent on 19 December 2002, through acquisition of Foresio's family shareholding, this becoming effective on 1 July 2003.

Control passed in January 2005 from Finmeccanica to Alenia Aeronautica, the leading industry of Finmeccanica's aeronautical sector.

Aermacchi is an aircraft manufacturing company, with plants in Venegono airfield occupying a total area of 274,000 m² (2,949,400 sq ft), including 113,000 m² (1,216,350 sq ft) covered space; flight test centre covers a space of 5,100 m² (54,900 sq ft) in a total area of 28,000 m² (301,400 sq ft).

Workforce in 2005 totalled over 1,840. Value of production was EUR298 million in 2005. The experience gained in the military sector has allowed the company to extend its business also to the civil aviation field, which currently accounts for around 3 per cent of the order portfolio.

Product range includes SF-260E/TP piston-engined or turboprop-powered screener/primary trainer; M-311 basic turbofan; MB-339CD advanced and lead-in fighter trainer; currently out of production; and M-346, an advanced and lead-in fighter trainer. Allied with Dassault, EADS and Saab, Aermacchi was the leading company for the EuroTraining Feasibility Study (contract signed 2 December 2002), for a 12-nation European Military Integrated Training System.

Since 1960, 40 countries have bought 2,000 Aermacchi trainers. Co-operation in international military programme has included AMX with Alenia Aeronautica and Embraer of Brazil, with work share of 24 per cent. Aermacchi developed and manufactured the fuselage forward and rear sections and installed some avionic equipment. A Mid-Life Updating program (ACOL) has been launched by the Italian Air Force. For Panavia Tornado, Aermacchi designed and produced wing pylons and wingtips, roots, trailing-edges and flaps, representing a 5 per cent share in the programme.

In Eurofighter, Aermacchi has a share exceeding 4 per cent, for design and development of wing pylons, twin missile and twin store carriers, ECM pods, carbon fibre structures and titanium engine cowlings.

After participating in the G.222 transport aircraft program, the company is currently involved with the C-27J Spartan, producing outer wings.

Aermacchi has added design and production of nacelle components for civil aircraft. In 1999, it established the joint venture MHD with the French company Hurel Dubois, to provide complete nacelle system services (including engine build up and thrust reversal), ranging from business jets to 100-seat airliners for the regional market. Aermacchi is collaborating with several customers and partners in international programmes such as: Pratt & Whitney for the inlets and fan cowls for the A330 with PW4168 engines; Aircelle for the inlet of Airbus A318s powered by PW6000 engines and for the translating cowls and fixed fan duct of the Airbus A380 (for both engine options: Engine Alliance GP7200 and Rolls Royce T900); with General Electric, through the MHD joint venture, for the complete nacelles, including EBU, for the Embraer 170; with Pratt & Whitney Canada, through the MHD joint venture, for the lateral and centre nacelles for the Dassault Falcon 7X; and with Goodrich Aerostructure for the fan cowls for both engine applications of the Boeing 787, in addition to the contract for the Airbus A350 and the collaboration for inlet and fan cowls for the CFM56-5A/B nacelles for the Airbus narrow-body line.

AERMACCHI SF-260

Uruguayan Air Force designation: T-260

TYPE: Basic prop trainer/attack lightplane.

PROGRAMME: Originated as F.250 designed by Stelio Frati and made by Aviamilano; SF.250 prototype (I-RAIE) flew 15 July 1964, combining wings of F.8L Falco and fuselage of F.15 Picchio with modified canopy. One only, followed by two SF.260 prototypes (I-ALLA and HB-ELB) before project passed to SIAI-Marchetti.

Initial civil variants were SF.260 and SF.260B (Waco TS-250-3 Meteor on US market), followed by increased wing span SF.260C; SF.260D was later civil variant; SF.260M military trainer, sold widely in several subvariants; current versions developed (unsuccessfully) for USAF's Enhanced Flight Screener requirement; still in low-volume production as a military trainer following transfer of design rights to Aermacchi in 1997 as SF-260 (with hyphen). By 2004, SF-260s had flown more than 1,800,000 hours.

CURRENT VERSIONS: **SF-260E:** Direct-injection engine, strengthened airframe and 100 kg (220 lb) higher aerobatic weight than superseded SF.260D. Wing aerodynamically refined to preserve original stalling speed, despite increased MTOW; fence at approximately two-thirds of span; automatic fuel management. Canopy height and width increased. Certified by RAI on 21 January 1992 and by FAA on 17 August 1994.

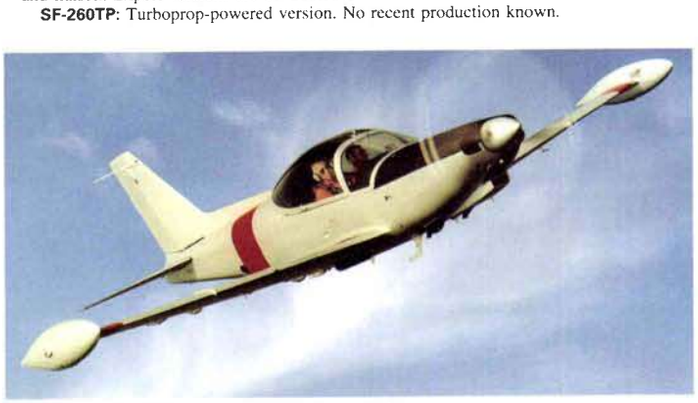
Main description applies to SF-260E and Warrior.

SF-260EA: In November 2003, 30 SF-260EAs were ordered by the Italian Air Force to replace SF-260AMs of 70° Stormo at Latina in the primary training role; deliveries contracted from early 2005, agreement also including buy-back of 21 SF-260AMs. First IAF aircraft (MM55098) flew 20 (initially announced as 21st) October 2004; certified by Italian National Armaments Directorate on 10 May 2005; initial two deliveries to 70° Stormo at Latina on 4 August 2005; last delivery due mid-2006. Compared with SF-260AM, has new navigation and communications equipment (VOR/ILS, ADF, DME, GPS, ADI and HSI; dual VHF/AM and UHF/AM); revised canopy shape, new ventilation and air conditioning system and improved servicing access.

SF-260F: As SF-260E, but carburetted engine. Promotion discontinued.

SF-260E Warrior: Two underwing pylons, for up to total 300 kg (661 lb) of external stores, and cockpit stores selection panel. Able to undertake a wide variety of roles, including low-level strike; forward air control; forward air support; armed reconnaissance; and liaison. Export versions are SF-260EU.

SF-260TP: Turboprop-powered version. No recent production known.



Aermacchi SF-260E basic piston-engined trainer 1159315

CUSTOMERS: Total of some 880 produced (including turboprop version) for customers in 27 countries. Civil operators include Sabena, Royal Air Maroc and Alitalia. Six SF-260Fs ordered by Air Force of Zimbabwe, early 1997, of which last delivered in October 1998; these were first of type built at Venegono. In June 1998, 12 SF-260Es bought by Venezuelan Air Force, and delivered to 14 Grupo at Maracay from late 2000. Delivery of 13 SF-260Es to Uruguayan Air Force began in September 1999, following first flight on 23 July, and completed in December 2000. Mexico placed order in early 1998, initially for 13, but subsequently 30, of which first six delivered in early 2000. Four Warrior variants of SF-260EU to Mauritania in 2000.

AERMACCHI SF-260 MILITARY CUSTOMERS

Operator	Variant	Qty	First Aircraft
Belgium	MB	36	ST-01
	D	9	ST-40
Bolivia	CB	6	FAB-180
Brunei	W	2	129
Burkina Faso		4[2]	
Burundi	C	3	9U-RUA
Congo Republic	MC	21	AT-101
Dubai	TP	6	401
	W	1	H
Ethiopia	TP	11	156?
Haiti	TP	6	1271
Ireland	WE	11	222
Italy	260	3	MM91004
	AM	45	MM54418
	EA	30	MM55098
Libya	W	240	
Mauritania	EU	4[1 and 5]	5T-MAK
Mexico	E	30[1]	6101
Myanmar	M	20	2001
Philippines	MP	30	601
	WP	16	631
	TP	18	701
Singapore	W	12	151
	MS	16	120
Somalia	C	6	6O-SBC
	W	10	
Sri Lanka	TP	9[3]	CT121
Thailand	MT	19	15–01
Tunisia	CT	6	W41501
	WT	12	W41401
Turkey	D	41	773
Uganda		3[4]	AF504
Uruguay	EU	13[1]	610
Venezuela	EU	12[1]	0027
Zambia	MZ	9	AF-507
Zimbabwe	C	17	R9900
	W	14	R3260
	F	6[1]	
Subtotal		**757**	
various civil		125	
Total		**882**	

[1] Built by Aermacchi
[2] Plus others second-hand
[3] Plus three second-hand
[4] Plus two or three from Libya
[5] Warrior

Notes: Nicaragua received some from Libya; Singapore donated 19 to Indonesia in 2002.

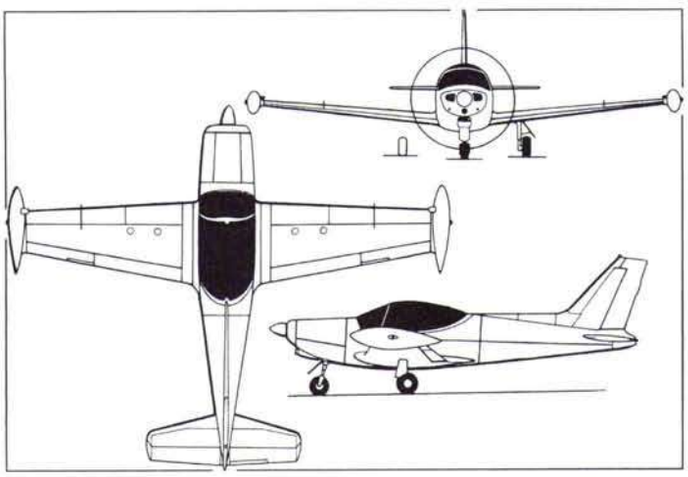
DESIGN FEATURES: Side-by-side, piston-engined aerobatic trainer. Low-mounted wings with forward-swept Trailing-edges and tip tanks; sweptback fin.

Wing section NACA 64_1-212 (modified) at root, 64_1-210 (modified) at tip; dihedral 6.5° 20' from roots.

FLYING CONTROLS: Conventional and manual. Frise ailerons each with servo tab; trim tabs for all three axes; four-way trim button on each stick top; electrically operated slotted flaps; controls operated by dual cables.

STRUCTURE: All-metal stressed skin structure; wing skin formed of butt-jointed panels flush riveted; single main spar and auxiliary rear spar; press-formed ribs; wings bolted together on centreline and attached to fuselage by six bolts. Fatigue life 15,000 hours.

LANDING GEAR: Electrically retractable tricycle type, with manual emergency actuation. Inward-retracting main gear, of trailing arm type, and rearward-retracting nose unit, each embodying Magnaghi oleo-pneumatic shock-absorber (Type 2/22028 in main units). Nose



Aermacchi SF-260E/F basic prop trainer *(Paul Jackson)* 1159397

unit is of leg and fork type, with coaxial shock-absorber and torque strut. Cleveland P/N 3080A mainwheels, with size 6.00–8 tube and tyre (6 ply rating), pressure 2.45 bar (36 lb/sq in). Cleveland P/N 40–77A nosewheel, with size 5.00–5 tube and tyre (8 ply rating), pressure 1.96 bar (28 lb/sq in). Cleveland P/N 3000–500 independent hydraulic single-disc brake on each mainwheel; parking brake. Nosewheel steering (±20°) operated directly by rudder pedals.

POWER PLANT: One 194 kW (260 hp) Textron Lycoming AEIO-540-D4A5 flat-six driving a Hartzell HC-C2YK-1BF/8477-8R two-blade, constant-speed, metal propeller.

Fuel in two light alloy tanks in wings each holding 49.5 litres (13.1 US gallons; 10.9 Imp gallons); and two permanent wingtip tanks each holding 72 litres (19.0 US gallons; 15.85 Imp gallons). Total internal fuel capacity 243 litres (64.2 US gallons; 53.3 Imp gallons), of which 235 litres (62.1 US gallons; 51.7 Imp gallons) are usable. Individual refuelling point on top of each tank. In addition, SF-260W may be fitted with two 80 litre (21.1 US gallon; 17.5 Imp gallon) auxiliary tanks on underwing pylons. Oil capacity (all models) 11.4 litres (3.0 US gallons; 2.5 Imp gallons).

ACCOMMODATION: Two pilots side by side in adjustable seats, with full blind-flying panel on right and reduced panel and radio on left. Third seat in rear. All three seats equipped with lap belts and shoulder harnesses. Baggage compartment aft of rear seat. Upper portion of sliding canopy tinted. Emergency canopy release handle for front seat occupant. Steel tube windscreen frame for protection in the event of an overturn. Air conditioning, oxygen and enlarged canopy optional.

SYSTEMS: Foot-powered hydraulics for mainwheel brakes only. No pneumatic system. 24 V DC electrical system of single-conductor negative earth type, including 70 A Prestolite engine-mounted alternator/rectifier and 24 V 24 Ah battery, for engine starting, flap and landing gear actuation, fuel booster pumps, electronics and lighting. Sealed battery compartment in rear of fuselage on port side. Connection of an external power source automatically disconnects the battery. Heating system for carburettor air intake. Cabin heating, and windscreen de-icing and demisting, by heat exchanger using engine exhaust muffler. Additional manually controlled warm air outlets for general cabin heating. Optional R134a gas air conditioning system and autopilot both available from 2000.

AVIONICS: *Comms:* Bendix/King or Rockwell Collins airways radio with dual com and nav; in SF-260E, avionics mounted aft of cabin and battery moved forward.

EQUIPMENT: Military equipment to customer's requirements. External stores can include one or two reconnaissance pods with two 70 mm automatic cameras, or two emergency supply containers or two external tanks. Landing light in nose, below spinner.

ARMAMENT: Warrior has two underwing hardpoints, able to carry external stores on NATO 356 mm (14 in) racks up to a maximum of 300 kg (661 lb) when flown as a single-seater. Typical alternative loads can include gun pods, each with 7.62 mm FN machine guns and 500 rounds; or 0.50 Browning machine gun; two Thiokol LUU-2/B parachute flares; bombs up to 150 kg (331 lb); Mk 76 practice bombs; two cartridge throwers for 70 mm multipurpose cartridges, F 725 flares or F 130 smoke cartridges.

DIMENSIONS, EXTERNAL:

Wing span over tip tanks	8.35 m (27 ft 4¾ in)
Wing chord: at root	1.60 m (5 ft 3 in)
mean aerodynamic	1.325 m (4 ft 4¼ in)
at tip	0.785 m (2 ft 7 in)
Wing aspect ratio (excl tip tanks)	6.3
Wing taper ratio	2.2
Length overall	7.10 m (23 ft 3½ in)
Fuselage: Max width	1.10 m (3 ft 7¼ in)
Max depth	1.04 m (3 ft 5 in)
Height overall	2.41 m (7 ft 11 in)
Elevator span	3.01 m (9 ft 10½ in)
Wheel track	2.275 m (7 ft 5½ in)
Wheelbase	1.66 m (5 ft 5¼ in)
Propeller diameter	1.93 m (6 ft 4 in)
Propeller ground clearance	0.32 m (1 ft 0½ in)

DIMENSIONS, INTERNAL:

Cabin: Length	1.66 m (5 ft 5¼ in)
Max width	1.00 m (3 ft 3¼ in)
Height: from seat cushion:	
to canopy	0.98 m (3 ft 2½ in)
to enlarged canopy	1.07 m (3 ft 6 in)
Volume	1.5 m^3 (53 cu ft)
Baggage compartment volume	0.18 m^3 (6.4 cu ft)

AREAS:

Wings, gross	10.10 m^2 (108.7 sq ft)
Ailerons (total, incl tabs)	0.76 m^2 (8.18 sq ft)
Trailing-edge flaps (total)	1.18 m^2 (12.70 sq ft)
Fin	0.76 m^2 (8.18 sq ft)
Dorsal fin	0.16 m^2 (1.72 sq ft)
Rudder, incl tab	0.60 m^2 (6.46 sq ft)
Tailplane	1.46 m^2 (15.70 sq ft)
Elevator, incl tab	0.96 m^2 (10.30 sq ft)

WEIGHTS AND LOADINGS:

Manufacturer's basic weight empty	779 kg (1,717 lb)
Weight empty, equipped	840 kg (1,852 lb)
Baggage capacity	20 kg (44 lb)
Max fuel weight: wing internal and tip tanks (all versions)	169 kg (372.5 lb)
underwing tanks	115 kg (254 lb)
Max T-O weight: E: Aerobatic	1,200 kg (2,645 lb)
Utility	1,300 kg (2,866 lb)
Warrior	1,350 kg (2,976 lb)
Max wing loading: E: Aerobatic	118.8 kg/m^2 (24.33 lb/sq ft)
Utility	128.7 kg/m^2 (26.36 lb/sq ft)
Warrior	128.7 kg/m^2 (26.36 lb/sq ft)
Max power loading: E: Aerobatic	6.18 kg/kW (10.17 lb/hp)
Utility	6.70 kg/kW (11.02 lb/hp)
Warrior	6.97 kg/kW (11.45 lb/hp)

PERFORMANCE (at 1,100 kg; 2,425 lb):

Never-exceed speed (VNE)	236 kt (437 km/h; 271 mph)
Max level speed at S/L	182 kt (337 km/h; 209 mph)
Cruising speed at 75% power at 1,830 m (6,000 ft)	175 kt (324 km/h; 201 mph)
Stalling speed, flaps down	59 kt (110 km/h; 68 mph)
Max rate of climb at S/L	548 m (1,800 ft)/min
Service ceiling	5,790 m (19,000 ft)
T-O run	275 m (905 ft)
Landing run	270 m (885 ft)
Range with max internal fuel	710 n miles (1,314 km; 817 miles)
Max range, internal and external fuel	1,090 n miles (2,018 km; 1,254 miles)
g limits	+6/−3

AERMACCHI M-311

TYPE: Basic jet trainer/light attack jet.

PROGRAMME: Announced at Farnborough International, July 2004, as substantially upgraded version of S.211, incorporating features of S.211A upgrade.

S.211 designed by SIAI-Marchetti and revealed in June 1977; first flight (I-SITF) 10 April 1981. Sold to Haiti (four; not used and to US civilian owners), Philippines (24, including 14 assembled locally) and Singapore (30, comprising six kits and 24 locally-built). Last delivery in 1991; promotion continued, including unsuccessful evaluation for USAF/USN JPATS programme. Acquired by Aermacchi in January 1997, which proposed modifications for existing machines, as detailed in *Jane's Aircraft Upgrades*.

M-311 avionics demonstrator (prototype) converted from S.211 JPATS demonstrator I-PATS. First flight 1 June 2005; exhibited at Paris Air Show later that month. Agreement signed with Turkish Aerospace Industries and announced on 16 June 2005 created joint engineering team and identified development and potential work-share areas for Turkey in M-311 programme.

Representative prototype, also converted from S.211 airframe, due to fly late 2006, incorporating most of proposed hardware changes for M-311, including JT15D-5C turbofan. First flight of production aircraft possible in late 2007, given early order.

CUSTOMERS: None. Offered to Singapore, Turkey and UK.

COSTS: Near-term market for 120 aircraft valued at USD900 million.

DESIGN FEATURES: Compared with S.211, has strengthened airframe for increased manoeuvre envelope and longer fatigue life, plus new systems and maintenance philosophy. HOTAS controls; HUD, MFDs and embedded simulation capability.

Shoulder-wing NASA GAW-1 aerofoil; drooped wingtips; sweepback 15° 30' at quarter-chord; thickness/chord ratio 15 per cent at root, 13 per cent at tip; anhedral 2° from root; twist −3° 17'.

FLYING CONTROLS: Variable incidence tailplane; servo tab and horn balanced elevator; boosted ailerons powered by single hydraulic actuator in fuselage with electrically actuated trim bias in aileron linkage; trimmable rudder; electrically actuated Fowler flaps; hydraulically actuated airbrake under centre-fuselage.

STRUCTURE: Two-spar, one-piece metal wing forming integral tank in torsion box and bolted to fuselage; upper and lower skins formed in single sheets; 60 per cent of external surfaces of fuselage in composites. Intake trunking made of GFRP moulding reinforced with helically wound CFRP tapes and metal-sprayed on inner surface.

LANDING GEAR: Hydraulically retractable tricycle type, of Messier/Magnaghi design. Oleo-pneumatic shock-absorber in each unit. All units retract forward into fuselage (main units turning through 90° to lie flat in undersides of engine air intake trunks). Nosewheel steerable ±18°; powered steering system may be offered. Mainwheels size 6.50-8; nosewheel size 5.00-5 with water-deflecting chined tyre. Designed for sink rate of 4 m (13 ft)/s. Wheel brakes actuated hydraulically, independently of main hydraulic system. Provision for emergency free-fall extension.

POWER PLANT: One 14.19 kN (3,190 lb st) Pratt & Whitney Canada JT15D-5C turbofan with automatic ignition, chip detectors and compressor bleed valve to eliminate surge; noise and emissions meet FAR Pt 36 and ICAO rules. Lateral intake each side of fuselage, with splitter plate. Fuel in integral wing tanks and fuselage bladder tank; total capacity approx 910 litres (240 US gallons; 200 Imp gallons). Single-point pressure refuelling in top surface of starboard wing. Electric fuel pump for engine starting and emergency use. Fuel and oil systems permit inverted flight. Provision for two 270 litre (71.3 US gallon; 59.4 Imp gallon) drop tanks on inboard underwing stores points. Oil capacity 10 kg (22 lb).

ACCOMMODATION: Two pilots in tandem, stepped up 28 cm (11 in) in rear, on Martin-Baker Mk 10 lightweight zero/zero ejection seats. Blast screen between seats. Pressurised and air conditioned cockpit under one-piece framed canopy opening sideways to starboard.

SYSTEMS: ECS for cockpit pressurisation and air conditioning, using engine bleed air for heating. Maximum pressure differential 0.24 bar (3.5 lb/sq in). Hydraulic system pressure 207 bars (3,000 lb/sq in), for actuation of airbrake, landing gear, Freon compressor and aileron boost, and independent actuation of wheel brakes. Primary electrical system is 28 V DC, using engine-driven starter/generator; Ni/Cd battery; two static inverters supply AC power for instruments and avionics. External power receptacle in port side of lower fuselage aft of wing. OBOGS.

AVIONICS: *Comms:* Dual V/UHF transceivers, intercom, and IFF or ATC transponder, standard.

Flight: Optional moving map display.

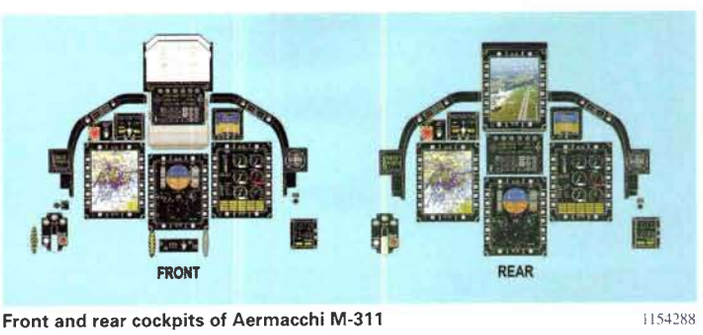
Instrumentation: HUD in front cockpit, plus repeater in rear; three-screen EFIS (127 × 178 mm; 5 × 7 in) in each cockpit. NVG compatible.

Mission: Onboard simulation of sensors including multimode fire control radar (air-air and air-ground) and electronic warfare suite (RWR, MWS, chaff/flare dispenser), weapons and tactical scenario operating air/ground datalink (computer-generated forces, hostile integrated air defence system, including airborne surface, naval and missile threats).

ARMAMENT: Optional stores management system. Four underwing hardpoints, stressed for loads of up to 350 kg (772 lb) inboard and 250 kg (551 lb) outboard, plus centreline pylon stressed for 90 kg (198 lb); maximum external load 1,090 kg (2,403 lb); (inboard only) two bombs or napalm containers of up to 300 kg; or four 74 mm cartridge dispensers; or parachuting containers; S.211A can have special container or 12.7 mm gun pod on fuselage centreline pylon.

DIMENSIONS, EXTERNAL:

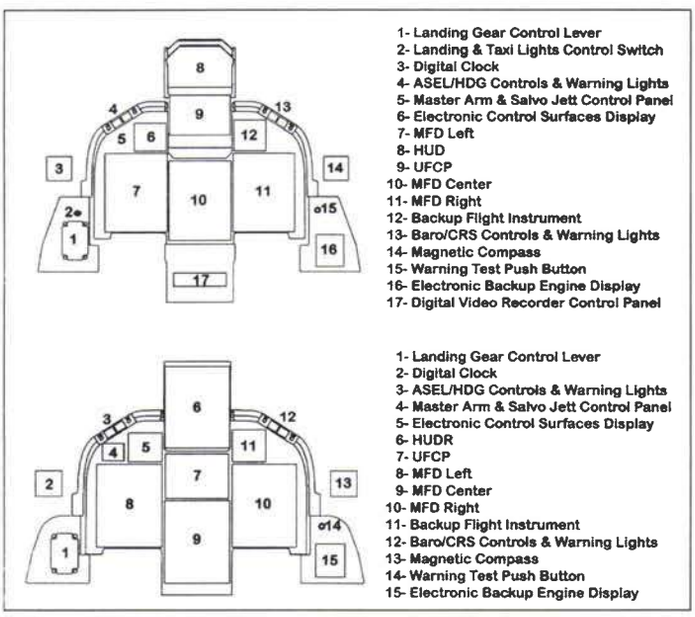
Wing span	8.47 m (27 ft 9½ in)
Wing chord: at root	2.15 m (7 ft 0¾ in)
mean aerodynamic	1.65 m (5 ft 5 in)
at tip	1.00 m (3 ft 3¼ in)
Wing aspect ratio	5.7
Length overall	9.85 m (32 ft 3¾ in)
Height overall	3.74 m (12 ft 3¼ in)
Tailplane span	4.16 m (13 ft 7¾ in)
Wheel track	2.40 m (7 ft 10½ in)
Wheelbase	4.04 m (13 ft 3 in)



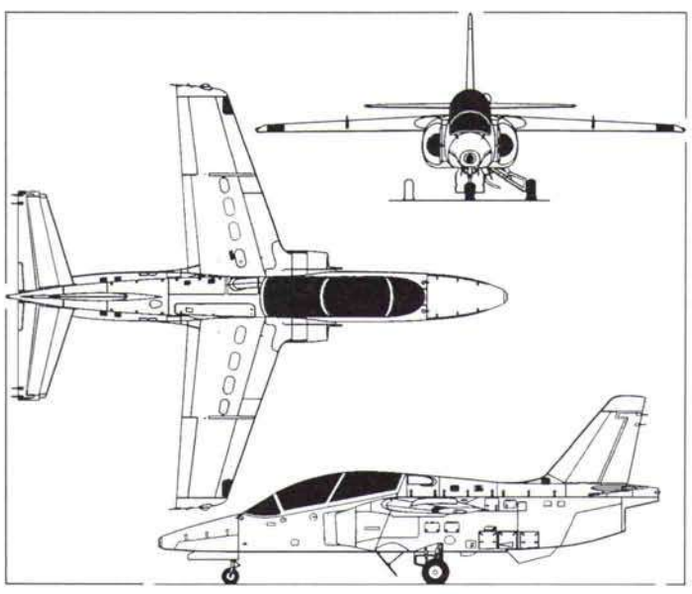
Front and rear cockpits of Aermacchi M-311 1154288

Aermacchi M-311 'avionics demonstrator' being exhibited at Singapore in February 2006 *(Paul Jackson)* 1154287

AREAS:
Wings, gross ..... 12.60 m² (135.6 sq ft)
Airbrake ..... 0.42 m² (4.52 sq ft)
Vertical tail surfaces (total) ..... 2.01 m² (21.64 sq ft)
Horizontal tail surfaces (total) ..... 3.38 m² (36.38 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 2,300 kg (5,070 lb)
Max weapon load ..... 1,000 kg (2,205 lb)
Max fuel weight: internal ..... 696 kg (1,534 lb)
external ..... 424 kg (935 lb)



Key to Aermacchi M-311 cockpits layout 1154286



Aermacchi M-311 basic jet trainer 1158269

Max T-O weight: trainer, clean ..... 3,200 kg (7,054 lb)
armed version ..... 4,100 kg (9,039 lb)
Max wing loading:
trainer, clean ..... 254.0 kg/m² (52.02 lb/sq ft)
armed version ..... 325.4 kg/m² (66.65 lb/sq ft)
Max power loading:
trainer, clean ..... 225 kg/kN (2.21 lb/lb st)
armed version ..... 289 kg/kN (2.83 lb/lb st)
PERFORMANCE (estimated):
Never-exceed speed (VNE) ..... M0.80 (430 kt; 796 km/h; 485 mph EAS)
Max level speed, clean: at S/L ..... 380 kt (704 km/h; 437 mph)
at FL200 ..... 400 kt (740 km/h; 460 mph)
Stalling speed, flaps down ..... 84 kt (156 km/h; 97 mph)
Max rate of climb at S/L ..... 1,438 m (4,718 ft)/min
Service ceiling ..... 12,200 m (40,000 ft)
T-O run ..... 450 m (1,480 ft)
Landing run ..... 460 m (1,510 ft)
Max range on internal fuel, reserves 10% ..... 740 n miles (1,370 km; 851 miles)
Ferry range with max internal and external fuel, 10% reserves ..... 960 n miles (1,777 km; 1,104 miles)
g limits: clean ..... +7/–3.5
with external stores ..... +5/–2.5

AERMACCHI MB-339

TYPE: Basic jet trainer/light attack jet.
PROGRAMME:

DEVELOPMENT MILESTONES

Programme launched	11 Feb 75
First flight	12 Aug 76
First flight, production	20 Jul 78
First delivery (IAF)	8 Aug 79

MB-339A selected by Italian Air Force on 11 February 1975 in preference to MB-338; one static test airframe and two prototypes: first flights (MM588) 12 August 1976 and (MM589) 20 May 1977; first flight of production MB-339A (MM54438) 20 July 1978; initial two deliveries (MM54439 and 54440) on 8 August 1979; first batch of 51 included three used as radio calibration aircraft at Pratica di Mare and 14 PANs for Frecce Tricolori aerobatic team.

MB-339C developed as an uprated MB-339 with a Viper 680 power plant; experimental installation in I-MABX, first flown on 9 June 1983; initial MB-339C first flight (I-AMDA) 17 December 1985; production aircraft (I-TRON) 8 November 1989. The 200th MB-339 (a 339CE for Eritrea) was delivered on 14 April 1997. MB-339s had flown some 500,000 hours by late 2002. Final delivery from main production run was made (to Italian Air Force) in 2004, but Malaysian Air Force ordered batch of eight in November 2006, deliveries to begin 24 months later.

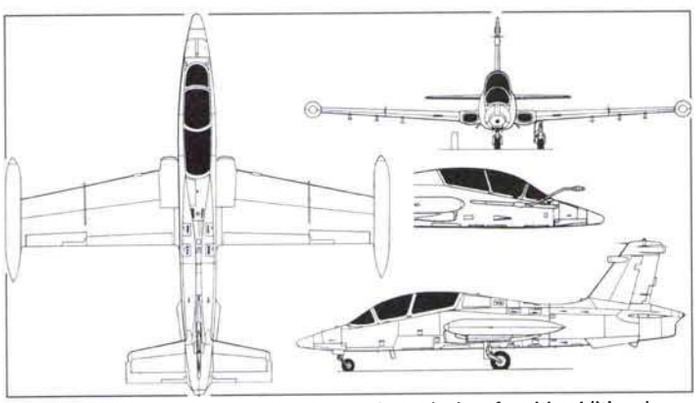
CURRENT VERSIONS: **MB-339A:** Initial military basic/advanced trainer. Final deliveries (small attrition replacement batch for Italy) in 1995. Main operator is 61° Stormo Scuola Volo Basico Iniziale su Aviogetti at Lecce-Galatina.

LIT110 billion MLU initiated in mid-1999 includes structural modifications on intended 70 aircraft to extend service lives from 10,000 to 15,000 hours (from 20 to 30 years). By A2004, updating reportedly to affect only 49 MB-339As, several others by then having been placed in storage or retired. Features of MLU include Litton Italia LISA-FG GPS/INS; new integrated air data transducer; provision for AN/ARC-150(V) Have Quick secure radio; Elmer crash recorder; ELT; instrument panel modifications; radio switches on control column; formation flying lights; higher-capacity batteries connected in parallel with starter/generator; provision for target towing; anti-skid brakes; nosewheel splash-guard; repositioned IFF antenna; airborne stress gauge; and improved access, by means of additional removable panels, to wing/fuselage joint for inspection and engine maintenance. Depot maintenance interval will increase to 1,500 hours after MLU. Prototype (CSX54453) first flown 20 December 1999; 'production' will take between eight and 10 years for whole fleet; first pair (MM54497 and MM54505) redelivered in 2002. As part of trials for expanded role of Italian MB-339s, AIM-9L Sidewinder AAM launch trials began mid-2003.

MB-339PAN: (*Pattuglia Acrobatica Nazionale:* national aerobatic team) Special version of MB-339A for Italian Air Force; smoke generator added; wingtip tanks deleted. Official debut 27 April 1982. Total 29 built as, or converted to, PAN. Included in MLU.

MB-339AM: Special anti-ship version armed with AOSM Marte Mk 2A missile; avionics, equivalent to MB-339C, include new inertial navigator, Doppler radar, navigation and attack computers, head-up display and multifunction display. Prototype converted from MB-339A; qualification completed January 1995. No known orders.

Aermacchi MB-339AMs from first Malaysian contract 1040563



Aermacchi MB-339CD advanced trainer and attack aircraft, with additional starboard side view of optional refuelling probe *(Dennis Punnett)* 0507612

MB-339B: Powered by 19.57 kN (4,400 lb st) Viper Mk 680-43; larger tip tanks. Prototype (demonstrator I-GROW) modified in 1993 with two LCD EFIS displays and air-to-air refuelling (AAR).

MB-339RM: (*Radiomisure:* radio calibration) Three produced for Italian Air Force, 1981; withdrawn and transferred to training as MB-339As. However, one MB-339RM reassigned to 71° Gruppo of 14° Stormo in February 2003 for calibration duties.

T-Bird II: One demonstrator modified for US JPATS competition; delivered to Lockheed factory at Marietta, Georgia, on 20 May 1992. Power plant, one Rolls-Royce Viper 680-582 of 17.79 kN (4,000 lb st) with noise reduction kit. Rejected in favour of Pilatus PC-9 (Raytheon T-6A Texan II), June 1995. Continues in use as chase aircraft.

MB-339CB: For Royal New Zealand Air Force; Viper 680 engine. Served with 14 Squadron at Ohakea in training and light attack roles until 13 December 2001, when unit disbanded and aircraft offered for sale being subsequently bought by Malaysia.

MB-339CD: (C Digital) Developed for Italian Air Force advanced/fighter lead-in training against order for 15. Rolled out 12 April 1996; first flight (conversion of MB-339A MM54544; renumbered MMX606) 24 April 1996. Rolls-Royce Viper Mk 632-43 engine; removable in-flight refuelling probe (first phase of tanker trials completed March 1996 by development MB-339 I-GROW); new avionic architecture based on a single central mission computer, MIL-STD-1553B digital databus, one ring laser gyro platform with embedded GPS, EFIS cockpits with HUD in each, three identical liquid crystal colour MFDs and HOTAS controls. Other details generally as MB-339CB, but (compared with MB-339A) nose lengthened; elevators modified to give handling characteristics closer to the fast jets to which students will progress; some structural parts and systems modified; and pilots' escape system updated. Achieved full operational capability with IAF in October 1998 after 148 sorties by prototype.

Contract signed in August 2001 for further 15 MB-339CDs, designated **MB-339CD2**; prototype was conversion of MMX606, first flown in new guise on 6 November 2001; new features of Lot 2 include 8.33 kHz radios, onboard simulation of electronic warfare (RWR, MAWS, chaff/flare), IFF Mode S, crash data recorder, ELT and underwater acoustic beacon, multifunctional information distribution system, full NVG capability, digital map system and autonomous air combat manoeuvring instrumentation. All new features being retrofitted to first batch, and contract includes full-mission simulator installed at Lecce-Galatina air base in December 2002. Initial aircraft of Lot 2 (MM55077) first flew 24 May 2002 and delivered September 2002. Clearance issued in July 2002 for carriage of autonomous air combat manoeuvring instrumentation (AACMI) pod on port outer wing pylon. Sidewinder AAM carriage qualified 2003.

In June 2003 the MB-339CD prototype made the first flight of an onboard embedded simulation system funded by five European air forces. Begun in February 2000 and designated RTP11.12, this allows pilots to train against simulated adversaries, in a virtual scenario including a threat environment, while flying a real aircraft — otherwise WaSiF: weapon simulation in flight. Project completed July 2003 on achievement of five test- and nine demonstration sorties.

Detailed description applies to the above version.

MB-339CM: Second-generation Malaysian version, generally as MB-339CD, but Malaysian industry providing ejection seats and some avionics. Deliveries from 2008.

MB-339CE: Variant of MB-339CD; Viper 680 engine. Six ordered by Eritrea on 7 November 1995; deliveries began April 1997.

MB-339FD: (Full Digital) Export equivalent of CD, with Viper 680 engine. Offered to Australia in 1994; unsuccessful in competition against the BAE Systems' Hawk. Also offered to Brazil and South Africa as Xavante/Impala replacement. Purchase by Venezuela of an initial eight announced 7 July 1998, but decision subsequently reversed and competition reopened; no further announcement by early 2003.

CUSTOMERS: Refer to table. Initial fifteen CDs ordered by Italian Air Force; delivery of two aircraft on 18 December 1996, followed by further 10 in 1997 and three in 1998 (last in November); first four to Reparto Sperimentale Volo at Pratica di Mare for trials before issue to 61° Stormo; some assigned to base flights at Gioia del Colle and Novara-Cameri for continuation training, including in-flight refuelling. Further 15 supplied in 2002–2003, comprising seven by December 2002 (initially on CB1 software configuration) and balance by December 2003.

COSTS: Malaysian contract for eight, plus spares and two years' support, valued at EUR88 million (2006).

DESIGN FEATURES: Conventional subsonic jet trainer with tandem, stepped cockpits and low, moderately sweptback wing. Designed to MIL-A-8866A for 15,000 hours service life. Intended maintenance requirement of 3.5 mmh/fh; scheduled maintenance at 150 and 300 hour intervals; inspection at 1,800 hours.

Wing section NACA 64A-114 (mod) at centreline, 64A-212 (mod) at tip; quarter-chord sweepback 8° 29'.

FLYING CONTROLS: Conventional. Power-assisted ailerons with artificial feel, plus servo tabs to assist emergency manual reversion; elevators and rudder actuated manually by pushrods; electrically controlled servo tab for control assistance and trimming on elevator; hydraulically actuated single-slotted flaps; two ventral strakes under tail; electrohydraulically actuated airbrake panel under forward fuselage; wing fence ahead of aileron inboard edge; both pilots have HUD; rear pilot elevated sufficiently to be able to aim guns and air-to-surface weapons and fly visual approaches (see nav/attack system under Avionics heading).

STRUCTURE: All-metal; stressed skin wings with main and auxiliary spars and spanwise stringers; bolted to fuselage; tip tanks permanently attached; rear fuselage detachable by four bolts for engine access.

LANDING GEAR: Hydraulically retractable tricycle type with oleo-pneumatic shock-absorbers, suitable for operation from semi-prepared runways. Hydraulically steerable nosewheel retracts forward; main units retract outward into wings. Low-pressure mainwheel tubeless tyres size 545×175-10 (14 ply); nosewheel tubeless tyre size 380×150-4 (6 ply). Emergency extension system. Hydraulic disc brakes with anti-skid system. Minimum ground turning radius 8.63 m (28 ft 3¾ in).

POWER PLANT: One Rolls-Royce Viper Mk 632-43 turbojet, rated at 17.79 kN (4,000 lb st). Fuel in two-cell rubber fuselage tank, capacity 781 litres (206 US gallons; 172 Imp gallons), and two wingtip tanks with combined capacity of 1,000 litres (264 US gallons; 220 Imp gallons). Total internal usable capacity 1,781 litres (470.5 US gallons; 392 Imp gallons). Self-sealing tanks optional. Single-point pressure refuelling point in port side of fuselage, below wing trailing-edge. Gravity refuelling points on top of fuselage and each tip tank. Provision for two drop tanks, each of 330 litres (87.1 US gallons; 72.6 Imp gallons) usable capacity, on centre underwing stations. Optional refuelling probe on starboard side of cockpits.

ACCOMMODATION: Crew of two in tandem, on Martin-Baker Mk 10LK zero/zero ejection seats in pressurised cockpit. Independent or rear-seat command ejection. Design in accordance with MIL-STD-203F. Rear seat elevated 32.5 cm (1 ft 1 in). Rearview mirror for each occupant. Two-piece moulded transparent canopy, opening sideways to starboard.

SYSTEMS: Pressurisation system maximum differential 0.24 bar (3.5 lb/sq in); cockpit designed for 40,000 pressurisation cycles. Bootstrap-type air conditioning system, also providing air for windscreen and canopy demisting. Hydraulic system, pressure 172.5 bar (2,500 lb/sq in), for actuation of flaps, aileron servos, airbrake, landing gear, wheel brakes and nosewheel steering. Back-up system for wheel brakes and emergency extension of landing gear. Main electrical DC power from one 28 V 9 kW engine-driven starter/generator and one 28 V 6 kW secondary generator; power distribution via five 28 V busses. Two 25 V 24 Ah Ni/Cd batteries for engine starting. Fixed-frequency 115/26 V AC power from two 600 VA single-phase static inverters; provision for additional inverter for three-phase AC. External power receptacle. Low-pressure demand oxygen system, operating at 28 bar (400 lb/sq in). Anti-icing system for engine air intakes.

AVIONICS: Representative fit includes following:

Comms: Honeywell AN/APX-100 IFF; Elmer SRT-651/N VHF/UHF transceiver.

Flight: Honeywell H-746-G GPS/INS, Rockwell Collins ADF-462 and VIR-432 VOR/ILS/MKR; Thales AN-490 tacan.

Instrumentation: Three MFDs; Thales LCD each cockpit; Alenia/Honeywell radalt.

Mission: Kaiser Sabre head-up display; Logic stores management system; Sekay video camera.

Self-defence: Optional RWR, chaff/flare dispenser and MAWS.

ARMAMENT: Up to 1,814 kg (4,000 lb) of external stores on six underwing hardpoints. Four inner hardpoints each stressed for up to 454 kg (1,000 lb) load, and two outer hardpoints each for up to 340 kg (750 lb) load. RNZAF aircraft fitted for AIM-9 Sidewinder and AGM-65 Maverick. Provision on two inner stations for installation of two Macchi gun pods, each containing either a 30 mm DEFA 553 cannon with 120 rounds or a 12.7 mm AN/M-3 machine gun with 350 rounds.

Other typical loads can include two Magic or AIM-9 Sidewinder air-to-air missiles on two outer stations; six general purpose or cluster bombs of appropriate weights; six AN/SUU-11A/A 7.62 mm Minigun pods, each with 1,500 rounds; six Matra 155 launchers, each for eighteen 68 mm rockets; six AN/LAU-68/A or AN/LAU-32G launchers, each for seven 2.75 in rockets; six Aerea AL-25-50 or AL-18-50 launchers, each with twenty-five or eighteen 50 mm rockets respectively; six Aerea AL-18-80 launchers, each with twelve 81 mm rockets; four AN/LAU-10/A launchers, each with four 5 in Zuni rockets; four TDA 100-4 launchers, each with four 100 mm TDA rockets; six Bristol Aerospace LAU-5002 launchers for CRV-7 high-velocity rockets; six Aerea BRD bomb/rocket dispensers; six Aermacchi 11B29-003 bomb/flare dispensers; six TDA 14-3-M2 adaptors, each with six BAP 100 anti-runway bombs or BAT 120 tactical support bombs. Marte 2A anti-ship missile completed MB-339 qualification trials in February 1995.

Following data are for MB-339CD.

DIMENSIONS, EXTERNAL:

Wing span over tip tanks	11.22 m (36 ft 9¾ in)
Wing aspect ratio	6.5
Length overall	11.24 m (36 ft 10½ in)
Height overall	3.945 m (12 ft 11¼ in)
Elevator span	4.16 m (13 ft 7¾ in)
Wheel track	2.48 m (8 ft 1¾ in)
Wheelbase	4.37 m (14 ft 4 in)

AREAS:

Wings, gross	19.30 m² (207.7 sq ft)
Ailerons (total)	1.33 m² (14.32 sq ft)
Trailing-edge flaps (total)	2.55 m² (27.45 sq ft)
Airbrake	0.52 m² (5.60 sq ft)
Fin	2.21 m² (23.78 sq ft)
Rudder, incl tab	0.68 m² (7.32 sq ft)
Tailplane	3.38 m² (36.38 sq ft)
Elevators (total incl tabs)	0.98 m² (10.55 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	3,335 kg (7,352 lb)
Max weapon load	1,814 kg (4,000 lb)
Max fuel weight: internal	1,430 kg (3,153 lb)
external	530 kg (1,168 lb)

MB-339 PRODUCTION

Customer	Variant	Qty	First Aircraft	First Delivered
Argentine Navy	AA	10[2]	0761	1980
Eritrean Air Force	CE	6	409[3]	Apr 1997
Ghana Air Force	A	2	G800	1987
		2	G802	1994
Italian Air Force	A[1]	80	MM54438	19 Feb 1979
		20	MM54533	1986
		4	MM55052	1994
		2	MM55058	1995
	CD	15	MM55062	18 Dec 1996
		15	MM55077	Sep 2002
Malaysian Air Force	AM	13	M34-01	1983
	CM	8	M34-14	2008
New Zealand Air Force	CB	18	NZ6460	13 Mar 1991
Nigerian Air Force	AN	12	301	Jun 1984
Peruvian Air Force	AP	16	452	Nov 1981
UAE (Dubai) Air Force	A	2	431	24 Mar 1984
		5	433	1987
Subtotal		**230**		
Prototypes		2	MM588	1976
Demonstrator	A	1	I-NEUN	1980
	B	1	I-GROW	1984
	C	1	I-AMDA	1985
	K	1	I-BITE	1980
Total		**236**		

[1] Also 339PAN and 339RM
[2] One converted to JPATS demonstrator N339L; others lost or withdrawn from service
[3] Eritrean aircraft serial numbered in reverse order

T-O weight, clean ..... 4,950 kg (10,913 lb)
Max T-O weight with external stores ..... 6,350 kg (14,000 lb)
Max wing loading ..... 329.0 kg/m^2 (67.39 lb/sq ft)
Max power loading ..... 357 kg/kN (3.50 lb/lb st)

PERFORMANCE (at trainer clean T-O weight, except where indicated):

Never-exceed speed (VNE) ..... M0.82 (500 kt; 926 km/h; 575 mph)
Max level speed at S/L:
clean ..... 470 kt (870 km/h; 541 mph)
with four 500 lb bombs ..... 440 kt (815 km/h; 506 mph)
Max level speed at 9,140 m (30,000 ft) ..... M0.77 (441 kt; 815 km/h; 508 mph)
Max speed for landing gear extension ..... 175 kt (324 km/h; 202 mph)
T-O speed ..... 100 kt (185 km/h; 115 mph)
Approach speed over 15 m (50 ft) obstacle ..... 102 kt (189 km/h; 117 mph)
Stalling speed, 20% fuel ..... 86 kt (160 km/h; 99 mph)
Max rate of climb at S/L ..... 1,631 m (5,350 ft)/min
Service ceiling ..... 13,715 m (45,000 ft)
T-O run ..... 620 m (2,035 ft)
Landing run at S/L, 20% fuel ..... 480 m (1,575 ft)
Radius of action, 10% reserves:
with four 500 lb bombs:
lo-lo-lo ..... 156 n miles (289 km; 179 miles)
hi-lo-hi ..... 278 n miles (515 km; 829 miles)
with two rocket launchers two gun pods and two gun pods, 5 min combat, hi-lo-hi ..... 280 n miles (519 km; 322 miles)
Ferry range, clean ..... 1,122 n miles (2,078 km; 1,291 miles)
Max endurance with drop tanks ..... 3 h 50 min
g limit ..... +8.0/−4.0

AERMACCHI M-346

TYPE: Advanced jet trainer/light attack jet.

PROGRAMME:

DEVELOPMENT MILESTONES

Design began	Jan 00
Announced	25 Jul 00
Rolled out (unofficially)	6 Jun 03
Rolled out	7 Jun 03
First flight	15 Jul 04

Announced 25 July 2000. Comprehensively redesigned and westernised version of Yakovlev Yak-130, on which Aermacchi had begun autonomous full-scale development in January 2000, conforming to requirements of Eurotrainer group. Three prototypes as follow-on to 300 trial flights with prototype Yak-130; mockup first shown at Paris, June 2001; maiden flight of P01/CMX615 scheduled for November 2003, following 7 June 2003 roll-out, but not achieved until 15 July 2004. Official (VIP) presentation 11 October 2004, by which time 11 hours amassed in 14 sorties. Total 50 sorties and 55 hours by 7 March 2005, when flown for first time with both FADECs operational.

P02/CMX616 first flew 17 May 2005. Both aircraft shown (001 flying) at Paris, 13 to 19 June 2005. On 9 January 2006, Aermacchi announced initial flight by M-346 (P02) with AFCS in full-authority mode. LRIP 00 (to production standard) to fly in late 2006, three aircraft contributing to 700-hour test programme. A01 initial production aircraft to fly in late 2007 (preceded by static test and fatigue test airframes to production standard in 2005 and 2006, respectively).

Aermacchi shares design rights and has production and modification rights for the Yak-130. Development of the aircraft was transferred to Italy in mid-1998 to prevent further delays resulting from the economic situation in Russia. Some funding provided by Italian Ministry of Industry. Italian military flight test centre (RSV) involved in certification testing, beginning with prototype's fourth sortie. Dott Massimo Luchesini is Aermacchi's AEM/Yak-130 programme director.

At Farnborough International, immediately following maiden flight, Aermacchi formally launched quest for industrial partners to share manufacture of any production aircraft. On 19 January 2005, Greek Ministry of Defence signed MoU for possible industrial participation in M-346; this confirmed with second MoU on 19 January 2006, giving Greece 10 per cent workshare, including design, production and assembly of several components, including rear fuselage.

CURRENT VERSIONS (SPECIFIC): **P01:** 001/CMX615. First flight 15 July 2004. Handling and performance trials, including envelope expansion, high AoA and FCS proving.

P02: 002/CMX616. As P01, plus avionics testing, including onboard simulation, and flight refuelling. Fuselage removed from assembly jig on 11 December 2003. First flight 17 May 2005.

LRIP 00: Avionics (including onboard simulation), definitive main landing gear, radar integration, electronic warfare and external stores trials. Following early flight trials of P01, decided in late 2004 to incorporate modified fuel system to eliminate sloshing and add further 40 litres (10.6 US gallons; 8.8 Imp gallons) of capacity.

CUSTOMERS: None. Estimated 600 sales in total market for 1,650 aircraft of this type over 25 years (2004).

DESIGN FEATURES: Extends flight envelope of existing jet trainers, notably turn and climb performance and usable AoA (40°). Related considerations are transonic aerodynamic configuration, twin-engine reliability, FBW control system, fighter-type cockpit and avionics, high reliability and low operational and maintenance costs. Able to 'download' some 30-40 per cent of training hours previously flown on combat aircraft at OCU.

Cockpit based on latest combat aircraft, such as Eurofighter Typhoon. 'Duck's beak' chine deleted from forward fuselage to simplify shape and facilitate optional addition of radar. Autonomous operation made possible by self-starting, OBOGS, BITE, APU and use of standard support equipment. Design to MIL-STD-1350A and MIL-A-8660A; maintenance to MIL-STD-470B; technical publications in accordance with applicable MIL-STD. Service life 16,000 hours. Wing dihedral 1°; tailplane anhedral 4°. Max sustained turn rate of 14.5°/s and load factor of 5.6 *g*, both at 4,570 m (15,000 ft).

FLYING CONTROLS: FBW. Ailerons, elevators and rudder on primary control circuit, protected against double failure; leading-edge flaps, double-slotted, constant chord trailing-edge flaps and spine airbrake on secondary control circuit, although first-mentioned are duplex. Smiths Aerospace primary actuators. Microtecnica actuators for leading- and trailing-edge flaps are rotary and ballscrew type, respectively. Airbrake failure mode is 'closed'.

STRUCTURE: Aluminium alloy skins, wings and fin; reinforced carbon fibre cockpit section and rear fuselage; metallic bonded composites ailerons, flaps, airbrake, rudder and elevons; Kevlar fin fillet, fin root fairings and tailcone; glass fibre nosecone and fintip. Low parts-count: is 2 t heavier than MB-339, but has 40 per cent fewer parts.

Wing comprises three main spars and two auxiliary spars with integral fuel tank. Main spars pick up one to three single-three machined mainframes.

LANDING GEAR: Nosewheel leg by Liebherr; tyre 18×5.5. Forward-retracting mainwheel legs from AMX fighter-bomber on first two prototypes; new units by Liebherr thereafter; tyres 24×8. Hydraulic actuation; two emergency accumulators.

POWER PLANT: Two 27.9 kN (6,280 lb st) Honeywell F124-GA-200 twin-shaft turbofans with dual-channel FADEC. Total fuel capacity of first two prototypes approximately 2,500 litres (660 US gallons; 550 Imp gallons), comprising 394 litres (104 US gallons; 86.7 Imp gallons) in two-section tanks in each wing; main 1,493 litre (394 US gallon; 329 Imp gallon) centre fuselage tank; and 219 litre (57.9 US gallon; 48.2 Imp gallon) collector tank. Single-point pressure refuelling; can be refuelled with engines running. Two inboard wing pylons 'wet', each with provision for 580 litre (153 US gallon; 128 Imp gallon) tank. Secondo Mona fuel system. Optional, removable refuelling probe.

ACCOMMODATION: Two Martin-Baker Mk 16D zero/zero ejection seats. HOTAS controls.

SYSTEMS: Teleavio/BAE Systems quadruplex, full authority reprogrammable FCS provides stability augmentation throughout flight envelope. Autopilot is part of FCS. Honeywell Normelair-Garrett environmental control system, providing 100 per cent conditioned air to cockpit, using engine or APU power; 'bootstrap' air cooler, precooler and dual heat exchangers, plus bleed leak detector; nominal cockpit pressure differential 0.25 bar (3.6 lb/sq in); Air Liquide OBOGS. Electrical system, by ASE and Logic, includes 20 kVA generator on each engine (100 per cent redundancy), two 9 kW transformer-rectifiers, one 5 kW 28 V DC emergency generator (Microturbo Rubis APU) and two Ni/Cd batteries. APU cleared for air-starts up to 6,100 m (20,000 ft); provides environmental control at 7 kg/s (15 lb/s) at 4.4 bar (64 lb/sq in) and 5 kW electrical power.

Two dual-redundant digital databusses conforming to MIL-STD-1553B: Avionics 1 for sensors and displays; Avionics 2 for radar, SMS, FLIR, AECM, RWR and HMD. Additional Armament databus to MIL-STD-1760 for weapons stations and SMS. Avionics 1 and 2 control is by mission computer symbol generator (MCSG) with failure back-up from miscellaneous computer (MISCO). Armament bus control by SMS acting as remote terminal of Avionics 2 bus. Air-to-air and air-to-ground attack computations by operational flight program (OFP) software in MCSG, latter also generating HUD symbology. Area navigation and flight director functions performed by embedded GPS inertial unit (EGI) and flight control computers, respectively.

Cockpit video recording provided by colour HUD TV camera, recording outside world with HUD symbology superimposed; associated VTR captures colour and monochrome

1127755

Prototype Aermacchi M-346 in June 2005, following repainting for Paris Air Show

video signals and is remotely controlled by a dedicated panel. MISCO also responsible for avionics system interface, aural warning generator for voice alert system (VAS), HUMS and gear down/locked confirmation tone. Crash-survivable memory unit (CSMU) interfaced via RS-422 to MISCO and audio system to record data for accident analysis. Two independent hydraulic systems by Microtecnica, both operating at 207 bar (3,000 lb/sq in): No.1 for flight controls, No. 2 for utilities and flight control back-up. Smiths/Microtecnica/OMA control surface actuators.

AVIONICS: Mission core system by Galileo Avionica.

Comms: Two Marconi VHF/UHF transceivers; Marconi IFF transponder. DbSystem intercom.

Radar: Provision in design.

Flight: Honeywell laser gyro INS with embedded GPS; Thales Tacan and Collins VOR/ILS/marker beacon receiver.

Instrumentation: Galileo Avionica raster/stroke HUD; three Galileo Avionica 127 × 127 mm (5 × 5 in) colour LCDs per cockpit; provision for HMD and NVGs. Up-front control panels for management of navigation and weapon delivery, communication, identification and radio navigation, plus optional FLIR.

Mission: Data transfer unit (DTU) for loading of mission plan. Centreline attachment for Vinten Vicon 19 reconnaissance pod. Litening FLIR, or ATLIS targeting pod. Cockpit video recorder. Radar and ECM simulation system integrated for advanced training.

Self-defence: Provision for RWR, chaff/flares and underwing ECM pod.

ARMAMENT: Nine hardpoints: one on centreline, rated at 600 kg (1,323 lb); four under each wing, rated at 1,050 kg (2,315 lb) (inboard), 550 kg (1,213 lb), 300 kg (661 lb) and 150 kg (331 lb) (wingtip). Optional cannon pod on centreline. Typical weapon loads include six Mk 82 (500 lb), four Mk 83 (1,000 lb) or two Mk 84 (2,000 lb) bombs; four GBU-12 (500 lb), GBU-16 (1,000 lb) or Opher Mk 82 guided bombs; six Rockeye or four BL 755 CBUs; six Durandal anti-runway dispensers; four BRD-4 or LAU-7/LAU-5002/LAU-32 rocket pods; four AIM-9 Sidewinder AAMs; four AGM-65 Maverick ASMs; or four Brimstone anti-armour missiles.

DIMENSIONS, EXTERNAL:

Wing span	9.72 m (31 ft 10¾ in)
Wing chord: at root (fuselage c/l)	3.87 m (12 ft 8¼ in)
at tip	0.97 m (3 ft 2¼ in)
mean aerodynamic	2.71 m (8 ft 10¾ in)

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Second Aermacchi M-346 flying in full-authority AFCS mode in January 2006

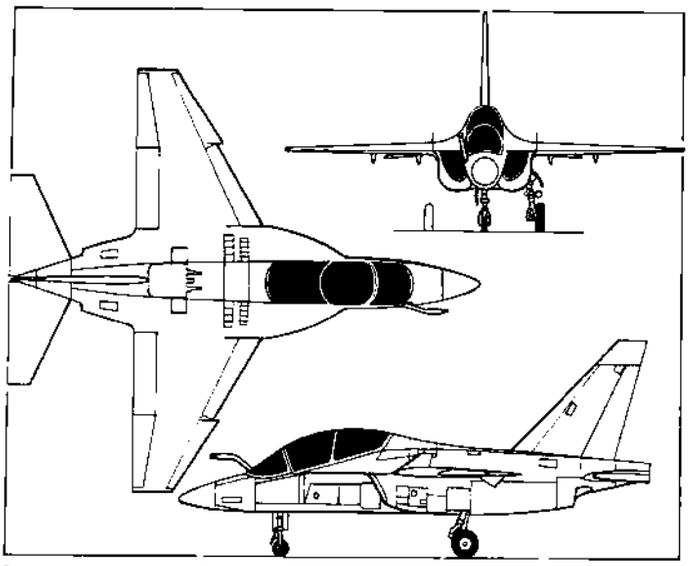
For details of the latest updates to ***Jane's All the World's Aircraft*** online and to discover the additional information available exclusively to online subscribers please visit
jawa.janes.com

Wing aspect ratio 4.0
Length overall ..... 11.49 m (37 ft 8¼ in)
Height ..... 4.76 m (15 ft 7½ in)
Tailplane span ..... 4.83 m (15 ft 10¼ in)
Wheelbase ..... 4.465 m (14 ft 7¾ in)
Wheel track ..... 2.71 m (8 ft 10¾ in)

AREAS:
Wings, gross ..... **23.52 m² (253.2 sq ft)**

WEIGHTS AND LOADINGS:
Weight empty ..... 4,610 kg (10,163 lb)
Max weapon load ..... 3,000 kg (6,614 lb)
Max internal fuel weight ..... 2,000 kg (4,409 lb)
Max T-O weight: trainer ..... 6,700 kg (14,771 lb)
attack ..... 9,500 kg (20,943 lb)
Max wing loading: trainer ..... 284.9 kg/m² (58.34 lb/sq ft)
attack ..... 403.9 kg/m² (82.73 lb/sq ft)
Max power loading: trainer ..... 120 kg/kN (1.18 lb/lb st)
attack ..... 171 kg/kN (1.68 lb/lb st)

PERFORMANCE:
Limiting speed ..... 572 kt (1,059 km/h; 658 mph) EAS/M1.2
Max level speed at 1,525 m (5,000 ft) ..... 590 kt (1,093 km/h; 679 mph)
Stalling speed, flaps down: full fuel ..... 103 kt (191 km/h; 119 mph)
20% fuel ..... 90 kt (167 km/h; 104 mph)
Max rate of climb at S/L ..... 6,100 m (20,000 ft)/min
Service ceiling ..... 13,715 m (45,000 ft)
T-O run ..... 320 m (1,050 ft)
Landing run ..... 470 m (1,545 ft)
Radius of action:
air combat training with ACMI pod and one SRAAM, 40 min manoeuvring ..... 120 n miles (222 km; 138 miles)
combat air patrol, two SRAAM, gun pod, plus two external fuel tanks, 2 h loiter ..... 165 n miles (306 km; 190 miles)
close air support, hi-lo-lo-hi, two rocket pods, two ASMs, two SRAAM, gun pod ..... 270 n miles (500 km; 311 miles)



General arrangement of Aermacchi M-346 *(James Goulding)* 1158241

interdiction, hi-lo-lo-hi, two Mk 83 bombs, two SRAAM, three external fuel tanks ..... 450 n miles (833 km; 518 miles)
Range, 10% reserves:
with max internal fuel ..... 1,120 n miles (2,074 km; 1,288 miles)
with three external tanks ..... 1,540 n miles (2,852 km; 1,772 miles)
g limits ..... +8/−3

ALENIA

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Alenia Aerospazio, a Finmeccanica company, is the leading Italian aerospace designer and manufacturer. Employees total 12,000, engaged on projects and programmes for civil and military applications. Alenia Aerospazio is organised into two Divisions: Aeronautics and Space (Alenia Spazio SpA). On 14 April 2000, it signed a joint venture agreement with EADS to form the European Military Aircraft Company (EMAC), but early establishment was not achieved and intermittent discussions continued into 2002 before being abandoned. In January 2003, Alenia declined to take up offered 5 per cent stake in Airbus, but instead signed wide-ranging collaborative agreement with Boeing, with specific areas to be decided by committee formed in 2003.

Aeronautics Division (Alenia Aeronautica) dedicated to full range of activities, from design and production to modification and product support for both military and civil aircraft; most entail collaboration with other aerospace companies; in 2002, division had 7,173 employees and conducted almost half of its activities in the military sphere

Division's activities fall into categories of Military Aircraft, Regional Aircraft and Aerostructures. It also operates Officine Aeronavali Venezia, specialising in maintenance, overhaul and modification of commercial and military aircraft.

In military sector, company designs and produces directly, or through international collaborations, combat and transport aircraft such as Tornado, Eurofighter Typhoon, C-27J, A400M and ATR 42 MP Surveyor; was also responsible for assembling AV-8B Harrier II Plus for the Italian Marina Militare.

In regional aircraft sector, activities include production of the ATR turboprop family developed with Aerospatiale Matra.

In the aerostructures sector, Alenia co-operates with other major aeronautical companies manufacturing structural parts for commercial aircraft such as B767, B777, B787, A321, A300/310, A330/A340, Falcon 900EX and Falcon 2000. Is 4 per cent risk-sharing partner in Airbus A380 programme, responsible for a fuselage section.

In the modification and maintenance field, Alenia Aerospazio has a full capability of design, production, installation and tests of complex parts and systems. DOMA (Design Organisation Military Approval) certification for C-27J was awarded on 1 March 2006.

ALENIA C-27J SPARTAN

TYPE: Twin-turboprop transport.
PROGRAMME:

DEVELOPMENT MILESTONES

G.222	
First flight	18 Jul 70
First flight, pre-production	23 Dec 75
First delivery (Dubai AF)	21 Nov 76
Subsequent versions	
C-27J	
Design began	Sep 96
Programme launched	17 Jun 97
Announced	Feb 96
Rolled out	14 Jun 99
First flight	24 Sep 99
Certification	20 Jun 01
First flight, production	12 May 00

Conceived in 1960s as jet-powered, V/STOL transport to NATO requirement (NBMR-4), but this version not developed. Original Fiat G222 designed by Giuseppe Gabrielli; two prototypes (lacking the pressurisation standard on later aircraft) flew on 18 July 1970 (MM582) and 22 July 1971 (MM583), both at Turin; MM582 handed over to Italian Air Force for operational evaluation on 21 December 1971. First production G222 (MM62101) flew 23 December 1975; deliveries began 21 November 1976 with single aircraft to Dubai, and to Italy on 21 April 1978. Tenth production aircraft was first to be built at Naples; 27th (March 1979) was 22nd and last built at Turin. Main users in Italy are 2° and 98° Gruppi of the 46° Brigata Aerea at Pisa. Civil category R (equivalent to FAR Pt 25) certification granted to G222SAA by Italian airworthiness authority on 1 April 1997. Several subvariants for specific roles.

Improved version of G222 conceived during 1995 negotiations between Lockheed Martin and Alenia on potential offsets for proposed Italian purchase of C-130J Hercules; initially designated G222J, by reason of having C-130J flight deck features and improved (T64G) versions of the G222's engines with new four-blade propellers. Formally announced as a joint project in February 1996, when commonality with the C-130J was further increased by adoption of the Allison (now Rolls-Royce) AE 2100 as power plant, allied to six-blade propellers. Accordingly redesignated C-27J, to reflect the C-27A version of G222 delivered to the US Air Force. Feasibility phase February to September 1996; definition phase September 1996 to May 1997

Development and certification costs being shared equally between Alenia Aerospazio and Lockheed Martin; latter responsible for propulsion systems, avionics, worldwide marketing and product support; Alenia for production, flight test and certification; promotion by Lockheed Martin Alenia Tactical Transport Systems. By 2003, Lockheed Martin was seeking reduced participation through voluntary relegation to subcontractor Accordingly, Global Military Aircraft Systems (GMAS) formed 21 April 2005 as joint venture by Alenia Aeronautica and L-3 Communications with near-term objective of promoting C-27J for US Army and National Guard requirements. GMAS was augmented in April 2006 by Boeing Integrated Defense Systems. C-27J promoted in 2006 for Canadian Fixed Wing Search and Rescue programme, valued at CAD1.3 billion for procurement, plus 20-year support contract

C-27J programme formally launched on 17 June 1997; 'propulsion test' prototype, a converted G222 demonstrator, rolled out at Turin/Caselle on 14 June 1999 and first flew (c/n 4043; I-CERX) 24 September 1999; initial testing completed second quarter of 2000; modified for certification trials and resumed flying on propulsion system, performance and handling evaluation.

Second C-27J and initial new-build aircraft, 4115/I-FBAX, first flew 12 May 2000; first with advanced flight deck and full avionics, new APU and new landing gear; achieved 54 hours/23 sorties in initial two months; available for sale after completion of civil certification trials. Third prototype, 4033/MMCSX62127, converted from Italian Air Force G222TCM, first flew 8 September 2000 returned to IAF after DGAA civil certification, which achieved on 20 June 2001. Military type certificate awarded 20 December 2001, following 445 sortie, 793 hour programme. First two batches, totalling 10, under construction (long lead items) by 1999. Final assembly remains in Italy only. First new-built export C-27J was Greek AF 4117 (temporarily CSX62231 for testing in Italy), first flown 15 December 2004.

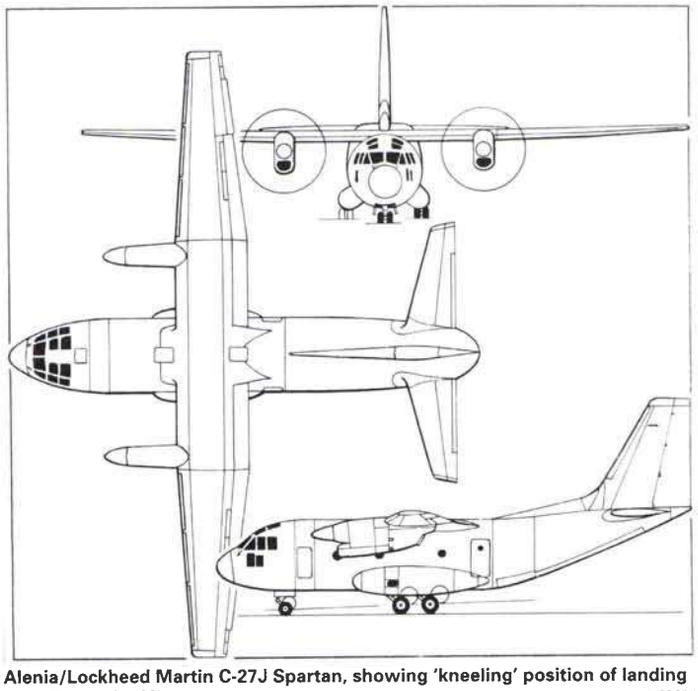
CURRENT VERSIONS: **Transport:** *As described.*

AEW: Airborne early warning version proposed in 1998, employing Ericsson Erieye system, as fitted to Saab S 100B Argus.

Firefighter: Proposed with 2,200 kg (4,850 lb) mission system and 6,800 kg (14,991 lb) of retardant liquid.

Aerial Sprayer: Proposed with 2,200 kg (4,850 lb) mission system; capable of covering 50 hectares (124 acres) at 150 litres/hectare (16.0 US gallons; 13.0 Imp gallons/acre).

Alenia C-27J Spartan during demonstrations in Canada 1159015



Alenia/Lockheed Martin C-27J Spartan, showing 'kneeling' position of landing gear *(James Goulding)* 1159584

Maritime: Patrol version under consideration by Taiwan in 2003 as alternative to Lockheed Martin P-3 Orion anti-submarine aircraft.

CUSTOMERS: See table. Italian Air Force announced proposed launch order for 12 on 11 November 1999, although this not signed until 27 June 2002 and for initial quantity of five; deliveries planned to begin in mid-2005 and be completed in late 2006, but programme deferred by some 12 months and first aircraft not flown until July 2006.

Greek Air Force selected C-27J on 1 March 2002, proposing 12 plus three options, and signed contract for 12 on 17 January 2003; deliveries to begin in 2004 and end 12 months later, but first aircraft not flown until 15 December 2004, deliveries beginning to 354 Squadron at Elefsis on 4 August (formal hand-over in Italy, 22 March) 2005 (eight due that year) and concluding in 2006 (four). However, by mid-2006 it appeared that the schedule had not been met.

Bulgaria announced proposal order in April 2005 for eight, although with only two deliverable in 2006 and two in 2007, balance depending upon financial issues. Formal order signed 24 February 2006 for five, with option on further three; deliveries to begin in June 2007 and continue at one per year. Lithuania ordered three on 26 June 2006 for delivery in 2006 and 2007.

Up to 500 sales anticipated over a 20 year period, mostly to existing Hercules operators. Lockheed Martin co-markets the aircraft. Sales targets include Argentina, Brazil (12), Canada (15 for SAR) and Taiwan (18 to 22). Also promoted for US Army's 40-aircraft Aerial Common Sensor programme; to US Army National Guard (33) as Future Cargo Aircraft replacement for Shorts Sherpas; and to US Air Force as Combat Rescue Tanker for air- and forward ground refuelling of personnel recovery missions. Following delay of 12 months, US Army and Air Force planned December 2006 decision on combined purchase of re-named Joint Cargo Aircraft (JCA), involving up to 75 and 70 aircraft, respectively, with only C-27J and EADS CASA C-295 in contention. L-3 Integrated Systems is partner for US marketing through GMAS co-venture and delivered JCA proposal in June 2006. Announced 18 July 2006 that Cecil Field, Jacksonville, Florida, selected as US C-27J assembly site, if chosen, although initial aircraft would be from Italian manufacture.

COSTS: EUR24.75 million (Greek programme unit cost, 2003). JCA contract for 145 valued at USD6 billion (2006), Lithuanian programme unit cost EUR25 million (2006).

DESIGN FEATURES: Conventional tactical transport configuration of high wing, pannier-mounted main landing gear and upswept rear fuselage with integral loading ramp.

Intended to complement the Lockheed Martin Hercules. Upgraded G222 with new, two-crew flight deck and increased performance. Propulsion system, cargo loading system and many of the avionics and flight controls are adapted from the C-130J Hercules. Compared with the G222, the C-27J is intended to provide increases of 35 per cent in range, 30 per cent cruise ceiling, 15 per cent high-speed cruise and over 200 per cent payload/range/speed; maintainability and reliability are scheduled to increase by 100 per cent for the engine, 275 per cent for propeller, 150 per cent for other systems and 30 per cent for avionics, resulting in a saving of 30 per cent in operating costs (including 5 per cent off fuel).

Wing has max thickness/chord ratio of 15 per cent. Dihedral 2° 30' on outer panels.

FLYING CONTROLS: Conventional; manually actuated ailerons and rudder; powered elevators with digital Q-feel. Automatic rudder limitation as airspeed function. Ailerons each have inset trim tab outboard and spring tab inboard. Two-section hydraulically actuated spoilers in upper wing surface ahead of each outboard flap segment, used also as lift dumpers on landing. Double-slotted flaps, inboard and outboard sections, extend over 60 per cent of Trailing-edge. Spoilers and flaps fully powered by tandem hydraulic actuators. Rudder fully powered by tandem hydraulic actuators; 17 vortex-generators on port side of fin, ahead of rudder, to increase control effectiveness in engine failure mode. Two tabs in each elevator: geared tab inboard and trim tab outboard; no rudder tabs.

STRUCTURE: Wing of aluminium alloy three-spar fail-safe box structure, built in three portions. One-piece constant chord centre-section fits into recess in top of fuselage and is secured by bolts at six main points. Outer panels tapered on leading- and trailing-edges. Upper surface skins are of 7075-T6 alloy, lower surface skins of 2024-T3 alloy. All control surfaces have bonded metal skins with metal honeycomb core.

Pressurised fail-safe fuselage of aluminium alloy stressed skin construction and circular cross-section. Easily removable stiffened floor panels. Cantilever safe-life tail surfaces of aluminium alloy, with sweptback three-spar fin and slightly swept two-spar variable incidence tailplane.

Subcontractors include Aermacchi (outer wings), Piaggio (wing centre-section), Agusta (tail unit), Magnaghi (landing gear) and Aeronavali Venezia (airframe components).

LANDING GEAR: Hydraulically retractable tricycle type, suitable for use from prepared runways, semi-prepared strips or grass fields. Main gear built by APPH; nose gear by Magnaghi. Steerable twin-wheel nose unit retracts forward. Main units, each consisting of two single wheels in tandem, retract into fairings on sides of fuselage. Oleo-pneumatic shock-absorbers. Gear can be lowered by gravity in emergency, the nose unit being aided by aerodynamic action and the main units by the shock-absorbers, which remain compressed in the retracted position. Oleo pressure in shock-absorbers is adjustable to permit 50 cm (20 in) variation in height and 4° 20' in attitude of cabin floor from ground. Low-pressure tubeless tyres on all units, size 39×13 (14/16 ply) on mainwheels, 29×11.00–12 or 29×11.00–10 (10 ply) on nosewheels. Tyre pressures 4.41 bar (64 lb/sq in) on main units, 3.92 bar (57 lb/sq in) on nose unit. Hydraulic multidisc brakes.

POWER PLANT: Two Rolls-Royce AE 2100D2 turboprops, each rated at 3,458 kW (4,637 shp), driving Dowty R391 six-blade composites propellers. Fuel in integral tanks; two in outer wings, combined capacity 6,720 litres (1,775 US gallons; 1,478 Imp gallons); two centre-section tanks, combined capacity 5,600 litres (1,480 US gallons; 1,232 Imp gallons); crossfeed provision to either engine. Total normal fuel capacity 12,320 litres (3,255 US gallons; 2,710 Imp gallons). Optional extended range wing tanks with additional 1,520 litres (402 US gallons; 334 Imp gallons), increasing fuel load to 13,840 litres (3,656 US gallons; 3,044 Imp gallons). Single-point pressure- and four-point gravity refuelling; central defuelling; in-flight jettison at 333 litres (88.0 US gallons; 73.3 Imp gallons)/min. Optional refuelling probe and OBIGGS.

ACCOMMODATION: Two-pilot crew on flight deck with third seat; provision for loadmaster or jumpmaster when required. Crew door, port, forward; Type III emergency door, starboard, forward; paratroop door each side, immediately rear of sponsons; rear loading ramp; emergency hatches (three) in roof, above flight deck and level with leading- and trailing edges. Interior reconfiguration between troop transport, paratroop dropping, cargo, cargo air dropping and medical evacuation: role interchange time by one loadmaster between 10 and 48 minutes.

Standard troop transport version has 34 foldaway sidewall seats and 12 port-facing, centreline stowable seats for total of 46 fully equipped troops (68 in high density) lavatory.

G222 AND C-27 CUSTOMERS

Customer	Version	Qty	First aircraft	Delivered
Argentine Army	G222	3	AE260	29 Mar 1977
Bulgarian Air Force	C-27J	5		2007
Congo Air Force	G222	3		on order[4]
Dubai Air Force	G222	1	321	21 Nov 1976
Greek Air Force	C-27J	12[8]	4117	4 aug 2005
Italy: prototypes	G222	2	MM582	21 Dec 1971
Air Force	G222TCM	40[3]	MM62101	Apr 1978
	C-27J	5[7]		2005
Air Force	G222RM	4	MM62139	Jan 1983
Air Force	G222VS	2	MM62107	1978
SNPC	G222PROCIV	5[6]	MM62145	1987
Libyan Air Force	G222T	20	221	1981
Lithuanian Air Force	C-27J	3		on order
Nigerian Air Force	G222	5[9]	950	Sep 1984
Somali Air Force	G222	2	AM-94	1980
Venezuelan: Army	G222	1[1]	EV-8327	1983
Air Force	G222	6	1258	1984
Thai Air Force	G222	6	60307	2 May 1995
US Air Force	C-27A	10[5]	90–0170	17 Apr 1991
Alenia (demonstrator)	G222/C-27J	1	I-CERX	1983
	C-27J	1	I-FBAX	2000
Total		**131**[2]		

[1] Transferred to air force
[2] Prototypes and 22 early aircraft built at Turin; remainder at Naples
[3] Including 10 with provision for rapid conversion to 222SAA; two to Tunisian Air Force 19 May 2001; C-27J purchase involves Alenia buy-back of 39 G222s for possible resale
[4] Built, but awaiting completion of contractual details
[5] Transferred to US government, with civil registrations, 1999
[6] All reverted to transports in 2001
[7] Plus seven options
[8] Plus three options
[9] To be refurbished in 2006-07 and augmented by one formerly operated by Italian Air Force

Paratroop transport can carry between 34 (normal) and 46 (maximum) fully equipped paratroops, and is fitted with 32 sidewall seats, plus eight stowable seats, door jump platforms and static lines. Cargo transport version can accept standard pallets of up to 2.24 m (88 in) wide comprising either three HCU-6/Es (2.74 m; 108 in wide) plus one HCU-12/E (1.37 m; 54 in wide); or seven HCU-12/Es.. Hydraulically operated rear-loading ramp and upward-opening door in underside of upswept rear fuselage, which can be opened in flight for airdrop operations. Typical drop loads of up to 12 A22 CDS bundles; 6,000 kg (13,228 lb) single load or two 4,500 kg (9,921 lb) loads; or 5,000 kg (11,023 lb) LAPES load. Paratroop jumps can be made either from ramp or from rear side doors. Medical evacuation accommodation for 36 stretchers and six attendants. Lavatory with electric flushing. Entire accommodation pressurised, giving S/L pressure up to 4,040 m (13,260 ft), then 0.4 bar (5.8 lb/sq in) differential up to max operational altitude of 9,145 m (30,000 ft). Three oxygen converters providing 14 h 30 min supply for three crew, plus 2 h 30 min for 47 in cargo hold, all at 7,620 m (25,000 ft). Drinking water tank: 22 litres (5.8 US gallons; 4.8 Imp gallons).

SYSTEMS: Twin digital autopilot and flight director system, including stall warning and T-O configuration warning. Pressurisation system maintains S/L atmosphere up to 4,035 m (13,240 ft) and a cabin differential of 0.41 bar (5.97 lb/sq in) up to max operating altitude. Air conditioning system uses engine bleed air during flight; on ground, it is fed by compressor bleed air from APU to provide cabin heating to a minimum of 18°C. Hamilton Sundstrand APS1000 (T62T-46C16) 113 kW (152 hp) APU, installed in starboard main landing gear fairing, provides power for engine starting up to 6,705 m (22,000 ft), hydraulic pump and alternator actuation, air conditioning on ground, and all hydraulic and electrical systems necessary for loading and unloading on ground.

Two independent hydraulic systems, each of 207 bar (3,000 lb/sq in) pressure at 50 litres (13.2 US gallons; 11.0 Imp gallons)/min by engine-driven pump or half that rate by electric pump. No. 1 system actuates flaps, elevators, spoilers, steering, rudder, wheel brakes and (in emergency only) landing gear extension; No. 2 system actuates landing gear extension, retraction and ground attitude; rear ramp/door; lift-dumpers; and windscreen wipers. Auxiliary hydraulic system, fed by APU-powered pump, can take over from No. 2 system in flight, if both main systems fail, to operate essential services. In addition, a standby hand pump is provided for emergency use to lower the landing gear and, on the ground, to operate the ramp/door and parking brakes.

Three 60 kVA alternators, one driven by each engine through constant-speed drive units and one by the APU, provide 115/200 V three-phase AC electrical power at 400 Hz. 28 V DC power is supplied from the main AC busses via three 350 A transformer-rectifiers, with static inverter and two 24V 40 Ah Ni/Cd batteries for standby and emergency power. External AC power socket. Engine intakes anti-iced by electrical/hot air system. Pneumatically inflated de-icing boots on outer wing leading-edges, and fin and tailplane leading-edges, using engine bleed air; electrically heated windscreens. Liquid oxygen system for crew and passengers (with cabin wall outlets); 10 litre (0.35 cu ft) converter for three flight deck crew providing 14 h 30 min supply, plus two similar units providing 46 troops and loadmaster with 2 h 30 min supply; this system can be replaced by a gaseous oxygen system if required. Emergency oxygen system, comprising five cylinders, available for all occupants in the event of a pressurisation failure.

EQUIPMENT: Navigation/anti-collision lights operable in normal, covert (IR) and NVG modes. Hold cargo winch with remote control; two independent retrieval winches.

AVIONICS: *Comms:* Two ARC-210 U/VHF, two HF radios. Digital audio intercom. Cockpit voice recorder.

Radar: Northrop Grumman AN/APN-241 digital mapping radar with Doppler beam sharpening, weather and turbulence detection, air target detection, windshear detection and beacon mode.

Flight: TCAS II, GCAS. FANS compatible. Twin DME, twin VOR/ILS/MKR, low frequency ADF, dual radalt, embedded GPS/INS. Flight data recorder.

Instrumentation: Five-screen EFIS based on C-130J flight deck. NVG-compatible. Optional HUD and digital map.

Self-defence: Optional RWR, MAWS. LWR, DIRCM, chaff/flare dispensers and towed decoy.

DIMENSIONS, EXTERNAL:

Wing span	28.70 m (94 ft 2 in)
Wing aspect ratio	10.0
Length overall	22.70 m (74 ft 5½ in)
Height overall: unladen	10.57 m (34 ft 8¼ in)
fully laden	9.70 m (31 ft 10 in)
Fuselage: Max diameter	3.55 m (11 ft 7¾ in)
Tailplane span	12.40 m (40 ft 8¼ in)
Wheel track	3.67 m (12 ft 0½ in)
Wheelbase (to c/l of main units):	
unladen	6.23 m (20 ft 5¼ in)
fully laden	6.40 m (21 ft 0 in)
Propeller diameter	4.11 m (13 ft 6 in)
Distance between propeller centres	9.50 m (31 ft 2 in)
Propeller/fuselage clearance	1.04 m (3 ft 5 in)
Rear-loading ramp/door: Width	2.45 m (8 ft 0½ in)
Height	2.25 m (7 ft 4½ in)
Crew door: Width	0.70 m (2 ft 3½ in)
Height	1.52 m (4 ft 11¾ in)
Emergency door: Width	0.53 m (1 ft 8¾ in)
Height	1.01 m (3 ft 3¾ in)
Paratroop doors: Width	0.91 m (2 ft 11¾ in)
Height	1.92 m (6 ft 3½ in)
Emergency hatch:	
Flight deck: Width	0.70 m (2 ft 3½ in)
Length	0.50 m (1 ft 7¾ in)
Cabin (both): Width	0.63 m (2 ft 0¾ in)
Length	0.90 m (2 ft 11½ in)

DIMENSIONS, INTERNAL:

Main cabin: Length	8.58 m (28 ft 1¾ in)
Width	2.45 m (8 ft 0½ in)
Height	2.25 m (7 ft 4½ in)
Floor area: excl ramp	21.0 m² (226 sq ft)
incl ramp	25.7 m² (276 sq ft)
Volume	58.0 m³ (2,048 cu ft)

AREAS:

Wings, gross	82.00 m² (882.6 sq ft)
Ailerons (total)	3.65 m² (39.29 sq ft)
Trailing-edge flaps (total)	18.40 m² (198.06 sq ft)
Spoilers (total)	1.65 m² (17.76 sq ft)
Fin (incl dorsal fin)	12.19 m² (131.21 sq ft)
Rudder	7.02 m² (75.56 sq ft)
Tailplane	19.09 m² (205.48 sq ft)
Elevators (total)	4.61 m² (49.62 sq ft)

WEIGHTS AND LOADINGS:

Operating weight empty	17,000 kg (37,479 lb)
Max payload: at 3.0 *g*	8,500 kg (18,739 lb)
at 2.5 *g*	9,000 kg (19,840 lb)
at 2.25 *g*	11,500 kg (25,353 lb)
airdrop: two/three HCU-6/E platforms	9,000 kg (19,842 lb)
single HCU-6/E platform	6,000 kg (13,228 lb)
LAPES	5,000 kg (11,023 lb)
Max normal fuel load	9,734 kg (21,460 lb)
Max T-O weight: logistical	31,800 kg (70,106 lb)
basic and tactical	30,500 kg (67,240 lb)
Max landing weight: logistical (2 m; 6 ft/s)	30,500 kg (67,240 lb)
tactical (3 m; 10 ft/s)	27,500 kg (60,627 lb)
Max cargo floor loading	1,500 kg/m² (307.2 lb/sq ft)
Max wing loading	387.8 kg/m² (79.43 lb/sq ft)
Max power loading	4.60 kg/kW (7.55 lb/shp)

PERFORMANCE:

Max level speed	315 kt (583 km/h; 362 mph)
Stalling speed	90 kt (167 km/h; 104 mph)
Time to 4,570 m (15,000 ft)	7 min
Initial cruising altitude	8,380 m (27,500 ft)
Max operating altitude	9,145 m (30,000 ft)
Service ceiling, OEI, 95% MTOW	4,420 m (14,500 ft)
T-O run: at logistic T-O weight	580 m (1,905 ft)
at tactical T-O weight	550 m (1,805 ft)

T-O to 15 m (50 ft)	640 m (2,100 ft)
Landing from 15 m (50 ft)	690 m (2,265 ft)
Landing run	340 m (1,115 ft)
Radius of action:	
with 46 paratroops	1,100 n miles (2,037 km; 1,265 miles)
with 5,000 kg (11,023 lb) airdrop load	1,215 n miles (2,250 km; 1,398 miles)
Range:	
with max payload	1,160 n miles (2,148 km; 1,334 miles)
with 10,000 t (22,046 lb) payload	1,000 n miles (1,852 km; 869 miles)
with 6,000 kg (13,228 lb) payload	2,301 n miles (4,262 km; 2,648 miles)
ferry	3,200 n miles (5,926 km; 3,682 miles)
g limits: at tactical weight	+3.0
at basic weight	+2.5
at logistical weight	+2.25
OPERATIONAL NOISE LEVELS:	
Flyover at full power	88 dB
Approach	95 dB
Sideline	89 dB

ALISPORT

ALISPORT SRL

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Alisport builds and markets the DEA-designed Yuma STOL lightplane as well as the Silent series of sailplanes. Related business includes sale of propellers and accessories.

ALISPORT YUMA

TYPE: Side-by-side ultralight kitbuilt.

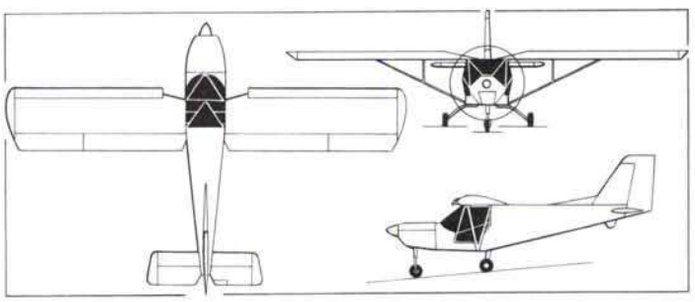
PROGRAMME: Development began 1994.

DESIGN FEATURES: Objectives included better performance than existing STOL light aircraft, but without sacrifice of cruising speed; effective and harmonised controls; foldable wings. High wings with V-struts; sweptback fin. Delivered as 85 per cent complete quick-build kit, less engine, propeller and instruments; quoted build time 200 hours.

FLYING CONTROLS: Conventional and manual. Large, cable-actuated control surfaces for effectiveness of response at slow speeds; 'spade'-type suspended aileron balance tabs. Flaps. Handley Page slats on wing leading-edge.

STRUCTURE: Generally of heat-treated and corrosion-proofed aluminium alloy; skins bonded before riveting. Welded tubular steel frame cockpit structure; steel alloy wing struts. Control surfaces covered in Dacron fabric. Wing leading-edge slats of carbon fibre. Composites tips to wing and empennage. Lexan windscreen; polycarbonate side windows.

Alisport Yuma ultralight kitplane operated in South Africa *(Patrick Allen)* 1110440



Alisport Yuma side-by-side ultralight *(James Goulding)* 0587527

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring cantilever mainwheel legs with optional speed fairings. Steerable, telescoping nosewheel leg. Hydraulic disc brakes. Optional amphibious floats.

POWER PLANT: Choice of 59.6 kW (79.9 hp) Rotax 912 UL, 73.5 kW (98.6 hp) Rotax 912 ULS or 84.5 kW (113.3 hp) turbocharged Rotax 914 UL. Fuel in wing tanks and header tank, total capacity 87 litres (23.0 US gallons; 19.1 Imp gallons) of which 85 litres (22.5 US gallons; 18.7 Imp gallons) are usable. GT two-blade wooden propeller.

EQUIPMENT: Optional glider towing hook and ventral baggage pod.

DIMENSIONS, EXTERNAL:	
Wing span	9.75 m (31 ft 11¾ in)
Length overall	6.45 m (21 ft 2 in)
Height overall	2.45 m (8 ft 0½ in)
Tailplane span	2.80 m (9 ft 2¼ in)
Wheel track	1.74 m (5 ft 8½ in)
Wheelbase	2.00 m (6 ft 6¾ in)
DIMENSIONS, INTERNAL:	
Cabin max width	1.18 m (3 ft 10½ in)
AREAS:	
Wings, gross	13.44 m² (144.7 sq ft)
WEIGHTS AND LOADINGS:	
Weight empty	282 kg (622 lb)
Max T-O weight	450 kg (992 lb)
Max wing loading	33.5 kg/m² (6.86 lb/sq ft)
PERFORMANCE (Rotax 912 ULS engine):	
Never-exceed speed (VNE)	100 kt (185 km/h; 115 mph)
Cruising speed at 75% power	86 kt (160 km/h; 99 mph)
Stalling speed, power off:	
flaps up	30 kt (55 km/h; 35 mph)
flaps down	27 kt (50 km/h; 32 mph)
Max rate of climb at S/L	480 m (1,575 ft)/min
Service ceiling	5,000 m (16,400 ft)
T-O run	30 m (100 ft)
Landing run	55 m (180 ft)
Endurance	4 h 18 m

ALPI

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Alpi Aviation was formed in 1999; its Alpi Pioneer 300S is a development of the Asso V, designed by Vidor Guiseppe and formerly marketed by Rusalen & Rusalen. German marketing is by Flugtechnik at Damme. Alpi also produces the all-wood Pioneer 200, aerobatic Pioneer 330 and Pioneer 300 Hawk, with improved aerodynamics. Alpi has a 5,000 m² (53,820 sq ft) factory at Pordenone; wooden components are sourced from a 3,000 m² (32,290 sq ft) facility in Croatia. US LSA approval procedure began in 2005.

ALPI PIONEER 200

TYPE: Side-by-side kitbuilt.

PROGRAMME: Introduced 2001; draws on experience gained from Pioneer 300, meeting JAR-VLA requirements. French certification achieved 2003, followed by German BFU certification in early 2005.

CURRENT VERSIONS: **Pioneer 200 Standard:** Baseline model; *as described.*

Pioneer 200 Sauer: As Standard, but with 48.5 kW (65 hp) Sauer engine.

Pioneer 200 Sparrow: As Standard, but with 73.5 kW (98.6 hp) Rotax 912 ULS and redesigned instrument panel.

Pioneer 200 Beluga: Utility version with port-side-hinged upper rear fuselage giving access to large baggage compartment.

CUSTOMERS: At least 97 produced by 2006. Exports include aircraft to Australia, Canada, New Zealand, the United States and most European Union countries.

COSTS: Kit EUR16,780; ready-to-fly EUR39,890 (2006).

DESIGN FEATURES: Derived from Pioneer 300, but with more upright fin, constant-chord wing and fixed landing gear. Quoted build time 500 hours.

FLYING CONTROLS: Conventional and manual. Ailerons externally mass-balanced. Flight-adjustable tab in port elevator. Electrically operated flaps.

STRUCTURE: Fuselage of spruce with plywood skin overlaid with Dacron, except for fabric-covered elevators and rudder. Wing spar of spruce with plywood skin to leading-edge; remainder, including ailerons and flaps, fabric covered; shortened (7.04 m; 23 ft 1¼ in) wing optional. Single-piece, forward-hinged canopy; glass fibre engine cowling.

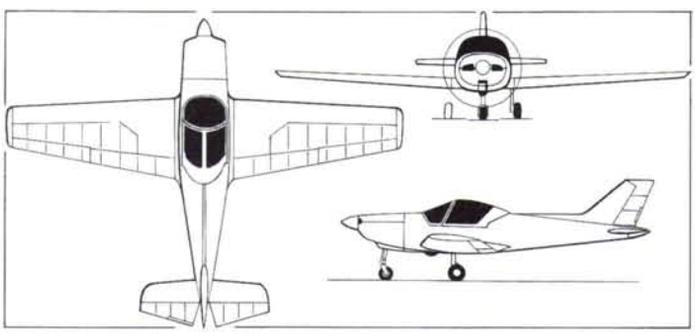
LANDING GEAR: Tricycle type; fixed. Fuselage-mounted, tube metal spring cantilever mainwheel legs. Composites wheel fairings optional. Rubber-in-compression nosewheel shock absorber.

POWER PLANT: One 59.6 kW (79.9 hp) Rotax 912 UL flat-four driving two-blade fixed-pitch propeller; 48.5 kW (65 hp) Sauer four-stroke driving a two-blade, fixed-pitch propeller in Pioneer 200 Sauer version or 59.7 kW (80 hp) Jabiru 2200 and two- or three-blade variable pitch propeller. Fuel capacity 54 litres (14.3 US gallons; 11.9 Imp gallons), of which 50 litres (13.2 US gallons; 11.0 Imp gallons) are usable, in single centrally positioned fuel tank; optional 17 litre (4.5 US gallon; 3.7 Imp gallon) auxiliary tank can be fitted.

DIMENSIONS, EXTERNAL:	
Wing span	7.54 m (24 ft 8¾ in)
Length overall	6.15 m (20 ft 2 in)
Height overall	1.96 m (6 ft 5¼ in)
DIMENSIONS, INTERNAL:	
Cockpit max width	1.05 m (3 ft 5¼ in)

Alpi Pioneer 200 side-by-side kitbuilt 1159290

AREAS:
Wings, gross ..... 10.50 m² (113.0 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 275 kg (606 lb)
Max T-O weight: Ultralight ..... 450 kg (992 lb)
Experimental ..... 520 kg (1,146 lb)
PERFORMANCE:
Never-exceed speed (VNE) ..... 129 kt (240 km/h; 149 mph)
Max operating speed ..... 111 kt (205 km/h; 127 mph)
Normal cruising speed at 75% power ..... 100 kt (185 km/h; 115 mph)
Stalling speed, flaps down ..... 36 kt (65 km/h; 41 mph)
Max rate of climb at S/L ..... 300 m (984 ft)/min
Service ceiling ..... 5000 m (16,400 ft)
T-O and landing run ..... 100 m (330 ft)
Range with max fuel ..... 351 n miles (650 km; 403 miles)
with auxiliary fuel ..... 448 n miles (830 km; 515 miles)
g limits ..... +4/–2



Alpi Pioneer 300 *(James Goulding)* 0137728

ALPI PIONEER 300

TYPE: Side-by-side kitbuilt.

PROGRAMME: First flight February 1999 (Italian ultralight category; Mid-West engine); public debut 2 April 1999 and exhibited at Aero '99, Friedrichshafen, later in the same month, at which time total of 11 hours flown. Certified to JAR-VLA standards.

CURRENT VERSIONS: **300L:** Long-span version for European market; no longer produced by Alpi.

300S: Short-span version, also known as **Standard**, predominantly for US market, *as described*.

300JS: Short-span, Jabiru engine.

300T: Short-span version with 84.5 kW (113.3 hp) Rotax 914.

300 Hawk: Short-span, rigid skin wing and redesigned cockpit interior.

330: Short-span, aerobatic version with inverted flight fuel system; *g* limits +6/–3. First known aircraft (I-7264) shown at Carpi Rally, 4 September 2004.

CUSTOMERS: At least 200 kits sold by early 2005; operated in Australia, Austria, Canada, France, Germany, Italy, Luxembourg, New Zealand, Portugal, Spain, Switzerland, the UK and the US.

COSTS: Kit EUR28,410; ready to fly with Rotax 912 ULS EUR67,220 (2006).

DESIGN FEATURES: Streamlined, retractable gear, low-wing monoplane, adaptable for Ultralight or Experimental category operation. Tapered wings and horizontal tail surfaces; sweptback fin; upturned wingtips; NACA 2315 aerofoil. Asso V has biconvex asymmetric wing section. Rearward-sliding canopy; fixed windscreen. Dual controls. Baggage shelf behind seats holds 27 kg (60 lb). Maximum roll rate 120°/s. Quoted build time 700 hours for standard kit; 350 hours for fast-build kit.

FLYING CONTROLS: Conventional and manual. Actuation by steel cables. Horn-balanced rudder. Electrically actuated flaps deflect 10, 20 and 30°. Trim tabs on rudder and port elevator.

STRUCTURE: Wooden airframe, including wing with single box spar; fuselage top and sides covered in carbon fibre shell, with Dacron covered undersides; latter replaced by removable carbon fibre shell on UK version. Integral fin with wooden spar and composites elsewhere;

Alpi Pioneer 300S 1159292

ailerons and flaps of wood with Dacron covering; tailplane wholly of composites; composites engine cowling and wingtips; Dacron-covered elevators and rudder; plywood-covered ailerons, flaps and tailplane.

LANDING GEAR: Retractable, tricycle type; steerable nosewheel with helical spring suspension. Mainwheels have levered oleo-pneumatic suspension (replacing rubber-in-compression in early aircraft). Mainwheels retract outwards; nosewheel rearwards; electric actuation with manual override. No doors, apart from fairing fixed ahead of nosewheel leg. Ingegno wheels with disc brakes; mainwheels size 4.00–6, nosewheel 4.00–4.

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS four-stroke, driving a two-blade GT-2/173/155 fixed-pitch propeller. Three-blade and variable-pitch propellers optional. Alternative Jabiru 3300, Rotax 914 (84.5 kW; 113.3 hp), 59.7 kW (80 hp) Sauer and Mid-West AE110 engines. Fuel tank in each wing, combined capacity 80 litres (21.1 US gallons; 17.6 Imp gallons); 35 litre (9.2 US gallon; 7.7 Imp gallon) fuselage tank optional; 54 litre (14.3 US gallon; 11.9 Imp gallon) tank standard in US.

AVIONICS: To customer's choice.

DIMENSIONS, EXTERNAL:

Wing span: standard	8.10 m (26 ft 7 in)
short-span	7.54 m (24 ft 8¾ in)
Length overall	6.25 m (20 ft 6 in)
Height overall	2.00 m (6 ft 6¾ in)

DIMENSIONS, INTERNAL:

Cockpit max width	1.05 m (3 ft 5¼ in)

AREAS:

Wings, gross	10.00 m² (107.6 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	285 kg (628 lb)
Max T-O weight: ultralight	450 kg (992 lb)
standard	520 kg (1,146 lb)
experimental	544 kg (1,200 lb)

PERFORMANCE (Rotax 914 engine):

Never-exceed speed (VNE) and max level speed	160 kt (296 km/h; 184 mph)
Cruising speed at 75% power	135 kt (250 km/h; 155 mph)
Stalling speed	33 kt (60 km/h; 38 mph)
Max rate of climb at S/L	457 m (1,500 ft)/min
T-O and landing run	100 m (328 ft)
Range	540 n miles (1,000 km; 621 miles)
g limits	+4/−2

AVIOTECHNICA

AVIOTECNICA

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Formed in 1996, AvioTecnica originally marketed an Italian version of the RotorWay Exec two-seat kitbuilt helicopter under the designation ES-101 Exec, which it offered with a turbine engine in place of the original liquid-cooled piston engine. More recently, it has developed a further modified version known as the Raven.

AVIOTECNICA ES-101 RAVEN

TYPE: Two-seat helicopter kitbuilt; two-seat ultralight helicopter kitbuilt.

PROGRAMME: Using a converted APU as power plant, AvioTecnica previously marketed the ES-101 Exec version of RotorWay Exec, the last of which was delivered in November 2003. In 2004 it launched the ES-101 Raven, flying since at least 2001, which features several improvements. Demonstrator (6th airframe) shown at Aero '05, Friedrichshafen, in April 2005 with new, carbon fibre main rotor blades designed by AvioTecnica. Production aircraft (from No. 7) additionally have new swashplate, tail rotor blade, digital cockpit and transparencies attached by adhesives.

DESIGN FEATURES: Generally as for Exec 162F, produced in US by Rotorway International. External differences include two-piece windscreen and unstreamlined skid legs.

POWER PLANT: One 89.5 kW (120 hp) AvioTecnica-modified Solar T-61-A turboshaft with belt drive to main and tail rotors. Fuel capacity 90 litres (23.8 US gallons; 19.8 Imp gallons).

DIMENSIONS, EXTERNAL:

Main rotor diameter	7.62 m (25 ft 0 in)
Tail rotor diameter	1.28 m (4 ft 2½ in)
Length overall, rotors turning	8.84 m (29 ft 0 in)
Fuselage max width over skids	1.60 m (5 ft 3 in)

AvioTecnica ES-101 Raven 1159279

Height overall	2.44 m (8 ft 0 in)

DIMENSIONS, INTERNAL:

Cabin max width	1.12 m (3 ft 8 in)

WEIGHTS AND LOADINGS:

Weight empty	275 kg (606 lb)
Max T-O weight: Ultralight	450 kg (992 lb)
Experimental	580 kg (1,278 lb)

PERFORMANCE:

Never-exceed speed (VNE)	129 kt (240 km/h; 149 mph)
Max level speed	119 kt (220 km/h; 137 mph)
Normal cruising speed	92 kt (170 km/h; 106 mph)
Max rate of climb at S/L	570 m (1,870 ft)/min
Service ceiling	5,500 m (18,040 ft)
Hovering ceiling: IGE	3,600 m (11,820 ft)
OGE	3,100 m (10,180 ft)

COAVIO

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TECHNICAL DIRECTOR: Antonio dell'Orco
COMMERCIAL DIRECTOR: Massimo Belloni

COAVIO DF 2000

TYPE: Side-by-side ultralight.

PROGRAMME: Promotion began in 2004. Production subcontracted to Officine Meccaniche Mingarelli at Ceccano.

CURRENT VERSIONS: **DF 2000 Base:** Baseline version with Rotax 912 UL engine.

DF 2000 Plus: Rotax 912 ULS engine.

DF 2000 Top: De luxe version, including three-blade propeller, cockpit heater, landing lights and radio as standard.

Production Coavio DF 2000 from the initial batch built by OMM
(Geoffrey P Jones) 1044620

CUSTOMERS: First production batch of five built from 2004. Early operators include flying school, Aviosuperficie La Selva.

COSTS: DF 2000 EUR33,000; EUR2000 Plus EUR40,000; DF 2000 Top EUR44,000 (all excluding tax, 2004).

DESIGN FEATURES: Objectives included short take-off, high-speed and economic cruising, comfort, aesthetic appearance, robustness and low price. High, constant-chord wing with upturned tips and single bracing strut each side. Low tailplane; sweptback fin with small fillet.

FLYING CONTROLS: Conventional and manual. Electrically actuated flaps.

STRUCTURE: Generally of 2017T4 and 2024T3 aluminium, with chromoly 4139 steel tube reinforcement of cockpit. Composites wingtips.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring cantilever mainwheel legs with optional wheel fairings; steerable nosewheel.

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS liquid-cooled flat-four driving a wooden two-blade or composites three-blade propeller. Optionally, one 59.6 kW (79.9 hp) Rotax 912 UL and two-blade wooden propeller. Two wing fuel tanks, combined usable capacity 70 litres (18.5 US gallons; 15.4 Imp gallons); optional additional central tank of 17 litres (4.5 US gallons; 3.7 Imp gallons).

DIMENSIONS, EXTERNAL:

Wing span	9.60 m (31 ft 6 in)
Length overall	6.35 m (20 ft 10 in)
Height overall	2.40 m (7 ft 10½ in)
Wheel track	2.10 m (6 ft 10¾ in)
Wheelbase	1.50 m (4 ft 11 in)

DIMENSIONS, INTERNAL:

Cockpit max width	1.15 m (3 ft 9¼ in)

AREAS:

Wings, gross	11.52 m² (124.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	275 kg (606 lb)
Max T-O weight	450 kg (992 lb)

PERFORMANCE:

Never-exceed speed (VNE)	129 kt (240 km/h; 149 mph)
Cruising speed at 75% power	105 kt (195 km/h; 121 mph)
Stalling speed, flaps down	22 kt (40 km/h; 25 mph)
T-O run	100 m (330 ft)
Landing run	80 m (265 ft)
g limits	+6/−4

DFH

DF HELICOPTERS SRL

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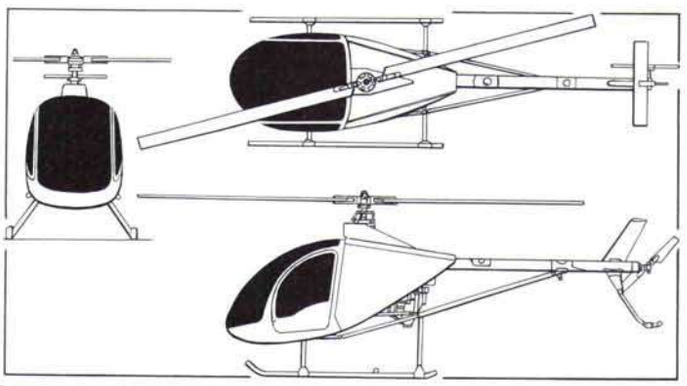
MARKETING MANAGER: Milan Vuckovic

Original Dragon Fly company founded in 1993 by twin brothers Angelo and Alfredo Castiglioni specifically to produce the Dragon Fly 333 light helicopter, rights to which were taken over from general engineering company CRAE Elettromeccanica SpA. The company was taken over by German owners in 2001 and moved to a new 1,800 m² (19,375 sq ft) factory at Ovada. The Dragon Fly 333 has been further developed into the Dragon Fly 334 GP. Production for 2005 is set at 50.

DF Helicopters factory at Ovada 1159334

DFH Dragon 334 *(Paul Jackson)* 1159359



DFH Dragon 334 *(James Goulding)* 0589011

DFH DRAGON 334

TYPE: Two-seat helicopter.

PROGRAMME: Developed originally by CRAE; design studies and manufacture of single-seat prototype 1985–88; ground and flight testing of this aircraft, 1989–90; two-seat Model 333AC prototype built and tested, 1991–93. Total of two single-seat and three two-seat prototypes, followed by four pre-series aircraft; production, as Dragon Fly 333, transferred to new factory from October 1994. Developed and tested by manufacturer to standards approaching FAR Pt 27; initial Italian certification is in ultralight class, but domestic VLR (very light rotorcraft) certification obtained 16 June 1996. Relaunched at Aero '03, Friedrichshafen, April 2003, under new ownership and new designation.

In 2001, a Dragon Fly was flown at the Cielo di Volo air show, powered by a 112 kW (150 hp) APU of undisclosed type.

CURRENT VERSIONS: **Dragon Fly 333:** Original version; discontinued. Powered by one Dragon Fly/Hirth F30A26AK four-cylinder two-stroke, rated at 82 kW (110 hp) for T-O, 70.8 kW (95 hp) maximum continuous.

Dragon Fly 333AC: Certified version to Italian VLR rules. Discontinued.

Héliot: RPV version developed in association with French companies Etudes et Développement Techniques (EDT) and CAC Systèmes; launched in June 1996 when prototype displayed at Eurosatory 1996 show at Le Bourget, Paris. No further production known. Discontinued.

DFH X 334: Proof-of-concept vehicle for 334GP, with new engine, rotor controls and drive system. Flying by 2002.

Dragon 334 GP: Based on Dragon Fly 333 with commercial applications including traffic and border observation, aerial photography, powerline patrolling and crop-spraying. New rotor controls, drive system and tapered tail rotor blades, plus single-piece front/upper glazing. Prototype unflown by May 2003, when exhibited at Aero '03. *As described.*

CUSTOMERS: First delivery of Dragon Fly in May 1994 to Chinese Civil Protection Volunteers. Total of 80 ordered, of which some 70 delivered, by late 1998 to customers in Abu Dhabi, Australia, Belgium, China, Czech Republic, France, Germany, Italy (37), New Zealand, Portugal and Turkey. First delivery of Italian certified version was in 1997; initial operator was Venice Aero Club. Dragon 334 deliveries had not begun by May 2004, although the company reported that 15 had been built. 2005 production set at 50 units, although no evidence of these having been built.

DESIGN FEATURES: Two-blade, semi-rigid main rotor and two-blade tail rotor; all blades of NACA 0012 aerofoil section; main rotor nominal speed 520 rpm. Can be road-towed on trailer with main blades folded. Optionally available in kit form.

STRUCTURE: Cabin is welded titanium frame with composites outer shell; aluminium alloy tailboom, rotor blades and landing skids. Full corrosion protection.

LANDING GEAR: Conventional twin-skid type. Emergency floats and skis under development.

POWER PLANT: One 84.6 kW (113.4 hp) Rotax 914 flat-six derated to 77.6 kW (104 hp) at 5,500 rpm. Transmission driven through centrifugal clutch and three polymer V-belts. Fuel capacity 64 litres (16.9 US gallons; 14.1 Imp gallons) of which 57 litres (15.0 US gallons; 12.5 Imp gallons) are usable.

ACCOMMODATION: Side-by-side seats for two persons. Dual controls standard. Small baggage compartment below seats.

SYSTEMS: 12 V electrical system with engine-driven 75 Ah generator and 12 V 19 Ah battery.

AVIONICS: *Comms:* Provision for transceiver and intercom.
Flight: Optional electric lateral trim.
Instrumentation: Standard VFR.

EQUIPMENT: Medevac and firefighting kits and external load hook under development.

DIMENSIONS, EXTERNAL:

Main rotor diameter	7.70 m (25 ft 3¼ in)
Tail rotor diameter	1.20 m (3 ft 11¼ in)
Length: overall, rotors turning	7.89 m (25 ft 10½ in)
fuselage	5.86 m (19 ft 2¾ in)
Height to top of rotor head	2.36 m (7 ft 9 in)
Skid track	1.55 m (5 ft 1 in)

DIMENSIONS, INTERNAL:

Cabin: Length	1.11 m (3 ft 7¾ in)
Max width	1.15 m (3 ft 9¼ in)
Max height	1.13 m (3 ft 8½ in)

AREAS:

Main rotor disc	35.21 m² (379.0 sq ft)
Tail rotor disc	0.985 m² (10.60 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	290 kg (639 lb)
T-O weight: normal	450 kg (992 lb)
max	550 kg (1,212 lb)

PERFORMANCE:

Never-exceed speed (VNE)	102 kt (190 km/h; 118 mph)
Max level speed at S/L	86 kt (160 km/h; 99 mph)
Max rate of climb at S/L	381 m (1,250 ft)/min
Service ceiling	3,050 m (10,000 ft)
Hovering ceiling: IGE	2,500 m (8,200 ft)
OGE	1,750 m (5,740 ft)
Range with 20 min reserves	216 n miles (400 km; 248 miles)
Endurance	3 h

EG VOYAGER

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Series manufacture began in 2006 of the Voyager 202 Ultralight/Experimental two-seater.

EG VOYAGER VR 202

TYPE: Two-seat lightplane/kitbuilt; side-by-side ultralight/kitbuilt.

PROGRAMME: Prototype (I-7698) first flew 2003. In production from 2006.

CURRENT VERSIONS: **VR 202 F 80:** Baseline version. Alpha series wing and ground-adjustable pitch propeller; Rotax 912 UL engine.

VR 202 FS 80: As F 80, but variable pitch propeller.

VR 202 F 100: Victor series wing and Rotax 912 ULS; ground-adjustable pitch propeller.

VR 202 FS 100: As F 100, but variable-pitch propeller.

COSTS: F 80 EUR39,860, FS 80 EUR49,690, F 100 EUR55,780, FS 100 EUR66,798 flyaway; kit EUR9,882 to EUR26,540, according to level of prior completion, plus EUR960 to EUR2,970 for Victor wing upgrade; LSA semi-complete kit EUR35,650 (all 2006).

DESIGN FEATURES: Streamlined design with low, trapezoidal wing having swept tips; low, trapezoidal tailplane and steeply sweptback fin.
Wing dihedral 5°; twist 2° 30'.

FLYING CONTROLS: Conventional and manual. Horn-balanced rudder. Flaps.

EG Voyager VR 202 FS 80 two-seat lightplane and kitbuilt *(Andrea Pozza, EG Voyager)* 1158847

STRUCTURE: Prototype of wood and fabric; production version generally with carbon fibre replacing fabric. Wing of spruce, with plywood lining and carbon fibre skin; Okumè plywood on Alpha series wing (450 kg; 992 lb MTOW) or aeronautical standard plywood on Victor wing (550 kg; 1,212 lb MTOW). Fuselage of carbon epoxy throughout; cockpit roll-bar.

LANDING GEAR: Tricycle type; fixed. Wing-mounted cantilever mainwheel legs with trailing-link shock absorbers; trailing-link nosewheel.

POWER PLANT: One Rotax flat-four driving a two-blade propeller: 58.8 kW (78.9 hp) 912 UL or 73.5 kW (98.6 hp) 912 ULS, according to version; ground-adjustable or variable-pitch propeller as version. Fuel tanks in wings, combined capacity 80 litres (21.1 US gallons; 17.6 Imp gallons) for 912 UL versions or 100 litres (26.4 US gallons; 22.0 Imp gallons) for 912 ULS versions; optionally 140 litres (37.0 US gallons; 30.8 Imp gallons).

ACCOMMODATION: Two persons, side by side under individual gull-wing doors; separate windscreen.

AVIONICS: *Comms:* Radio. Optional ELT.
Flight: GPS standard in F/FS 100 versions.
Instrumentation: Day VFR.

EQUIPMENT: Optional ballistic recovery parachute.

DIMENSIONS, EXTERNAL:

Wing span	8.00 m (26 ft 3 in)
Wing aspect ratio	6.4
Length overall	6.40 m (21 ft 0 in)
Height overall	2.30 m (7 ft 6½ in)
Doors: Height	0.86 m (2 ft 9¾ in)
Max width	0.66 m (2 ft 2 in)
Wheel track	2.15 m (7 ft 0¾ in)
Wheelbase	1.49 m (4 ft 10¾ in)

DIMENSIONS, INTERNAL:

Cockpit width: at shoulders	1.16 m (3 ft 9¾ in)
max	1.57 m (5 ft 1¾ in)

AREAS:

Wings, gross	10.00 m² (107.6 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	278 kg (613 lb)
Max T-O weight: Ultralight	450 kg (992 lb)
Experimental/LSA	550 kg (1,212 lb)
Max wing loading: Ultralight	45.0 kg/m² (9.22 lb/sq ft)
Experimental/LSA	55.0 kg/m² (11.26 lb/sq ft)
Max power loading, Experimental/LSA	7.48 kg/kW (12.29 lb/hp)

PERFORMANCE (FS 80):

Never-exceed speed (VNE):	
Alpha wing	145 kt (270 km/h; 167 mph)
Victor wing	156 kt (290 km/h; 180 mph)
Max level speed: Alpha wing	135 kt (250 km/h; 155 mph)
Victor wing	146 kt (270 km/h; 168 mph)
Cruising speed: max	124 kt (230 km/h; 143 mph)
econ	97 kt (180 km/h; 112 mph)
Stalling speed: flaps up	38 kt (70 km/h; 44 mph)
flaps down	33 kt (60 km/h; 38 mph)
Max rate of climb at S/L	200 m (660 ft)/min
T-O run	300 m (984 ft)
Range	648 n miles (1,200 km; 745 miles)
g limits: Alpha wing	+4.5/–2.5
Victor wing	+6/–3

EURO ALA

EURO ALA

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The Advanced Light Aircraft (ALA) company was established in 1985, initially to import ultralights, but in 1991 began sales of its own Jet Fox 91. The company changed name to Euroala in 1995. In 2003, it revealed that it was working on an improved Jet Fox, due for completion at the end of the year. By 2005, a low-wing design was understood to be under consideration.

At the end of 2002, the company employed 15 workers at its 1,000 m² (10,764 sq ft) factory. Jet Fox is also marketed in US.

Euroala Jet Fox Amphib registered as a US Ultralight *(Paul Jackson)* 1159360

EUROALA JET FOX 97

TYPE: Side-by-side ultralight.

PROGRAMME: Earlier Jet Fox 91 first flown in 1991; 140 sold by 1993. Considerably improved Jet Fox 97 first flown 10 March 1997 and exhibited at Aero '97 at Friedrichshafen the following month. Jet Fox series certified in Germany 1993; France and Belgium in 1995 and Israel and Spain in 2001.

In January 2003 the company revealed that it was working on a new Jet Fox with wider cabin, new door opening system and aluminium wings with Fowler flaps, giving a cruise speed approaching 108 kt (200 km/h; 124 mph). Estimated first flight date given as end of 2003, but had not appeared by mid-2006.

An amphibian version (prototype A06AJB, c/n 061/05) made public debut at Sun 'n' Fun, April 2006.

CURRENT VERSIONS: **Jet Fox:** Baseline version; *as described.*

Jet Fox Amphib: Amphibian version introduced in United States. Powered by 73.5 kW (98.6 hp) Rotax 912 UL-S, maximum T-O weight 622 kg (1,373 lb).

Jet Fox GT: As Jet Fox, powered by Rotax 912 UL-S.

CUSTOMERS: Total of 61 built by the end of 2005, excluding remanufactured Jet Fox 91s.

COSTS: USD43,100 with Rotax 912UL; USD43,900 with Rotax 912UL-S (both 2003).

DESIGN FEATURES: Considerably refined version of earlier design, but bears structural resemblance to Fox-C22; fully faired fuselage and engine; flaps. Wings rapidly detachable for transport.

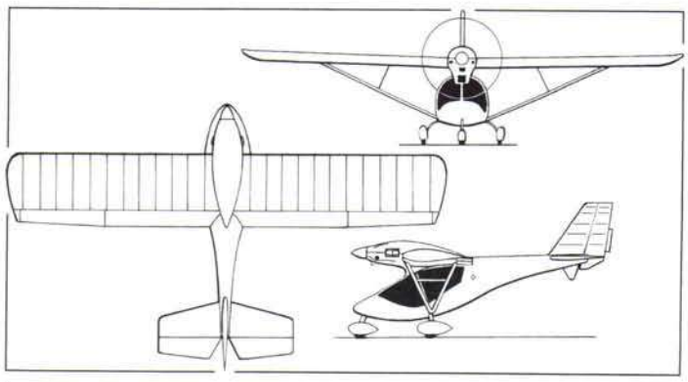
FLYING CONTROLS: Conventional and manual. Flight-adjustable elevator trim.

STRUCTURE: Alloy tube and steel fuselage frame with composites shell; Dacron-covered aluminium wings and tail surfaces; glass fibre and carbon fibre for landing gear.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted composites spring cantilever mainwheel legs. Mainwheels 4.00–6. Cable-operated disc brakes. Steerable nosewheel, size 4.00-4. Speed fairings optional. Optional amphibious floats.

POWER PLANT: One 47.8 kW (64.1 hp) Rotax 582 UL two-stroke or 59.6 kW (79.9 hp) Rotax 912 UL four-stroke engine, driving a two-blade GT wooden propeller; 73.5 kW (98.6 hp) Rotax 912 UL-S also available. Single fuel tank behind seats, capacity 59 litres (15.6 US gallons; 13.0 Imp gallons).

EQUIPMENT: Optional ballistic parachute.



General arrangement of the Euroala Jet Fox 97 *(James Goulding)* 1158756

DIMENSIONS, EXTERNAL:
- Wing span ..... 9.78 m (32 ft 1 in)
- Length overall ..... 5.78 m (18 ft 11½ in)
- Height overall ..... 2.80 m (9 ft 2¼ in)

AREAS:
- Wings, gross ..... 14.62 m² (157.4 sq ft)

WEIGHTS AND LOADINGS (Rotax 912):
- Weight empty, incl parachute ..... 290 kg (639 lb)
- Max T-O weight ..... 450 kg (992 lb)

PERFORMANCE (Rotax 912UL):
- Max level speed ..... 94 kt (175 km/h; 109 mph)
- Cruising speed ..... 81 kt (150 km/h; 93 mph)
- Stalling speed ..... 33 kt (60 km/h; 38 mph)
- Max rate of climb at S/L ..... 360 m (1,181 ft)/min
- T-O run ..... 100 m (330 ft)
- Landing run ..... 120 m (395 ft)
- Endurance ..... 4 h 30 min
- *g* limits ..... +6/−3.5

EURO FLY

EURO FLY SRL

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Established in the early 1990s, Euro Fly markets a range of lightplanes and flexwing trikes including the Flash Light, Fire Fox, Fire Fox 2000 and Viper. Most recent of these is the FB5 Star Light.

EURO FLY FB5 STAR LIGHT

Manoeuvring a Euro Fly FB5 Star Light 1159282

TYPE: Side-by-side ultralight.

DESIGN FEATURES: Low, constant-chord wing; low tailplane with bracing strut below, each side. Large, sweptback fin.

FLYING CONTROLS: Conventional and manual. Flaps.

STRUCTURE: Metal tube structure; ALS 500 steel in cockpit area and 6082T6 alloy longerons; fabric covering.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring cantilever mainwheel legs and castoring nosewheel. Optional wheel fairings.

POWER PLANT: One Rotax, liquid-cooled, flat-four piston engine; option of 59.6 kW (79.9 hp) Rotax 912 UL or 73.5 kW (98.6 hp) Rotax 912 ULS. Fuel capacity 60 litres (15.9 US gallons; 13.2 Imp gallons).

DIMENSIONS, EXTERNAL:
- Wing span ..... 8.35 m (27 ft 4¾ in)
- Length overall ..... 6.60 m (21 ft 7¾ in)
- Height overall ..... 2.05 m (6 ft 8¾ in)

AREAS:
- Wings, gross ..... 11.48 m² (123.6 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty ..... 282 kg (622 lb)
- Max T-O weight ..... 450 kg (992 lb)

PERFORMANCE:
- Max level speed ..... 121 kt (225 km/h; 140 mph)
- Normal cruising speed ..... 103 kt (190 km/h; 118 mph)
- Stalling speed, flaps down ..... 32 kt (58 km/h; 36 mph)
- Max rate of climb at S/L ..... 342 m (1,122 ft)/min
- T-O run ..... 95 m (315 ft)
- Landing run ..... 100 m (330 ft)
- *g* limits ..... +6/-4

FLYITALIA

FLYITALIA SRL

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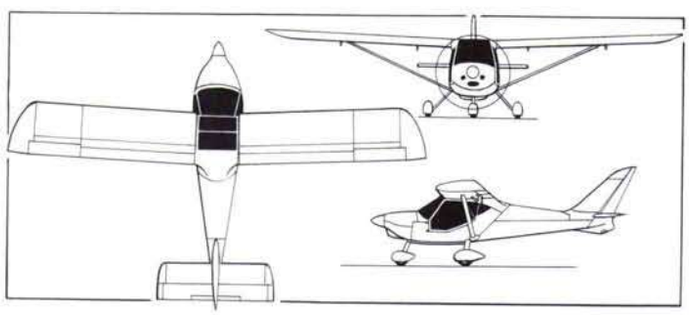
Formed on 30 November 2002, FlyItalia has been local distributor for two types of ultralight built in the Slovak Republic: Aeropro Eurofox and Aerospool WT9 Dynamic.

In 2004, it launched a third product known as the MD3 Rider. The aircraft is produced by Gryf Aircraft (www.gryfair.cz) of the Czech Republic, a subsidiary of FlyItalia, originally formed in 1985 as a flying club within LET.

In late 2005, the company was working on a low-wing version of the Rider, using the designation MD4.

First FlyItalia MD3 Rider to be powered by Rotax 912S flat-four *(Petr Šterba)* 1159284



FlyItalia MD3 Rider *(James Goulding)* 1127532

FLYITALIA MD3 RIDER

TYPE: Side-by-side ultralight kitbuilt.

PROGRAMME: Designed by Jaroslav Dostal, also responsible for the Interplane Skyboy. Prototype (OK-JUR 06) first flew at Kunovice, Czech Republic, 25 February 2004. First production (OK-JUR 17) flew 7 August 2004 and delivered to Sigi Salomoni and Salgaro of *Take-Off* Magazine; No. 003 for static tests. Czech certification awarded 31 May 2006. Tests of Rider (OK-KUU 71, c/n 031) powered by 73.5 kW (98.6 hp) Rotax 912S completed June 2006. Production due to move to Pribam, also in Czech Republic, in late 2006.

CURRENT VERSIONS: **Sporty:** Baseline version, aimed at general aviation and flight training markets. *Data refers to this version unless otherwise stated.*

UL: Lower-powered version, with 59.6 kW (79.9 hp) Rotax 912UL engine. Empty weight 275 kg (606 lb); max T-O weight 450 kg (992 lb).

CUSTOMERS: Total 31 built by June 2006 for customers in France, Italy, Slovak Republic and US.

DESIGN FEATURES: Designed to meet certification requirements throughout Europe. High-mounted, strut-braced wing of constant chord; sweptback fin with characteristic Gryf design curved tip; small underfin; constant-chord tailplane. Wings have MS(1)-0313 aerofoil and 3° forward sweep. Wings fold and tail surfaces are removable for transportation and storage. Symmetrical NACA 12% profile tailplane.

FLYING CONTROLS: Conventional and manual. Cable-operated rudder; rod-operated single-piece elevator and ailerons. Electrically operated four-position (0, 15, 30, 42°) flaps cover 60 per cent of wing span. Electrically controlled trim tab on elevator centreline.

STRUCTURE: All-metal semi-monocoque airframe and integral empennage with composite-skinned welded steel tube fuselage cockpit cage and composites engine cowlings.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted, cantilever spring composites mainwheel legs and steerable nosewheel leg, latter with steel tube fork and rubber shock absorption. Hydraulic disc brakes on mainwheels. All wheels 16×4 in.

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 UL flat-four driving a three-blade, ground-adjustable pitch Woodcomp SR-200B propeller, diameter 1.68 m (5 ft 6¼ in). Fuel capacity 72 litres (19.0 US gallons; 15.8 Imp gallons) of which 70 litres (18.5 US gallons; 15.4 Imp gallons) are usable; optionally 100 litres (26.4 US gallons; 22.0 Imp gallons).

EQUIPMENT: Optional ballistic parachute.
DIMENSIONS, EXTERNAL:
Wing span ..... 8.50 m (27 ft 10½ in)
Length overall ..... 5.70 m (18 ft 8½ in)
Height overall ..... 2.30 m (7 ft 6½ in)
Propeller diameter ..... 1.63 m (5 ft 4¼ in)
DIMENSIONS, INTERNAL:
Cockpit max width ..... 1.16 m (3 ft 9½ in)
AREAS:
Wings, gross ..... 9.50 m² (102.3 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 297 kg (655 lb)
Max baggage weight ..... 15 kg (33 lb)
Max T-O weight ..... 480 kg (1,058 lb)
PERFORMANCE:
Never-exceed speed (VNE) ..... 145 kt (270 km/h; 167 mph)
Max operating speed ..... 119 kt (220 km/h; 137 mph)
Stalling speed, flaps down ..... 33 kt (60 km/h; 38 mph)
Max rate of climb at S/L ..... 420 m (1,378 ft)/min
Range with max fuel ..... 540 n miles (1,000 km; 621 miles)

FLY LINE

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DIRECTOR: Giuseppe Milito

Sig Milito designed aircraft for Fly Synthesis (Storch, Wallaby and Texan) before forming Fly Line to produce an aircraft similar in design to the last-mentioned. The prototype has since been converted to ethanol power in collaboration with Baylor Institute for Air Science, USA. No further production has been advised to *Jane's*.

FLY SYNTHESIS

FLY SYNTHESIS SRL

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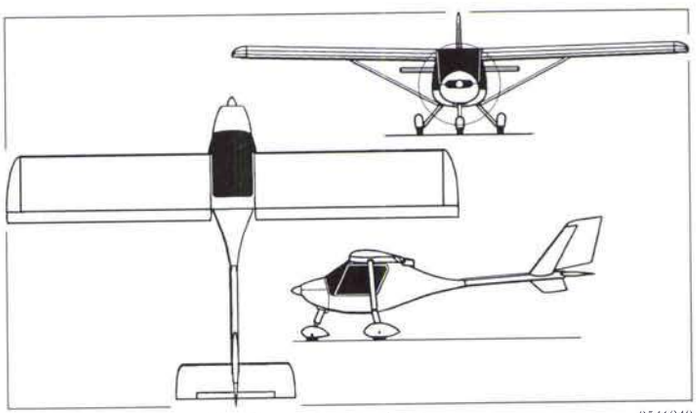
OWNER AND DIRECTOR: Sonia Felice
PRODUCTION DIRECTOR: Rodolfo Ciotti
TECHNICAL, RESEARCH AND DEVELOPMENT DIRECTOR: Corrado Pinzana

The Storch ultralight produced by this company also provides the basis of the tailwheel/T tail Pipistrel Sinus motor glider and ultralight, built in Slovenia. US marketing undertaken by American Ghiles Aircraft.

At the end of 2004, FlySynthesis employed 16 in its 1,100 m² (11,850 sq ft) factory.

Fly Synthesis Storch HS (High Speed) *(Paul Jackson)* 1159361



Jabiru-engined Storch High Speed *(Paul Jackson)* 0546948

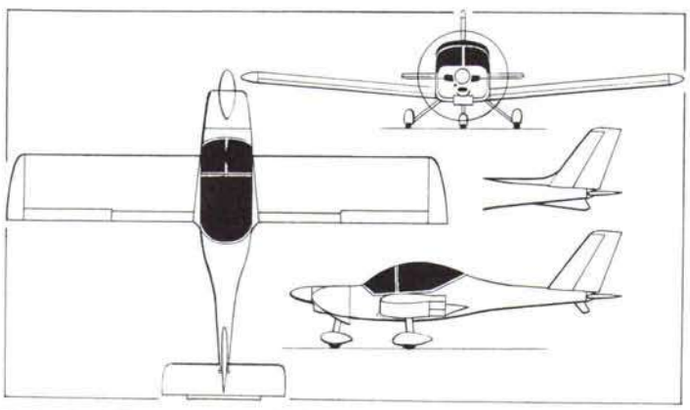
FLY SYNTHESIS STORCH

US Name: Lafayette Stork
TYPE: Side-by-side ultralight/kitbuilt.
PROGRAMME: First flown in 1991 and initially marketed as Rodaro Storch. Certified in Austria, Belgium, France, Germany, Greece, Hungary, Israel, Italy, Malaysia, Slovenia and the USA.
CURRENT VERSIONS: **Classic:** Standard version, *as described.*
Super Speed: As Classic but with shorter overall length (5.95 m; 19 ft 6¼ in) and wing span (9.32 m; 30 ft 7 in) and Rotax 912 UL or Jabiru 2200 engine. Flaps. Not available in kit form.
High Speed: As Super Speed, but with shorter overall length (5.75 m; 18 ft 10¾ in) and (8.71 m; 28 ft 7 in) wing span.
CUSTOMERS: 350 built by end of 2004. Recent sales to customers in South Korea and Congo-Brazzaville.
COSTS: Ready-to-fly: Classic, High Speed: (Rotax 582) EUR34,000, (Jabiru) EUR38,000; S: EUR40,000; kit: Classic, High Speed EUR20,500 (all 2005).
DESIGN FEATURES: Laminar flow aerofoil section. Strut-braced wings fold alongside fuselage for storage. Quoted build time 180 hours.
FLYING CONTROLS: Manual. Cable operated rudder and elevator; rod-operated ailerons. Full-span, Junkers-type slotted ailerons and all-moving tailplane with anti-balance tab.
STRUCTURE: Composites main fuselage shell with welded steel tube frame in cabin area and tubular alloy tailboom; light alloy constant chord wing has 6082 light alloy spar and composites skin; all-composites wing optional.
LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring alloy tube mainwheel legs with wheel fairings. Mainwheels 4.00–6, nosewheel 4.00-4. Drum brakes on Classic and High Speed, disc brakes on Super Speed and, optionally, High Speed. Oil-damped, steerable nosewheel with maximum deflection ±40°. Optional floats.
POWER PLANT: Classic and High Speed have one 47.8 kW (64.1 hp) Rotax 582 UL or 59.7 kW (80 hp) Jabiru 2200; Super Speed has one 59.6 kW (79.9 hp) Rotax 912 UL or 59.7 kW (80 hp) Jabiru 2200, each driving a two-blade wood or composites, or three-blade composites propeller. Standard fuel capacity 60 litres (15.9 US gallons; 13.2 Imp gallons), of which 56 litres (14.8 US gallons; 12.3 Imp gallons) are usable.
ACCOMMODATION: Cabin doors open upwards.
EQUIPMENT: BRS ballistic recovery parachute optional.
Data below refer to Classic with Jabiru 2200 engine, except where stated.
DIMENSIONS, EXTERNAL:
Wing span: Classic ..... 10.14 m (33 ft 3¼ in)
High Speed ..... 8.71 m (28 ft 7 in)
Super Speed ..... 9.32 m (30 ft 7 in)
Length overall ..... 6.25 m (20 ft 6 in)
Height overall: landplane ..... 2.45 m (8 ft 0½ in)
amphibian ..... 3.15 m (10 ft 4 in)
AREAS:
Wings, gross: Classic ..... 13.50 m² (145.3 sq ft)
High Speed ..... 11.60 m² (124.9 sq ft)
Super Speed ..... 10.20 m² (109.8 sq ft)
WEIGHTS AND LOADINGS:
Weight empty: Classic ..... 270 kg (595 lb)
High Speed ..... 262 kg (578 lb)
Super Speed ..... 275 kg (606 lb)
Max T-O weight ..... 450 kg (992 lb)
PERFORMANCE:
Never-exceed speed (VNE): Classic ..... 97 kt (180 km/h; 112 mph)
High Speed, Super Speed ..... 129 kt (240 km/h; 149 mph)
Cruising speed at 75% power: Classic ..... 84 kt (155 km/h; 96 mph)
High Speed ..... 90 kt (165 km/h; 103 mph)
Super Speed ..... 103 kt (190 km/h; 118 mph)
Stalling speed ..... 31 kt (57 km/h; 35 mph)
High Speed, Super Speed ..... 36 kt (65 km/h; 41 mph)
Max rate of climb at S/L:
Classic ..... 300 m (984 ft)/min
High Speed ..... 270 m (886 ft)/min
Super Speed ..... 240 m (787 ft)/min
T-O run: Classic ..... 88 m (289 ft)
High Speed ..... 90 m (295 ft)
Super Speed ..... 130 m (427 ft)
Landing run: Classic ..... 115 m (377 ft)
High Speed ..... 130 m (427 ft)
Super Speed ..... 140 m (460 ft)
Range: Classic ..... 356 n miles (659 km; 410 miles)
Endurance ..... 3 h 18 min
g limits ..... +4/−2

FLY SYNTHESIS TEXAN

TYPE: Side-by-side ultralight.
PROGRAMME: First flown 1999. Available factory-built only.
CURRENT VERSIONS: **Texan Top Class:** Standard version, *as described.*
Texan RG: Launched at Aero'03 Friedrichshafen where shown statically and first flown May 2003; electrically operated retractable landing gear; mainwheels retract outward and nosewheel rearward; manual emergency operation. Dimensions as standard Texan, but increased vertical area at empennage provided by fin fillet and ventral strake. Empty weight 285 kg (628 lb); stalling speed 34 kt (62 km/h; 39 mph); never-exceed speed 151 kt (280 km/h; 174 mph).

Fly Synthesis Texan *(Paul Jackson)* 1159362



Fly Synthesis Texan two-seat ultralight, with scrap view of Texan RG empennage *(James Goulding)* 1159391

Texan Solaris: Special edition version of Texan RG with 84.6 kW (113.4 hp) Rotax 914 driving variable-pitch Idrovario propeller. Features leather seating and improved instrumentation.

CUSTOMERS: More than 60 built by January 2006, including several to Israel. Certified in Australia, Belgium, France, Israel, Italy and Portugal.

COSTS: Kit EUR35,000. Ready to fly EUR54,500 (Jabiru); EUR56,500 (Rotax 912) (all 2005).

DESIGN FEATURES: Low-wing monoplane. Constant-chord wing of laminar flow aerofoil section; sweptback fin and rudder; rearward-sliding cockpit canopy with fixed windscreen. Quoted build time 280 hours.

FLYING CONTROLS: Manual. Rudder and elevator are cable-operated; ailerons are rod-operated. Ground-adjustable trim tab on starboard aileron; all-moving tailplane with anti-balance tab and mass balance weights; horn-balanced rudder. Four-position slotted flaps, maximum droop 45°.

STRUCTURE: Carbon fibre fuselage with Nomex sandwiched carbon fibre wings, tailplane and control surfaces.

LANDING GEAR: Tricycle type; fixed (except RG version). Fuselage-mounted spring cantilever mainwheel legs with wheel fairings. Mainwheels 4.00–6, nosewheel 4.00-4; streamlined fairings on all three wheels. Hydraulic disc brakes on mainwheels.

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS driving a two-blade GT-2/173/155 wooden or three-blade Pipistrel PBM300 BAM3D 165 composites propeller; propellers by DUC, Avtek and Quinti Avio can also be fitted. Fuel in wingroot tanks, total capacity 72 litres (19.0 US gallons; 15.8 Imp gallons), of which 68 litres (18.0 US gallons; 15.0 Imp gallons) usable.

ACCOMMODATION: All aircraft have provision for rapid conversion for disabled pilots.

EQUIPMENT: BRS ballistic recovery parachute system optional.

Data below refer to Texan Top Class unless otherwise indicated.

DIMENSIONS, EXTERNAL:

Wing span: both	8.60 m (28 ft 2½ in)
Length overall: both	6.92 m (22 ft 8½ in)
Height overall: both	2.61 m (8 ft 6¾ in)

AREAS:

Wings, gross: both	12.04 m² (129.6 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: both	290 kg (639 lb)
Max T-O weight: both	450 kg (992 lb)

PERFORMANCE (Rotax 912 ULS):

Never-exceed speed (VNE): Texan Top Class	129 kt (240 km/h; 149 mph)
Texan RG	151 kt (280 km/h; 174 mph)
Cruising speed at 75% power: Texan Top Class	103 kt (190 km/h; 118 mph)
Texan RG	124 kt (230 km/h; 143 mph)
Stalling speed: both	36 kt (65 km/h; 41 mph)
Max rate of climb at S/L: Texan Top Class	360 m (1,181 ft)/min
Texan RG	480 m (1,575 ft)/min
T-O run: Texan Top Class	155 m (508 ft)
Landing run: Texan Top Class	140 m (460 ft)

FLY SYNTHESIS NEW WALLABY

TYPE: Side-by-side ultralight kitbuilt.

PROGRAMME: First flight took place in 1999. Certified in Belgium, France and Italy.

CURRENT VERSIONS: **Wallaby:** Original single-seat version; now superseded.

New Wallaby: Two-seat version introduced by 2004.

CUSTOMERS: More than 23 of all versions built by end of 2005.

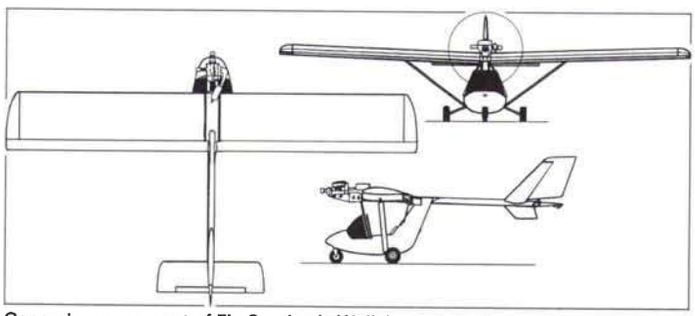
COSTS: Kit EUR11,200, ready-to-fly EUR20,300 (2005).

DESIGN FEATURES: Strut-braced high-wing monoplane. Pod-and-boom fuselage. Wings fold for storage/transport. Open cockpit with windscreen; optional 'winter canopy'. Sweptback fin. Quoted build time 150 hours.

FLYING CONTROLS: Manual. All-moving tailplane with anti-balance tab and mass balance weights.

STRUCTURE: Utilises Storch wing and tail unit, but in composites and with reprofiled ventral fin. Glass fibre fuselage pod.

Single-seat Fly Synthesis Wallaby *(Paul Jackson)* 1159363



General arrangement of Fly Synthesis Wallaby *(Paul Jackson)* 0546957

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring metal tube cantilever mainwheel legs. Mainwheel size 14×4. Drum brakes on mainwheels.

POWER PLANT: One 37.0 kW (49.6 hp) Rotax 503 UL driving a two-blade GT-2/170/90 wooden propeller. Fuel capacity 60 litres (15.9 US gallons; 13.2 Imp gallons) in wingroot tanks.

ACCOMMODATION: Open, but 'winter canopy' available, as extra, to enclose occupants.

DIMENSIONS, EXTERNAL:

Wing span	10.14 m (33 ft 3¼ in)
Length overall	5.75 m (18 ft 10½ in)
Height overall	2.41 m (7 ft 10¾ in)

AREAS:

Wings, gross	13.50 m² (145.3 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	236 kg (520 lb)
Max T-O weight	425 kg (937 lb)

PERFORMANCE:

Never-exceed speed (VNE)	81 kt (150 km/h; 93 mph)
Cruising speed at 75% power	64 kt (118 km/h; 73 mph)
Stalling speed	27 kt (50 km/h; 32 mph)
Max rate of climb at S/L	150 m (492 ft)/min
T-O run	60 m (197 ft)
Landing run	75 m (246 ft)
g limits	+4/–2

FLY SYNTHESIS MANTHOS

TYPE: Side-by-side ultralight.

PROGRAMME: Announced at Aero '05, Friedrichshafen, in April 2005 when second of two scale, aerodynamic proving, flying models was shown. First flight of prototype then planned in 2007; prototype development was continuing during 2006.

DESIGN FEATURES: New concept for ultralight aircraft, based on lifting fuselage with pressure recovery. Trapezoidal wing; twin fins with rudders; winglets.

FLYING CONTROLS: Manual. Differential ailerons; slotted flaps.

STRUCTURE: Composites throughout.

LANDING GEAR: Tricycle type; retractable.

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS flat-four. Fuel capacity 150 litres (39.6 US gallons; 33.0 Imp gallons).

Experimental flying scale model of proposed Fly Synthesis Manthos two-seat ultralight *(Paul Jackson)* 1127745

DIMENSIONS, EXTERNAL:
- Wing span ..... 8.60 m (28 ft 2½ in)
- Length overall ..... 5.90 m (19 ft 4¼ in)
- Height overall ..... 2.15 m (7 ft 0¾ in)

AREAS:
- Wings, gross ..... 13.10 m² (141.0 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty ..... 260 kg (573 lb)
- Max T-O weight ..... 450 kg (992 lb)

PERFORMANCE:
- Never-exceed speed (VNE) ..... 178 kt (330 km/h; 205 mph)
- Cruising speed at 75% power ..... 151 kt (280 km/h; 174 mph)
- Stalling speed: flaps up ..... 33 kt (60 km/h; 38 mph)
- flaps down ..... 26 kt (48 km/h; 30 mph)
- T-O run ..... 110 m (360 ft)
- Landing run ..... 120 m (395 ft)

FRATI

STELIO FRATI

Via Noe 1, I-20100 Milano
Tel/Fax: (+39 02) 204 78 31
CHIEF DESIGNER: Dott Ing Stelio Frati

In 1998, Dott Ing Frati left General Avia to resume the activities of a freelance designer - a career successfully practised since 1950. His past designs include the F.4 and F.7 Rondone, F.8 Falco, F.14 Nibbio, F.15 Picchio, F.250 (now manufactured by Aermacchi as the SF-260), SF.600A Canguro (for SIAI-Marchetti, and now VulcanAir), F.20 Pegaso, and the F.22 Pinguino. The F.8 Falco is marketed as a kit aircraft by Sequoia Aircraft Corporation of the USA.

Frati has designed a new four-seat, all-composites tourer with a 194 kW (260 hp) engine for III of Italy and the similar F28 for ICP; continuing projects are the F.1000 light jet and the F.2500 twin-turboprop, described in previous editions of *Jane's All the World's Aircraft* .

HELISPORT

CH-7 HELISPORT SRL

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Fax: (+39 011) 899 55 50
e-mail: kompress@tin.it
Web: www.ch-7helicopter.com

Previously known as EliSport, the company markets the Kompress, a development by Josi and Claudio Barbero of the CH-6 open frame helicopter produced in 1987 by the Argentine designer Augusto Cicaré. US agent is Lancair.

HELISPORT CH-7 KOMPRESS

TYPE: Two-seat ultralight helicopter kitbuilt.

PROGRAMME: CH-6 project acquired in 1989 by HeliSport; added new cockpit by sports car designer Marcello Gandini; renamed CH-7 Angel, two-seat version became Kompress.

CURRENT VERSIONS: **CH-7 Kompress:** Standard version, replaced by Kompress Charlie.

CH-7 Kompress Charlie: Developed in 2005 from earlier Kompress, *as described*. Earlier versions can be upgraded to this standard.

CH-7 Mariner: Float-equipped version. Multi-tube inflatable floats add 15 kg (33 lb) to empty weight.

HeliSport CH-7 Kompress *(Paul Jackson)* 1159364

CH-7 Angel: Single-seat version, powered by either 47.8 kW (64.1 hp) Rotax 582 UL (as Angel 582) or 59.6 kW (79.9 hp) Rotax 912 UL (as Angel 912). Max T-O weight of both versions is 300 kg (661 lb). No longer available.

CUSTOMERS: Following 120 single-seat Angels built up to 1997, some 120 Kompress versions built by mid-2006. Owners in Australia, Germany, Italy, South Africa, Taiwan, USA and elsewhere.

COSTS: Basic kit, less engine and tax EUR78,000 (2006).

DESIGN FEATURES: Small 'penny-farthing' helicopter with two-blade, semi-rigid, teetering main and two-blade rotors; pod-and-boom fuselage; sweptback upper and lower fins, latter with tailskid. Main rotor transmission by single 10 cm (4 in) five-groove Goodyear belt. Main rotor has 10,000-hour life, on condition. Quoted build time 200 hours; quick-build kit 85 hours.

Rotor blade aerofoil sections NACA 8-H-12 (main) and NACA 63-014 (tail); 1.5 kg (3.3 lb) main rotor tip weights; max 520 rpm main, 2,808 rpm tail rotor.

FLYING CONTROLS: Conventional and manual, by pushrods and bell cranks.

STRUCTURE: Welded 4130 steel tube cabin frame, with nitrogen filling; glass fibre cockpit shell and Plexiglas or Lexan canopy; 2024T3 anodised aluminium alloy tailboom and landing skids. Rotor blades of composites (main) and aluminium alloy (tail).

LANDING GEAR: Fixed; twin-skid type.

POWER PLANT: One 84.6 kW (113.4 hp) Rotax 914 piston engine. Fuel capacity 40 litres (10.6 US gallons; 8.8 Imp gallons) standard in early versions; additional 19 litre (5.0 US gallon; 4.2 Imp gallon) tank optional. Kompress Charlie fuel capacity 60 litres (15.8 US gallons; 13.2 Imp gallons); additional optional tank as earlier versions.

EQUIPMENT: Optional hook beneath fuselage; max load 100 kg (220 lb). Optional agricultural spray system.

DIMENSIONS, EXTERNAL:
- Main rotor diameter ..... 6.27 m (20 ft 6¾ in)
- Tail rotor diameter ..... 1.03 m (3 ft 4½ in)
- Length: fuselage ..... 5.31 m (17 ft 5 in)
- overall, rotors turning ..... 7.41 m (24 ft 4 in)
- Fuselage max width ..... 0.82 m (2 ft 8¼ in)
- Height to top of rotor head ..... 2.31 m (7 ft 7 in)
- Skid track ..... 1.50 m (4 ft 11 in)

DIMENSIONS, INTERNAL:
- Cabin max width ..... 0.76 m (2 ft 6 in)

AREAS:
- Main rotor disc ..... 29.90 m² (321.8 sq ft)
- Tail rotor disc ..... 0.83 m² (8.93 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty: Europe ..... 275 kg (606 lb)
- USA ..... 281 kg (620 lb)
- Max T-O weight: Europe ..... 450 kg (992 lb)
- USA ..... 499 kg (1,100 lb)

PERFORMANCE:
- Never-exceed speed (VNE) ..... 112 kt (209 km/h; 129 mph)
- Max cruising speed: ..... 86 kt (160 km/h; 99 mph)
- Max rate of climb at S/L: Europe ..... 450 m (1,476 ft)/min
- USA ..... 347 m (1,140 ft)/min
- Hovering ceiling: IGE ..... 3,500 m (11,480 ft)
- OGE ..... 2,500 m (8,200 ft)
- Service ceiling ..... 5,000 m (16,400 ft)
- Range: with normal fuel ..... 259 n miles (480 km; 298 miles)
- with optional fuel ..... 388 n miles (719 km; 477 miles)
- Endurance: ..... 3 h 0 min

ICP

ICP SRL

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Web: www.icp.it
PRESIDENT: Tancredi Razzano
TECHNICAL MANAGER: Stefano Agostinetto
QUALITY MANAGER: Renato Pescamona

The company was founded in 1991 and markets aircraft strongly resembling Zenair designs from the USA. It is also active in the automotive industry. Factory floor area 3,000 m² (32,300 sq ft); workforce 40 in January 2003. Production of the Amigo (Zenith Zodiac) has ended.

ICP MXP-740 SAVANNAH

TYPE: Side-by-side ultralight.

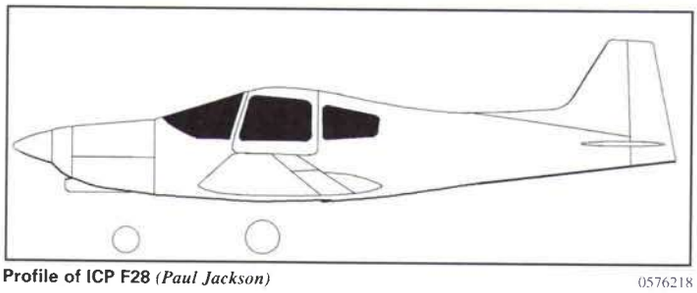
PROGRAMME: Strongly resembles Zenith CH 701, except for conventional rudder and elevators; see Ekoflug MXP-740 (Slovak Republic) for description. Version with amphibious floats is designated **Savannah Hydro**; with Rotax 503 engine is **Bingo 503**; with Simonnini Victor 2 engine (first flown 19 October 2001) is **Super Bingo**; with HKS

ICP Savannah registered in Ireland *(Paul Jackson)* 1037926

Prototype ICP Vimana two-seat LSA 1158995

700E is **Bingo 4T** (2003). ICP offers a retrofit tapered wing (span 8.00 m; 26 ft 3 in, area 9.40 m²; 101.2 sq ft, root chord 1.50 m; 4 ft 11 in, tip chord 0.75 m; 2 ft 5½ in) to produce the **Savannah Advanced**. Savannah is certified for operation as an ultralight in Belgium, France, Germany, Israel, Italy, Luxembourg, Netherlands, Norway and Slovak Republic. Some 420 built by early 2006 (including Bingo).

COSTS: GBP13,500 less engine, or GBP21,650 with Jabiru 2200 engine, including UK VAT (2006).



Profile of ICP F28 *(Paul Jackson)* 0576218

ICP SA2 VIMANA

North American marketing name: Rampage

TYPE: Two-seat lightplane.

PROGRAMME: First details released in 2003. Prototype (I-8439) completed in May 2006. Public debut at Cielo e Volo air show, Ozzano, 10-11 June 2006. Marketed in North America (US LSA category) under name of Rampage by Skykits of Alberta, Canada.

Vimana is the ancient Sanskrit word for a flying machine.

COSTS: CAD89,995 flyaway (2007).

DESIGN FEATURES: Optimised for STOL performance. High wing of trapezoidal planform; single bracing strut and auxiliary strut each side. Sweptback fin with fillet; low tailplane; large rudder and elevators. Optional lightened version has smaller wheels, lighter upholstery and instruments and other weight savings.

Wing section NACA 23015.

FLYING CONTROLS: Conventional and manual. Horn-balanced elevators; full-height rudder. Double-slotted flaps; electrically operated (manual back-up) leading-edge slat.

STRUCTURE: Generally of riveted aluminium.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted, spring cantilever mainwheel legs. Steerable nosewheel. Fairings on all wheels.

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS flat-four driving a KievProp three-blade, ground-adjustable pitch, composites propeller.

ACCOMMODATION: Two persons, side by side. Fully-glazed door each side.

DIMENSIONS, EXTERNAL:

Wing span	8.00 m (26 ft 3 in)
Wing chord: at root	1.50 m (4 ft 11 in)
at tip	0.75 m (2 ft 5½ in)
Wing aspect ratio	6.8

AREAS:

Wings, gross	9.40 m² (101.2 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: normal	300-330 kg (661-728 lb)
optional	286 kg (631 lb)
Max T-O weight	560 kg (1,234 lb)
Max wing loading	59.6 kg/m² (12.20 lb/sq ft)
Max power loading	7.62 kg/kW (12.52 lb/hp)

PERFORMANCE (estimated):

Max level speed	129 kt (240 km/h; 149 mph)
Normal cruising speed	108 kt (200 km/h; 124 mph)
Stalling speed, flaps down	27 kt (50 km/h; 31 mph)
Max rate of climb at S/L	366 m (1,200 ft)/min
T-O run	35 m (115 ft)
g limits	+6/–3

ICP F28

ICP has commissioned the design of a four-seat light aircraft from Stelio Frati. No details of timescale have been announced.

The machine is of typical Frati appearance, with low, tapered wings, centre-hinged cabin doors and retractable tricycle landing gear.

Leading particulars include span of 8.80 m (28 ft 10½ in); length 6.80 m (22 ft 3¾ in); max level speed 184 kt (340 km/h; 211 mph); cruising speed 167 kt (310 km/h; 193 mph).

III

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Web: www.skyarrowusa.com
PRESIDENT: Edward V Dempsey Jr

Company formed April 1947 in Trieste, as Meteor SpA. Main R&D and production facility then in Monfalcone, where two- and four-seat aircraft produced for training and sport flying, plus target aircraft and electronic systems for military market. Present company created in 1985; relocated to new facility in Monterotondo 1989; now produces general aviation aircraft and platforms based on the Sky Arrow for aerial surveillance and environmental monitoring. Plans to market a range of low-wing lightplanes have been delayed.

III SKY ARROW

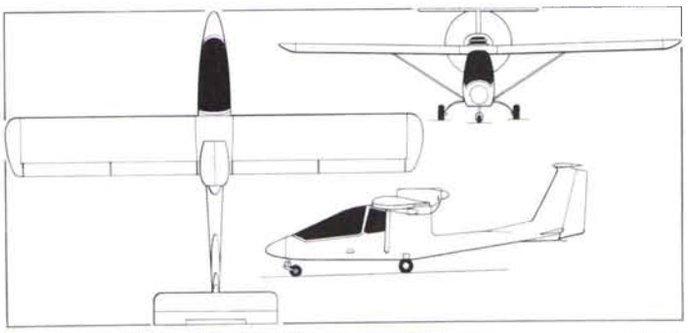
TYPE: Two-seat lightplane; tandem-seat ultralight.

PROGRAMME: First flight March 1993; certified by FAA to FAR Pt 23 and by ENAC (Italy) to JAR-VLA, primary aircraft sport category.

CURRENT VERSIONS: Designations refer to maximum T-O weights in kilograms.

III Sky Arrow 650T amateur-built in UK *(Paul Jackson)* 1159078

First III Sky Arrow 600 Sport, marketed in US Light Sport Aircraft category *(Paul Jackson)* 1159079



III Sky Arrow 650 very light aircraft *(James Goulding)* 0011089

450TS and 450TGS: For markets where MTOW for ultralights is 450 kg (including Czech Republic, Germany, Greece, Netherlands and Norway). TGS is German version.

480TS: For markets (including Australia, Canada and New Zealand) where MTOW for ultralights is 480 kg.

500TF: For markets (including France) where MTOW for ultralights is 500 kg.

600 Sport: Approved as Light Sport Aircraft for US market on 4 November 2005, following delivery of US prototype (N389SA) shortly before. MTOW 599 kg (1,320 lb).

650TCS: JAR-VLA and FAR Pt 23 certified for day or night VFR. MTOW 650 kg.

650TCNS: JAR-VLA and FAR Pt 23 certified for day or night VFR operation. FAA certificate awarded 3 March 2003. MTOW 650 kg. Total 29 built by mid 2004, including first eight as TCN. Retractable gear prototype (I-RGSA) flown mid-2004.

Description below applies to these versions, except where noted.

650 TCNS ERA: Environmental Research Aircraft variant equipped with surface surveillance sensors provided by the US National Oceanic Atmospheric Administration. Features fully retractable nosewheel and folding main landing gear.

650 TCNS RAWAS: Remotely Assisted Working Aerial System. Mission equipment can include gyrostabilised and traversable video cameras, FLIR, IR linescan, vertical multispectral sensor, crop growth monitoring sensors, magnetometer or vertical panoramic still camera; operates as airborne relay station for RAWAS surveillance system, receiving and transmitting data via digital link at range up to 65 n miles (120 km; 75 miles) from fixed or mobile ground stations. Fully retractable nosewheel and folding main landing gear.

RFG: 'Retractable Fixed Gear'. One aircraft (I-RAWE), demonstrated 2001; proof-of-concept for ERA and RAWAS versions, providing clear field of view for ventral sensors. Nosewheel retracts conventionally; regular Sky Arrow mainwheel legs splay outwards and upwards.

710RG: 'Complex aircraft', certified to JAR-VLA for day and night VFR operation and intended for use as an advanced trainer. MTOW 710 kg (1,565 lb). Retractable landing gear.

Twin Arrow: Twin fuselage, four-seat (two-pilot), STOL, amphibious variant, under development in 2006 for long endurance public security surveillance and environment monitoring missions. Two fuselages and outer wings linked by new wing centre-section. Avionics and instrumentation include differential GPS, laser altimeter, digital map display and night flying equipment. Maximum take-off weight 1,230 kg (2,711 lb).

CUSTOMERS: Some 250 built by 2004.

DESIGN FEATURES: Designed with objectives of good view from cockpit, lightness, ease of maintenance, ease of disassembly for transport and storage. Capable of being converted to an amphibian, with additional endplate fins on tailplane. High-mounted engine behind wing; pusher propeller; low-mounted pod fuselage below propeller carries T tail.

Wing aerofoil Gottingen 398 modified to enhance low-speed handling; constant wing chord; dihedral 1° 30'; twist 1°; strut-braced wings easily detachable at centreline joint.

FLYING CONTROLS: Conventional and manual. Ailerons and elevator are actuated by aluminium pushrods, rudder by cables and pushrods. Electrically actuated half-span flaps and tabs; aileron deflections +20/−14°, elevator +22/−14°, rudder ±23°; flap deflections 10, 20 and 30°; centrally mounted elevator tab for trimming. Full dual controls (sidestick and rudder) and throttle.

STRUCTURE: Fuselage, wings, tail unit and landing gear manufactured from carbon fibre sandwich with Kevlar for strengthening in some areas, such as the cabin. Fuselage constructed of right and left halves bonded together, containing nine bulkheads. Wings built round two C-section spars. Sky Arrow 450 and 480 series have aluminium wings which can be replaced by carbon fibre units. Horizontal tail surfaces of aluminium.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring; multilayer carbon- and glass fibre cantilever mainwheel legs with optional wheel fairings and hand operated hydraulic disc brakes. Steel/carbon fibre castoring nose leg with rubber and spring shock-absorber. Twin amphibious floats optional. 710RG has retractable landing gear with mainwheels housed in two fuselage-mounted pods.

POWER PLANT: *500TF:* One 59.6 kW (79.9 hp) Rotax 912 UL flat-four four-stroke, driving a two-blade fixed-pitch propeller via 1:2.27 reduction gear.

450TS, 450TGS and 480TS: One 73.5 kW (98.6 hp) Rotax 912 ULS driving a two-blade fixed-pitch propeller via 1:2.43 reduction gear; three-blade propeller standard on 450TGS.

600 Sport: As 450TS, but with three-blade ground-adjustable propeller.

650TCS and 650TCNS: One 73.5 kW (98.6 hp) Rotax 912 S2 driving a Hoffmann HO176 -174 177CLD wood/composites, two-blade, constant-speed propeller via 1:2.43 reduction gear.

710RG: As 650TCS but with Rotax 912 S3 engine of same horsepower driving a HO-V352 wood/composites, two-blade, constant-speed propeller. Optional 88 litre (23.25 US gallon; 19.36 Imp gallon) fuel tank.

Fuel capacity (all) 68 litres (18.0 US gallons; 15.0 Imp gallons), of which 67 litres (17.8 US gallons; 14.8 Imp gallons) are usable. Tank behind rear seat.

ACCOMMODATION: Two seats in tandem; sideways-opening tinted canopy; baggage compartments below and behind rear seat.

SYSTEMS: Dual hydraulic brakes. Electrical system includes 12 V 14 Ah battery; alternator. 12 V 19 Ah battery optional.

AVIONICS (650 series and 710RG): *Comms:* Single Bendix/King KX-125 nav/com, dual optional; KT-76A transponder; altitude encoder; audio panel with voice-activated intercom; two Sigtronics headsets; ELT.

Flight: Optional Bendix/King KLX-155 nav/com with KI 204 indicator or Garmin GNS-430 nav/com/GPS with GI-106A indicator.

Instrumentation: ASI; altimeter; rate of climb indicator; attitude indicator; directional gyro; turn-and-bank indicator; magnetic compass; pitch trim indicator; tachometer; fuel quantity, fuel pressure, oil temperature, oil pressure, water temperature and vacuum gauges; ammeter/voltmeter; flight hours meter; OAT gauge, and digital chronometer, all standard.

EQUIPMENT: Optional handicapped pilot kit comprises sidestick controller on port cockpit console for rudder and throttle inputs, enabling the aircraft to be flown by pilots unable to use their legs; baggage compartment accommodates folding wheelchair. Fitted trailer for road transportation, with hydraulic loading system, optional.

DIMENSIONS, EXTERNAL:

Wing span: all	9.70 m (31 ft 9¾ in)
Wing chord, constant	1.40 m (4 ft 7 in)
Wing aspect ratio	7.0
Length overall: all	7.60 m (24 ft 11¼ in)
Height overall: all	2.60 m (8 ft 6¼ in)
Tailplane span: all	2.80 m (9 ft 2¼ in)
Tailplane chord: all	0.75 m (2 ft 5½ in)
Wheel track: (except RG)	1.75 m (5 ft 9 in)
710RG	1.52 m (5 ft 0 in)
Propeller diameter: 650	1.75 m (5 ft 8¾ in)
710RG	1.70 m (5 ft 7 in)

AREAS:

Wings, gross: all	13.50 m² (145.3 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: 450TGS	287 kg (633 lb)
450TS	286 kg (631 lb)
480TS	298 kg (657 lb)
500TF	335 kg (739 lb)
600 Sport	375 kg (827 lb)
650TCS, 650TCNS	400 kg (882 lb)
710RG	475 kg (1,047 lb)
Max T-O weight: 450TS, 450TGS	450 kg (992 lb)
480TS	480 kg (1,058 lb)
500TF	500 kg (1,102 lb)
600 Sport	600 kg (1,323 lb)
650TCS, 650TCNS	650 kg (1,433 lb)
710RG	710 kg (1,565 lb)
Max wing loading:	
450TS, 450TGS	33.3 kg/m² (6.83 lb/sq ft)
480TS	35.6 kg/m² (7.28 lb/sq ft)
500TF	37.0 kg/m² (7.59 lb/sq ft)
600 Sport	44.4 kg/m² (9.09 lb/sq ft)
650TCS, 650TCNS	48.2 kg/m² (9.86 lb/sq ft)
710RG	52.6 kg/m² (10.77 lb/sq ft)
Max power loading:	
450TS, 450TGS	6.12 kg/kW (10.06 lb/hp)
500TF	8.39 kg/kW (13.78 lb/hp)
600 Sport	8.16 kg/kW (13.41 lb/hp)

650TCS, 650TCNS ..... 8.84 kg/kW (15.53 lb/hp)
710RG ..... 9.66 kg/kW (15.87 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE):
450TS, 450TGS, 480T, 480TS, 500TF ..... 121 kt (224 km/h; 139 mph)
600 Sport, 650TCS, 650TCNS, 710RG ..... 132 kt (244 km/h; 151 mph)

Max level speed at S/L:
450TS, 450TGS, 480TS, 500TF ..... 108 kt (200 km/h; 124 mph)
600 Sport, 650TCS, 650TCNS, 710RG ..... 107 kt (198 km/h; 123 mph)

Cruising speed at 75% power at S/L:
500TF ..... 90 kt (167 km/h; 104 mph)
450TS, 450TGS, 480TS, 600 Sport ..... 92 kt (170 km/h; 106 mph)
650TCS, 650TCNS ..... 97 kt (180 km/h; 112 mph)
710RG ..... 95 kt (176 km/h; 109 mph)

Stalling speed, power off, flaps down:
450TS, 450TGS ..... 33 kt (62 km/h; 38 mph)
480TS ..... 34 kt (63 km/h; 40 mph)
500TF ..... 35 kt (65 km/h; 41 mph)
600 Sport ..... 38 kt (70 km/h; 44 mph)
650TCS, 650TCNS ..... 40 kt (75 km/h; 47 mph)
710RG ..... 42 kt (78 km/h; 48 mph)

Service ceiling: except 710RG ..... 4,100 m (13,460 ft)
710RG ..... 4,000 m (13,120 ft)

Max rate of climb at S/L:
450TS, 450TGS ..... 384 m (1,260 ft)/min
480TS ..... 372 m (1,220 ft)/min
500TF ..... 274 m (900 ft)/min
600 Sport ..... 318 m (1,043 ft)/min
650TCS, 650TCNS ..... 258 m (846 ft)/min
710RG ..... 183 m (600 ft)/min

T-O run: 450TS, 450TGS ..... 100 m (330 ft)
480TS ..... 115 m (380 ft)
500TF, 600 Sport ..... 145 m (480 ft)
650TCS, 650TCNS ..... 177 m (585 ft)
710RG ..... 180 m (590 ft)

T-O to 15 m (50 ft): 450TS, 450TGS ..... 160 m (525 ft)
480TS ..... 180 m (595 ft)
500TF ..... 230 m (755 ft)
600 Sport ..... 325 m (1,070 ft)
650TCS, 650TCNS, 710RG ..... 380 m (1,250 ft)

Landing run: 450TS, 450TGS ..... 75 m (250 ft)
480TS ..... 86 m (285 ft)
500TF ..... 100 m (330 ft)
600 Sport ..... 120 m (394 ft)
650TCS, 650TCNS ..... 135 m (443 ft)
710RG ..... 140 m (460 ft)

Landing from 15 m (50 ft): 450TG, 450TGS ..... 170 m (560 ft)
480TS ..... 188 m (620 ft)
500TF ..... 200 m (445 ft)
600 Sport ..... 205 m (675 ft)
650TCS, 650TCNS ..... 215 m (705 ft)
710RG ..... 223 m (735 ft)

Max range, 75% power, no reserves:
450TS, 450TGS, 480TS ..... 340 n miles (630 km; 391 miles)
500TF ..... 380 n miles (703 km; 437 miles)
600 Sport (with increased fuel capacity) ..... 405 n miles (750 km; 466 miles)
650TCS, 650TCNS ..... 329 n miles (610 km; 379 miles)
710RG ..... 314 n miles (581 km; 361 miles)

Endurance, 75% power, no reserves:
450TS, 450TGS, 480TS ..... 3 h 40 min
500TF ..... 4 h 10 min
600 Sport with increased fuel capacity ..... 4 h 25 min
650TCS, 650TCNS ..... 3 h 25 min
710RG ..... 3 h 17 min

g limits: all ..... +3.8/−1.9

III ARROW F200 TSJ and F300 FSJ

TYPE: Two-seat lightplane; four-seat lightplane.

PROGRAMME: Design (by Dott Ing Stelio Frati) started in 2000; initially envisaged as family of four, including D-130 primary trainer and a Sport version of F300; manufacture of mockup, and wind tunnel testing, under way mid-2001; production scheduled to begin at end of 2002 but postponed until after 2004, when kit versions were to be offered. Certification of all variants to EASA CS-23 and FAA FAR Pt23 IFR requirements planned, with initial approval of F-300 expected by the end of 2006.

CURRENT VERSIONS: **F200 TSJ**: Aerobatic trainer.

F300 FSJ: Tourer and business aircraft.

DESIGN FEATURES: Typical Stelio Frati design with low wing of tapered planform, and swept fin with long dorsal fillet.

FLYING CONTROLS: Conventional and manual; cable actuated. Horn-balanced elevators and rudder; trim tabs on each aileron and elevator; tab on rudder.

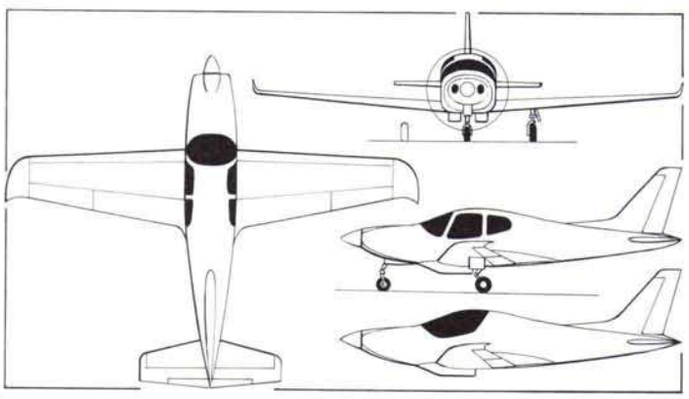
STRUCTURE: All composites; mostly carbon fibre.

LANDING GEAR: Retractable tricycle type; main units retract inwards, nosewheel rearwards.

POWER PLANT: *F200 TSJ*: One 149 kW (200 hp) Textron Lycoming IO-360 flat-four driving a three-blade constant-speed propeller. Max fuel capacity 300 litres (79.2 US gallons; 66.0 Imp gallons).

Artist's impression of III Arrow F200 TSJ 1159041

III Arrow F300 FSJ artist's impression 1159042



III Arrow F300, with additional side view (lower) of F200 (*James Goulding*) 1158780

F300 TSJ: One 231 kW (310 hp) Textron Lycoming IO-550-N2B flat-six with FADEC and three-blade constant-speed propeller. Max fuel capacity 490 litres (129 US gallons; 108 Imp gallons).

ACCOMMODATION: Two persons, side by side in F200 TSJ; four in F300 FSJ, which has conventional cabin accessed via doors. Control sticks standard. Two baggage compartments at rear of cabin on F300 FSJ, with external baggage door on port side aft of wing.

DIMENSIONS, EXTERNAL:
Wing span: F200 TSJ ..... 8.60 m (28 ft 2½ in)
F300 FSJ ..... 10.10 m (33 ft 1½ in)
Wing chord: at root, both ..... 1.78 m (5 ft 10 in)
at tip, both ..... 0.995 m (3 ft 3 in)
Wing aspect ratio: F200 TSJ 6.3
F300 FSJ 7.56
Length overall, both ..... 7.97 m (26 ft 1¾ in)
Height overall, both ..... 3.16 m (10 ft 4½ in)
Tailplane span, both ..... 3.44 m (11 ft 3½ in)
Wheel track, both ..... 3.03 m (9 ft 11¼ in)
Wheelbase, both ..... 2.38 m (7 ft 9¾ in)

AREAS:
Wings, gross: F200 TSJ ..... 11.70 m² (125.94 sq ft)
F200 TSJ ..... 13.50 m² (145.31 sq ft)

WEIGHTS AND LOADINGS:
Max T-O weight: F200 TSJ ..... 1,200 kg (2,645 lb)
F300 FSJ ..... 1,550 kg (3,417 lb)
Max baggage weight, both ..... 65 kg (29 lb)
Max wing loading: F200 TSJ ..... 102.53 kg/m² (21.00 lb/sq ft)
F300 FSJ ..... 114.78 kg/m² (23.51 lb/sq ft)
Max power loading: F200 TSJ ..... 8.05 kg/kW (13.22 lb/hp)
F300 FSJ ..... 6.71 kg/kW (11.02 lb/hp)

PERFORMANCE (estimated):
Max cruising speed: F200 TSJ, F300 FSJ ..... 200 kt (370 km/h; 230 mph)
Cruising speed at 75% power at 1,830 m (6,000 ft):
F200 TSJ, F300 FSJ ..... 175 kt (324 km/h; 201 mph)
Range, 75% power cruising speed, at 1,830 m (6,000 ft)
F200 TSJ ..... 900 n miles (1,667 km; 1,036 miles)
F300 FSJ ..... 1,200 n miles (2,222 km; 1,381 miles)
g limits, both ..... +6/−3

MAGNI

MAGNI GYRO

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FOUNDER: Vittorio Magni

Founded as VPM in 1976 by Vittorio Magni, this company developed the single-seat MT5 and two-seat MT7 gyrocopters. It was renamed Magni Gyro in 1996 and currently produces a range of ultralight autogyros, including the open-cockpit single-seat M-18 Spartan and two-seat M-14 Scout and M-16 Tandem Trainer. In total, around 300 examples were active at the beginning of 2006. In June 2005, the M-22 Voyager was introduced to the range, apparently replacing the M-21, which built only as prototype.

MAGNI M-16 TANDEM TRAINER

TYPE: Two-seat autogyro ultralight/kitbuilt.
PROGRAMME: Current production Magni aircraft.
CURRENT VERSIONS: **Tandem Trainer:** *As described.*
COSTS: Kit EUR75,895; ready-to-fly EUR79,065 both with Rotax 914 (2004).
DESIGN FEATURES: Open, tandem seating. Pod and boom fuselage with sweptback tailplane and triple fins; rudder on central fin only.
STRUCTURE: Chrome-alloy 4130 steel; TIG welded; glass fibre pod.
LANDING GEAR: Tricycle type; fixed. Fuselage-mounted, spring cantilever mainwheel legs with glass fibre wheel fairings. Unfaired nosewheel.
POWER PLANT: One turbocharged 84.6 kW (113.4 hp) Rotax 914 UL flat-four with electric starter, driving a ground-adjustable pitch, three-blade, carbon fibre Arplast pusher propeller. Optionally, 73.5 kW (98.6 hp) Rotax 912 ULS can be fitted. Fuel in integral cockpit seat/tank of epoxy/glass fibre, capacity 72 litres (19.0 US gallons; 15.8 Imp gallons).
EQUIPMENT: Optional 150 litre (39.6 US gallon; 33.0 Imp gallon) agricultural spray gear.
DIMENSIONS, EXTERNAL:

Rotor diameter	8.53 m (27 ft 11¾ in)
Length overall	4.65 m (15 ft 3 in)
Height overall	2.60 m (8 ft 6¼ in)
Width overall	1.80 m (5 ft 10¾ in)
Propeller diameter	1.70 m (5 ft 7 in)

WEIGHTS AND LOADINGS:

Weight empty	270 kg (595 lb)
Max T-O weight: Europe	450 kg (992 lb)
USA	550 kg (1,212 lb)

PERFORMANCE:

Max level speed	100 kt (185 km/h; 115 mph)
Cruising speed	78 kt (145 km/h; 90 mph)
Max rate of climb at S/L	300 m (984 ft)/min
Service ceiling	3,500 m (11,480 ft)
T-O run	70 m (230 ft)
Landing run	up to 30 m (100 ft)
Range, no reserves	260 n miles (481 km; 299 miles)
Endurance	3 h

Magni M-16 Tandem Trainer *(Paul Jackson)* 1159365

MAGNI M-22 VOYAGER

TYPE: Two-seat autogyro ultralight/kitbuilt.
PROGRAMME: Introduced in June 2005 as a replacement for, and improvement to, the M-16 Tandem Trainer; optimised for cross-country flights.
COSTS: Kit EUR75,895; ready-to-fly EUR79,065; both with Rotax 914 (2004).
DESIGN FEATURES: Partially enclosed; tandem seating. Pod and boom fuselage with sweptback tailplane and triple fins; rudder on central fin only. Streamlined side pods with external doors provide baggage capacity.
STRUCTURE: Chrome-alloy 4130 steel; TIG welded; glass fibre pod.
LANDING GEAR: Tricycle type; fixed. Fuselage-mounted, spring cantilever mainwheel legs with glass fibre wheel fairings. Unfaired nosewheel.
POWER PLANT: One turbocharged 84.6 kW (113.4 hp) Rotax 914 UL flat-four with electric starter, driving an Arplast ground-adjustable pitch, three-blade carbon fibre pusher propeller. Fuel in integral cockpit seat/tank of epoxy/glass fibre, capacity 72 litres (19.0 US gallons; 15.8 Imp gallons).
ACCOMMODATION: Flight controls in front cockpit only.
DIMENSIONS, EXTERNAL:

Rotor diameter	8.53 m (27 ft 11¾ in)
Length overall	4.655 m (15 ft 3¼ in)
Height overall	2.60 m (8 ft 6¼ in)
Width overall	1.80 m (5 ft 10¾ in)
Propeller diameter	1.70 m (5 ft 7 in)

DIMENSIONS, INTERNAL:

Baggage compartment	0.15 m^3 (5.3 cu ft)

WEIGHTS AND LOADINGS:

Weight empty	272 kg (600 lb)
Max T-O weight: Europe	450 kg (992 lb)
US	550 kg (1,212 lb)

PERFORMANCE:

Max operating speed	100 kt (185 km/h; 115 mph)
Normal cruising speed	78 kt (145 km/h; 90 mph)
Max rate of climb at S/L	300 m (984 ft)/min
Service ceiling	3,500 m (11,480 ft)
T-O run	70 m (230 ft)
Landing run	0 to 30 m (0 to 100 ft)
Range with max fuel	259 n miles (481 km; 299 miles)

Magni M-22 Voyager prototype 1159286

MB AVIO

MB AVIO

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Little information has been released concerning the company's C26 ultralight, which now appears to be in production.

MB AVIO C26

TYPE: Side-by-side ultralight.
PROGRAMME: Prototype (I-6699) flying by 2002; in production by 2004. One (I-7344) marked in spurious Italian military camouflage and insignia.
COSTS: EUR67,000, plus tax (2004).
DESIGN FEATURES: Low, constant-chord wing; sweptback fin and moderately tapered tailplane.
FLYING CONTROLS: Conventional and manual. Horn-balanced rudder and elevators. Flaps.
STRUCTURE: Generally of metal. All control surfaces have fluted skins.
LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted spring cantilever mainwheel legs.
POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS liquid-cooled flat four driving a three-blade propeller.
DIMENSIONS, EXTERNAL:

Wing span	8.30 m (27 ft 2¾ in)
Length overall	6.80 m (22 ft 3¾ in)

Prototype MB Avio C26 *(Geoffrey P Jones)* 1044615

WEIGHTS AND LOADINGS:

Weight empty	281 kg (619 lb)
Max T-O weight	450 kg (992 lb)

PERFORMANCE:

Never-exceed speed (VNE)	162 kt (300 km/h; 186 mph)
Max level speed	119 kt (220 km/h; 137 mph)
Cruising speed at 75% power	103 kt (190 km/h; 118 mph)
Stalling speed	35 kt (64 km/h; 40 mph)
Endurance	6 h
g limits	+6/–6

OMA SUD

OMA SUD SKY TECHNOLOGIES SPA

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Company established in 1988 as airframe subcontractor, including work for Airbus and Boeing. Began design activities in 2003, initial product being Skycar, developed jointly with Israel Aircraft Industries.

Preliminary details of the Skycar were published at the 2005 Paris Air Show and on 4 November 2005 co-development agreement signed with Rucker Aerospace GmbH of Germany.

OMA SUD SKYCAR

TYPE: Five-seat utility twin.

PROGRAMME: Development began 2003 in conjunction with Israel Aircraft Industries; wing aerodynamic design verification subcontracted to VulcanAir; EASA/FAR Pt 23 certification expected in 2007, application having been made on 17 May 2004. No further progress reports by mid-2006.

DESIGN FEATURES: Twin-boom pusher with high, constant-chord wing and high tailplane with sweptback leading-edge; sweptback, tapered twin fins; upturned wingtips. Deep tailbooms are continuations of fuselage sides.

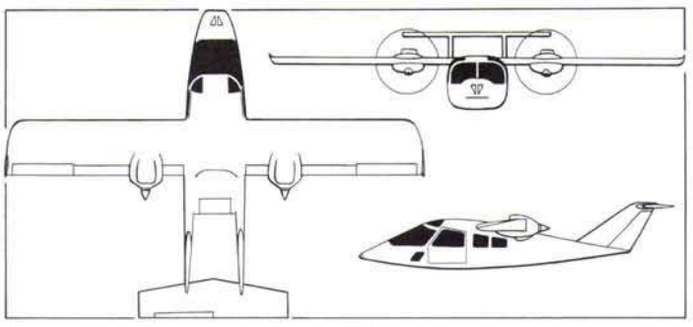
FLYING CONTROLS: Manual. Actuation by pushrods. All-moving tailplane with anti-balance tab port; flaps; twin rudders. Tailplane and rudder trim operated electrically.

LANDING GEAR: Tricycle type; retractable. Electrical actuation, with manual emergency deployment.

POWER PLANT: Two 149 kW (200 hp) Textron Lycoming IO-360-C1E6 flat-four piston engines, each driving a Hartzell two-balde metal constant-speed (hydraulic), fully feathering, pusher propeller.

Fuel tanks in wings; combined capacity 500 litres (132 US gallons; 110 Imp gallons).

Artist's impression of OMA SUD Skycar 1127791



OMA SUD Skycar five-seat twin *(James Goulding)* 1129589

ACCOMMODATION: Five persons; two individual front seats; three on bench seat behind; baggage area to rear, accessible from cabin, but also with 'beaver tail' (horizontally split) door at rear, between tailbooms. Rear seats removal for additional cargo space.

SYSTEMS: Optional wing de-icing.

DIMENSIONS, EXTERNAL:

Wing span	12.00 m (39 ft 4½ in)
Wing chord (constant)	1.40 m (4 ft 7 in)
Length overall	8.92 m (29 ft 3¼ in)
Height overall	2.55 m (8 ft 4½ in)
Tailplane span	4.30 m (14 ft 1¼ in)
Propeller diameter	1.83 m (6 ft 0 in)

DIMENSIONS, INTERNAL:

Cabin volume	5.0 m³ (177 cu ft)
Baggage volume	1.8 m³ (64 cu ft)

WEIGHTS AND LOADINGS:

Weight empty	1,200 kg (2,646 lb)
Payload: max	500 kg (1,102 lb)
with max fuel	335 kg (739 lb)
Max fuel weight	360 kg (794 lb)
Max T-O weight	1,895 kg (4,177 lb)
Max ramp weight	1,915 kg (4,222 lb)
Max landing weight	1,800 kg (3,968 lb)
Max zero-fuel weight	1,700 kg (3,748 lb)

PERFORMANCE:

Max cruising speed	186 kt (344 km/h; 214 mph)
Stalling speed	60 kt (112 km/h; 70 mph)
Max rate of climb at S/L	518 m (1,700 ft)/min
Rate of climb at S/L, OEI	168 m (550 ft)/min
Service ceiling	5,486 m (18,000 ft)
T-O run	387 m (1,270 ft)
Landing run	527 m (1,730 ft)
Range at 65% power at 2,440 m (8,000 ft), 45 min reserves at 45% power	
with max payload	570 n miles (1,055 km; 655 miles)
with max fuel	1,170 n miles (2,166 km; 1,346 miles)

PIAGGIO

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CEO AND PRESIDENT: Tom Appleton

Piaggio began aircraft production at Genoa Sestri in 1916 and later extended to Finale Ligure; Rinaldo Piaggio SpA formed 29 February 1964; covered floor area 50,000 m² (538, 200 sq ft) at Sestri and 70,000 m² (753,475 sq ft) at Finale Ligure. Workforce 775 and 525, respectively, in 2004, plus 35 at Naples research centre. Early in 1993, Rinaldo Piaggio restructured with Piaggio family retaining 19 per cent of stock; Alenia acquired 31 per cent holding in Piaggio in 1988 (adjusted to 24.5 per cent in 1992, but raised to 30.9 per cent in early 1993 following further restructuring and reorganisation). Industrie Aeronautiche and Meccaniche Rinaldo Piaggio SpA placed in administration in November 1994; following takeover in November 1998 by Turkish state holding company Tushav, which acquired 51 per cent of stock, was renamed Piaggio Aero Industries SpA, with balance of stock held by Italian investment group Aero Trust via Royal Bank of Canada (44 per cent), CSC of Italy (3 per cent) and the Buitoni family (2 per cent). However, Aero Trust share increased to 60 per cent in June 1999, returning company to Italian control. Sviluppo Italia, the Italian government industrial investment agency, acquired a 20 per cent share in Piaggio in Septemeber 2003, with an investment of EUR20 million.

Two new subsidiaries were established in 2000: Piaggio Aero France SAS at Nice, France, which is a branch of Piaggio's Finale Ligure engineering department; and Piaggio America Inc, based in Greenville, South Carolina, but scheduled to move to Palm Beach International Airport, Florida, in first quarter 2004. In April 2003, Piaggio purchased Foxair, a corporate and air ambulance operator with a fleet of six aircraft (mainly Avantis), which is the North American support organisation for the P.180 Avanti. In April 2005, Mubadala Development of Abu Dhabi acquired a 35 per cent share of Piaggio Aero.

Piaggio also licence-produces engines, including the RRT1 RTM 322 and mobile shelters; manufactures subassemblies of Alenia (Lockheed Martin) C-27J, Lockheed Martin F-35 Joint Strike Fighter and Dassault Falcon 2000 and overhauls and supports Viper, T53 and T55 power plants.

PIAGGIO P.180 AVANTI

English name: Forward

TYPE: Business twin-turboprop.

PROGRAMME: Design studies began 1979; launched 1982; Gates Learjet became partner in 1983, but withdrew for economic reasons on 13 January 1986; all existing Learjet P.180 tooling and first three forward fuselages transferred to Piaggio; first flights of two prototypes I-PJAV 23 September 1986 and I-PJAR 14 May 1987; two static test fuselages; first Italian certification 7 March 1990; first flight full production P.180 (I-RAIH/N180BP), 30 May 1990; Italian certification 7 March 1990; US certification 2 October 1990; first customer delivery (N180BP to Robert Pond) 30 September 1990; French certification March 1993. P.180 is certified to Italian RAI 223 and FAR Pt 23 including single pilot, night and day, VFR/IFR and flight into known icing. RVSM approval announced 24 July 2002. FAA Domestic RVSM and Canadian RVSM approvals granted in 2003. UK Civil Aviation Authority approval granted 5 June 2004.

On 5 October 2003 an Avanti established a new Class C.1.E world speed record while en route to the NBAA Convention, completing the 854 n miles (1,582 km; 983 mile flight from Chicago-Midway Airport to Orlando Executive Airport in 2 hours, 18 minutes, 12 seconds at an average speed of 374 kt (693 km/h; 430 mph).

CURRENT VERSIONS: **Avanti:** Increased gross weight giving higher payload/range decided 1991 and early aircraft retrofitted with minor modifications to allow new weights; weights increased again in 1992. Modified version relaunched in 1997 incorporates changes including fin, rudder and foreplane of aluminium alloy construction and increased fuel capacity.

Avanti II: *As described.* Upgraded version announced at the NBAA Convention in Las Vegas in October 2004, when first flight of the prototype was said to be imminent. Features

Piaggio P.180 Avanti in Italian Air Force service *(Paul Jackson)* 1159147

include Rockwell Collins Pro Line 21 avionics package with three-tube 254 × 203 mm (10 × 8 in) active matrix liquid crystal EFIS display. Prototype I-RAIL (c/n 1105) made public debut at NBAA Convention, Orlando, Florida 9 to 11 November 2005, having been certified by EASA on 21 October 2005. First delivery, to a Swiss customer, took place in January 2006. Avanti II package may become available as a retrofit upgrade for earlier aircraft. PT6-66B engine to be certified for Avanti in late 2006 or early 2007, allowing increased maximum take-off weight.

Data apply to this version. However, from January 2006, option available of 5,488 kg (12,100 lb) MTOW; 5,511 kg (12,150 lb) ramp weight; and 5,216 kg (11,500 lb) MLW.

CUSTOMERS: Total 30 (including prototypes) built by early 1995. 31st followed in early 1999; eight delivered in 2000, 12 in 2001, 16 in 2002, 20 in 2003,16 in 2004, 14 in 2005, and two in the first six months of 2006. Total of 24 scheduled for production in 2006, and 30 in 2007. Hundredth (N134SL c/n 1100) rolled out 9 June 2005 and subsequently delivered to Avantair. Italian Air Force ordered six for communications; first delivery MM62159 14 May 1993; further five (three for Italian Army; two for SNPC civil protection service) ordered 1994, of which first, MM62167, handed over on 28 July 1997 and delivered 29 August 1997, and second and third delivered March-April 1998, with two SNPC aircraft following in late 1998 and mid-1999. Additional six aircraft delivered for military use by mid-2004, including three for Italian Navy and at least one in navigation aids calibration role for IAF.

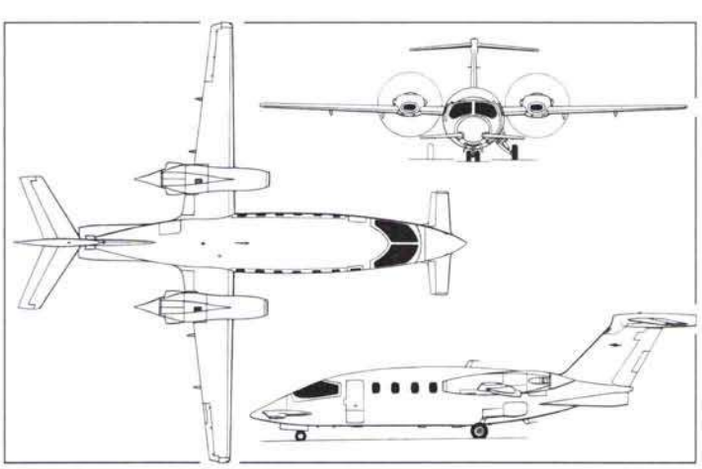
First new aircraft delivery since company reorganisation took place on 2 February 2000 to Aviation Services for Business Aircraft Inc, Portland, Oregon (N680JP). Recent customers include Italian car manufacturer Ferrari, which took delivery of the first of two aircraft (I-FXRB) on 18 May 2000 (these operated by Foxair, which is 75% owned by Piaggio); the Greek Ministry of Health, which ordered two in EMS configuration and, although built, these were not delivered; Locafit (Italy); CIT Group Equipment Financing (Arizona, USA); US charter broker Skyline Aviation, which ordered eight in 2002; Avia Aviation of Canada which has ordered six for delivery from early 2003; Pan Européenne Air Service of France, which ordered one for delivery in May 2003, plus one option; Maserati of Italy, which has taken delivery of one; Euro SkyLink UK, which ordered two plus three options of which first (G-OESL) delivered at the European Business Aviation Convention and Exhibition at Geneva 26 May 2004 but subsequently sold; Blue Panorama Airlines of Italy, which ordered two for delivery in April and July 2004; and Avantair, of Fairfield, New Jersey, ordered 43 Avantis in 2004, and 36 Avanti IIs in 2005, last named for delivery between 2007 and 2010. Order backlog for Avanti IIs stood at 98 in July 2006.

COSTS: Avanti USD5.35 million (2004); Avanti II USD6.195 million (2005). Avantair contract for 36 Avanti IIs valued at USD230 million (2005).

DESIGN FEATURES: Intended to provide jet-type speeds with turboprop economy. Three-surface control with foreplane and T tail to allow unobstructed cabin with maximum headroom to be placed forward of mid-mounted wing carry-through structure; pusher turboprops aft of cabin and wing reduce cabin noise and propeller vortices on wing, assisting in achievement of 50 per cent laminar flow; mid-wing avoids root bulges of low-set wings and spar does not pass through cabin; lift from foreplane allows horizontal tail to act as lifting surface and thereby reduce required wing area by 34 per cent.

Laminar flow wing section Piaggio PE 1491 G (mod) at root, PE 1332 G at tip; thickness/chord ratio 13 per cent at tip, 14.5 per cent at root; dihedral 2°; sweepback 1° 11' 24″; taper ratio 0.34; foreplane aerofoil Piaggio PE 1300 GN4 unswept; 5° anhedral on foreplane and tailplane; latter sweptback 29° 48' at 25 per cent chord. Tailplane swept 40° at 25 per cent chord.

FLYING CONTROLS: Manual. Aerodynamically and mass-balanced elevators; horn- and mass-balanced rudder. Variable incidence swept tailplane for trim; electrically actuated trim tab in starboard aileron and in rudder; two strakes under tail; electrically actuated outboard Fowler and inboard single-slotted flaps on wing synchronised with single-slotted flaps in foreplanes; three flap positions; dual control circuits; foreplane stalls before wing, providing pitch-down moment. All control surfaces have sealed gaps and are aerodynamically balanced. No dampers or stick-pusher.



Piaggio P.180 Avanti corporate transport *(Dennis Punnett)* 0507420

STRUCTURE: Airframe 90 per cent aluminium alloy and 10 per cent composites. Fuselage precision stretch-formed in large seamless sections and inner structure matched to precise outer contour in innovative 'outside-in' construction technique; CFRP in high-stress areas; 'Working skin' wing main box, with machined spars and panels, plus integral stiffeners; two main spars; third spar runs from nacelle to fuselage centreline; aluminium leading-edges and aluminium and composites trailing-edges, both connected to main box. Similar construction of forward wing, which connected to lower fuselage at four points and has aluminium alloy leading-edges with electric de-icing blanket and full-depth honeycomb aluminium flaps. Tailplane has two-spar sandwich construction of graphite fabric on Nomex honeycomb core; elevators are single-spar and full-depth aluminium honeycomb with aluminium skins. Fin attached to tailcone bulkheads by four vertical aluminium machined spars; chemically milled aluminium sheet skins. Two-spar rudder, with aluminium alloy skin and carbon fibre and foam core.

Composites parts manufactured by Moreggio (nacelles) and Salver (horizontal stabiliser), wings and tail section and final assembly by Piaggio in Genoa. Interior completion of aircraft for the North American market is undertaken by Stevens Aviation of Greenville, South Carolina.

LANDING GEAR: Dowty Aerospace hydraulically retractable tricycle type, with Goodrich single-wheel main units and twin-wheel nose unit. Main units retract rearward into sides of fuselage; nose unit retracts forward. Emergency hand pump. Dowty hydraulic shock-absorbers. Electro-hydraulic nosewheel steering available through ±20° on take-off and ±50° for taxying. Tyre sizes 6.50-10 (12-ply, main) and 5.00-5 (8-ply, nose). Goodrich hydraulic, multidisc carbon brakes.

POWER PLANT: Two 1,216 kW (1,630 shp) Pratt & Whitney Canada PT6A-66B turboprops, flat rated at 634 kW (850 shp), each mounted above wing in all-composites nacelle and driving a Hartzell HC-E5N five-blade aluminium constant-speed fully feathering reversible-pitch pusher propeller; propellers handed to counterrotate; blades LE8218 with HC-E5N-3 hubs; port propellor rotates anticlockwise, viewed from rear. Fuel in two fuselage tanks and two wing tanks; total fuel capacity 1,597 litres (422 US gallons; 351 Imp gallons), of which 1,583 litres (418 US gallons; 348 Imp gallons) are usable. Tanks divided into left and right groups (plus primary and secondary collector tanks) which are independent, except during optional pressure refuelling via single point on starboard centre-fuselage. Gravity refuelling point in upper part of fuselage.

ACCOMMODATION: Crew of one or two on flight deck; certified for single-pilot operation. Seating in main cabin for up to nine passengers, with galley, fully enclosed lavatory and coat storage area; choice of nine-passenger high-density or five-seat VIP cabins. Club passenger seats are armchair type, which can be reclined, tracked and swivelled, and locked at any angle. Foldaway tables can be extended between facing club seats. Two-piece wraparound electrically heated windscreen. Rectangular cabin windows, including one emergency exit at front on starboard side. Indirect lighting behind each window ring, plus individual overhead lights. Airstair door at front on port side is horizontally split, upper part forward-opening. Baggage compartment aft of rear pressure bulkhead, with upward-opening door immediately aft of wing on port side. Entire cabin area pressurised and air conditioned. New interior by Sergio Pininfarina under development in mid-1999; total of 15 interior options available.

SYSTEMS: Hamilton Sundstrand R70-3WG three-wheel air-cycle bleed air ECS, with maximum pressure differential of 0.62 bar (9.0 lb/sq in) maintaining sea level cabin altitude to 7,315 m (24,000 ft) and a 2,012 m (6,600 ft) cabin altitude at 12,500 m (41,000 ft). Single hydraulic system driven by electric motor, with hand pump for emergency back-up, for landing gear (up to 207 bar; 3,000 lb/sq in), brakes and steering (up to 83 bar; 1,200 lb/sq in). Electrical system powered by two 400 A 28 V starter/Lear Siegler generators and 25 V 38 Ah Ni/Cd battery, with triple-redundant essential bus. Two 250 VA static inverters for AC. External power receptacle above port mainwheel well. Scott 1.13 m^3 (40 cu ft) oxygen system. Hot air anti-icing of main wing outer and inner leading-edges; electric anti-icing for foreplane and windscreen; rubber boot for engine intakes, with dynamic particle separator; propeller blades de-iced by engine exhaust.

AVIONICS: Rockwell Collins ProLine 21 as core system.

Comms: Dual Rockwell Collins VHF com; dual TDR-94D Mode S transponders; dual Baker M-1035 audio panels.

Radar: RTA-852 turbulence detection radar.

Flight: Dual FGC-3003 flight guidance systems; FMC-3000 FMS; NAV-4000 VOR/ILS/MKR/ADF; NAV-4500 VOR/ILS/MKR; DME-4000; AHS-3000 AHRS; ALT-4000 radio altimeter; GPS-4000A; L-3 Communications TCAS I Skywatch HP; TAWS Class B.

Instrumentation: Three 254 × 203 mm (10 × 8 in) LCD adaptive flight displays for PFD (two) and MFD (one) functions.

DIMENSIONS, EXTERNAL:

Wing span	14.035 m (46 ft 0½ in)
Foreplane span	3.355 m (11 ft 0 in)
Wing chord: at root	1.82 m (5 ft 11¾ in)
at tip	0.62 m (2 ft 0½ in)

Prototype Piaggio P.180 Avanti II at its public debut in Orlando, November 2005 *(Paul Jackson)* 1151484

Foreplane chord: at root ..... 0.79 m (2 ft 7 in)
at tip ..... 0.55 m (1 ft 9¾ in)
Wing aspect ratio 12.3
Foreplane aspect ratio 5.1
Length overall ..... 14.41 m (47 ft 3½ in)
Fuselage: Length ..... 12.53 m (41 ft 1¼ in)
Max width ..... 1.95 m (6 ft 4¾ in)
Height overall ..... 3.98 m (13 ft 0¾ in)
Tailplane span ..... 4.26 m (13 ft 11¾ in)
Wheel track ..... 2.84 m (9 ft 4 in)
Wheelbase ..... 5.79 m (19 ft 0 in)
Propeller diameter ..... 2.16 m (7 ft 1 in)
Propeller ground clearance ..... 0.795 m (2 ft 7¼ in)
Distance between propeller centres ..... 4.125 m (13 ft 6½ in)
Passenger door (fwd, port): Height ..... 1.345 m (4 ft 5 in)
Width ..... 0.61 m (2 ft 0 in)
Height to sill ..... 0.58 m (1 ft 10¾ in)
Baggage door (rear, port): Height ..... 0.60 m (1 ft 11¾ in)
Width ..... 0.70 m (2 ft 3½ in)
Height to sill ..... 1.38 m (4 ft 6½ in)
Emergency exit (stbd): Height ..... 0.67 m (2 ft 2¼ in)
Width ..... 0.48 m (1 ft 7 in)

DIMENSIONS, INTERNAL:

Passenger cabin (excl flight deck):
Length ..... 4.55 m (14 ft 11¼ in)
Max width ..... 1.85 m (6 ft 0¾ in)
Max height ..... 1.75 m (5 ft 9 in)
Volume ..... 10.6 m³ (375 cu ft)
Flight deck: Length ..... 1.45 m (4 ft 9 in)
Volume ..... 2.26 m³ (79.8 cu ft)
Baggage compartment: Floor length ..... 1.70 m (5 ft 7 in)
Max length ..... 1.95 m (6 ft 4¾ in)
Volume ..... 1.25 m³ (44 cu ft)

AREAS:

Wings, gross ..... 16.00 m² (172.2 sq ft)
Ailerons (total, incl tab) ..... 0.66 m² (7.10 sq ft)
Trailing-edge flaps (total) ..... 1.60 m² (17.23 sq ft)
Foreplane ..... 2.19 m² (23.57 sq ft)
Foreplane flaps (total) ..... 0.58 m² (6.30 sq ft)
Fin ..... 4.73 m² (50.91 sq ft)
Rudder, incl tab ..... 1.05 m² (11.30 sq ft)
Tailplane ..... 3.83 m² (41.23 sq ft)
Elevators (total, incl tabs) ..... 1.24 m² (13.35 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, equipped ..... 3,538 kg (7,800 lb)
Max baggage weight:
cabin floor ..... 23 kg (50 lb)
wardrobe ..... 18 kg (40 lb)
rear compartment ..... 181 kg (400 lb)
Max usable fuel weight ..... 1,271 kg (2,802 lb)
Max payload ..... 907 kg (2,000 lb)
Payload with max fuel ..... 679 kg (1,498 lb)
Max T-O weight ..... 5,465 kg (12,050 lb)
Max ramp weight ..... 5,488 kg (12,100 lb)
Max landing weight ..... 5,194 kg (11,450 lb)
Max zero-fuel weight ..... 4,445 kg (9,800 lb)
Max wing loading ..... 341.7 kg/m² (69.98 lb/sq ft)
Max power loading ..... 4.31 kg/kW (7.09 lb/shp)

PERFORMANCE:

Max operating Mach No (MMO) 0.70
Max operating speed (VMO) ..... 260 kt (482 km/h; 299 mph) IAS
Max level speed at FL280 ..... 398 kt (737 km/h; 458 mph)
Manoeuvring speed ..... 199 kt (368 km/h; 229 mph)
Cruising speed at max cruise power:
at FL300 ..... 390 kt (722 km/h; 449 mph)
at FL350 ..... 374 kt (693 km/h; 430 mph)
at FL390 ..... 349 kt (646 km/h; 402 mph)
Stalling speed at max landing weight:
flaps down ..... 97 kt (180 km/h; 112 mph)
Max rate of climb at S/L ..... 844 m (2,770 ft)/min
Rate of climb at S/L, OEI ..... 204 m (670 ft)/min
Max certified altitude ..... 12,500 m (41,000 ft)
Service ceiling ..... 12,040 m (39,500 ft)
Service ceiling, OEI ..... 7,391 m (24,250 ft)
T-O to 15 m (50 ft) ISA, S/L at max T-O weight ..... 986 m (3,235 ft)
Landing from 15 m (50 ft) at max landing weight, no propeller reversal ..... 1,067 m (3,500 ft)
Range:
at max range power:
VFR reserves at FL390 ..... 1,793 n miles (3,320 km; 2,063 miles)
Max range, IFR reserves:
at max range power: ..... 1,507 n miles (2,791 km; 1,734 miles)
at max cruise power: ..... 1,456 n miles (2,696 km; 1,675 miles)

OPERATIONAL NOISE LEVELS (FAR Pt 36):

Appendix F ..... 76.0 dB(A)
Appendix G ..... 81.8 dB(A)

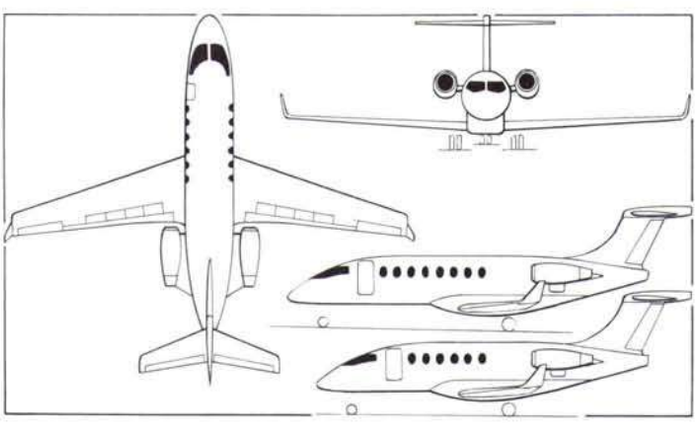
PIAGGIO P.1XX

TYPE: Business jet.

PROGRAMME: First revealed, anonymously, in a market survey conducted by Forecast International in early 2005; then suspected to be related to plans by Piaggio to develop a family of light, light-medium and medium business jets. Design goals include larger cabin cross-section and volume than competing designs; high cruising speed; supercritical wing aerofoil section; new-generation, fully integrated avionics; high utilisation rates; and cross-crew qualification between the different versions. Piaggio conceded responsibility for the design at NBAA Convention, Orlando, Florida, October 2006 and revealed provisional designation P.1XX.

Provisional data for the eight-passenger light-medium variant include a maximum T-O weight of 10,900 kg (24,030 lb); max cruising speed M0.8; certified ceiling 14,325 m (47,000 ft); IFR range 2,300 n miles (4,260 km; 2,647 miles); and price less than USD11 million. The medium jet, which was expected by late 2006 to be selected for further development, would have a longer fuselage accommodating 10 passengers, maximum T-O weight of 13,600 kg (29,982 lb); max cruising speed M0.8; certified ceiling 14,325 m (47,000 ft), IFR range 2,996 n miles (5,550 km; 3,448 miles) and price less than USD13.5 million. Both variants would be powered by two pod-mounted turbofans in the 20.46 kN (4,600 lb st) class and feature fully integrated EFIS avionics, either Honeywell Primus Epic or Collins Pro Line 21 suites. The light jet would seat six to nine passengers and be powered by engines in the Honeywell TFE731 or Pratt & Whitney Canada PW500/PW600 class. The three variants would share 80 per cent commonality of parts.

Artist's impression of proposed Piaggio P.1XX medium jet *(Forecast International)* 1133987



Piaggio medium business jet, with additional side view of light jet *(James Goulding)* 1133956

SAI

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SAI was established in 1997 to design, market and support ultralight aircraft; conduct aerodynamic research; and manage static and flight certification test programmes.

Sales and production of the G97 Spotter, renamed Sky-MAXX, have been transferred to German Aircraft GmbH.

SG

SG AVIATION

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In addition to the Storm series of light aircraft (based on an original Jean Pottier design); and Sea Storm, SG Aviation manufactures spare parts and subassemblies for the Italian Air Force in its 1,800 m² (19,375 sq ft) factory. The workforce numbered 70 in February 2003.

In April 2002, SG launched the high-wing Rally. By 2004, more than 1,000 complete aircraft and kits had been produced and sold to more than 20 countries.

In early 2006, Storm granted a licence to Prestige Aircraft of Jackson, Michigan, to produce aircraft for LSA compliance in the US, with marketing and distribution by Air Elite Aviation.

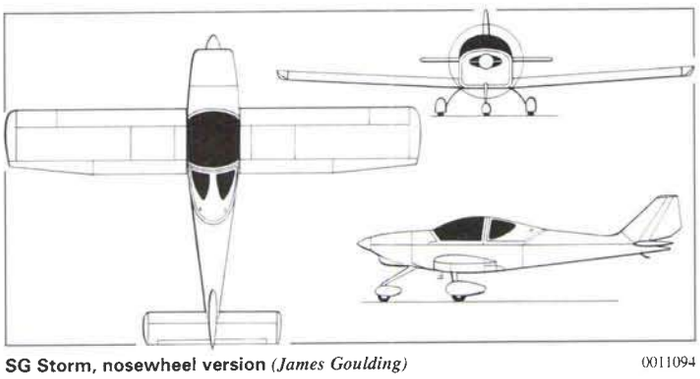
SG STORM

TYPE: Side-by-side lightplane/kitbuilt.

PROGRAMME: Design started 11 February 1989 (Storm 280 SI); construction of prototype started 24 November 1990; first flight March 1991; certified to Aero Club Italia ULM category. Production aircraft manufacture began 29 March 1993, first flight July 1993; first delivery August 1993. US production to LSA standard was expected to begin in August 2006.

CURRENT VERSIONS: Total of three versions currently available, both above and below ultralight weight limit: The **Storm Century**, a development of the Storm 300 Special, was introduced in 2000 and is available in tricycle and tailwheel versions. Other modifications include a lengthened engine cowling, increased fuel capacity using wing tanks, and a baggage compartment behind rear cabin. Also available is the 119 kW (160 hp); and Storm Century '04 development of Century. The Storm 280 E, 280G, 280 SI, 300, 300 Focus, 300 Special, 320 E, 400 Focus, 400 Special and 400TI are no longer available.

Storm 500: Introduced in 2001 in two versions (basic CLK and retractable-gear SLK); is full-four-seat version, available only in tricycle form. No longer available.



SG Storm, nosewheel version *(James Goulding)* 0011094

Storm RG: First flown 2001; development of 400 with conventional tailplane and modified fin with dorsal fillet. First deliveries in 2002. Prototype being tested with winglets; not standard. Available for both ultralight and VLA markets.

Cyclone: Military version of Storm RG; hardpoint under each wing. Cockpit glazing comprises fixed windscreen; rearward sliding canopy; and fixed rear windows. No known production.

Sea Storm: Unrelated design; described separately.

CUSTOMERS: By early 2003 (no more recent data supplied), over 650 Storms ordered, of which more than 250 were flying. Around 80 per cent are tricycle landing gear versions.

COSTS: Kits: Storm Century EUR17,900; Storm RG EUR23,800; Storm Century '04 EUR18,500. Ready to fly: Storm Century EUR55,800; Storm RG EUR69,500; Storm Century '04 EUR58,400 (all 2006).

DESIGN FEATURES: Extensive use of modern materials and technology. Low, constant-chord wing with tip fence on some versions; sweptback fin including large cutaway base to rudder for all-moving tailplane travel. Quoted build time for kits 600 hours.

Wing thickness/chord ratio 15 per cent; 3° dihedral; 3° incidence.

FLYING CONTROLS: Manual. All-moving tailplane with electrically actuated anti-balance tab on most versions; rudder tab introduced on some recent versions. Storm RG has conventional horizontal tail. Balanced Frise ailerons. All models have Fowler flaps.

LANDING GEAR: Main legs are cantilever sprung. Tricycle versions have tubular steel sprung nosewheel leg steerable ±40°. Hydraulic disc brakes on mainwheels. Speed fairings can be fitted. Matco tyres; mainwheels 15×6.00, pressure 2.00 bar (29 lb/sq in); tailwheel 15 cm (6 in), pressure 1.80 bar (26 lb/sq in). Storm RG has 5.00-5 wheels on all legs; main wheels retract inwards, nosewheel rearwards. No doors.

Storm Century tailwheel version with appropriate registration 1159293

For details of the latest updates to ***Jane's All the World's Aircraft*** online and to discover the additional information available exclusively to online subscribers please visit
jawa.janes.com

SG Rally 105 UL ultralight version belonging to a Portuguese owner *(Geoffrey P Jones)* 1044950

POWER PLANT: *Storm Century and Century '04:* One 59.6 kW (79.9 hp) Rotax 912 UL turbocharged four-cylinder four-stroke engine driving a two-blade Rospeller constant-speed metal propeller. Mid-West AE 110 Hawk 78.3 kW (105 hp) rotary engine optional.Fuel capacity100 litres (26.4 US gallons; 22.0 Imp gallons). Oil capacity 3.5 litres (0.92 US gallon; 0.77 Imp gallon).

Storm RG: One 73.5 kW (98.6 hp) Rotax 912 ULS driving a Duc three-blade propeller or one 84.6 kW (113.4 hp) Rotax 914. Fuel capacity as Storm Century.

ACCOMMODATION: Two persons, side by side, with dual controls; single-piece canopy hinged upwards and forwards. Large baggage area behind cockpit.

SYSTEMS: 12 V battery.

AVIONICS: *Instrumentation:* Option of full IFR fit.

DIMENSIONS, EXTERNAL (A: Century, B: RG with Rotax 912 ULS):

Wing span: A, B	7.80 m (25 ft 7 in)
Length overall: A, B	6.80 m (22 ft 3¾ in)
Height overall: B	2.04 m (6 ft 8¼ in)

DIMENSIONS, INTERNAL:

Cabin max width: A, B	1.10 m (3 ft 7¼ in)

AREAS:

Wings, gross: A, B	9.98 m² (107.4 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: B (UL)	293 kg (646 lb)
A	320 kg (705 lb)
B (VLA)	350 kg (771 lb)
Max T-O weight: B (UL)	450 kg (992 lb)
A	560 kg (1,234 lb)
B (VLA)	599 kg (1,320 lb)
Max wing loading: A	56.1 kg/m² (11.49 lb/sq ft)
B (UL)	35.1 kg/m² (7.18 lb/sq ft)
B (VLA)	60.0 kg/m² (12.29 lb/sq ft)
Max power loading: A	6.62 kg/kW (10.88 lb/hp)
B (UL)	4.76 kg/kW (7.82 lb/hp)
B (VLA)	8.15 kg/kW (13.39 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE):	
A, B	167 kt (310 km/h; 192 mph)
Max operating speed (VMO):	
A	155 kt (287 km/h; 178 mph)
B	157 kt (290 km/h; 180 mph)
Cruising speed at 75% power:	
B	143 kt (265 km/h; 165 mph)
A	150 kt (278 km/h; 173 mph)
Stalling speed, power off, flaps down:	
A, B	30 kt (55 km/h; 35 mph)
Max rate of climb at S/L: A	420 m (1,378 ft)/min
B	390 m (1,280 ft)/min
Service ceiling: A	6,096 m (20,000 ft)
B	5,485 m (18,000 ft)
T-O run: A	90 m (295 ft)
B	110 m (360 ft)
Landing run: A	120 m (305 ft)
B	140 m (460 ft)
Range with max fuel:	
A	864 n miles (1,600 km; 994 miles)
B	779 n miles (1,444 km; 897 miles)
g limits: A	+4.2/–2
B	+4.5/–2.0

SG SEA STORM

Development and promotion of this amphibious kitbuilt has been taken over by Air Elite Aviation of the US.

SG RALLY

TYPE: Side-by-side ultralight.

PROGRAMME: Aerodynamic studies began 1991; prototype flew in 1993, but development was suspended in favour of Sea Storm and Storm 300, both of which employed the Rally's wing profile. Work resumed in 2000; marketing launched in April 2002 to meet new, more liberal European sport pilot and US Experimental category legislation. US LSA compliant production started early 2006.

CURRENT VERSIONS: **Rally 105 S:** Experimental category or Ultralight version. *As described.*

Rally 105 UL: Ultralight version only. Empty weight 265 kg (584 lb); MTOW 435 kg (959 lb); reduced fuel and power.

Storm Rally: Built in US by Prestige Aircraft and marketed by Air Elite (which see).

CUSTOMERS: More than 20 sold by February 2004.

COSTS: Kit EUR27,100; ready-to-fly EUR55,800 (2006).

DESIGN FEATURES: High-mounted, strut-braced, constant-chord wings. Low tailplane and sweptback fin mounted on steeply waisted rear fuselage.

Limited aerobatic performance.

FLYING CONTROLS: Conventional and manual. Horn-balanced elevators and rudder. Flight-adjustable tab in starboard elevator. Slotted flaps, settings 0, 10 and 20°.

STRUCTURE: All-composites fuselage, with aluminium wing. Wing section NACA 63-215 mod.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring cantilever mainwheel legs with wheel fairings; 5.00-5 wheels on all legs.

POWER PLANT: One 59.6 kW (79.9 hp) Rotax 912 UL-2 flat-four in Rally UL; 73.5 kW (98.6 hp) Rotax 912 ULS-2 in Rally S, latter driving three-blade ground adjustable WarpDrive propeller. Other suitable engines up to 93.2 kW (125 hp). Standard total fuel capacity 80 litres (21.1 US gallons; 17.6 Imp gallons) in two tanks in wing leading-edges; can be increased to 130 litres (34.3 US gallons; 28.6 Imp gallons); latter standard for US market. Oil capacity 3 litres (0.8 US gallons; 0.7 Imp gallons).

ACCOMMODATION: Gull-wing door on each side of cabin.

DIMENSIONS, EXTERNAL:

Wing span	9.18 m (30 ft 1½ in)
Length overall	7.08 m (23 ft 2¾ in)
Height overall	2.14 m (7 ft 0¼ in)

DIMENSIONS, INTERNAL:

Cabin max width	1.16 m (3 ft 9¾ in)

AREAS:

Wings, gross	12.48 m² (155.9 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	290 kg (639 lb)[1]
Max T-O weight	450 kg (992 lb)[1]
where allowed	599 kg (1,320 lb)

[1] *if flown as ultralight*

PERFORMANCE (Rally 105 UL):

Max level speed	130 kt (240 km/h; 149 mph)
Cruising speed at 75% power	116 kt (215 km/h; 134 mph)
Stalling speed: flaps up	44 kt (82 km/h; 51 mph)
flaps down	35 kt (65 km/h; 41 mph)
Max rate of climb at S/L	390 m (1,280 ft)/min
Service ceiling	3,657 m (12,000 ft)
T-O run	110 m (360 ft)
Landing run	137 m (450 ft)
Max range	809 n miles (1,500 km; 932 miles)
g limits	+4.5/–2.2

TECNAM

COSTRUZIONI AERONAUTICHE TECNAM SRL

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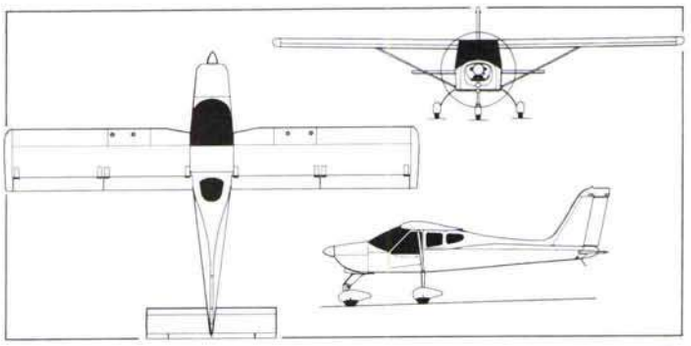
MANAGING DIRECTOR: Prof Luigi Pascale Langer
MARKETING AND SALES DIRECTOR: Paolo Pascale Langer

Company founded 1986, after Pascale brothers were released from the original Pascale company, Partenavia (see now VulcanAir), which had been placed under control of Alenia in 1981. Tecnam manufactures tailplane and other components of ATR 42/72 and parts of A 109, C-27J, SF-260, P.68, plus fuselage panels for Boeing. Workshops qualified to NATO AQAP4 and to Italian Aeronautical Register, JAR 21/F. Manufactures P92 Echo ultralight aircraft and P92-J very light aircraft and in 1997 launched production of the P96 and P96-J; P92 SeaSky amphibian added to range in 1998, P92-S in 1999, 2000 RG in 2000, Sierra in 2003 and P2004 Bravo in 2004. First twin was P2006T, announced in early 2006. Pacific Aerosystem of San Diego appointed US agents in 2001.

By June 2005, had produced more than 1,300 kits and complete aircraft.

The company operates from an 11,000 m² (118,400 sq ft) facility at Napoli-Capodichino.



Tecnam P92-J two-seat ultralight *(Paul Jackson)* 1158031

TECNAM P92 ECHO

TYPE: Side-by-side lightplane/kitbuilt.

PROGRAMME: First flight 14 March 1993. Prototype P92-J (I- TECN) first flown second quarter 1995 and received type certificate 10 November 1995. Production rate 10 per month by end 2001.

CURRENT VERSIONS: **P92:** Standard ultralight version (Italian ULM rules).

P92-J: Detail differences in airframe and equipment to comply with JAR-VLA airworthiness requirements. First delivery (002), to US distributor, second quarter 1996; 12 built by 1998; manufacture suspended until 2001, when replaced by upgraded P92-JS.

P92-JS: Upgraded, certified, version of P-92J with higher-powered Rotax 912 ULS and slightly higher max T-O weight plus increased fuel capacity.

P92-S and P92-ES Echo Super: Added to range in 1999; redesigned rear cabin with additional window; redesigned wing profile and wingtips, revised engine cowling and windscreen; improvements in performance. Jabiru-engined ultralight version is **P92-EM**. *As described.*

P92-ES Echo Super LSA: Approved for US LSA category; MTOW 598 kg (1,320 lb). Basic cost (2006) USD80,900.

P92 Echo Short-Wing: Version for German market with lower empty weight of 275 kg (606 lb), max T-O weight 550 kg (1,212 lb). Bulged cockpit doors, but only one rear quarterlight each side.

P92 Echo 2000 RG: Retractable landing gear version introduced in 2000. Similar to P92-S, but with shorter (8.70 m; 28 ft 6½ in) wing span and reprofiled flaps and fintips. Fuselage lower surfaces redesigned (rounded and deeper) to accommodate retracted gear; bulged doors provide extra 4 cm (1½ in) of shoulder room.

P92 SeaSky: Amphibious floatplane version first flown 1 July 1997; strake below rear fuselage. Full Lotus floats with optional wheels for land operations. Rotax 912 ULS engine and increased empty and maximum T-O weights.

Echo 80: Either P92 or P92-S available with standard Rotax 912 UL engine.

Echo 100S: Either P92 or P92-S available with optional Rotax 912 ULS engine. Latter variant designated P92 Echo S 100S.

CUSTOMERS: Some 960 of all versions delivered by mid-2006; six to Cambodian Air Force (first two September 1994); overseas orders currently account for 51 per cent of production, including many to Israel. P92-J and -JS deliveries totalled 47 by mid-2005. P92 2000 RG deliveries totalled 45 by October 2004.

COSTS: P92 Echo EUR57,400 with Rotax 912UL, EUR59,300 with Rotax 912ULS; P92-JS EUR95,900 certified; P92-S EUR62,600 with Rotax 912UL; EUR64,500 with Rotax 912ULS; P92-ES EUR64,800 with Rotax 912, EUR69,800 with Rotax 912ULS; P92 2000RG EUR71,700 (all less taxes, 2005).

DESIGN FEATURES: Objectives were lightness, simplicity and accessibility for inspection and servicing. Braced single-spar high wing; aerofoil chosen for good performance at low Reynolds number; untapered with 1° 30' dihedral; underside of fuselage mostly flat for ease of kit assembly; large one-piece windscreen, inward-tapered inboard wing leading-edges, large windows in doors; rear view window(s).

FLYING CONTROLS: Manual. Frise ailerons; all-moving tailplane with anti-balance tab; electrically actuated flaps cover half trailing-edge.

STRUCTURE: Fuselage mainly metal except GFRP lower shell of engine cowling and wing leading-edge; ailerons and part of tailplane fabric covered; GFRP rudder tip; tailplane halves can be unpinned and removed quickly for transport; engine cowling removable by undoing four quick latches to reveal whole power plant.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring steel cantilever mainwheel legs with wheel fairings; hand-powered hydraulic disc brakes operated together from single lever in cockpit; nosewheel, with compressed rubber shock absorber, steered from rudder pedals; designed for grass field operation. Wheels 5.00-5 on P92-S and P92-JS; with option to increase to 6.00-6; 400-6 on SeaSky. P92 2000 RG nosewheel is 11×4.00, has oleo-pneumatic shock-absorber and retracts rearwards; 14×4 mainwheels retract inward. Both tube legs are mounted on a single cantilever arm.

POWER PLANT: One 59.6 kW (79.9 hp) Rotax 912 UL (P92) or 912A (P92-J) or 73.5 kW (98.6 hp) Rotax 912 ULS flat-four engine; integrated reduction gear driving two-blade wooden propeller: GT-166/146 for Rotax 912 UL; GT-172/164 for Rotax 912 ULS landplane; GT-182/118 for SeaSky.

Limbach 2000 (59.7 kW; 80 hp) and Rotax 582 (47.8 kW; 64.1 hp) two-stroke offered as options for P92; P92 prototype had the latter; 59.7 kW (80 hp) Jabiru 2200 flat-four available from 2000.

P92 Echo Short-Wing has 59.7 kW (80 hp) Jabiru 2200 as standard, with options to fit 59.6 kW (79.9 hp) Rotax 912 UL or 73.5 kW (98.6 hp) Rotax 912 ULS.

Fuel capacity 70 litres (18.5 US gallons; 15.4 Imp gallons) in two wing tanks, of which 60 litres (15.9 US gallons; 13.2 Imp gallons) are usable.

P92-JS fuel capacity 90 litres (23.8 US gallons; 19.18 Imp gallons).

ACCOMMODATION: Side-by-side seats with three-point harness; baggage space behind seats. Full dual controls and two throttles. Bulged doors on current versions give increased cabin width.

SYSTEMS: 14 V 55 A battery; 100 W alternator. Optional BRS-5 parachute in P92 2000 RG.

AVIONICS: Customer specified; optional IFR nav/com in P92-J.

DIMENSIONS, EXTERNAL (all versions, except where indicated):

Wing span: P92 2000 RG, P92-JS	8.70 m (28 ft 6½ in)
P92, P92-S	9.30 m (30 ft 6 in)
P92-J, SeaSky	9.60 m (31 ft 6 in)
Wing chord, constant portion	1.40 m (4 ft 7 in)
Length overall: except P92 2000 RG	6.30 m (20 ft 8 in)
P92 2000 RG	6.40 m (21 ft 0 in)
Height overall: except SeaSky	2.49 m (8 ft 2 in)
SeaSky	2.97 m (9 ft 9 in)
Tailplane span	2.90 m (9 ft 6 in)
Wheel track:	
except SeaSky, P92 2000 RG, P92-JS	1.78 m (5 ft 10 in)
P92 2000 RG	1.73 m (5 ft 8 in)
P92-JS	1.80 m (5 ft 11 in)
Float track: SeaSky	2.79 m (9 ft 2 in)
Propeller diameter: 59.7 kW engine	1.66 m (5 ft 5¼ in)
73.5 kW engine	1.72 m (5 ft 7¾ in)

DIMENSIONS, INTERNAL:

Cabin max width	1.14 m (3 ft 9 in)

US LSA version of Tecnam P92-ES Echo Super *(Paul Jackson)* 1158010

AREAS:
Wings, gross:
P92, P92-J, P92-S ..... 13.20 m² (142.1 sq ft)
P92 2000 RG, P92-ES ..... 11.98 m² (129.0 sq ft)
SeaSky ..... 13.40 m² (144.2 sq ft)
Tailplane ..... 1.97 m² (21.20 sq ft)
WEIGHTS AND LOADINGS:
Basic weight empty:
P92, P92-S, P92 2000 RG ..... 281 kg (619 lb)
P92-J ..... 305 kg (672 lb)
P92-JS ..... 310 kg (683 lb)
SeaSky ..... 330 kg (728 lb)
LSA ..... 331 kg (730 lb)
Max T-O weight:
ultralight: P92, P92-S, P92 2000 RG ..... 450 kg (992 lb)
SeaSky ..... 500 kg (1,102 lb)
certified: P-92, P92-S, P92-JS ..... 550 kg (1,212 lb)
P92-J ..... 520 kg (1,146 lb)
SeaSky ..... 600 kg (1,322 lb)
LSA ..... 598 kg (1,320 lb)
PERFORMANCE, POWERED (P92 in Echo 80 form, P92-S in Echo 100 form, LSA in P92-ES form):
Never-exceed speed (VNE):
except SeaSky and P92-JS ..... 135 kt (250 km/h; 155 mph)
P92-JS ..... 145 kt (270 km/h; 167 mph)
SeaSky ..... 108 kt (200 km/h; 124 mph)
LSA ..... 132 kt (244 km/h; 151 mph)
Max level speed at S/L:
P92, P92-JS ..... 119 kt (220 km/h; 137 mph)
P92-S ..... 124 kt (230 km/h; 143 mph)
P92-J ..... 110 kt (204 km/h; 127 mph)
P92 2000RG ..... 135 kt (250 km/h; 155 mph)
SeaSky ..... 92 kt (170 km/h; 106 mph)
LSA ..... 118 kt (219 km/h; 136 mph)
Cruising speed at 75% power:
P92 2000 RG ..... 124 kt (230 km/h; 143 mph)
P92, P92-J, P92-JS ..... 100 kt (185 km/h; 115 mph)
P92-S ..... 105 kt (195 km/h; 121 mph)
SeaSky ..... 84 kt (156 km/h; 97 mph)
LSA ..... 112 kt (207 km/h; 129 mph)
Stalling speed:
flaps up: P92 ..... 36 kt (68 km/h; 42 mph)
P92-J ..... 40 kt (74 km/h; 46 mph)
LSA ..... 45 kt (84 km/h; 52 mph)
flaps down:
P92, P92-S, P92 2000 RG ..... 33 kt (61 km/h; 38 mph)
P92-J, SeaSky ..... 35 kt (64 km/h; 40 mph)
P92-JS ..... 36 kt (67 km/h; 42 mph)
LSA ..... 37 kt (69 km/h; 43 mph)
Max rate of climb at S/L: P92 ..... 330 m (1,082 ft)/min
P92-J ..... 262 m (860 ft)/min
P92-JS ..... 360 m (1,180 ft)/min
P92-S, P92 2000 RG ..... 384 m (1,260 ft)/min
SeaSky ..... 244 m (800 ft)/min
LSA ..... 325 m (1,067 ft)/min
Service ceiling: P92, P92-JS ..... 4,265 m (14,000 ft)
P92 2000 RG, P92-S ..... 4,510 m (14,800 ft)
P92-J ..... 4,115 m (13,500 ft)
SeaSky ..... 3,505 m (11,500 ft)
LSA ..... 3,990 m (13,100 ft)
T-O run:
on land: P92 ..... 110 m (360 ft)
P92-J ..... 122 m (400 ft)
P92-JS ..... 143 m (470 ft)
P92-S ..... 100 m (330 ft)
P92 2000 RG ..... 140 m (460 ft)
SeaSky ..... 122 m (400 ft)
LSA ..... 186 m (610 ft)
on water: SeaSky ..... 350 m (1,150 ft)
Landing run:
on land:
P92, P92-S, P92-ES ..... 100 m (328 ft)
P92 2000 RG ..... 110 m (360 ft)
P92-J ..... 92 m (300 ft)
SeaSky ..... 122 m (400 ft)
LSA ..... 150 m (490 ft)
on water (SeaSky) ..... 350 m (1,150 ft)
Max range, no reserves:
except SeaSky and P92-JS ..... 400 n miles (740 km; 460 miles)
P92-JS ..... 450 n miles (833 km; 517 miles)
SeaSky ..... 300 n miles (555 km; 345 miles)
Endurance: P92 ..... 4 h 30 min
P92-J ..... 5 h
g limits: P92-J, P-92-S, LSA ..... +6/−3
P92-JS ..... +3.8/−1.5
SeaSky ..... +5.3/−2
PERFORMANCE, UNPOWERED:
Best glide ratio: P92, P92-J 13

TECNAM P96 GOLF

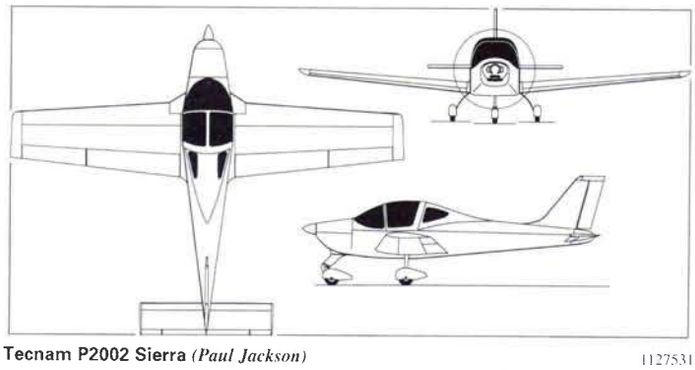
TYPE: Side-by-side ultralight.
PROGRAMME: Prototype construction began July 1996; first flight March 1997. Uprated Golf 100 added in 1999. Replaced by P2002 Sierra, although promotion was continuing in 2006.
CURRENT VERSIONS: **P96 Golf 80:** Ultralight version.
P96 Golf 100: Higher-powered ultralight version.
CUSTOMERS: The 200th Golf registered in Canada (C-ITEC) in February 2002; by October 2004 this had risen to 267, but none further reported by mid-2006.
COSTS: Kit EUR67,900 excluding tax (2005).

Tecnam P96 Golf 100 *(Paul Jackson)* 1158011

TECNAM P2002 SIERRA

TYPE: Side-by-side lightplane/kitbuilt.
PROGRAMME: First publicly displayed (I-TEJF) at Aero '03, Friedrichshafen, April 2003. EASA certification awarded 27 May 2004 as P2002-JF; Australian certification 16 November 2004.
CURRENT VERSIONS: **P2002:** Standard ultralight version.
P2002-JF: Certified version for German and Australian markets; *as described*.
P2002 LSA: Approved for US LSA category; MTOW 598 kg (1,320 lb). Basic price USD86,900 (2006).
P2002-JR: Certified version. Prototype (I-TEJR) shown at Aero '05, Friedrichshafen, April 2005. Retractable landing gear; mainwheels retract outwards, having trailing link suspension with compressed rubber shock absorbers; nosewheel retracts rearward on oleo leg.
CUSTOMERS: Total of 180 kits produced by April 2006 for customers in Australia, Austria, Brazil, Canada, Czech Republic, France, New Zealand, South Africa, Spain, Switzerland, US and elsewhere. Chosen by Basair as a Cessna 152 replacement in May 2005.
COSTS: P2002 EUR74,200, P2002-JF ready-to-fly EUR101,450, both excluding tax (2005).
DESIGN FEATURES: Considerably upgraded Tecnam P96 Golf to meet EASA certification standards.
FLYING CONTROLS: As P96. Control surface movements: ailerons +20/−15°; tailplane +15/−3°; rudder ±30°; flaps 0, 15 and 40°.
STRUCTURE: Redesigned fuselage with reprofiled cabin area. New all-metal tapered wing (ratio 0.6) has 5° dihedral and upturned tips.
LANDING GEAR: As P96 Golf. Cleveland wheels and brakes.
POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912S-2 with 1:2.42 reduction gear driving a Hoffmann HO-17-GHMA-174-177C (as certified), GT Propellers GT-2/173/VRR-FW101SRTC or similar two-blade, fixed-pitch propeller. Fuel in two wing tanks; total capacity 100 litres (26.4 US gallons; 22.0 Imp gallons) of which 99 litres (26.1 US gallons; 21.8 Imp gallons) usable. Optional P96 Golf fuel tanks of reduced capacity.
ACCOMMODATION: Two seats side by side. Canopy slides rearwards and can be opened with engine on and during flight.
SYSTEMS: 12 V 18 Ah battery, 200 W alternator.
AVIONICS: Bendix/King or Garmin equipment, to customer's choice.
Comms: KX 155 nav/com or ICOM-IC-A200 VHF, KT 76A, GTX 320 or GTX 327 transponder.
Flight: GNS 430 GPS/NAV receiver.
Instrumentation: KI 208 or GI 106A VOR/LOC.
DIMENSIONS, EXTERNAL:
Wing span ..... 8.60 m (28 ft 2½ in)
Wing aspect ratio 6.4
Length overall ..... 6.61 m (21 ft 8¼ in)
Height overall ..... 2.43 m (7 ft 11½ in)
Tailplane span ..... 2.90 m (9 ft 6¼ in)
Wheel track ..... 1.85 m (6 ft 0¾ in)
Wheelbase ..... 1.62 m (5 ft 3¾ in)
Propeller diameter ..... 1.74 m (5 ft 8½ in)
DIMENSIONS, INTERNAL:
Cabin max width ..... 1.10 m (3 ft 7¼ in)

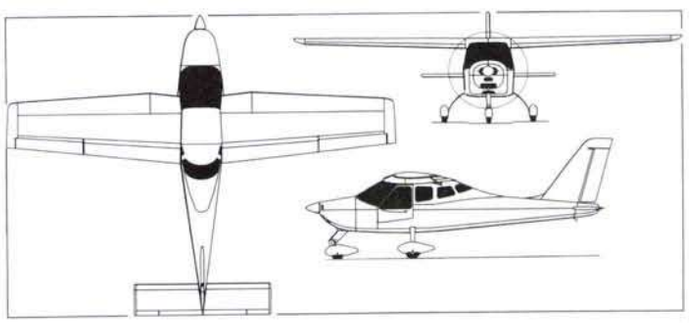
Tecnam P2002 Sierra operated in US LSA category *(Paul Jackson)* 1158013


Tecnam P2002 Sierra *(Paul Jackson)* 1127531

AREAS:
Wings, gross ..... 11.50 m² (123.8 sq ft)
WEIGHTS AND LOADINGS:
Weight empty: P2002 ..... 337 kg (743 lb)
LSA ..... 331 kg (730 lb)
Max baggage weight ..... 20 kg (44 lb)
Max T-O weight: P2002 ..... 580 kg (1,279 lb)
LSA ..... 598 kg (1,320 lb)
Max wing loading: P2002 ..... 50.4 kg/m² (10.33 lb/sq ft)
LSA ..... 52.06 kg/m² (10.66 lb/sq ft)
Max power loading: P2002 ..... 7.90 kg/kW (12.97 lb/hp)
LSA ..... 8.15 kg/kW (13.39 lb/hp)
PERFORMANCE (LSA):
Never-exceed speed (VNE) ..... 135 kt (250 km/h; 155 mph)
Max level speed ..... 120 kt (222 km/h; 138 mph)
Cruising speed at 75% power ..... 116 kt (215 km/h; 133 mph)
Stalling speed, power off: flaps up ..... 45 kt (84 km/h; 52 mph)
flaps down ..... 38 kt (71 km/h; 44 mph)
Max rate of climb at S/L ..... 372 m (1,220 ft)/min
Service ceiling ..... 3,995 m (13,110 ft)
T-O run ..... 232 m (762 ft)
Landing run ..... 186 m (610 ft)
Range at cruising speed ..... 590 n miles (1,092 km; 679 miles)
g limits ..... +6/−3

TECNAM P2004 BRAVO

TYPE: Side-by-side lightplane/kitbuilt.
PROGRAMME: High-wing version of Tecnam P2002 Sierra; first flight 9 September 2004.
Description generally as for P2002 Sierra. Differences include:
CURRENT VERSIONS: **P2004 Bravo:** Baseline version. *As described.*
P2004 Bravo LSA: US LSA category; MTOW 598 kg (1,320 lb).
CUSTOMERS: Total 54 kits produced by April 2006 for customers in Canada, New Zealand, US and elsewhere.
COSTS: USD84,900 basically equipped, LSA (2006).
DESIGN FEATURES: Wing dihedral 1° 30'.
POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS flat four driving a Tonini two-blade propeller via a 2.4286:1 reduction gear.
DIMENSIONS, EXTERNAL:
Wing span ..... 8.40 m (27 ft 6¾ in)
Length overall ..... 6.61 m (21 ft 8¼ in)
Height overall ..... 2.60 m (8 ft 6¼ in)
Tailplane span ..... 2.90 m (9 ft 6¼ in)
Wheel track ..... 1.85 m (6 ft 0¾ in)
DIMENSIONS, INTERNAL:
Cabin max width ..... 1.15 m (3 ft 9¼ in)
AREAS:
Wings, gross ..... 11.00 m² (118.4 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 283 kg (624 lb)

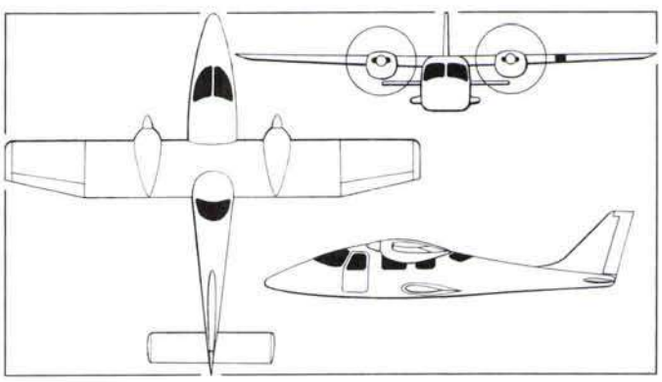


Tecnam P2004 Bravo *(Paul Jackson)* 1127530

PERFORMANCE:
Never-exceed speed (VNE): P2002 ..... 157 kt (290 km/h; 180 mph)
LSA ..... 135 kt (250 km/h; 155 mph)
Max level speed at S/L: P2002 ..... 129 kt (238 km/h; 148 mph)
LSA ..... 120 kt (222 km/h; 138 mph)
Cruising speed at 75% power ..... 116 kt (215 km/h; 134 mph)
Stalling speed: flaps up, LSA ..... 46 kt (84 km/h; 53 mph)
flaps down: P2002 ..... 35 kt (64 km/h; 40 mph)
LSA ..... 39 kt (71 km/h; 45 mph)
Max rate of climb at S/L ..... 360 m (1,181 ft)/min
Service ceiling ..... 4,270 m (14,000 ft)
T-O run ..... 140 m (460 ft)
Landing run ..... 120 m (394 ft)
Range at cruising speed, LSA ..... 589 n miles (1,092 km; 678 miles)

TECNAM P2006T

TYPE: Four-seat utility twin.
PROGRAMME: Announced early 2006.
COSTS: EUR235,000 (2006).
DESIGN FEATURES: High-wing twin-prop; straight wing leading edge with constant-chord centre section and forward sweep on outer panels; sweptback fin with low, constant-chord tailplane.
Wing section NACA 63A.
FLYING CONTROLS: Manual. All-moving, low-mounted tailplane with anti-balance tab; Frise ailerons; rudder with electronic trim tab. Slotted flaps, electrically actuated.
STRUCTURE: Generally of aluminium alloy. Single-spar wing.
LANDING GEAR: Tricycle type; retractable. Trailing-link, aluminium main gear legs attached to fuselage bulkhead and fitted with oleo-pneumatic shock absorbers; electro-hydraulic inboard retraction, turning through 90°; retracted mechanism partly covered by fairings scabbed to fuselage sides. Cleveland mainwheels and hydraulic brakes; 6.00-6 tyres. Oleo-pneumatic, telescoping, steerable nosewheel leg braced to forward bulkhead by steel truss; 5.00-5 tyre. Gravity-actuated backup deployment system.
POWER PLANT: Two 73.5 kW (98.6 hp) Rotax 912S liquid-cooled, flat-fours driving Hoffmann HO-V352 two-blade, constant-speed, feathering propellers via 2.4286:1 reduction gear. Fuel tanks in wings, outboard of engines; combined capacity 200 litres (52.8 US gallons; 44.0 Imp gallons), of which 190 litres (50.2 US gallons; 41.8 Imp gallons) usable.
ACCOMMODATION: Four persons in two side-by-side pairs. Door each side; left, front for flight crew; right, rear for passengers. Windscreen; door windows; two windows each side, rear of doors; and rear-facing window. Cabin crashworthiness to FAR Pt 23/EASA CS23 standards. Dual controls. Accommodation heated and ventilated. Baggage compartment with external door.
SYSTEMS: Electrical system includes two 12 V 21 A alternators and Gill 35 Ah battery.
AVIONICS: Standard equipment generally by Garmin.
Comms: GNS 430 COM/NAV/GPS; GTX 327 transponder; GMA 430 audio panel. Optional second GNS 430 and substitute GTX 330 Mode S transponder and substitute GNS 530 panel.
Flight: Optional S-Tec 55X dual-axis autopilot and ST-360 altitude selector with ST-361 flight director; Bendix/King KCS 55A HSI, KR 87/KI 227 ADF and KN 63 DME.



Provisional general arrangement of Tecnam P2006T *(James Goulding)* 1159812

US Light Sport (LSA) version of Tecnam P2004 Bravo *(Paul Jackson)* 1158016

Artist's impression of Tecnam P2006T project 1158019

Standard instrument panel for Tecnam P2006T 1158021

Optional EFIS cockpit offered for Tecnam P2006 1158020

Full IFR analogue panel option for Tecnam P2006T 1158022

Instrumentation: GI 106 indicator. Optional Pegasus EFIS with two 264 mm (10.4 in) PFD/MFD screens incorporating AHRS, ADC, EICAS, dual mav/com, GPS, Mode S and digital audio panel.

EQUIPMENT: Navigation and landing/taxi lights.

DIMENSIONS, EXTERNAL:

Wing span	10.60 m (34 ft 9¼ in)
Wing aspect ratio	7.8
Length overall	8.66 m (28 ft 5 in)
Height overall	2.85 m (9 ft 4¼ in)
Propeller diameter	1.72 m (5 ft 7¾ in)

DIMENSIONS, INTERNAL:

Cabin: Length	2.50 m (8 ft 2½ in)
Max width	1.14 m (3 ft 9 in)
Baggage compartment volume	0.35 m³ (12.4 cu ft)

AREAS:

Wings, gross	14.40 m² (155.0 sq ft)

WEIGHTS AND LOADINGS (estimated):

Weight empty	640 kg (1,411 lb)
Max baggage weight	60 kg (132 lb)
Max T-O weight	1,100 kg (2,425 lb)
Max wing loading	76.4 kg/m² (15.65 lb/sq ft)
Max power loading	7.48 kg/kW (12.30 lb/hp)

PERFORMANCE (estimated):

Max level speed at S/L	153 kt (283 km/h; 176 mph)
Cruising speed: at 75% power	147 kt (272 km/h; 169 mph)
at 65% power	141 kt (261 km/h; 162 mph)
Stalling speed: flaps up	54 kt (100 km/h; 63 mph)
flaps down	48 kt (89 km/h; 56 mph)
Max rate of climb at S/L	415 m (1,361 ft)/min
Service ceiling	4,875 m (16,000 ft)
Service ceiling, OEI	2,040 m (6,700 ft)
T-O run	225 m (740 ft)
T-O to 15 m (50 ft)	420 m (1,380 ft)
Landing from 15 m (50 ft)	340 m (1,115 ft)
Landing run	180 m (590 ft)
Range with 30 min reserves:	
75% power	685 n miles (1,268 km; 788 miles)
65% power	710 n miles (1,314 km; 817 miles)

VULCANAIR

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Samanta aircraft service company purchased by Carlo de Feo in 1997; Samanta renamed as VulcanAir in April 1998 when it purchased bankrupt Partenavia company. VulcanAir returned P.68 series to production in 1999 and continues to supply spares for Partenavia aircraft. Acquired rights to SF.600 Canguro from SIAI-Marchetti on latter's incorporation into Aermacchi in 1997. In June 1999, VulcanAir announced development of the VA 300 twin-diesel-engined light transport derivative of the P.68 and single-engined VF 600W Mission, the latter a new aircraft with some commonality with the SF.600A and P.68 series.

Workforce 160 in 2004; 60,000 m² (645,834 sq ft) production facility at Naples-Capodochino Airport.

At the Dubai Air Show in November 2005, Vulcanair announced plans for an updated version of the former Partenavia AP.68TP 600 Viator twin-turboprop 11-seat utility aircraft, of which six examples were built by Partenavia before Vulcanair acquired the company. The new version would incorporate airframe and systems upgrades including a new avionics suite in a 'glass' cockpit. A new prototype Viator was under construction in late 2005, and subject to proof-of-concept and market studies, production could resume during 2006 if sufficient customer demand is established. The Viator was last described in the 2001-02 edition of *Jane's All the World's Aircraft*.

VULCANAIR P.68

TYPE: Light utility twin-prop transport; multisensor surveillance twin-prop.

PROGRAMME: Prototype (I-TWIN) first flew 25 May 1970. Production of P.68 Victor and P.68B by Partenavia in Italy started 1978, followed by P.68C in 1980. Partenavia manufacture ended in 1994, but assets subsequently acquired by VulcanAir; 10 assembled in India up to 1999 by TAAL. Improvements announced in 1999 included Garmin avionics.

CURRENT VERSIONS: **P.68C:** Basic version, as described.

P.68C TC: As P.68C, but with turbocharged engines for better hot-and-high performance.

P.68C Jet: As P.68C, but with SMA SR305 Diesel engines. Engine runs under way by February 2004, first flight (I-DJET, c/n 426) 24 February 2005. EASA certification was then expected in second quarter of 2005, but had not been received a year later.

P.68 Observer 2: For use by government and specialised services for patrol, surveillance and search; largely transparent nose section with lowered, compact instrument panel; 63 × 46 cm (2 ft 1 in × 1 ft 6 in) underfuselage hatch can carry variety of electro-optical sensors; slightly different equipment from other versions.

P.68 Observer Jet: As P.68 Observer 2, but with SMA SR305 Diesel engines.

P.68 TC Observer TC: Turbocharged version of Observer 2 for hot/high performance.

CUSTOMERS: Total 401 P.68s of all versions built in Italy by end 1998; these comprised 12 P.68s, 196 P.68Bs, 91 P.68Cs, 47 P.68C TCs, 39 Observers, seven Observer 2s, three Observer TCs and six untraced. VulcanAir began production batch of 20 (mainly Observer 2s) in 1998, these all complete by end of 2003. Eight Observer 2s sold to Italian police; first delivery (PS-B07) 11 November 1999. Further four (including three Observer 2s) registered in USA 2000–02, excluding demonstrator; others to Germany (two), Spain (three) and Italy (two) in 2003. Total of some 430 P.68s, including 26 Observer 2s built in Italy by late 2005. Also built in India by Taneja Aerospace, although this manufacture not approved by Vulcanair: 10 (nine P.68Cs and one Observer) between 1995 and 2001, plus further two P.68Cs in 2006.

COSTS: USD475,000 (P.68C); USD485,000 (P.68 Observer 2); USD505,000 (P.68C-TC); USD515,000 (P.68 TC Observer), all IFR equipped (2001).

DESIGN FEATURES: High wing with NACA 63-3515 aerofoil section and Hoerner tips; dihedral 1°, incidence 1° 3'.

1159043

Australian registered Vulcanair P.68C

FLYING CONTROLS: Manual. Pushrod and cable actuated, with all-moving tailplane and anti-balance tab; trim tab in rudder; electrically operated single-slotted flaps.

STRUCTURE: Light alloy stressed skin fuselage with frames and longerons; stressed skin two-spar torsion box wing; metal stressed skin tailplane and fin; fuselage/wing fairings mainly GFRP.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring steel cantilever mainwheel legs; oleo suspension for nosewheel, steered from rudder pedals. Mainwheels Cleveland 40-142 with Goodyear 7.00-6 (8 ply) tyres; nosewheel Cleveland 40-77B with Goodyear 5.00-5 (6 ply) tyre 6.00-6 (8 ply) tyre optional; Cleveland Type 30-61 foot actuated heavy duty hydraulic disc brakes; streamlined wheel fairings optional. P.68 Observer 2 has larger mainwheel tyres as standard. Minimum ground turning radius 5.70 m (18 ft 8 in).

POWER PLANT: *P.68C:* Two 149 kW (200 hp) Textron Lycoming IO-360-A1B6 flat-four engines, each driving a Hartzell HC-C2YK-2CUF two-blade constant-speed fully feathering propeller. Fuel capacity 696 litres (184 US gallons; 153 Imp gallons) in integral wing tanks, of which 670 litres (177 US gallons; 147 Imp gallons) usable.

P.68C TC: Two 157 kW (210 hp) Textron Lycoming TIO-360-C1A6D; same propellers as P.68C.

P.68C Jet and P.68 Observer Jet: Two 171.5 kW (230 hp) Snecma-Renault SR305-230 turbocharged flat-four diesel engines.

Usable fuel capacity 520 litres (137 US gallons; 114 Imp gallons) in integral wing tank; overwing gravity refuelling. Oil capacity 7.5 litres (2.0 US gallons; 1.7 Imp gallons) for each engine.

ACCOMMODATION: One or two pilots and five or six passengers; cabin has two forward-facing seats in middle and three-seat rear bench; club seating optional; baggage door at rear and pilot door at front on starboard side; passenger door to port in centre cabin; escape hatch on starboard side; baggage compartment accessible from inside cabin. P.68 Observer 2 has no front starboard door for pilots. Optional aerophotogrammetric floor hatch, 0.63 × 0.46 m (2 ft 0¾ in × 1 ft 6 in) on P.68C.

SYSTEMS: Two 28 V 130 Ah alternators and one 24 V 24 Ah battery; Goodrich pneumatic de-icing boots and eletro-thermal propeller de-icing optional; air conditioning optional.

AVIONICS: Garmin and Bendix/King avionics package standard.

Comms: GMA 340 audio panel with marker beacon receiver and intercom; GTX 320A transponder; control wheel PTT switch; micophone with headset; speakers with microphone jacks; avionics master switch; ELT 910 automatic ELT, all standard. NAT AMS44TL audio panel optional.

Radar: Bendix/King RDR 2000 vertical profile weather radar optional.

Flight: Dual Garmin GNS 430 com/nav/GS/GPS; Bendix/King KFC 150 two-axis autopilot with CWS instant disconnect; KEA 130 encoding altimeter; dual KI 209A VOR/LOC/GS/GPS indicators; KI 256 ADI; KI 525A HSI; KCS 55 compass, all standard. Options include GNS 530 (exchange for GNS 430); Goodrich WX500 Stormscope; Goodrich Skywatch; Bendix/King KRA 10A radar altimeter; KR 87 digital ADF; KN-62A DME; KI 229 RMI, all standard.

Instrumentation: ASI; VSI; electric turn-and-bank indicator; Vision Microsystems LCD graphic/digital monitoring system; magnetic compass; DVR 300I digital voice recorder/clock; gyro pressure gauge; annunciator panel; engine hours meter, all standard. Optional duplicated co-pilot's instruments comprise sensitive altimeter, ASI, vacuum turn-and-bank indicator, VSI and electric or vacuum attitude gyro indicator.

Mission: Observer 2 can carry FLIR, ATAL video surveillance pod with data downlink and SLAR. Aerial cameras, thermal imager and video camera can be operated through floor hatch.

EQUIPMENT: Standard equipment includes heated pitot and stall warning systems, 24 V 2 A auxiliary power socket, pilot and co-pilot storm windows, polished wing-mounted taxi and landing lights, wingtip recognition and strobe lights, ice inspection light on port wing, tail recognition and strobe lights, tiedown rings and control surface locks. Leather seats and tinted windows optional.

DIMENSIONS, EXTERNAL (C: P.68C, D: P.68C Jet and P.68 Observer Jet, TC: P.68C-TC, O: P.68 Observer 2, TCO: P.68 Observer TC):

Wing span	12.00 m (39 ft 4½ in)
Wing chord, constant	1.55 m (5 ft 1 in)
Wing aspect ratio	7.7
Length overall: C, D, TC	9.55 m (31 ft 4 in)
O, TCO	9.43 m (30 ft 11¼ in)
Height overall	3.40 m (11 ft 1¾ in)
Tailplane span	3.90 m (12 ft 9½ in)
Wheel track	2.40 m (7 ft 10½ in)
Wheelbase	3.65 m (11 ft 11¾ in)
Propeller diameter: all versions	1.83 m (6 ft 0 in)
Propeller ground clearance	0.77 m (2 ft 6¼ in)
Passenger doors (C, TC):	
Each Side: max width	0.54 m (1 ft 9¼ in)
Port, centre: max width	0.82 m (2 ft 8¼ in)
Baggage door, stbd, aft:	
Max height	0.83 m (2 ft 8¾ in)
Max width	0.80 m (2 ft 7½ in)

DIMENSIONS, INTERNAL:

Cabin: Length	4.05 m (13 ft 3½ in)
Max width	1.16 m (3 ft 9½ in)
Max height	1.20 m (3 ft 11¼ in)
Baggage compartment volume	0.56 m³ (19.8 cu ft)

AREAS:

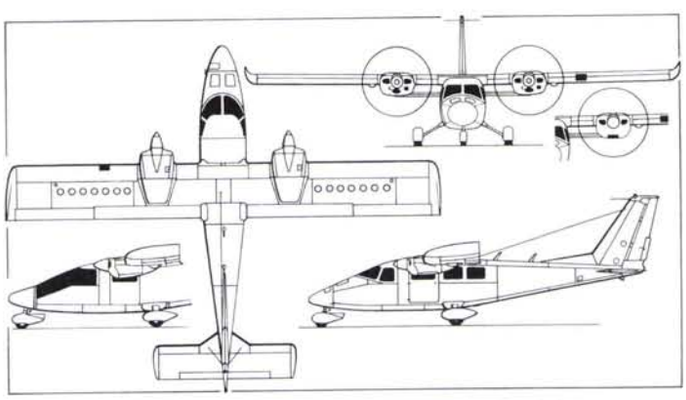
Wings, gross	18.60 m² (200.2 sq ft)
Ailerons (total)	1.79 m² (19.27 sq ft)
Trailing-edge flaps (total)	2.37 m² (25.51 sq ft)
Fin	1.59 m² (17.11 sq ft)
Rudder, incl tab	0.44 m² (4.74 sq ft)
Tailplane, incl tab	4.41 m² (47.47 sq ft)

WEIGHTS AND LOADINGS:

Weight empty equipped: C, O	1,320 kg (2,910 lb)
TC, D, TCO	1,350 kg (2,976 lb)
Baggage capacity	181 kg (400 lb)
Max T-O weight	2,084 kg (4,594 lb)
Max ramp weight	2,100 kg (4,630 lb)
Max landing weight	1,980 kg (4,365 lb)
Max zero-fuel weight	1,890 kg (4,167 lb)
Max wing loading	112.0 kg/m² (22.94 lb/sq ft)
Max power loading	6.99 kg/kW (11.49 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE):	
C, TC	193 kt (358 km/h; 222 mph)
O	194 kt (359 km/h; 223 mph)
Max level speed:	
D at S/L	159 kt (295 km/h; 183 mph)
C, O, TC at S/L	173 kt (320 km/h; 199 mph)
TCO at S/L	174 kt (322 km/h; 200 mph)
Max cruising speed at 75% power:	
D at FL100	170 kt (315 km/h; 196 mph)
C, O at FL75	165 kt (306 km/h; 190 mph)
TC at FL120	170 kt (315 km/h; 196 mph)
TCO	165 kt (306 km/h; 190 mph)
Stalling speed, power off:	
flaps up	68 kt (126 km/h; 79 mph)



VulcanAir P.68C, with scrap view of Observer 2 nose and P.68C Jet engine cowling *(Mike Keep)*

0580553

Prototype P.68C Jet on display at Paris in June 2005 *(Paul Jackson)*

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flaps down: O	57 kt (106 km/h; 66 mph)
TC	61 kt (113 km/h; 71 mph)
C, TCO	62 kt (115 km/h; 72 mph)
Max rate of climb at S/L: C, O	378 m (1,240 ft)/min
D	457 m (1,500 ft)/min
TC	465 m (1,525 ft)/min
TCO	427 m (1,400 ft)/min
D	530 m (1,740 ft)/min
Rate of climb, OEI: C, O	64 m (210 ft)/min
TCO	73 m (240 ft)/min
TC	88 m (290 ft)/min
D	134 m (440 ft)/min
Service ceiling: C	6,020 m (19,750 ft)
O	6,000 m (19,685 ft)
D, TC, TCO	6,100 m (20,000 ft)
Service ceiling, OEI: C, O	1,753 m (5,750 ft)
TC	4,420 m (14,500 ft)
TCO	3,505 m (11,500 ft)
D	3,660 m (12,000 ft)
T-O run: C, O	240 m (790 ft)
TC, TCO	230 m (755 ft)
T-O to 15 m (50 ft): C, O	400 m (1,312 ft)
TC	384 m (1,260 ft)
TCO	415 m (1,362 ft)
Landing from 15 m (50 ft): C, O	600 m (1,970 ft)
TC	500 m (1,640 ft)
TCO	485 m (1,591 ft)
Landing run: all	200 m (656 ft)
Range with max payload:	
TC	300 n miles (556 km; 345 miles)
O with auxiliary fuel	590 n miles (1,093 km; 679 miles)
Range with max fuel, best economy power:	
D at FL70	1,513 n miles (2,802 km; 2,003 miles)
C, O at FL70	1,601 n miles (2,965 km; 1,842 miles)
TCO at FL100	1,376 n miles (2,550 km; 1,584 miles)
TC at FL100	1,104 n miles (2,046 km; 1,271 miles)
Endurance with max fuel:, C, TC, O	11 h
D	12 h 18 min
g limits: C, O	+3.74/−1.50
TC, TCO	+3.80/−1.52

VULCANAIR VF 600w MISSION

TYPE: Light utility turboprop.

PROGRAMME: Launched (as WF 600w) 1999; construction of first prototype began May 2001, at which time first flight planned for following September, but not achieved until 30 January 2003 (following roll-out on 31 May 2002 and first 'hop' on 4 December 2002); public debut (I-VAVF) at Paris Air Show 14 June 2003. Total of 88 flight hours recorded by June 2004, when the aircraft was grounded for modifications including a forward crew door and an aft passenger door on the starboard side, and an enlarged cargo door on the port side. Second prototype and one static test airframe then under construction, with maiden flight of second prototype scheduled for October 2004, and EASA certification expected in March 2005, followed by FAA approval about two months later.

Company subsequently announced indeterminate delay; by mid-2006, second aircraft had not flown, although promotion was continuing.

CUSTOMERS: Aimed at cargo/feeder market, law enforcement/security agencies, medevac surveillance, paratrooping and military logistics support. Order book scheduled to open in February 2005.

COSTS: Unit cost approximately US$1.2 million (2004). Estimated direct operating cost, based on utilisation of 1,000 hours per year, US$354.32 (2004).

DESIGN FEATURES: Single-engined derivative of Canguro. Nose-mounted engine; longer-span wings with new (modified NACA 63A3.515) aerofoil section; modified landing gear.

Following details summarise main differences from SF.600A.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring cantilever mainwheel legs; single mainwheels, with size 8.50–10 tyres, pressure 3.79 bar (55 lb/sq in); nosewheel tyre 6.50–8, pressure 5.17 bar (75 lb/sq in). Cleveland mainwheel disc brakes. Seaplane version being studied.

POWER PLANT: One 580 kW (778 shp) Walter M 601F-11 turboprop, driving an Avia V 510 five-blade constant-speed feathering and reversing metal propeller. Optional Pratt & Whitney Canada PT6A turboprop installation. Alternative power plants may be offered according to market requirements. Fuel capacity (two wing tanks plus reservoir) 1,338 litres (353 US gallons; 294 Imp gallons), of which 1,300 litres (343 US gallons; 286 Imp gallons) are usable.

ACCOMMODATION: Pilot and up to 10 passengers, or up to 15 passengers where local certification criteria permit. In cargo configuration the cabin can accommodate up to three standard Euro pallets. Quick-change cargo loading system with roller tracks, ball plates and latches optional. Pilot's door on port side; cargo/passenger sliding door on port side.

AVIONICS: Bendix/King avionics suite standard, three-tube EFIS optional.

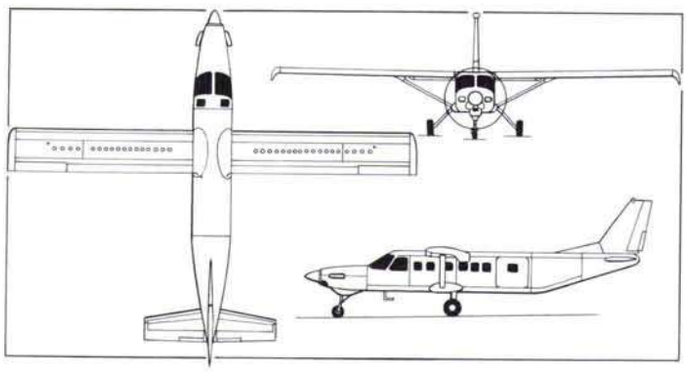
Comms: Bendix/King COM/NAV/GS/GPS, audio panel with marker beacon receiver and intercom, transponder, ELT 910.

Radar: INI 82A colour radar indicator.

Flight: KI 256 ADI, KI 229 RMI, KI 525A HSI, KN 62A DME, KR 87 ADF, KC 192 flight computer, KEA 130 encoding altimeter, VOR/LOC/GS indicator.

Instrumentation: Moritz engine instruments and annunciator panel, ASI, electric artificial horizon, sensitive altimeter, gyro pressure gauge with source indicator, rate of climb indicator, turn-and-bank indicator, flap position indicator, digital voice record clock.

VulcanAir VF 600w Mission light utility turboprop *(Paul Jackson)* 0576506



VulcanAir VF 600w Mission general arrangement *(James Goulding)* 0587526

DIMENSIONS, EXTERNAL:	
Wing span	15.30 m (50 ft 2½ in)
Length overall	13.12 m (43 ft 0½ in)
Height overall	4.55 m (14 ft 11¼ in)
Tailplane span	5.00 m (16 ft 4¾ in)
Wheel track	3.50 m (11 ft 5¾ in)
Passenger door: Height	1.10 m (3 ft 7¼ in)
Width	0.60 m (1 ft 11½ in)
Cargo door: Height	1.40 m (4 ft 7 in)
Width	1.10 m (3 ft 7¼ in)
Service door: Height	1.40 m (4 ft 7 in)
Width	0.80 m (2 ft 7½ in)
DIMENSIONS, INTERNAL:	
Cabin:	
Length, excl flight deck	5.08 m (16 ft 8 in)
Max width	1.23 m (4 ft 0¼ in)
Max height	1.17 m (3 ft 10 in)
Volume	7.3 m³ (258 cu ft)
Baggage compartment:	
Length	0.41 m (1 ft 4 in)
Max width	1.23 m (4 ft 0¼ in)
Max height	1.17 m (3 ft 10 in)
Volume	0.59 m³ (20.84 cu ft)
AREAS:	
Wings, gross	24.80 m² (266.9 sq ft)
WEIGHTS AND LOADINGS:	
Weight empty: passenger	2,000 kg (4,409 lb)
freighter	1,950 kg (4,299 lb)
Max payload	1,600 kg (3,527 lb)
Max fuel weight	1,040 kg (2,293 lb)
Max T-O weight	3,925 kg (8,653 lb)
Max ramp weight	3,946 kg (8,699 lb)
Max landing weight	3,720 kg (8,201 lb)
Max zero-fuel weight	3,600 kg (7,937 lb)
Max wing loading	158.27 kg/m² (32.42 lb/sq ft)
Max power loading	6.77 kg/kW (11.12 lb/shp)
PERFORMANCE:	
Max level speed	190 kt (352 km/h; 219 mph)
Max cruising speed:	
at FL100	183 kt (339 km/h; 211 mph)
at FL200	166 kt (307 km/h; 191 mph)
Stalling speed, flaps down	61 kt (113 km/h; 71 mph)
Max rate of climb at S/L	274 m (900 ft)/min
Service ceiling	6,095 m (20,000 ft)
T-O run	433 m (1,420 ft)
FAA balanced field T-O length	616 m (2,020 ft)
FAA balanced field landing length	519 m (1,700 ft)
Landing run	244 m (800 ft)
Max range at FL200	1,190 n miles (2,204 km; 1,369 miles)
Endurance at FL200	6 h 48 min
g limits	+3.5/−1.4

VULCANAIR VA 300

TYPE: Light utility twin-prop transport.

PROGRAMME: Announced at Paris, June 1999, as a concept based on the VulcanAir AP.68TP Viator. Diesel engine test-flown on a tri-motor-configured P.68C in March 2001 and Phase 1 of the certification process has been completed; flying with the diesel engines running was due to start in late 2001, but the programme was delayed pending delivery of engines and certification target date put back to 2005. By 2006, however, the VA 300 was no longer being promoted.

Retouched image, showing projected VulcanAir VA 300 0085593

Japan

FUJI

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Established 15 July 1953 as successor to Nakajima. Utsunomiya headquarters occupies 47.7 ha (117.9 acre) site, including 153,000 m² (1,646,880 sq ft) floor area; workforce 2,745 in April 2000. On 20 April 2006, Fuji announced completion of two new plants at Handa, one to manufacture aircraft composites material parts and the other to assemble wing centre-section boxes for its participation in the Boeing 777/787 and Kawasaki C-X/P-X programmes.

Fuji producing Bell UH-1J (see *Jane's Aircraft Upgrades*); delivered last of 89 AH-1S attack helicopters (serial No. 73492) to JGSDF on 14 December 2000; now producing T-7 trainer and is prime contractor for JGSDF AH-64D; manufactured wings, tailplanes and canopies for Kawasaki T-4; produces tail units and canopies for Kawasaki OH-1; wings and tail units for Mitsubishi F-2; outer wings, nacelles and tail unit for ShinMaywa US-1A/US-2. Responsible for wings and tailfins of Kawasaki C-X and P-X. Is also pursuing concept studies for very light jet, tentatively named **Subaru Jet**, to materialise "within 10 years".

Commercial aircraft components produced are elevators for Boeing 737; spoilers, inboard and outboard ailerons for Boeing 747; outboard flaps for Boeing 757; wing/body fairings and main landing gear doors for Boeing 767 and 777, plus front centre wing box for 777, with 787 centre wing to follow; and complete wing sets for the Hawker Horizon business jet (which see). Company was selected in May 2000 as risk-sharing subcontractor to produce composites fuselages for Bell/Agusta BA609 tiltrotor; named in June 2002 as vertical tail leading/trailing-edge source for Airbus A380; agreement in October 2003 with Eclipse Aviation to manufacture entire wing assembly for Eclipse 500, this beginning in March 2006. Other products include BQM-34AJKai (modified Firebee) and J/AQM-1 target drones and RPH-2 and FFOS unmanned helicopters (see *Jane's Unmanned Aerial Vehicles and Targets*).

Fuji has participated in such projects as design of the HOPE-X space shuttle and development of an NAL aero-spaceplane. Research continues towards an SST/HST (supersonic/hypersonic transport), including a thermal protection system, heat-resistant structures and composites materials.

FUJI T-7

TYPE: Basic turboprop trainer.

PROGRAMME: Modification (Fuji designation KM-2D) of JASDF piston-engined T-3, which it is intended to replace on an approximately one-for-one basis. Selected by JDA (in preference to Pilatus PC-7 Mk IIM) in third quarter 1998 to meet T-7 requirement; two prototypes included in FY99 budget request, but in late 1998 procurement deferred for one year. JDA reopened competition in August 1999, with bids in third quarter 2000; T-3Kai selected as basis for T-7, September 2000; first 11 T-7s approved in FY01 budget. A T-3Kai prototype was test flown and awarded JCAB type certificate. First two production aircraft (26-5901 and 26-5902; first flight July 2002) delivered to Air Development & Test Wing at Gifu in September 2002 and to training unit 12 Hikotai Kyokudan at Hofu in April 2003; nine delivered by end of 2003, including seven in that year.

CUSTOMERS: JASDF requirement for 47 T-7s; 11 funded in FY01 defence budget; further 10 in FY02, nine in FY03 and 11 in FY04; three in FY05; three in FY06. Equip 11th and 12th Flying Training Wings at Shizuhama and Hofu respectively. At least 32 delivered by end of 2005 (two in 2002; seven in 2003; 13 in 2004; and balance in 2005).

DESIGN FEATURES: Modifications to engine cowling, wings and tail unit (last-named swept) compared with T-3.

Wing section NACA 23016.5 at root, NACA 23012 at tip; dihedral 6° from roots; sweepback 0° at quarter-chord.

FLYING CONTROLS: Conventional and manual. Plain ailerons, each with balance tab (port tab controllable for trim); controllable tab in each elevator; anti-balance tab in rudder. Single-slotted flaps.

STRUCTURE: Two-spar all-metal wing; all-metal semi-monocoque fuselage.

LANDING GEAR: Electrically retractable tricycle type (nosewheel rearward, mainwheels inward).

POWER PLANT: One 336 kW (450 shp) Rolls-Royce 250-B17F turboprop; three-blade propeller. Two bladder-type fuel tanks in each wing, combined capacity 375 litres (99.0 US gallons; 82.4 Imp gallons).

ACCOMMODATION: Crew of two in tandem. Dual controls standard.

SYSTEMS: Include vapour cycle air conditioning system.

Fuji T-7 basic turboprop trainer of JASDF *(Matsuhiro Kadota)* 1158166

AVIONICS: Include VHF, UHF, ATC transponder, ICS and Tacan.

DIMENSIONS, EXTERNAL:

Wing span	10.04 m (32 ft 11¼ in)
Wing aspect ratio	6.1
Length overall	8.59 m (28 ft 2¼ in)
Height overall	2.96 m (9 ft 8½ in)
Tailplane span	3.71 m (12 ft 2 in)
Propeller diameter	2.12 m (6 ft 11½ in)

AREAS:

Wings, gross	16.50 m² (177.6 sq ft)
Fin	1.28 m² (13.78 sq ft)
Rudder, incl tab	0.66 m² (7.10 sq ft)
Tailplane	2.07 m² (22.28 sq ft)
Elevators (total, incl tabs)	1.39 m² (14.96 sq ft)

WEIGHTS AND LOADINGS:

Max T-O weight	1,585 kg (3,494 lb)
Max wing loading	96.1 kg/m² (19.67 lb/sq ft)
Max power loading	4.73 kg/kW (7.76 lb/shp)

PERFORMANCE:

Max level speed	203 kt (376 km/h; 233 mph)
Econ cruising speed at 915 m (3,000 ft)	161 kt (298 km/h; 185 mph)
Stalling speed, flaps and gear down	56 kt (104 km/h; 65 mph)
Service ceiling	7,620 m (25,000 ft)
T-O to 15 m (50 ft) at S/L	608 m (1,995 ft)
Landing from 15 m (50 ft) at S/L	566 m (1,860 ft)

FUJI (BOEING) AH-64DJP

TYPE: Attack helicopter.

PROGRAMME: To replace existing JGSDF fleet of 80-plus AH-1Ss; original AH-X requirement said to be for up to 100, and government approval to acquire first 10 of selected design announced on 15 December 2000; these to be delivered by March 2006. RFP, issued 27 March 2001, resulted in submissions from Fuji/Boeing (AH-64D) and Mitsubishi/Bell (AH-1Z Viper), selection of former being announced on 27 August 2001. Selection of initially more expensive AH-64D said to be justified on grounds of better 20-year life-cycle costs, enabling smaller total number of aircraft to be procured; requirement accordingly now expected to be fulfilled by between 50 and 60 aircraft, of which only a proportion (possibly no more than one-third) to have Longbow radar.

Initial batch (possibly all of first 10) to be US-built, with Fuji as prime contractor for remainder; funding for first two included in FY02 budget allocations, followed by two more in each of FYs 03, 04 and 05; one in FY06; one in FY07. First Boeing built AH-64DJP (provisional designation) completed late 2004 with DoD serial 02-0004 and US civil registration N3216N; handed over (in US) 15 December 2005, delivered by Fuji to JDA 15 March 2006, having made maiden flight in Japan on 25 January 2006, newly serialled 74501.

POWER PLANT: General Electric T700-GE-701C turboshafts confirmed.

SYSTEMS: Kanto (Smiths licence) electrical power generating system.

AVIONICS: Customer-specified, including new digital nav/com and datalinks.

ARMAMENT: Raytheon AIM-92 Stinger AAMs.

First Fuji (Boeing) AH-64DJP conducting its maiden flight in Japan *(Subaru)* 1158251

GEN

GEN CORPORATION

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Mr Yanagisawa, whose nickname is 'Gen', developed a small, but comparatively high-powered, horizontally opposed two-cylinder engine while working for the Zenoa company. By 1985, this had been tested in a hang-glider, para-glider and model aircraft, but failed to find a market. Tests of a coaxial rotor RPV in 1987 were unsuccessful because of control problems, while a manned twin-engined design in 1992 failed to produce sufficient lift. By 1994, however, this had evolved into the BDH-1 (Boy's Dream Helicopter 1), exhibited at that year's Japan Aerospace Show. A three-engined BDH-2 followed in 1996 and was further modified as the BDH-3 which, although successful, was unable to sustain height with one engine inoperative.

Development and promotion handled initially by the designer's diverse manufacturing company, Gen Yanagisawa Engineering System, but in 2004 the Gen Corporation was established specifically for this purpose. The BDH-4 was shown at AirVenture, Oshkosh, USA, in 1997 and continues to be refined. The assistance of a US agent was enlisted to collaborate on H-4 trials, such as ballistic parachutes and high-speed cruising, which are prohibited by Japanese air law. Numerous successful demonstration flights had been made in Japan by early 2006, including an appearance at the Japan Aerospace 2004 show in Yokohama. The remote control system has been further developed since 2002 and a UAV version is planned.

GEN H-4

TYPE: Exoskelitor flying vehicle.

PROGRAMME: Four-engined development of BDH-3; basic version shown at AirVenture, Oshkosh, 1997; yaw control by small, electrically powered, auxiliary propellers; by 1998, yaw accomplished by differentiation of rotor rpm. Two prototypes; current configuration first flew in 1999. Marketed in kit form only. Current Japanese demonstrators, registered JX0076 and JX0077, are production version.

CURRENT VERSIONS: **H-4:** *As described.*

H-4 UAV: Radio-controlled version, first flown 22 March 2002. Development continuing.

CUSTOMERS: Five customer aircraft completed by March 2005.

COSTS: Kit USD35,900 (2006); not available ready-built.

DESIGN FEATURES: 'Strap-on' personal helicopter with contrarotating twin blades of tapered planform and fixed pitch (thus no autorotation capability — replaced by ballistic parachute, if desired). Seat, with fuel tank at rear, supported by triangular tube framework landing gear and footrest. Gimballed platform above occupant's head houses four small motors, central transmission and rotor assembly with gears. Combined hand-grip control column and instrument panel attached to front of platform. Rotor speed 800 to 900 rpm. Quoted build time 40 hours.

FLYING CONTROLS: Two-axis control by tilting of engine/rotor platform; yaw control effected by thumb switch on instrument panel, operating electric motor which differentiates speed of rotors by 1 per cent.

STRUCTURE: Framework of 5 cm (2 in) aluminium tube; glass fibre seat and backpack; rotors of carbon fibre and Kevlar, with foam core.

LANDING GEAR: Four small 'wheels' each comprise multiple rollers in circular arrangement.

POWER PLANT: Four 124 cc (7.56 cu in) Gen 125 two-stroke, horizontally opposed, two-cylinder piston engines with independent ignition, positioned symmetrically on pivoting platform, each developing 7.5 kW (10 hp) at 8,500 rpm. Fuel, of 30:1 petrol and oil premix, in seatback tank, capacity up to maximum of 19 litres (5.0 US gallons; 4.2 Imp gallons).

DIMENSIONS, EXTERNAL:

Rotor diameter (each)	4.00 m (13 ft 1½ in)
Height overall	2.44 m (8 ft 0 in)

AREAS:

Rotor disc (each)	12.57 m² (135.3 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	70 kg (154 lb)
Max T-O weight	220 kg (485 lb)

PERFORMANCE:

Never-exceed speed (VNE)	108 kt (200 km/h; 124 mph)
Cruising speed	43 kt (80 km/h; 50 mph)
Service ceiling	3,000 m (9,840 ft)
Endurance	up to 1 h

Details of Gen H-4 power plant, rotor head and fuel storage *(Matsuhiro Kadota)* 1158256

Gen H-4 being checked for size *(Matsuhiro Kadota)* 1158255

JADC

JAPAN AIRCRAFT DEVELOPMENT CORPORATION

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VICE-CHAIRMAN: Teiichi Nishikawa
SENIOR MANAGING DIRECTOR: Toshinori Nishi
MANAGING DIRECTORS:
Yoichi Sugimura
Atsushi Kaneko
GENERAL MANAGER: Yasutada Sasaki

Known as CTDC (Civil Transport Development Corporation) from 30 March 1973 until 27 December 1982, JADC is a non-profit consortium established by airframe manufacturers Mitsubishi, Kawasaki and Fuji to promote commercial aircraft business; members now also include Nippi and ShinMaywa.

Current development programme is as partner in Boeing 787 Dreamliner; research programmes include high-speed transport studies; next-generation avionics; plus R&D for high-performance and environmental adaptability of small aircraft.

JADC YSX

TYPE: Regional jet airliner.
PROGRAMME: Feasibility studies, continuing in 2006, are intended for market slot between current regional jets and larger, single-aisle jets. JADC responsible for establishing configuration and structural parameters. Possibility of linking YSX with developing military aircraft such as Kawasaki P-X and C-X programme.

KAC

KANEMATSU AEROSPACE CORPORATION

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e-mail: pr@kanematsu.co.jp
Web: www.kanematsu.co.jp
CHAIRMAN: Tadashi Kurachi
PRESIDENT AND CEO: Yoshihiro Miwa
SALES DIVISION MANAGER: Akiro Ohdoi
PUBLIC RELATIONS: Kazumasa Sato

The Aerospace Department of Kanematsu's IT Division (workforce 879 at 31 March 2005) is prime contractor for outfitting Hawker 800s to JASDF specifications. Fuji is systems integrator and responsible for U-125/U-125A maintenance. Kanematsu is also Japanese distributor for Embraer ERJ-145.

KANEMATSU (HAWKER) 800

JASDF designations: U-125 and U-125A

TYPE: Multirole twin-jet.
PROGRAMME: Hawker 800 (which see) selected under JASDF H-X programme to replace Mitsubishi MU-2J and MU-2E in navaid calibration and SAR roles respectively; first U-125 delivered to JASDF 18 December 1992 and first U-125A (52-3001) delivered on 11 December 1994; three U-125As delivered by 31 January 1995 in preparation for formal handover. First six U-125As assembled in UK; seventh aircraft (from Wichita production line) delivered to Kanematsu November 1997; 21st arrived in Japan in January 2003 for fitting out; 22nd in December 2003; and 23rd in August 2005.
CURRENT VERSIONS: **U-125:** For navaid flight check role, replacing MU-2J; operated by Flight Check Group at Iruma. Three ordered; all delivered from UK production.

U-125A: Search and rescue version, replacing MU-2E; 360° search radar, FLIR, airdroppable marker flares, liferaft and rescue equipment. Operated by detachments of the Air Rescue Wing at Chitose, Hyakuri, Komatsu and Naha, initially going to its Training Squadron at Komaki.

CUSTOMERS: JASDF (three U-125 and 24 U-125A ordered by FY04; one approved in FY05; one in FY06; one in FY07. Options for total of 27 U-125As. Kanematsu received No. 24 for outfitting in May 2006.
COSTS: JPY3.85 billion (2000).
DESIGN FEATURES: U-125A has deep observation 'patio' window each side of fuselage immediately ahead of wing, and dinghy/rescue pack dropping system via pressure door built into lower fuselage which is exposed for operation when landing gear is deployed.
AVIONICS (U-125A): *Radar:* Toshiba-built Raytheon APQ-2 360° search radar (seven ordered November 2005 in USD8.6 million contract).
Mission: Mitsubishi Electric IR imager in retractable underfuselage turret.
EQUIPMENT (U-125A): Flare and marker buoy dispenser; liferaft.

Kanematsu (Hawker) U-125A SAR twin-jet *(Matsuhiro Kadota)* 1158167

U-125/A PROCUREMENT AND DELIVERY(JASDF)
(at 1 January 2007)

Ordered			Delivered		
FY	U-125	U-125A	CY	First Acft	Qty
90	1		92	29-3041	1
91	1		93	39-3042	1
92	1		94	49-3043	1
92		3	95	52-3001	3
93		1	96	62-3004	1
94		1	97	72-3005	2
95		2	98	82-3007	3
96		3	99	92-3010	3
97		4	00	02-3013	3
98		3	01	12-3016	3
99		2	02	22-3019	2
00		2	03	32-3021	1
01		1	04	42-3022	1
02			05	52-3023	1
03		1			
04		1			
05		1			
06		1			
07		1			
Totals	**3**	**27**			**30**

KAWASAKI

KAWASAKI JUKOGYO KABUSHIKI KAISHA (KAWASAKI HEAVY INDUSTRIES LTD)

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PRESIDENT: Chikashi Motoyama
MANAGING DIRECTOR AND PRESIDENT OF AEROSPACE COMPANY: Takashi Sugoh
MANAGING DIRECTOR AND PRESIDENT OF GAS TURBINE & MACHINERY GROUP:
Takashi Yoshino
SENIOR STAFF OFFICER, MARKETING AND SALES: Shojiro Ootake
WORKS: Gifu, Nagoya 1 and 2 (Aerospace Group); Akashi and Seishin (Gas Turbine & Machinery Group)

Company originated 1923 at Gifu when opened as Kakamigahara subplant for aircraft division of Kawasaki Dockyards. Present Gifu facility is on 71.2 ha (176 acre) site with 291,000 m² (3.13 million sq ft) covered area. Nagoya 1 Works, opened December 1992, has site and covered areas of 7.1 ha (17.5 acres) and 10,000 m² (107,650 sq ft) respectively; corresponding figures for Nagoya 2 (opened 1979) are 1.8 ha (4.4 acres) and 6,000 m² (64,600 sq ft).

Kawasaki Aircraft Company has built many US aircraft under licence since 1955; amalgamated with Kawasaki Dockyard Company and Kawasaki Rolling Stock Manufacturing Company to form Kawasaki Heavy Industries Ltd 1 April 1969; Aerospace Group employs some 3,200 people; Gas Turbine & Machinery Group has some 800 aerospace-related employees. Kawasaki acquired 25 per cent holding in Nippi in 1970; increased to 100 per cent with effect from 1 April 2003.

Kawasaki is prime contractor for OH-1 observation helicopter; now also leading development of C-X/P-X transport/maritime patroller programme; co-developer and co-producer, with Eurocopter, of BK 117/EC 145 helicopter; those EC 145s produced in Japan continue to be marketed as the BK 117C-2. Is prime contractor for Japanese licensed production of CH-47 Chinooks for JGSDF and JASDF; was prime contractor for P-3C variants for JMSDF and T-4 for JASDF (now completed); also built MD Helicopters MD 500 under licence. Selected on 5 June 2003 as prime contractor for EH101 helicopters ordered by Japan, first of which handed over to JMSDF 3 March 2006.

Subcontract work includes centre fuselage for Mitsubishi F-2; currently producing forward and centre-fuselage barrel sections and wing ribs for Boeing 767 and 777, plus rear centre

wing box and rear pressure bulkhead for 777; now also to produce forward fuselage, fixed portion of wing trailing edge and main landing gear wheel wells of Boeing 787, for which new plant at Nagoya 1 opened in 2006. Delivery of blended winglets for retrofit of early-model Boeing 737s (–300/400/500) began in October 2002. Acquisition of Nippi brought in additional component work for Boeing 747 (fuselage frames) and 777 (wing in-spar ribs and nosewheel doors); Mitsubishi F-2 (wing pylons); and ShinMaywa US-2 (main landing gear fairing). Kawasaki also responsible for design and sole-source manufacture of transmission for MD Helicopters Explorer; in 1999 signed agreement with Aerostructures of USA to manufacture cabin doors and tailcones for Bell/Agusta BA609. Risk-sharing partner on Embraer 170/175 and 190/195, for which wing components of former produced by Kawasaki from April 2001. Kawasaki Aeronáutica do Brasil established April 2002 and new Neiva-built facility at Gavião Peixoto, 300 km (186 miles) north-west of São José dos Campos, inaugurated 24 April 2003; first set of wings for 190/195 shipped to Embraer 10 October 2003. Nominated as prime contractor for maintenance and support of JASDF E-2C Hawkeyes, E-767 AWACS and C-130 Hercules.

Kawasaki also extensively involved in satellites and launch vehicles; is member of International Aero Engines consortium and produces T53 and T55 engines under licence (see *Jane's Aero-Engines*); overhauls engines; and builds hangars, docks, passenger bridges and other airport equipment.

KAWASAKI C-X and P-X

TYPE: Medium transport/multirole (C-X); maritime reconnaissance four-jet (P-X).

PROGRAMME: Initial development funding of JPY5.3 billion in FY01; RFP issued in May 2001. Foreign proposals for C-X included Airbus A310, Boeing C-17 and Lockheed Martin C-130J, but Kawasaki selected by JDA on 27 November 2001 to lead development of an indigenous design to meet both C-X and P-X requirements, with optimum degree of structural commonality; Fuji and Mitsubishi involved in programme, which could also lead to a 100- to 150-seat civil transport version for production post-2010, although C-X civilian freighter was being promoted by 2006, involving minimal change from military variant. Two-year design phase begun in 2003, with prototype/preproduction development following from 2005 (JPY64 billion (USD589 million) contract March of that year). First flights targeted for 2007; engineering and operational testing until 2009 for P-X, 2010 for C-X; service entry 2011 and 2012 respectively. Wooden mockups of each aircraft displayed at Gifu in late 2004. C-X static test airframe (01) handed over to TRDI at Gifu on 16 March 2006, having been transferred from Kawasaki's local plant in December 2005 and subsequently assembled. P-X 01 static test frame to follow, while C-X 1 and P-X 1 flying prototypes under construction by early 2006; former targeted for completion in March 2007 and maiden flight in mid-year; P-X 1 approximately six months later.

CURRENT VERSIONS: **C-X:** To fulfil long-standing JASDF requirement to replace current Kawasaki C-1A fleet with a transport of increased range and payload capacity. Features include a twin-turbofan power plant and a payload approximately double that of the Lockheed Martin C-130; earlier need for secondary aerial tanker capability no longer applicable, but envisaged also as commercial airlifter for oversize cargo. According to JDA's Technical Research and Development Institute (TRDI) in late 2000, design parameters include high-mounted wing, rear-loading ramp/door, digital AFCS and 'glass cockpit' avionics; outer wing and flight deck to be common with those of JMSDF's P-X. Engine RFP issued by TRDI 16 December 2002; General Electric CF6-80C2 selected 12 August 2003, in preference to PW4000 and R-R Trent 500.

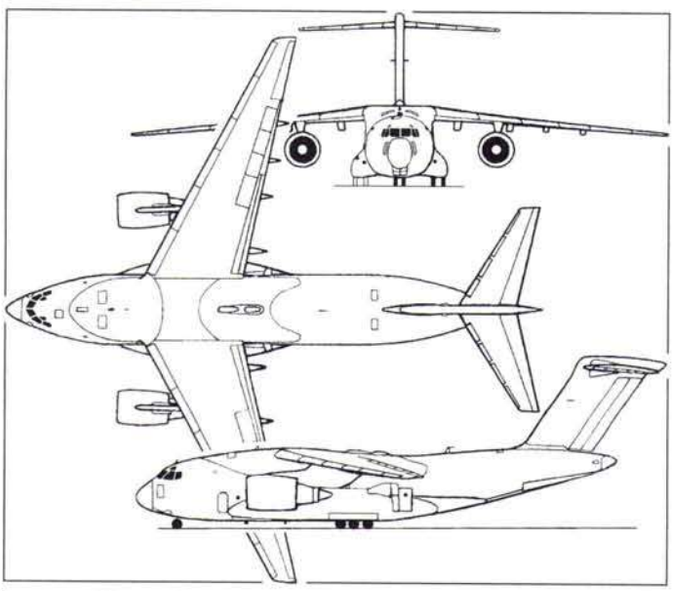
P-X: Patrol version for JMSDF. Outer wing and flight deck as for C-X, but different fuselage cross-section; wing to be low-mounted, carrying four (lower-powered) engines instead of two; low-set (instead of T) horizontal tail; AFCS to be fly-by-light as protection against electromagnetic interference (EMI). TRDI and IHI developing XF7-10 engine, further seven of which ordered April 2005, increasing total to 12. Under flight test in late 2005, in starboard outer position on Kawasaki C-1 testbed. P-X static test fuselage handed over to Japan Defence Agency (at TRDI, Tachikawa) on 13 October 2006. Envisaged also as basis for possible 110/130-seat commercial airliner.

C-X (left) and P-X static test airframes under construction in late 2005

1158252

P-X (nearest) and C-X mockups

1158254



Kawasaki C-X general arrangement *(Paul Jackson)*

1158503

CUSTOMERS: At least 44 C-Xs required by JASDF, to replace C-1As and C-130Hs; JMSDF needs about 80 P-Xs to replace Kawasaki (Lockheed Martin) P-3C fleet. Eight C-X and four P-X envisaged in current five-year plan.

COSTS: JPY80 billion allocated to programme in FY03; further JPY86 billion (USD800 million) earmarked for FY04; JPY78.3 billion requested for FY05. Overall development costs estimated in 2004 at JPY340 billion for aircraft and JPY20 billion for XF7-10 engine.

Following details are provisional:

POWER PLANT: *C-X:* Two 222 to 267 kN (50,000 to 60,000 lb st) class General Electric CF6-80C2L1F turbofans; Goodrich nacelles.

P-X: Four 53.4 kN (12,000 lb st) class IHI XF7-10 turbofans.

LANDING GEAR: Six-wheel main bogies (three tandem pairs), retracting into fuselage-side fairings; forward-retracting twin nosewheels.

ACCOMMODATION: Two-crew flight deck, with option for third member. Rear-loading ramp and retractable floor rollers on C-X.

SYSTEMS: Honeywell APU, ram air turbine and environmental control system.

Cutaway drawings of Kawasaki C-X (left) and P-X

1162252

AVIONICS: In process of selection; include triple-redundant fly by wire FCS, fully integrated FMS, HUDs and onboard maintenance system. CAE AN/ASQ-508(V) MAD chosen for P-X in February 2004; some others by Honeywell.

EQUIPMENT: Honeywell sonobuoy dispensers for P-X. Cargo handling and parachute extraction system for C-X by AAR Cargo Systems and ShinMaywa.

DIMENSIONS, EXTERNAL:

Wing span: P-X	35 m (114.8 ft)
C-X	44.4 m (145.7 ft)
Length overall: P-X	38 m (124.7 ft)
C-X	43.9 m (144.0 ft)
Ramp length: C-X	5.5 m (18 ft)
Height overall: P-X	12 m (39.4 ft)
C-X	14.2 m (46.6 ft)

DIMENSIONS, INTERNAL:

Cargo hold (C-X):	
Length	16 m (52.5 ft)
Max width	4 m (13.1 ft)
Max height	4 m (13.1 ft)
Ramp length: C-X	5.5 m (18 ft)

WEIGHTS AND LOADINGS:

Operating weight empty: C-X	60,800 kg (134,040 lb)
Max payload: C-X	37,600 kg (82,894 lb)
Basic T-O weight:	
P-X	80,000 kg (176,370 lb)
C-X	141,100 kg (311,072 lb)

PERFORMANCE (design):

Cruising speed:	
C-X at FL400	M0.8
P-X at FL300	450 kt (833 km/h; 518 mph)
Max operating altitude: C-X	12,200 m (40,000 ft)
T-O field length: C-X	2,300 m (7,545 ft)
Landing field length: C-X	2,400 m (7,875 ft)
Range:	
C-X with max payload	3,023 n miles (5,600 km; 3,479 miles)
C-X with 12,000 kg (26,455 lb) payload	4,805 n miles (8,900 km; 5,530 miles)
C-X (self-ferry)	5,399 n miles (10,000 km; 6,213 miles)
P-X	4,300 n miles (7,963 km; 4,948 miles)

KAWASAKI OH-1

TYPE: Armed observation helicopter.

PROGRAMME: Developed to replace OH-6Ds of JGSDF. Japan Defence Agency (JDA) awarded JPY2.7 billion (USD22.5 million) in FY92 to cover basic design phase of helicopter then provisionally designated OH-X; RFPs issued by JDA's Technical Research & Development Institute (TRDI) 17 April 1992; Kawasaki selected as prime contractor (60 per cent of programme) 18 September 1992, with Fuji and Mitsubishi (20 per cent each) as partners; Observation Helicopter Engineering Team (OHCET), formed by these three companies, began preliminary design phase 1 October 1992. Mockup made public 2 September 1994 under Japanese name *Kogata Kansoku* (new small observation [helicopter]).

Programme included six prototypes (four flying, two for ground test); first aircraft (32001) rolled out at Gifu on 15 March 1996 and made first flight 6 August 1996, followed by second prototype on 12 November; OH-1 designation assigned late 1996; first two XOH-1s handed over to JDA on 26 May and 6 June 1997; third flown on 9 January 1997, at which time earlier aircraft had accumulated some 30 and 20 hours, respectively; handed over 24 June 1997; fourth flown on 12 February 1997 and handed over 29 August 1997. Prototypes renumbered by 1999 from 32001-04 to 32601-04.

First three production OH-1s funded FY97 and ordered 1998; first prototype flown with more fuel-efficient TS1-10QT (replacing XTS1-10) engines, 30 March 1998. By early 1999, four prototypes had flown 450 hours and were due to complete further 450 hours by end of 1999, including operational evaluation at Akeno JGSDF base. First production OH-1 (32605) flown July 1999 and handed over to JGSDF at Gifu 24 January 2000.

Name 'Ninja' reportedly given in 2002, but not officially confirmed.

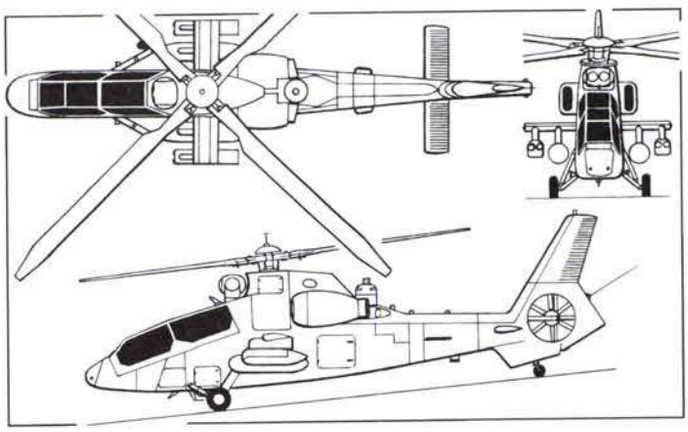
CURRENT VERSIONS: **OH-1:** Basic initial production version; *as described.*

Growth versions: Under study with more powerful engines (possibly LHTEC T800 or R-R/Turbomeca/MTU MTR 390) and uprated gearbox. **OH-1Kai** is possible candidate for AH-X requirement with tentative designation AH-2, armour-plated forward and centre fuselage, upgraded engines and transmission and additional weapons carriage. Utility version reportedly also being considered as possible replacement for Fuji (Bell) UH-1J (UH-X programme).

CUSTOMERS: See table. Total of 26, including prototypes, ordered by FY05; at least 20 delivered by 31 December 2005; two approved for FY06; two for FY07. Japan Ground Self-Defence Force requirement for 150 to 200.

Hiko Jikkentai (Flight Test Squadron) formed at Akeno with first four production aircraft on 27 March 2001; other deliveries by late 2002 included small numbers to Kasumigaura Bunko, Utsunomiya Bunko and Kyoiku Shien Hikotai (at Akeno), all of which are departments of the Army's Koku Gako (Aviation School). 1st Taisensha Herikoputatai (Anti-Tank Helicopter Squadron) at Tokashi began receiving OH-1s to replace OH-6Ds in 2003.

Kawasaki OH-1 armed observation helicopter *(Mitsuhiro Kadota)* 1158168



Kawasaki OH-1 (two Mitsubishi TS1 turboshafts) *(James Goulding)* 1158169

COSTS: Funding for development, prototypes and flight testing JPY2.5 billion in FY92, JPY10.2 billion in FY93, JPY50.1 billion in FY94 and JPY23.3 billion in FY95. Unit costs of first four production lots JPY1.924 billion (FY97), JPY2.018 billion (FY98), JPY2.229 billion (FY99) and JPY2.075 billion (FY00).

DESIGN FEATURES: Kawasaki hingeless, bearingless and 20 mm ballistic-tolerant four-blade elastomeric main rotor and transmission system; Fenestron-type tail rotor with eight unevenly angled 'scissor' blades (35 and 55°); stub-wings for stores carriage. Active vibration damping system.

FLYING CONTROLS: Integrated AFCS and stability control augmentation system (SCAS).

STRUCTURE: Rotor blades and hub manufactured from GFRP composites; centre-fuselage and engines by Mitsubishi, tail unit/canopy/stub-wings/cowling by Fuji, rest by Kawasaki. Some 37 per cent of airframe (by weight) in GFRP/CFRP.

LANDING GEAR: Non-retractable tailwheel type. Provision for wheel/skis on main units.

POWER PLANT: Twin 659 kW (884 shp) FADEC-equipped Mitsubishi TS1-M-10 turboshafts (XTS1-10 originally in prototypes). Possibility of off-the-shelf alternative engines not ruled out. Transmission has 30-minute run-dry capability. Stub-wings can each carry a 235 litre (62.0 US gallon; 52.0 Imp gallon) auxiliary fuel tank.

ACCOMMODATION: Crew of two on tandem armoured seats (pilot in front). Flat-plate cockpit transparencies, upward-opening on starboard side for crew access.

AVIONICS: *Flight:* AFCS with stability augmentation and holding functions; dual HOCAS controls.

KAWASAKI OH-1 PROCUREMENT AND DELIVERY(JGSDF)

PROCUREMENT			DELIVERY			
FY	Qty	Cum total	FY	Qty	First aircraft	Cum total
93	2[1]	2				
95	2[1]	4				
97	3	7	97	4	32601	4
98	2	9				
99	3	12	99	3	32605	7
00	4	16				
01	2	18				
02	2	20				
03	2	22				
04	2	24				
05	2	26				
06	2	28				
07	2	30				

[1] XOH-1 prototypes

Instrumentation: Two Yokogawa Electric large, flat-panel, liquid crystal colour MFDs in each cockpit, linked to a MIL-STD-1553B databus; Shimadzu HUD in front cockpit.

Mission: Kawasaki electrically operated roof-mounted turret combining Fujitsu thermal imager, NEC real-time colour TV camera and NEC laser range-finder/designator; field of regard 110° in azimuth, 40° in elevation.

Self-defence: Spine-mounted IR jammer based on BAE Systems AN/ALQ-144.

ARMAMENT: Four Toshiba Type 91 (modified) lightweight, short-range, IR-guided AAMs on pylons under stub-wings for self-defence.

Following data all provisional:

DIMENSIONS, EXTERNAL:

Main rotor diameter	11.6 m (38 ft 0¾ in)
Main rotor blade chord, constant portion	0.38 m (1 ft 3 in)
Wing span	3.0 m (9 ft 10 in)
Fuselage: Length	12.0 m (39 ft 4½ in)
Max width	1.0 m (3 ft 3¼ in)
Height: to top of rotor head	3.4 m (11 ft 1¾ in)
over tailfin	3.8 m (12 ft 5½ in)
Tailplane span	3.0 m (9 ft 10 in)

AREAS:

Main rotor disc	105.68 m² (1,137.5 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	2,450 kg (5,401 lb)
Max weapons load	132 kg (291 lb)
T-O weight: design	3,550 kg (7,826 lb)
max	4,000 kg (8,818 lb)
Max disc loading	37.9 kg/m² (7.75 lb/sq ft)

PERFORMANCE:

Max level speed	150 kt (277 km/h; 172 mph)
Combat radius	108 n miles (200 km; 124 miles)
Range	297 n miles (550 km; 342 miles)
g limits	+3.5/−1

KAWASAKI (BOEING) CH-47

JASDF/JGSDF designations: CH-47J and CH-47JA

TYPE: Medium lift helicopter.

PROGRAMME: FY84 defence budget approved purchase of three Boeing CH-47s, two for JGSDF and one for JASDF; first two built in USA and delivered second quarter 1986; Nos. 3 to 7 delivered as CKD kits for assembly in Japan; Kawasaki granted manufacturing licence for Japanese services' Chinooks; first CH-47Js delivered late 1986.

CURRENT VERSIONS: **CH-47J:** Generally similar to US CH-47D. Total 34 (from all sources) delivered to JGSDF by 1996, when CH-47JA introduced; procurement continued for JASDF.

CH-47JA: Designation introduced to describe CH-47Js delivered to army aviation from 1996 with nose-mounted weather radar; first (52951) was 35th JGSDF Chinook, 50th Japanese Chinook; total 15 delivered by late 2002. More recent JASDF Chinooks reported as CH-47JA variant.

CUSTOMERS: See table. Total of 85 ordered, of which 76 (including US-built) delivered by end of 2005. One J and one JA approved for FY07. JGSDF had requirement (now exceeded) for 52, of which 53 in service by late 2002. Operated by 1st and 2nd Squadrons of 1st Helicopter Brigade at Kisarazu (CH-47J), 1st Composite Brigade on Okinawa (CH-47JA) and Aviation School at Akeno.

JASDF 24 CH-47J delivered by end of 2005. Operated by Air Rescue Wing flights at Iruma, Kasuga, Misawa and Naha (Okinawa).

KAWASAKI CH-47J/JA PROCUREMENT

FY	JASDF	First aircraft	JGSDF	First aircraft	Cum total
84	1	67-4471	2	52901	3
85	1	77-4472	3	52903	7
86	3	87-4473	4	52906	14
87	2	97-4476	4	52910	20
88	3	07-4478	5	52914	28
89	2	27-4481	5	52919	35
90	2	37-4483	5	52924	42
91	1	47-4485	3	52929	46
92			3	52932	49
93			2[2]	52951	51
94			2[2]	52953	53
95	1	87-4486	2[2]	52955	56
96			2[2]	52957	58
97			2[2]	52959	60
98			1[2]	52961	61
99	2	07-4487	2[2]	52962	65
00	1[2]	37-4489	2[2]	52964	68
01	1[2]	47-4490	1[2]	52966	70
02	2[2]	57-4491	2[2]	52967	74
03	4[2]	57-4493	1[2]		79
04			2[2]		81
05			1[2]		82
06	2[2]		1[2]		85
07	1		1[2]		87
Totals	**29**		**58**		**87**

[1] First seven built in US (two) or assembled from kits
[2] CH-47JA

Kawasaki CH-47J of JASDF *(Miatsuhiro Kadota)* 1158170

COSTS: Unit cost JPY4.5 billion for CH-47J, JPY5.1 billion for CH-47JA (2000).

AVIONICS: *Flight:* GPS in JGSDF aircraft from 1993; Mitsubishi Precision INS.

KAWASAKI (AGUSTAWESTLAND EH101) KHI-01

TYPE: Multirole medium helicopter.

PROGRAMME: Kawasaki selected 5 June 2003 as prime contractor for 14 EH101s to be ordered by Japan: 11 as JMSDF airborne mine countermeasures replacements for Sikorsky Sea Dragons and three as support transports for use in the Antarctic. All have rear loading ramp. Licensed production and support agreement signed 22 September 2003. First aircraft (test flown as G-17-518), ordered in FY03, is UK-built; shipped to Japan mid-June 2005 and handed over to JMSDF 3 March 2006. Delivery of first CKD kit followed in fourth quarter of 2005 and assembly under way by March 2006. Second (ordered in FY04) and subsequent aircraft assembled or manufactured by Kawasaki.

CURRENT VERSIONS: **CH101:** Designation of three aircraft to be configured for Antarctic support missions. First delivery scheduled for second quarter 2007.

MCH101: Airborne mine countermeasures (AMCM) version. Eleven to be so configured, replacing MH-53E Sea Dragon and S-61. First delivery (8651) due 3 March 2007, initially in utility role pending development completion of AMCM equipment (post-2010).

POWER PLANT: RRTM RTM322 turboshafts assembled in Japan by Kawasaki.

CUSTOMERS: JMSDF (requirement for 14); one ordered in FY03 and one in FY04; none in FY05 or FY06.

AVIONICS: *Mission:* EDO Corporation OASIS (Organic Airborne and Service Influence Sweep) mine countermeasures system, integration of which due to begin in 2011.

First (UK-built) KHI-01, delivered to JMSDF in March 2006 1158265

Cutaway of MCH101 mine countermeasures helicopter 1158257

KAWASAKI YPX

TYPE: Regional jet airliner.

PROGRAMME: Japan Aircraft Development Corporation is co-ordinating indigenous designs for a regional jet airliner, with both Kawasaki and Mitsubishi offering competing projects. Kawasaki first showed model of its YPX at Farnborough in July 2006, but has not disclosed further details.

Model of Kawasaki YPX proposed regional airliner *(Paul Jackson)* 1162253

MITSUBISHI

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Main Nagoya facility (previously known as Nagoya Aircraft Works) was divided in 1989 into Aerospace Systems Works and Guidance & Propulsion Systems Works; former has 346,000 m² (3,724,300 sq ft) of floor space on a 67.3 ha (166.3 acre) site and had an April 2006 workforce of 4,061; latter occupies a 140.4 ha (346.9 acre) site with 84,530 m² (909,900 sq ft) of covered space and had a 1,714 workforce in April 2006. Oye plant manufactures aircraft fuselage components, spacecraft parts and other aero-related equipment; Tobishima plant responsible for aircraft fuselage subassembly, plus assembly and check-out of space systems; fuselage subassembly, final assembly, outfitting, flight test and repair undertaken by Komaki South plant.

Mitsubishi developed the MU-2 utility aircraft, MU-300 business jet and F-2 support fighter, and is currently prime contractor for the F-2 and (Sikorsky) SH/UH-60 helicopter series; Mitsubishi also developed MH2000 helicopter and its MG5 turboshaft engine. Studies under way to evaluate potential successors to UH-60J for production start within 2005–2010 time frame. Previously, company was prime contractor for the T-2 supersonic trainer, F-4EJ Phantom II, F-1 close support aircraft and F-15J/DJ for the JASDF, with Fuji, Kawasaki, Nippi and ShinMaywa as principal subcontractors.

Since 2003, Mitsubishi has been conducting an R&D programme for a future 70/90-seat regional jet under contract from the Japanese Ministry of Economy, Trade and Industry (METI).

Subcontract work includes participation in programmes for the Airbus A319/320 (shroud boxes since 2000), A330/340 (aft cargo doors from 2002), A380 (lower cargo doors; first delivered 2 October 2003); Boeing 737 (flaps); Boeing 747 (wing centre-section and flaps); main deck cargo door for Boeing 747-400 Special Freighter; Boeing 767/777 (fuselage panels and doors); Bombardier Global Express and Challenger 300 (wings); and components for JT8D-200, PW4000, PW6000 and V2500 turbofan engines. Development of composites outer wing boxes for Boeing 787 Dreamliner is under way.

MITSUBISHI F-2

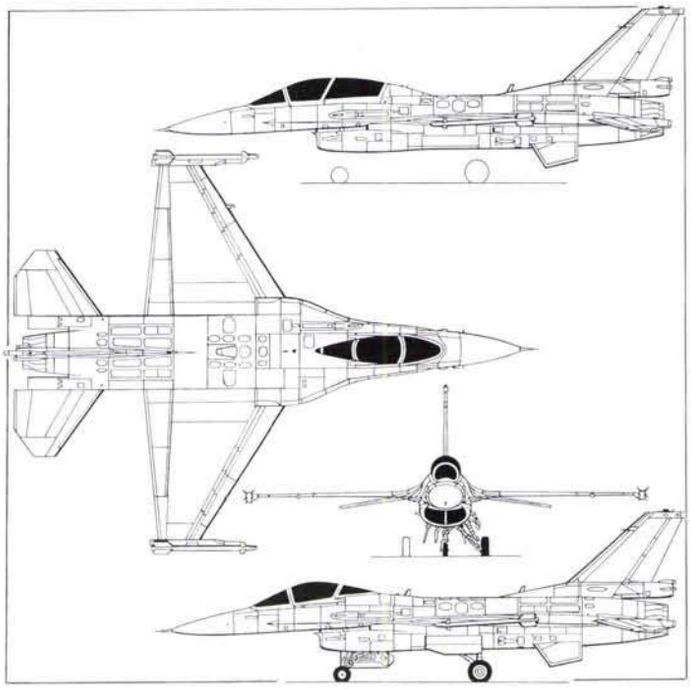
TYPE: Attack fighter.

PROGRAMME: Indigenous design, plus proposals based on F-15, F-16, F/A-18 and Tornado ADV, were originally considered; modified F-16C selected as Japan's FS-X replacement for Mitsubishi F-1 on 21 October 1987. Programme delayed by questions of development sharing with General Dynamics (now Lockheed Martin Aeronautics Company (LMAC)) and technology transfer to Japan, but agreed at Japan 60 per cent and US 40 per cent cost sharing (confirmed November 1988); Mitsubishi appointed prime contractor November 1988; initial contracts awarded for airframe design March 1989 and prototype active phased-array radar February 1990; General Electric F110-GE-129 Improved Performance Engine selected 21 December 1990. First subcontracts to GD let February 1990 for design and development of rear fuselage, wing, leading-edge flaps, avionics and computer-based test equipment. Active phased-array radar, EW (ECM/ESM), mission computer and inertial reference system being developed using Japanese domestic technology.

Japan totally responsible for programme, including all funding; Japanese airframe subcontractors include Kawasaki and Fuji (see Structure). Programme involves four flying prototypes (two single-seat XF-2A first, then two tandem two-seat XF-2B) and two for static and fatigue test; construction began early 1994, final assembly mid-1994; first prototype (single-seat 63-0001) rolled out 12 January 1995; first flight 7 October 1995, followed by second prototype (63-0002) on 13 December 1995; third prototype (63-0003) flew on 18 April 1996 and fourth (63-0004; first in blue colour scheme) on 24 May 1996. Japanese Cabinet approved 130-aircraft programme and allocated F-2 designation on 15 December 1995. Static test airframe (No. '991') under loading trials by 1995.

First XF-2A handed over to JDA on 22 March 1996, followed by '02 on 26 April 1997 and the two XF-2Bs on 9 August and 20 September 1997; prototypes re-serialled 63-8501/02 and 63-8101/02 on 1 December 1997. Congressional approval of US participation in September 1996 followed in October by USD75 million Mitsubishi initial production contract to Lockheed Martin. First Lockheed Martin rear fuselage accepted by Mitsubishi

Mitsubishi F-2A attack fighter *(Mitsuhiro Kadota)* 1158171



Mitsubishi F-2A, with additional side view (top) of two-seat F-2B *(Mike Keep)* 1158173

MITSUBISHI F-2 PROCUREMENT AND DELIVERY(JASDF)

PROCUREMENT						DELIVERY						
FY	Lot	Qty		Cum total		CY	Qty		First aircraft		Cum total	
		F-2A	F-2B	F-2A	F-2B		F-2A	F-2B	F-2A	F-2B	F-2A	F-2B
92		1[1]	0	1	0							
93		1[1]	2[1]	2	2							
94												
95												
96	1	7	4	9	6	96	2	2	63-8501	63-8101	2	2
97	2	8	0	17	6	97						
98	3	4	5	21	11	98						
99	4	2	6	23	17	99						
00	5	0	9	23	26	00	6	4	03-8503	03-8103	8	6
01	6	9	3	32	29	01	13	0	13-8509		21	6
02	7	6	2	38	31	02	0	9		23-8107	21	15
03	8	5	1	43	32	03	2	9	33-8522	33-8117	23	24
04	9	3	2	46	34	04	7	5	43-8524	43-8125	30	29
05	10	5	0	51	34	05	4	2	53-8531	53-8130	34	31
06	11	5	0	56	34	06						
07	12	8	0	64	34							

[1] Prototypes; originally numbered 63-0001/02 (XF-2A) and 63-0003/04 (XF-2B)

Two-seat Mitsubishi F-2B 1158172

in November 1998; first licence-built engines delivered by IHI in early 1999. Discovery in May 1998 of wing cracks, and evidence, when flying with two ASM-2 anti-ship missiles, of severe flutter, necessitated modifications to wingtips and pylon attachments, resulting in nine-month slippage of March 1999 scheduled completion date. Flight and static/fatigue testing rescheduled for completion in December 1999 and deliveries for FY99 (three) and FY00 (eight), but further wing crack problems revealed in mid-1999, causing completion of development testing to be extended to 30 June 2000 and first deliveries rescheduled to third quarter 2000. First production F-2A made maiden flight 12 October 1999 and delivered to JASDF on 25 September 2000. Total of 57 production F-2As and F-2Bs delivered by 31 March 2005.

Development of an 'F-2 Super Kai' dedicated air superiority version is under consideration, to replace the F-4EJ Kai, but no decision by mid-2006.

CURRENT VERSIONS: **F-2A:** Single-seat support fighter.

Description applies to F-2A except where indicated.

F-2B: Combat-capable two-seater.

CUSTOMERS: See table. Total of 85 aircraft, including four flying prototypes, ordered by March 2006; eight approved for FY07. JASDF (sole user) originally stated requirement for approximately 72 F-2As to replace F-1s in three support fighter squadrons, plus approximately 50 F-2Bs for OCU and possibly to replace T-2/2A. Plans were to acquire 130 single/two-seaters (83 + 47, reduced from earlier figure of 141 by cancellation of 11 two-seaters); however, in December 2004 JDA decided to curtail this to 98, of which 55 delivered by end of that month.

First recipient originally due to begin conversion in FY99 and to be completely equipped by FY00; however, first delivery (03-8503) not made until 25 September 2000 (formal acceptance 3 October). Six F-2As and eight F-2Bs delivered by year-end: one F-2A temporarily to No. 1 Technical School at Hamamatsu and seven to Rinji F-2 Hikotai (temporary F-2 Squadron) at Misawa, which became 3 Squadron of 3 Wing at same base on 27 March 2001. Remainder of first 45 aircraft allocated to Matsushima OCU (19 Bs). In 2006, 6 Squadron of 8 Wing at Tsuiki will convert from F-1; followed in 2009 by 8 Squadron/3 Wing at Misawa (which, pending F-2s, converted from F-1 to F-4EJKai Phantom).

COSTS: Total JDA expenditure (1988 to 1995) USD3.27 billion, including JPY75.7 billion (USD575 million) in FY92 to include first prototype and radar development; further JPY96.5 billion (USD804 million) in FY94 provided for three more flying prototypes and two for ground test. First two Mitsubishi contracts to GD totalled USD280.5 million; follow-on contract to Lockheed (5 February 1993) valued at USD74.2 million. FY96 batch of 11 cost USD1,081.58 million (USD98.32 million per unit); FY97 batch of eight cost USD797.47 million (USD99.68 million per unit); FY00 aircraft cost JPY11.8 billion each.

Unit costs of FY01, 02, 03 and 04 were JPY11.15 billion, 12.0 billion, 11.9 billion and 12.34 billion respectively. Corresponding batch totals were JPY133.895 billion, 96.156 billion, 71.534 billion and 61.772 billion.

DESIGN FEATURES: Configuration based on Lockheed Martin F-16. New co-cured composites wing of Japanese design, with greater span, root chord and 25 per cent more area than that of F-16; tapered trailing-edge; slightly longer radome and forward fuselage to house new radar and other mission avionics; longer mid-fuselage and shorter jetpipes; increased-span tailplane; addition of brake-chute; adoption of increased performance engine.

Wing leading-edge sweepback 33° 12'; incidence 0°. Tailplane anhedral 8°.

FLYING CONTROLS: Full-span leading-edge flaps and trailing-edge flaperons; all-moving tailplane; rudder; twin, fixed ventral fins, canted outward 15°. Initially planned vertical canards deleted; CCV functions achieved instead by triple-redundant digital fly-by-wire system, developed jointly by Japan Aviation Electronics and Honeywell. Based on earlier Mitsubishi work with T-2 CCV testbed. Available modes include control augmentation, relaxed static stability, manoeuvre load control, decoupled yaw and manoeuvre enhancement. Single analogue back-up flight control system for three-axis control.

STRUCTURE: Composites structure wing (except leading-edge flaps), horizontal tail, fin (except leading-edge and base), rudder and landing gear doors; other structures also use advanced materials and structure technology, including radar-absorbent material on nose, wing leading-edges and engine intakes; titanium in rear fuselage and tail unit.

Mitsubishi builds forward fuselage and wings; other Japanese airframe companies involved include Fuji (upper wing skins, wing fairings, radome, flaperons, engine air intakes and tail unit) and Kawasaki (fuselage mid-section, mainwheel doors and engine access doors). Lockheed Martin providing rear fuselage, 80 per cent of all port-side wing boxes, all leading-edge flaps, avionics systems, stores management systems and some test equipment; first LM production rear fuselage accepted 10 November 1998; first wing box delivered March 1999.

LANDING GEAR: Retractable tricycle type, with single wheel on each unit; mainwheels retract inward, nosewheel rearward. Mainwheel tyres size 27.75×8.75R145, pressure 22.06 bar (320 lb/sq in); nosewheel tyre size 18×5.7–8, pressure 20.69 bar (300 lb/sq in). Brake-chute in fairing at base of rudder.

POWER PLANT: One General Electric F110-GE-129 turbofan (131.2 kN; 29,500 lb st with afterburning), licence-built by IHI for production aircraft. Maximum internal fuel capacity 4,637 litres (1,225 US gallons; 1,020 Imp gallons), of which 4,588 litres (1,212 US gallons; 1,009 Imp gallons) are usable; reduced to 3,948 litres (1,043 US gallons; 868.5 Imp gallons), of which 3,903 litres (1,031 US gallons; 858.5 Imp gallons) usable, in F-2B. Maximum external fuel capacity (both) 5,678 litres (1,500 US gallons; 1,249 Imp gallons) (one 1,135.5 litre; 300 US gallon; 249.8 Imp gallon and two 2,271.25 litre; 600 US gallon; 499.6 Imp gallon tanks). In-flight refuelling receptacle on top of centre-fuselage.

ACCOMMODATION: One pilot in F-2A, two in tandem in F-2B, in pressurised and air-conditioned cockpit(s). Boeing ACES II ejection seat(s). Upward-opening canopy with separate windscreen.

SYSTEMS: Shimadzu/Honeywell environmental control system uses engine bleed air for pressurisation and cooling of crew stations and avionics compartment. Tokyo Aircraft Instruments/Carlton onboard oxygen generation system (OBOGS).

AVIONICS: *Comms:* Raytheon AN/ARC-164 Have Quick UHF transceiver; NEC V/UHF transceiver; Tokyo Radio System/BAE AIFF; Hitachi Kokusai Electric HF radio.

Radar: Mitsubishi Electric active phased-array radar.

Flight: Japan Aviation Electronics/Honeywell digital AFCS; Japan Aviation Electronics ring laser IRS; Toshiba VOR/ILS; Rockwell Collins Tacan.

Instrumentation: Shimadzu wide-angle holographic HUD with raster video capability. Koito integrated control panel. Yokogawa 137 × 137 mm (5.4 × 5.4 in) colour LCD MFD, two 108 × 108 mm (4.25 × 4.25 in) MFDs and an LCD standby display.

Mission: Mitsubishi Electric mission computer. Mitsubishi MDS mission planning system; Toshiba digital map display system.

Self-defence: Mitsubishi Electric integrated EW system.

ARMAMENT: One internal M61A2 Vulcan 20 mm multibarrel gun in port wingroot, plus 13 external stores stations: Sta 6 on centreline; Sta 1 (port) and 11 at each wingtip; and five under each wing (Sta 2, 3, 4L, 4, 5, 8, 8R, 9 and 10); AIM-7F/M Sparrow medium-range air-to-air missiles (Sta 2 and 10); AIM-9L or Mitsubishi AAM-3 air-to-air missiles (Sta 1, 2, 10 and 11) and ASM-1 and ASM-2 anti-shipping missiles (Sta 3, 4, 8 and 9); 500 lb general purpose bombs (Sta 4L and 8R); CBU-87/B cluster bombs (Sta 4 and 8); and JLAU-3/A or RL-4 rocket launchers (Sta 4 and 8). Centreline and inboard underwing stations (5, 6 and 7) wet for carriage of external tanks.

DIMENSIONS, EXTERNAL:

Wing span: over missile rails	11.125 m (36 ft 6 in)
excl missile rails	10.80 m (35 ft 5¼ in)
Wing chord: at root	5.27 m (17 ft 3½ in)
at tip	1.185 m (3 ft 10¾ in)
Wing aspect ratio	3.3
Length overall	15.52 m (50 ft 11 in)
Height overall	4.96 m (16 ft 3¼ in)
Tailplane span	6.045 m (19 ft 10 in)
Wheel track	2.36 m (7 ft 9 in)
Wheelbase	4.05 m (13 ft 3½ in)

AREAS:

Wings, gross	34.84 m² (375.0 sq ft)
Leading-edge flaps (total)	4.70 m² (50.59 sq ft)
Flaperons (total)	3.96 m² (42.63 sq ft)
Fin, incl dorsal fin	4.00 m² (43.06 sq ft)
Rudder	1.08 m² (11.63 sq ft)
Ventral fins (total)	1.50 m² (16.15 sq ft)
Horizontal tail surfaces (total)	7.05 m² (75.89 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: F-2A	9,527 kg (21,003 lb)
F-2B	9,633 kg (21,237 lb)
T-O weight:	
clean: F-2A	13,459 kg (29,672 lb)
F-2B	13,230 kg (29,167 lb)
with two short-range AAMs:	
F-2A	13,713 kg (30,232 lb)
F-2B	13,412 kg (29,568 lb)
with four short-range and four medium-range AAMs:	
F-2A	15,711 kg (34,637 lb)
F-2B	15,392 kg (33,934 lb)
with two short-range AAMs, six 500 lb bombs and two drop tanks:	
F-2A	19,888 kg (43,845 lb)
F-2B	19,569 kg (43,142 lb)
with two short-range AAMs, four anti-ship missiles and two drop tanks:	
F-2A	20,517 kg (45,232 lb)
F-2B	20,198 kg (44,529 lb)
Design max T-O weight with external stores:	
F-2A, F-2B	22,100 kg (48,722 lb)
Design max landing weight:	
F-2A, F-2B	18,300 kg (40,345 lb)
Design max wing loading	634.3 kg/m² (129.92 lb/sq ft)
Design max power loading	168 kg/kN (1.65 lb/lb st)

PERFORMANCE (F-2A):

Design max level speed: at high altitude	approx M2.0
at low altitude	approx M1.1
Typical combat radius:	
F-2A	more than 450 n miles (833 km; 518 miles)

MITSUBISHI (SIKORSKY) SH-60

JMSDF designations: SH-60J and SH-60K

TYPE: Naval combat helicopter.

PROGRAMME: Detail design of S-70B-3 version of Sikorsky SH-60B Seahawk (see US section), to meet JMSDF requirements, started August 1983; Japanese avionics and equipment integrated by Technical Research and Development Institute (TRDI) of JDA. First flight of first of two XSH-60J prototypes (8201), based on imported airframes, 31 August 1987; evaluation by 51st Air Development Squadron of JMSDF at Atsugi completed early 1991; first production SH-60J (8203) flown 10 May 1991, delivered 26 August.

CURRENT VERSIONS: **SH-60J:** Initial Japanese production version; *as described.*

SH-60K: Following trials begun by TRDI in 1995 on an all-composites rotor system with redesigned planforms and tips, offering increase in hovering efficiency and vibration reduction, FY97 budget requested funding for first prototype (then known as SH-60Kai or XSH-60K), upgraded with new main rotor hub and blades, increased cabin cross-section (33 cm; 13 in longer and 15 cm; 6 in more headroom), active dipping sonar, a tactical data processing and display system, and a laser-based shipboard automatic landing system. First of two prototypes (8401) eventually rolled out 8 August 2001 and made its first hovering flight on 9 August. Both delivered to JMSDF 24 June 2002 for technical and operational evaluation, which continued to end of March 2005. First production SH-60K (8403) delivered on 10 August 2005.

CUSTOMERS: See table. JMSDF requirement for about 100 SH-60Js; 103 ordered, of which more than 80 in service, by 1 April 2002; half of force land-based. Three new aircraft approved in FY01 to offset delays in SH-60K programme. SH-60Js operated by Nos. 101, 121 and 123 Squadrons (at Tateyama); Nos. 122 and 124 (at Ohmura); No. 211 (training unit at Kanoya); squadron at Komatsushima undergoing conversion in 2001.

Seven SH-60Ks approved in each of FYs 02, 03 and 04; further seven approved for FY05 and five for FY06; five more approved for FY07. Total of 44 planned. At least five delivered by late 2005.

COSTS: Unit cost JPY5.07 billion (2000).

POWER PLANT: T700-401C engines (-401C2 in SH-60K) manufactured by IHI.

ACCOMMODATION: Crew of three plus nine systems operators/observers.

Second production Mitsubishi SH-60K *(Miatsuhiro Kadota)* 1158174

MITSUBISHI SH-60 PROCUREMENT(JMSDF)

SH-60J				SH-60K		
FY	Qty	First aircraft	Cum total	Qty	First aircraft	Cum total
82	1[1]	8201	1			
83	1[1]	8202	2			
88	12	8203	14			
89	12	8215	26			
90	11	8227	37			
91	5	8238	42			
92	7	8243	49			
93	4	8250	53			
94	5	8254	58			
95	6	8259	64			
96	6	8265	70			
97	7	8271	77	1[2]	8401	1
98	7	8278	84	1[2]	8402	2
99	9	8285	93			
00	7	8294	100			
01	3	8301	103			
02				7	8403	9
03				7	8410	16
04				7	8417	23
05				7		30
06				5		35
07				5		40
Total	**103**		**103**	**40**		**40**

[1] Sikorsky-built XSH-60Js
[2] SH-60K prototypes

AVIONICS (SH-60J): *Radar:* Japanese HPS-105 search radar.

Flight: Japanese automatic flight management system and ring laser gyro AHRS.

Instrumentation: Japanese controls and displays subsystem, datalink and tactical data processor.

Mission: Japanese HQS-104 sonar; Raytheon AN/ASQ-81D(V)4 MAD; Japanese HRR-1 sonobuoy receiver.

Self-defence: Japanese HLR-108C ESM. Some aircraft equipped with chaff/flare dispensers.

AVIONICS (SH-60K): Include Kanto (Smiths licence) enhanced flight data recorder; advanced helicopter combat direction system (AHCDS; sensors for ocean stream, water temperature and submarine topography); datalink system; tactical estimation support capability; and automatic ship landing assistance system.

EQUIPMENT: RAST, sonobuoys, rescue hoist and cargo sling.

ARMAMENT (SH-60J): Some being equipped with 7.62 mm machine guns for self-protection against terrorist attacks.

ARMAMENT (SH-60K): Anti-shipping missiles and gun.

MITSUBISHI (SIKORSKY) UH-60

JASDF/JMSDF designation: UH-60J
JGSDF designation: UH-60JA

TYPE: Medium transport helicopter.

PROGRAMME: Detail design to Japanese requirements started April 1988; one US-built S-70A-12 imported, followed by two CKD kits for licence assembly (first flight 20 December 1989 at Sikorsky; delivered to JASDF 28 February 1991; second kit aircraft first flew February 1990, delivered to JASDF 29 March 1991). Remainder being built in Japan.

CURRENT VERSIONS: **UH-60J:** Standard search and rescue version for JASDF and JMSDF; can fly one hour search at 250 n miles (463 km; 288 miles) from base.

UH-60JA: JGSDF version; navigation/weather radar and FLIR night and adverse weather vision system. First (43101) completed late 1997; initial deliveries (four) January 1998.

CUSTOMERS: See table. JASDF has total requirement for 46 UH-60Js, JMSDF for 19; total of 26 in service with JASDF and 18 with JMSDF by 1 March 2003. JASDF aircraft operated by detached flights of Air Rescue Wing (HQ: Iruma); JMSDF UH-60Js to Atsugi Rescue Squadron in 1992; subsequently Kanoya, Tokushima, Shimofusa and Hachinohe.

JGSDF plans to procure up to 80 UH-60JAs in a US$2.67 billion programme announced early 1995; procurement began that year; JGSDF will deploy 50 with five district helicopter units alongside UH-1Js, with balance assigned to VIP transport and training; six delivered by 1 April 1999, this remaining as inventory total on 1 April 2000, despite more then awaiting acceptance. First two units are Nos. 1 and 12 Squadrons.

FY06 budget included two for JASDF and one for JGSDF; two J and one JA approved for FY07.

JASDF Mitsubishi UH-60J *(Mitsuhiro Kadota)* 1158175

Low visibility colour scheme applied to JASDF Mitsubishi UH-60J delivered in 2005 *(Mitsuhiro Kadota)* 1158176

COSTS: Unit costs in FY00 were JPY3.37 billion for UH-60JA and JPY3.6 billion for air force UH-60J.

POWER PLANT: T700-401C turboshafts manufactured by IHI.

ACCOMMODATION: Crew of four (JMSDF) or five (JASDF) plus up to 11 other persons. Bubble windows for pilot and on each side at front of main cabin.

AVIONICS: *Radar:* Nose-mounted Honeywell search/weather radar.

MITSUBISHI UH-60 PROCUREMENT

FY	UH-60J (JASDF)	First aircraft	UH-60J (JMSDF)	First aircraft	UH-60JA (JGSDF)	First aircraft	Cum total
88	3[1]	18–4551					3
89	2	28–4554	3	8961			8
90	2	28–4556					10
91	4	38–4558	3	8964			17
92	2	58–4562	2	8967			21
93	1	68–4564	2	8969			24
94	2	68–4565	1	8971			27
95	2	78–4567	1	8972	2	43101	32
96	1	98–4569	2	8973	4	43103	39
97	3	08–4570	2	8975	4	43107	48
98	2	08–4573	2	8977	5	43111	57
99	2	18–4575			3	43116	62
00	2	28–4577			3	43119	67
01	2	48–4579	1	8979	2	43122	72
02	1	58-4581			2	43124	75
03	2	68-4582			1	43126	78
04	2	78-4584			1	43127	81
05	2	78-4586			1	43128	84
06	2				1		
07	2				1		
Totals	**41**		**19**		**30**		**90**

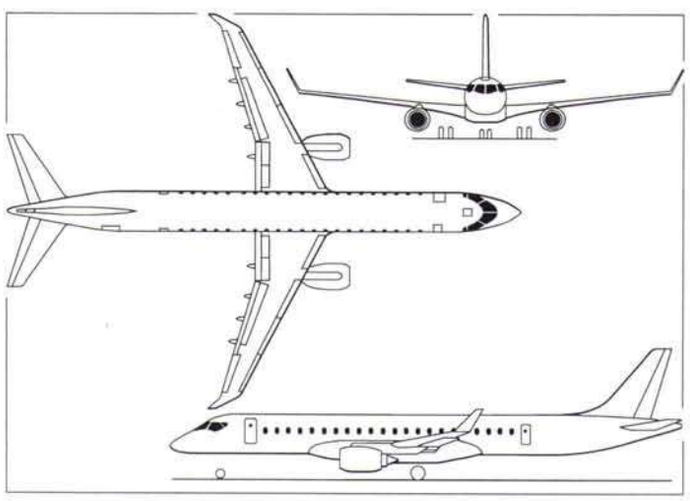
[1] One Sikorsky-built, two Mitsubishi-assembled from CKD kits

Flight: Japanese self-contained navigation system.
Mission: Turret-mounted Raytheon FLIR beneath nose.
EQUIPMENT: Rescue hoist, ETS (external tank support) system, and hook for cargo sling.

MITSUBISHI NGRJ

TYPE: Regional jet airliner.
PROGRAMME: Japan Aircraft Development Corporation is co-ordinating indigenous designs for a next-generation regional jet (NGRJ) airliner, with both Kawasaki and Mitsubishi offering competing projects. First provisional details of Mitsubishi design revealed in 2004, then as T-tailed, rear-engined design (two 30.7 kN; 6,900 lb st class turbofans) in 30-passengers class. By 2006, this had transmuted into stretched-fuselage, low-tailed design with underwing podded engines and aimed at 70/90-passenger market. Late 2006 was planning to fix engine, avionics and equipment configurations by March 2007, leading to launch in 2008 (given appropriate support from industrial partners) and certification in 2012.
CURRENT VERSIONS: Projected as **MJ-70** and **MJ-90**, indicating approximate passenger capacity.
DESIGN FEATURES: See accompanying illustrations.
Following data all provisional:
POWER PLANT: Two "brand new" (sic) turbofans, pod-mounted under wings; each 57.8 kN (13,000 lb st) in MJ-70, 66.3 kN (14,900 lb st) in MJ-90. Rolls-Royce and General Electric showing interest in participation.
DIMENSIONS, EXTERNAL (MJ-90):
Wing span over winglets ..... 28.9 m (94.8 ft)
Length overall ..... 35.0 m (114.8 ft)

Revised (2006) appearance of Mitsubishi's next generation RJ 1162251



Provisional (2006) general arrangement of Mitsubishi's MJ-90 proposed NGRJ next-generation regional jet *(Paul Jackson)* 1158266

Height overall ..... 9.8 m (32.2 ft)
Door height to sill: fwd ..... 2.4 m (7.9 ft)
rear ..... 2.7 m (8.9 ft)
WEIGHTS AND LOADINGS:
Operating weight empty: MJ-70 ..... 22,680 kg (50,000 lb)
MJ-90 ..... 23,905 kg (52,700 lb)
Max T-O weight: MJ-70 ..... 38,283 kg (84,400 lb)
MJ-90 ..... 42,093 kg (92,800 lb)
Max landing weight: MJ-70 ..... 34,500 kg (76,060 lb)
MJ-90 ..... 37,900 kg (83,555 lb)
PERFORMANCE:
Normal cruising speed (both) M0.78
Max operating altitude (both) ..... 11,880 m (39,000 ft)
T-O field length: MJ-70 ..... 1,740 m (5,710 ft)
MJ-90 ..... 1,820 m (5,970 ft)
Landing field length at MLW: MJ-70 ..... 1,410 m (4,630 ft)
MJ-90 ..... 1,490 m (4,890 ft)
Design range, typical payload (both) ..... 1,950 n miles (3,611 km; 2,244 miles)

SHINMAYWA

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GENERAL MANAGER: Motoaki Nishimoto

Former Kawanishi Aircraft Company (established November 1928); became Shin Meiwa in November 1949 and renamed ShinMaywa Industries in June 1992; major overhaul centre for Japanese and US military and commercial aircraft. Principal activities are production and/or upgrading of US-1A for JMSDF, and overhaul work on amphibians; upgraded US-1AKai made maiden flight in December 2003 and now being offered for export.

Manufactures wing trailing-edges and external drop tanks for Mitsubishi F-2; tailplanes for Mitsubishi-built SH-60J and K; internal cargo handling system for Kawasaki-built CH-47JA; wingroot fillet fairings and ramp skins for Airbus A380; fixed trailing-edges for Boeing 767, under subcontract to Vought; design and manufacture of wing/body fairings for Boeing 777. Support centre for U-36A (Learjet 36A); maintenance and technical support for JASDF U-4

(Gulfstream IV) since 1996; manufacture of control surfaces, wing/body fairing, mainwheel doors and fairings, and radome, for Gulfstream V/500/550.

SHINMAYWA US-1A and US-2

TYPE: Four-turboprop amphibian.

PROGRAMME: First flown 16 October 1974; first delivery (as US-1) 5 March 1975 (see 1985-86 *Jane's All the World's Aircraft*); all now have T64-IHI-10J engines as US-1As. Upgrade of original design (as US-1AKai) began 1 November 1996; redesignated US-2 in late 2004. ShinMaywa seeking government approval in 2005-06 to develop a commercial firefighting version of US-2 with a 15-ton capacity internal water tank. A 38/42-passenger version has also been proposed. These civil versions now being actively promoted, with marketing assistance from 2006 by JADC.

CURRENT VERSIONS: **US-1A**: SAR amphibian, developed from PS-1 ASW flying-boat; manufacturer's designation **SS-2A.**

Data apply to US-1A except where indicated.

US-2: Rolls-Royce AE 2100J turboprops, six-blade Smiths Aerospace propellers, modified wing with integral fuel tanks and composites floats, pressurised upper hull, FBW controls, 'glass cockpit', Thales Ocean Master radar, Honeywell RE-220 APU and LHTEC CTS800-based BLC compressor. Expected performance enhancements include maximum speed of 300 kt (555 km/h; 345 mph), service ceiling greater than 6,100 m (20,000 ft), extended range and a 50 per cent reduction in take-off distance on water.

Parts manufacture for first aircraft began in April 2000; major assembly started 3 July 2001; static and fatigue test airframes completed; former began testing in 2002, latter started in 2003; due to conclude in March 2005 and early 2006 respectively. First prototype (9901) rolled out 22 April 2003; first flight achieved on 18 December 2003; handed over to JMSDF's 51st Air Wing at Iwakuni 24 March 2004, for 27-month test programme. Second aircraft flew 30 June 2004 and handed over to 51st AW in December. Both planned to be brought up to production standard for 2008 service entry. Service entry planned 2007, replacing US-1As, which will be retired.

Firefighting amphibian: PS-1 modified in 1976 to firefighting configuration; 7,348 kg (16,200 lb) capacity water tank in centre-fuselage forward of step. One US-1A modified experimentally in 1986 to 1988, with more than 13,608 kg (30,000 lb) tank capacity; details in earlier editions. No orders by mid-2006, but promotion continues.

CUSTOMERS: Total of 20 US-1/1As ordered, last of which delivered 23 February 2005. Orders since 1988 have been for attrition replacements and, more recently, due to phase-out of older aircraft. No. 71 SAR Squadron of the JMSDF maintains fleet structure of seven aircraft at Iwakuni and Atsugi bases.

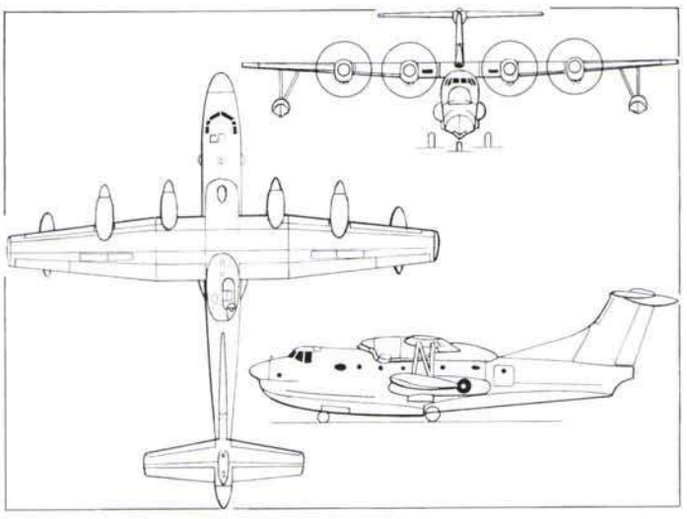
JMSDF said to have requirement for 14 US-2s to replace existing US-1A fleet; JDA expected to request up to seven subject to successful completion of flight test programme; first one included in FY07 budget. First unit will be 71st Air Wing.

US-1 AND US-2 PROCUREMENT (JMSDF)

FY	Qty	Cum Total
72	1	1
73	2	3
77	1	4
78	2	6
79	1	7
80	1	8
82	1	9
83	1	10
84	1	11
88	1	12
92	1	13
93	1	14
95	1	15
96	1	16
97	1	17
99	1	18
01		18
02	1	19
04	1	20
05	1	21
06	1	22
07	1	23

COSTS: US-2 development costs estimated at JPY66 billion (USD630 million) in 1996.

DESIGN FEATURES: Large turboprop-powered amphibian, suitable for maritime patrol and sea rescue missions. Boundary layer control system and extensive flaps for propeller slipstream deflection for very low landing and take-off speeds; low-speed control and stability enhanced by blowing rudder, flaps and elevators, and by use of automatic flight control system (see Flying Controls). Fuselage high length/beam ratio; V-shaped single-step planing bottom, with curved spray suppression strakes along sides of nose and spray suppressor slots in lower fuselage sides aft of inboard propeller line; double-deck interior. Large dorsal fin.



ShinMaywa US-2 (US-1AKai) SAR amphibian *(James Goulding)* 1158178

FLYING CONTROLS: Digital flight control system controlling elevators, rudder and outboard flaps. Hydraulically powered ailerons, elevators (with tabs) and rudder, all with feel trim. High-lift devices include outboard leading-edge slats over 17 per cent of wing span and large outer and inner blown trailing-edge flaps deflecting 60° and 80° respectively; outboard flaps can be linked with ailerons; inboard flaps, elevators and rudder blown by Mitsubishi BLC system. Spoiler in front of outer flap on each wing. Inverted slats on tailplane leading-edge.

STRUCTURE: Wings built by Fuji, fuselage by ShinMaywa and floats by Showa (Mitsubishi, Kawasaki and Nippi co-operated with ShinMaywa for US-2).

LANDING GEAR: Flying-boat hull, plus hydraulically retractable Sumitomo tricycle landing gear with twin wheels on all units. Steerable nose unit. Oleo-pneumatic shock-absorbers. Main units, which retract rearward into fairings on hull sides, have 40×14.22 tyres, pressure 7.79 bar (113 lb/sq in). Nosewheel tyres size 25×6.75-18, pressure 20.69 bar (300 lb/sq in). Three-rotor hydraulic disc brakes. No anti-skid units. Minimum ground turning radius 18.80 m (61 ft 8¼ in) towed, 21.20 m (69 ft 6¾ in) self-powered.

POWER PLANT: *US-1A:* Four 2,535 kW (3,400 shp) Ishikawajima-built General Electric T64-IHI-10J turboprops, each driving a Sumitomo-built Hamilton Sundstrand 63E60-27 three-blade constant-speed reversible-pitch propeller.

US-2: Four 3,356 kW (4,500 shp) Rolls-Royce AE 2100J turboprops, with FADEC and six-blade Dowty R414 propellers.

Fuel (both) in five wing tanks, with total usable capacity of 11,640 litres (3,075 US gallons; 2,560.5 Imp gallons) and two fuselage tanks (10,849 litres; 2,866 US gallons; 2,386.5 Imp gallons); total usable capacity 22,489 litres (5,941 US gallons; 4,947 Imp gallons). Pressure refuelling point on port side, near bow hatch. Oil capacity 152 litres (40.2 US gallons; 33.4 Imp gallons). Aircraft can be refuelled on open sea, either from surface vessel or from another US-1A with detachable at-sea refuelling equipment.

ACCOMMODATION: Crew of three on flight deck (pilot, co-pilot and flight engineer), plus navigator, radio/radar operator and medical attendant's seats in main cabin. Latter can accommodate up to 20 seated survivors or 12 stretchers, one auxiliary seat and two observers' seats. Sliding rescue door on port side of fuselage, aft of wing.

SYSTEMS: Cabin air conditioning system. Two independent hydraulic systems, each 207 bar (3,000 lb/sq in). No. 1 system actuates ailerons, outboard flaps, spoilers, elevators, rudder and control surface feel; No. 2 system actuates ailerons, inboard and outboard flaps, wing leading-edge slats, elevators, rudder, landing gear extension/retraction and lock/unlock, nosewheel steering, mainwheel brakes and windscreen wipers. Emergency system, also of 207 bar (3,000 lb/sq in), driven by 24 V DC motor, for actuation of inboard flaps, landing gear extension/retraction and lock/unlock, and mainwheel brakes.

Honeywell 85-131J APU (RE-220 in US-1AKai) provides power for starting main engines and shaft power for 40 kVA emergency AC generator. Boundary layer control (BLC) system includes a C-2 compressor, driven by a 1,119 kW (1,500 shp) Ishikawajima-built General Electric T58-IHI-10-M2 gas turbine, housed in upper centre portion of

Second prototype ShinMaywa US-2 1158177

fuselage, which delivers compressed air at 14 kg (30.9 lb)/s and pressure of 1.86 bar (27 lb/sq in) for ducting to inner and outer flaps, rudder and elevators (US-2 has LHTEC CTS800-4K turbine).

Electrical system includes 115/200 V three-phase 400 Hz constant-frequency AC and three transformer-rectifiers to provide 28 V DC. Two 40 kVA AC generators, driven by Nos. 2 and 3 main engines. Emergency 40 kVA AC generator driven by APU. DC emergency power from two 24 V 34 Ah Ni/Cd batteries.

De-icing of wing and tailplane leading-edges. Oxygen system for all crew and stretcher stations. Fire detection and extinguishing systems standard.

AVIONICS: *Comms:* HRC-121 HF, HRC-113 VHF and HRC-115-1 U/VHF radios; HIC-3B interphone; AN/APX-68-NB IFF transponder; RRC-22 emergency transmitter.

Radar: Thales OM-100 Ocean Master search radar.

Flight: HRN-101 ADF; OA-8697A/ARD UHF/DF; AN/ARN-118(V)2 Tacan; HRN-115-5 GPS nav system; HRN-107B-1 VOR/ILS receiver; AN/APN-171 (N2) radio altimeter; HPN-101B wave height meter; HSN-4 INS; N-TR-45 TAS transmitter; HRA-6-3 nav display; and N-ID-66/HRN BDHI.

EQUIPMENT: Marker launcher, 10 marine markers, six green markers, two droppable message cylinders, 10 float lights, pyrotechnic pistol, parachute flares, two flare storage boxes, binoculars, two rescue equipment kits, two droppable liferaft containers, rescue equipment launcher, lifeline pistol, lifeline, three lifebuoys, loudspeaker, hoist unit, rescue platform, lifeboat with outboard motor, camera, and 12 stretchers. Sea anchor in nose compartment. Stretchers can be replaced by troop seats.

DIMENSIONS, EXTERNAL:

Wing span	33.15 m (108 ft 9 in)
Wing chord: at root	5.00 m (16 ft 4¾ in)
at tip	2.39 m (7 ft 10 in)
Wing aspect ratio	8.1
Length overall	33.46 m (109 ft 9¼ in)
Height overall	9.95 m (32 ft 7¾ in)
Tailplane span	12.36 m (40 ft 8½ in)
Wheel track	3.56 m (11 ft 8¼ in)
Wheelbase	8.33 m (27 ft 4 in)
Propeller diameter	4.42 m (14 ft 6 in)
Rescue hatch (port side, rear fuselage):	
Height	1.58 m (5 ft 2¼ in)
Width	1.46 m (4 ft 9½ in)

AREAS:

Wings, gross	135.82 m² (1,462.0 sq ft)
Ailerons (total)	6.40 m² (68.90 sq ft)
Inner flaps (total)	9.40 m² (101.18 sq ft)
Outer flaps (total)	14.20 m² (152.85 sq ft)
Leading-edge slats (total)	2.64 m² (28.42 sq ft)
Spoilers (total)	2.10 m² (22.60 sq ft)
Fin	17.56 m² (189.0 sq ft)
Dorsal fin	6.32 m² (68.03 sq ft)
Rudder	7.01 m² (75.50 sq ft)
Tailplane	23.04 m² (248.00 sq ft)
Elevators, incl tabs	8.78 m² (94.50 sq ft)

WEIGHTS AND LOADINGS (search and rescue):

Manufacturer's weight empty	23,300 kg (51,367 lb)
Weight empty, equipped	25,630 kg (56,505 lb)
Usable fuel: JP-4	17,518 kg (38,620 lb)
JP-5	18,397 kg (40,560 lb)
Max oversea operating weight	36,000 kg (79,365 lb)
Max T-O weight: from water	43,000 kg (94,800 lb)
from land	45,000 kg (99,200 lb)
Max wing loading	331.3 kg/m² (67.85 lb/sq ft)
Max power loading	4.24 kg/kW (6.97 lb/shp)

PERFORMANCE (search and rescue, land T-O. A: at 36,000 kg; 79,365 lb weight, B: at 43,000 kg; 94,800 lb, C: at max T-O weight):

Max level speed: C	276 kt (511 km/h; 318 mph)
Max level speed at FL100:	
A	282 kt (522 km/h; 325 mph)
Cruising speed at FL100:	
C	230 kt (426 km/h; 265 mph)
Max rate of climb at S/L: A	713 m (2,340 ft)/min
C	488 m (1,600 ft)/min
Service ceiling: A	8,655 m (28,400 ft)
C	7,195 m (23,600 ft)
T-O to 15 m (50 ft) on land, 30° flap, BLC on (ISA):	
C	655 m (2,150 ft)
T-O distance on water, 40° flap, BLC on (ISA):	
B	555 m (1,820 ft)
Landing from 15 m (50 ft) on land, AUW of 36,000 kg (79,365 lb), 40° flap, BLC on, with reverse pitch:	
A	810 m (2,655 ft)
Landing distance on water, AUW of 36,000 kg (79,365 lb), 60° flap, BLC on:	
A	220 m (720 ft)
Runway LCN requirement: B	42
Max range at 230 kt (426 km/h; 265 mph) at FL100	2,060 n miles (3,815 km; 2,370 miles)

TIT

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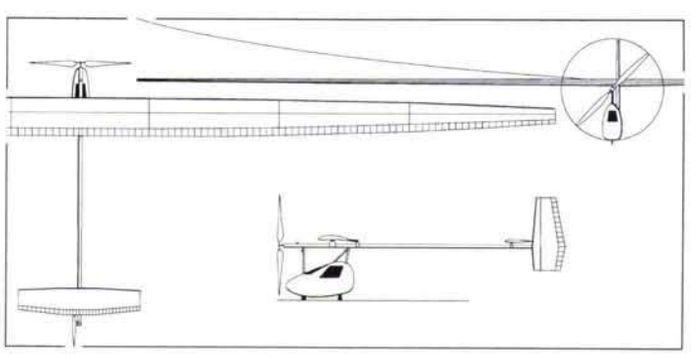
On 19 July 2006, electrical goods manufacturer Panasonic announced that, three days earlier, an aircraft had made the world's first manned flight powered entirely by dry cell batteries. The flight, made from Okegawa Airport north of Tokyo, was the outcome of the Oxyride Dry Cell Manned Flight Project, a joint programme begun in January 2006 by Panasonic and the Tokyo Institute of Technology (TIT).

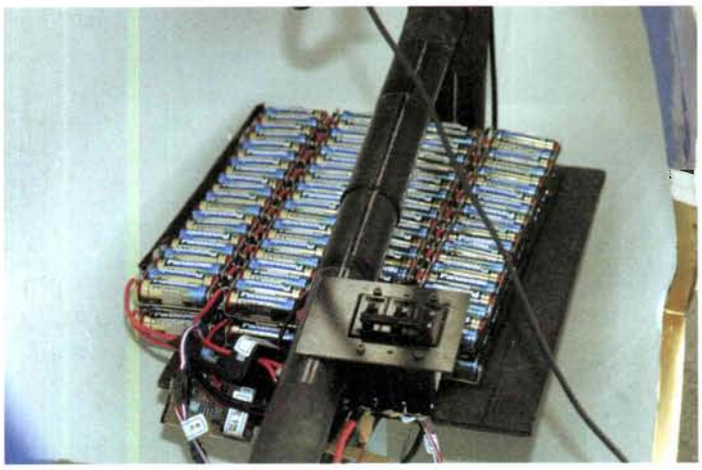
The aircraft was based on five years of development by the 'Meister' club (www.meister.ne.jp) club of TIT students specialising in innovative solutions not restricted to aviation. The same machine, then powered by its pilot alone, had participated in the propeller-driven section of the 29th Human Bird Contest on 17 July 2005, coming third. Man-powered development was continuing in 2007.

Panasonic's Oxyride battery derives its name from the use of oxyhydroxide, which releases a higher initial voltage than traditional alkaline batteries, combined with proprietary vacuum-pouring technology that allows more electrolytes to be inserted into the battery. A total of 160 of the AA-size units was used to power the test aircraft, a former single-seat man-powered ultralight with a 31 m (101.7 ft) wing span and a weight of just 54 kg (119 lb). Following completion and roll-out in April 2006, it was piloted for the 59-second historic flight on 16 July by Tomohiro Kamiya, a 53 kg (117 lb) TIT student. The aircraft flew a distance of 391.4 m (1,284 ft) at an altitude of 5.2 m (17 ft), and was monitored by the Japan Aeronautic Association for later submission to the FAI for recognition as an official record. A second



Man- or battery-powered aircraft designed and built by 'Meister' club of Tokyo Institute of Technology ***(Paul Jackson)*** 1158761

A moment of aviation history as TIT man-powered aircraft flies on battery power only 1158870



The 160-battery Oxyride dry cell power pack 1158871

flight was made later, using only 96 of the Oxyride batteries. On this occasion, the aircraft flew for 269 m (882.5 ft) at an altitude of 2 m (6.6 ft).

Tokyo Institute of Technology man-powered aircraft in 2005, with winglets 1158865

TIT MAN-POWERED AIRCRAFT

TYPE: Technology demonstrator.
DESIGN FEATURES: Tailplane incidence ±10°.
STRUCTURE: Wing spar and fuselage boom of CFRP.
DIMENSIONS, EXTERNAL:

Wing span (before 2006 modifications)	29.25 m (95 ft 11½ in)
Wing chord: at root	1.17 m (3 ft 10 in)
at tip	0.45 m (1 ft 5¾ in)
Wing deflection under load	1.90 m (6 ft 2¾ in)
Length: pod	2.09 m (6 ft 10¼ in)
overall	8.94 m (29 ft 4 in)
Height overall, propeller turning	3.28 m (10 ft 9 in)
Tailplane span	3.75 m (12 ft 3½ in)
Propeller diameter	3.15 m (10 ft 4 in)
Propeller ground clearance	0.26 m (10¼ in)

Jordan

JAI

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MARKETING DIRECTOR: Tamara Marsh

MANUFACTURING PLANT
Queen Alia International Airport, Private Free Zone, Amman

Founded 2001 to provide aviation-related services to Middle East, Africa and Asia. By late 2003, had formed alliances with Remos and Germany, Lilienthal of Ukraine and SportCopter and Zenair of USA for local assembly of various light aircraft, as detailed. Awarded Product on Certification No. 1 (J-SCH-01) by Jordanian Civil Aviation Authority on 4 December 2003, initially for assembly of CH2000, first of which flew in Jordan on 14 December 2003. Had sold 25 aircraft (types not disclosed) by end of 2003.

The 6,200 m² (66,650 sq ft) Queen Alia plant is staffed by engineers trained and certified in Canada.

Associated ventures include flight training, research& development, aerial work (pipe/power-line monitoring, agricultural spraying), support of law enforcement, aerial tourism and spare parts supply.

Aircraft offered by JAI have been given local names, as summarised:

Hawk-I CH8000: Version of Zenith Super STOL CH 801 metal, four-seat lightplane. Offered with 134 kW (180 hp) Lycoming or 169 kW (227 hp) SMA Diesel. Military version known as **Shark**. In March 2005, USD6 million contract received for six (plus training and spare parts) in spraying role for Iraq Ministry of Agriculture. Production certificate (J-SCH-02) issued 16 June 2005.

RaLi: Version of German Remos G-3 Mirage composites, two-seat ultralight.

SAMA-CH2000: Version of AMD Zenith CH2T (CH 2000 Alarus) metal two-seat lightplane and primary trainer; retains 86.5 kW (116 hp) Textron Lycoming O-235 engine. Four ordered by Royal Jordanian Air Academy (RJAA) at Amman for delivery from November 2003; demonstrator, US-built CH2000 N604AM, displayed at Dubai Air Show, 7 to 12 December 2003. First Jordanian-built, JY-MA8, flew 14 December 2003. Deliveries to RJAA began 24 January 2004. Options include Sandel 3308 EFIS for instrument training.

SAMA CH2000 MTSA: Surveillance version (launched as CH2000-S330) with Harris

JAI-built SAMA CH2000s of Royal Jordanian Air Academy 1151734

secure comms (30 to 50 mHz and 1.5 to 60 mHz) and ventral, gyro-stabilised Ultra 8500FW IR and TV imaging turret, having 450 mm telephoto and 3.5 km (2.2 mile) range from 600 m (2,000 ft); IFR capable; fuel capacity increased to 129 litres (34.0 US gallons; 28.3 Imp gallons) for up to 5 h 30 min endurance and range of 470 n miles (870 km; 540 miles) at 60-70 kt (111-130 km/h; 69-81 mph).

In October 2004, 16 SAMA CH2000-S330s ordered for Iraqi Air Force in USD12 million contract placed by US Army and including training (pilots and engineers) and long-term support. Deliveries began February 2005, following issue of Supplementary Type Certificate for turret installation on 25 November 2004.

SAMA CH2000-A: Uprated version with 104 kW (140 hp) Lycoming and multifunction displays.

SAMA CH2000-B: Available from 2006 with 99 kW (132.8 hp) Thielert Centurion 1.7 Diesel engine.

SAMA CH2000-C: Available from 2007; enlarged wing and rudder; Diesel power under consideration.

Hajanah: El Gavilán EL-1 Gavilán 358 eight-seat utility transport (261 kW; 350 hp Textron Lycoming TIO-540) last produced in Colombia. Available in EL-1, EL-1C, EL-1D and EL-1T versions. Production rights acquired via Zenair in 2005.

Shibel: Viper ViperJet two-seat personal jet; available in MT3 and MMP3 versions.

The following no longer appear to be receiving promotion:

Barq S Copter: Single-seat autogyro. Version of Sport Copter Lightning. US manufacture by Sport Copter Inc (www.sportcopter.com). Rotax 503 UL engine; 37.0 kW; 49.6 hp. Weight 114 kg (252 lb) empty; 272 lb (600 lb) max T-O; max level speed 55 kt (101 km/h; 63 mph); max rate of climb 305 m (1,000 ft)/min; range 90 n miles (161 km; 100 miles).

Gulf Bird X-34: Three-seat, ultralight development of Lilienthal X-32.

RumBird X-32: Tandem-seat ultralight. Version of Lilienthal X-32 Bekas.

JAI Hajanah, alias EL-1 Gavilán

0106488

Shark military version of JAI CH8000 with armoured door and belly

1151733

Gulf Bird Observer: X-32 variant with surveillance equipment as for CH2000-S330, but VFR avionics. Optional alternative of aerial mapping camera.

Sea Copter: Floatplane version of Vortex S Copter.

Vortex S Copter: Single-seat autogyro. Version of Sport Copter Vortex. Rotax 582 UL two-stroke, 48.0 kW (64.4 hp) but Subaru EA81 offered by JAI. Rotor diameter 7.62 m (25 ft 0 in); max T-O weight 345 kg (760 lb); max level speed 87 kt (161 km/h; 100 mph); max rate of climb 365 m (1,200 ft)/min; range 147 n miles (273 km; 170 miles). Optional enclosed cockpit with, or without, doors.

Vortex 2S Copter: Two-seat autogyro. Version of Sport Copter 2. Subaru EA81 flat-four engine, 82.0 kW (110 hp) or turbocharged 119 kW (160 hp). Weight 295 kg (650 lb) empty; 589 kg (1,300 lb) max T-O; max level speed 113 kt (209 km/h; 130 mph); max rate of climb 265 m (1,200 ft/min; range 269 n miles (498 km; 310 miles).

SEABIRD JORDAN

SEABIRD AVIATION JORDAN LLC

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Joint venture with King Abdullah II Design and Development Bureau (KADDB), known as Seabird Aviation Jordan (SAJ) and 51 per cent Australian-owned, formed in 2003 to assemble Seeker lightplane. KADDB has acquired intellectual property and world manufacturing and sales rights, plus 100 per cent of equity. Initial operations at Marka Airport are due to have been transferred to Queen Alia IAP in 2007. First deliveries – albeit from Australian production – in 2004. Production capability to reach two per month by first quarter of 2007. Dabin Group of Iraq bought a "significant portion" of KADDB's equity, releasing funds to accelerate SAJ's production build-up.

Also in 2004, Seabird Jordan acquired Middle East assembly and support rights for Jabiru J400 four-seat ultralight/lightplane, initially building a J430 demonstrator. J160 version is also marketed, both under local name of **Yamamah** (Bird of Peace) Y160 and Y430.

Announced in 2005, local assembly and marketing agreement for Gippsland GA200 agricultural sprayer and at Dubai Air Show in November 2005 announced VN 1100 version of FH-1100 FHoenix light helicopter as currently promoted in US. By mid-2006, both had been removed from SAJ's portfolio.

FLIR turret fitted to Seabird Seeker 1158850

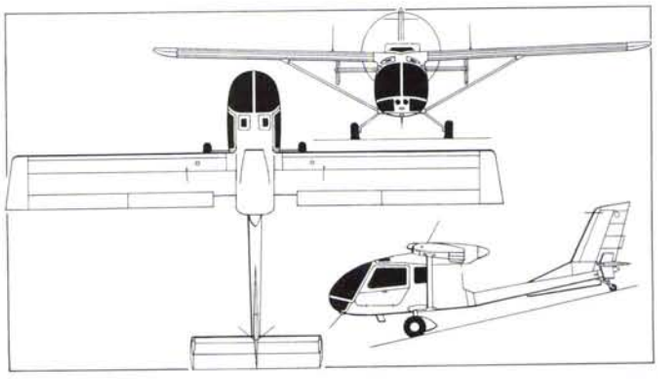
SEABIRD JORDAN SB7L-360 SEEKER

TYPE: Multisensor surveillance lightplane.

PROGRAMME: Design (by Bill Whitney) began January 1985; Seabird Aviation Australia began construction January 1988; first flight of first (SB5N) prototype (VH-SBI, c/n 001, with Norton rotary engine) 1 October 1989, and of SB5E second prototype (VH-SBU, c/n 003, with Emdair engine) 11 January 1991 (c/n 002 was structural test airframe); fourth aircraft (c/n 004, VH-ZIG) was SB7L Seeker prototype, making first flight 6 June 1991; Seabird SB7L-235 certified by CASA 12 March 1993; definitive SB7L-360A (VH-OPT) first flight early 1993) has Textron Lycoming O-360 engine for higher performance and received Australian CAA type approval on 24 January 1994 and certification to FAR Pt 23 on 24 March 1999. Operational testing of Seeker included use as an airborne surveillance platform in October 1995 trials by the Australian Army. Components for an initial production batch of five aircraft completed by December 1997. Project then frozen and franchised producer sought, apparently being achieved in July 2000, on signature of agreement with Evektor Aerotechnik. Negotiations were said to be continuing up to early 2003, at which time commercial discussions opened with KADDB in Jordan.

Fifth aircraft (VH-SBO c/n 006) registered June 2003, being first to conform to production certification. On 17 August 2003, KADDB and Seabird Australia revealed joint venture (Seabird Jordan) for assembly of Seekers at Marka. First aircraft, JY-SEE (the former VH-ZIG), shipped from Australia in September 2003 and flew in Jordan on 2 October. Second arrival in Jordan, March 2004, was former VH-OPT, joined in July 2004 by VH-SBO. After integration of communications equipment, avionics and surveillance systems by Seabird Jordan, two last mentioned supplied to Iraqi Air Force. First locally built aircraft were due in mid-2006, with manufacture transferring to new plant at Queen Alia International Airport in late 2006.

Australian certification revised on 18 January 2006 to incorporate MTOW increase from 897 kg (1,977 lb) to 925 kg (2,039 lb) and additional fuel capacity, effective from seventh aircraft, previous having 160 litres (42.3 US gallons, 35.2 Imp gallons) gross. In 2006, further improvements under development for Royal Jordanian Air Force Seekers including Dyneema ballistic protection system for fuselage at weight penalty of 5 kg (11 lb); improved cooling system; and replacement of BB177 propeller by Hoffmann unit offering 10 per cent more thrust, increasing climb rate by 91 m (300 ft) per minute and endurance at cruising power from 4 h 30 min to 5 h 40 min. Later improvements intended to include 134 kW (180 hp) Vantage fuel-injected engine and three-blade, constant speed propeller.



Seabird SB7L Seeker *(Mike Keep)* 0093657

CURRENT VERSIONS: **SB7L**: *As described.*

Four-seat: Reportedly under development by 2006.

CUSTOMERS: Initial Jordanian order placed mid-2003 for two (2004 and 2005 deliveries) for Aqaba Special Economic Zone Authority in maritime surveillance role. Royal Jordanian Air Academy ordered two on 8 October 2003 and holds option on further pair for 2005 delivery. On 10 June 2004, Iraq Air Force purchased two Seekers from KADDB; requirement existed

Jordanian-assembled Seeker delivered to South Africa *(Jane's/Patrick Allen)* 1196608

Current Seabird Seeker with Garmin GNS 530 screen 1158243

for fleet of 16 in surveillance role but these orders were assigned, instead, to rival JAI and its SAMA 2000. Initial two aircraft, registered YI-101 and YI-102, both from previous Australian production, handed over 29 July 2004 and delivered from Jordan to Basrah, Iraq, by USAF C-130 Hercules on 3 August 2004, as equipment of 1 Air Reconnaissance Squadron.

In October 2004, Paramount Group of South Africa ordered five Seekers, for immediate delivery and placed option on further five to be supplied in 2006; two of initial order for operation by Ghana Air Force, while another to be South African-based demonstrator. Two ordered December 2005 by Jordan Aviation on behalf of two countries "with close ties to Jordan". Deliveries of new-built Jordanian aircraft began early 2006 with JY-SE1 to South Africa. Demonstrator (N94399) shipped to US in July 2006 for promotion by Seabird Aviation America at Albuquerque.

Jordanian Air Force ordered six Seekers in March 2006.

SEABIRD SEEKER PRODUCTION

c/n	Version	Registration
89001	SB5	VH-SBI. Withdrawn. Cancelled 6 Aug 04
002	SB5	static test airframe
90003	SB5	VH-SBU. Withdrawn. Cancelled 6 Aug 04
91004	SB7L	VH-ZIG, JY-SEE
92005	SB7L	VH-OPT, JY-SEA, YI-101
02006	SB7L	VH-SBO, YI-102
SAJ06001	SB7L-360B	JY-SE1
SAJ06002	SB7L-360B	
07009	SB7L-360A	N94399

Notes: 007 to 011 in stock as components since 1996

COSTS: USD269,000 in basic configuration (2006).

DESIGN FEATURES: Braced high-wing monoplane with pod and boom fuselage, extensively glazed cabin and slightly sweptback vertical tail. Ventral and auxiliary fins added early 1993. Primary applications are observation/reconnaissance, offering helicopter-like view from cockpit and good low-speed handling and loiter capabilities; training and agricultural use also foreseen.

Wing section NACA 63_2-215 (modified); wedge tips; twist 3°, incidence 4° at root, 1° at tip; dihedral 2° 30' from roots.

FLYING CONTROLS: Conventional and manual. Rod-actuated slotted ailerons, one-piece horn-balanced elevator (with trim tab) and horn-balanced rudder; three-position (0, 20, 40°) slotted flaps on wing trailing-edge; fixed incidence tailplane. Inboard stall strips; vortex generators on wing upper surface near leading-edge and lower surface forward of ailerons; elevator bias trim.

STRUCTURE: Front fuselage mainly of 4130 chromoly steel tube with Kevlar non-load-bearing skin; aluminium alloy tubular tailboom; wings and tail unit conventional aluminium alloy stressed skin structures, former with single bracing strut and jury strut each side.

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted spring steel cantilever mainwheel legs with cutaway wheel fairings. Cleveland 8.00-6 mainwheels and fairings on cantilever spring steel legs; fully castoring Scott 8 in tailwheel with oil/nitrogen oleo strut and 210×65 McCreary tyre. Mainwheel tyre pressure 1.38 bar (20 lb/sq in); Cleveland disc brakes. Float gear to be developed.

POWER PLANT: One Textron Lycoming O-360-B2C flat-four engine, derated to 125 kW (168 hp) from 134 kW (180 hp) with lower compression ratio of 7.5:1 for Mogas fuel. Low propeller tip speed for minimal noise; Bishton BB177 two-blade fixed-pitch wood/composites pusher propeller. Fuel in two 92 litre (24.3 US gallon; 20.2 Imp gallon) integral wing tanks, each with overwing gravity filling point. Total 172 litres (45.4 US gallons; 37.8 Imp gallons) usable. Provision for auxiliary fuel tanks on underwing hardpoints. Oil capacity 7.5 litres (2.0 US gallons; 1.6 Imp gallons).

ACCOMMODATION: Side-by-side seats, adjustable fore and aft, for pilot and co-pilot or observer/passenger in extensively glazed cabin. Dual controls and four-point inertia reel seatbelts standard. Split (upward/downward-hinged) door each side, both removable. Ram air cabin ventilation. Space for 43 kg (95 lb) of baggage aft of seats.

SYSTEMS: 28 V electrical system, with 70 A alternator and Gill 246 battery, for engine start, instruments and lighting.

AVIONICS: *Comms:* Garmin GMA 340 audio panel, GL 40 VHF, GNS 430/530 com/nav, GTX 327 transponder.

Flight: Garmin GI 106 VOR/GS/LOC.

Mission: Iraqi aircraft have FLIR Systems 8500 surveillance system. Jordanian Air Force aircraft to have L-3 Wescam MX-15 and NVG capability.

Self-defence: Lacroix flare dispensing system under development in 2006, one eight-round unit under each wing.

EQUIPMENT: Hardpoint for 60 kg (132 lb) of external stores beneath each wing. Quick-change photo/survey modules, stretcher or 100 litre (26.4 US gallon; 22.0 Imp gallon) spraytank optional in place of right-hand seat.

DIMENSIONS, EXTERNAL:

Wing span	11.07 m (36 ft 4 in)
Wing chord, constant	1.22 m (4 ft 0 in)
Wing aspect ratio	9.4
Length overall	7.01 m (23 ft 0 in)
Fuselage max width	1.14 m (3 ft 9 in)
Height: to fintip	2.03 m (6 ft 8 in)
overall, propeller vertical	2.49 m (8 ft 2 in)
Tailplane span	2.90 m (9 ft 6 in)
Wheel track	2.03 m (6 ft 8 in)
Wheelbase	4.75 m (15 ft 7 in)
Propeller diameter	1.77 m (5 ft 9¾ in)
Cabin doors (two, each): Height	0.83 m (2 ft 8¾ in)
Width	0.98 m (3 ft 2½ in)
Height to sill	0.98 m (3 ft 2½ in)

DIMENSIONS, INTERNAL:

Cabin, incl baggage space:	
Length	2.21 m (7 ft 3 in)
Max width	1.12 m (3 ft 8 in)
Max height	1.09 m (3 ft 7 in)
Baggage compartment volume	0.75 m^3 (26.5 cu ft)

AREAS:

Wings, gross	13.06 m^2 (140.6 sq ft)

WEIGHTS AND LOADINGS:

Basic weight empty	604 kg (1,332 lb)
Max fuel weight	132 kg (292 lb)
Baggage capacity	45 kg (99 lb)
Max T-O and landing weight	925 kg (2,039 lb)
Max wing loading	70.8 kg/m^2 (14.50 lb/sq ft)
Max power loading	7.39 kg/kW (12.14 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	134 kt (248 km/h; 154 mph) CAS
Cruising speed at 75% power	108 kt (200 km/h; 124 mph)
Minimum patrol speed	65 kt (120 km/h; 75 mph) CAS
Stalling speed, flaps down	53 kt (99 km/h; 61 mph) IAS
Rate of climb: at S/L	330 m (1,085 ft)/min
at FL60	190 m (650 ft)/min
Service ceiling	4,648 m (15,250 ft)
T-O run	265 m (870 ft)
Landing run	199 m (655 ft)
Range with reserves:	
at min patrol speed	423 n miles (783 km; 487 miles)
at 65% power	570 n miles (1,056 km; 656 miles)
Endurance, with reserves: at min patrol speed	6 h 30 min
at 65% power	5 h 42 min
g limits	+3.8/–1.52

Kazakhstan

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This company was formed in conjunction with the Yakovlev design bureau of Russia to complete Russian certification of, market and manufacture the Yak-58, although it also markets the Yak-18T, 40, 42D, 52 and 54. US marketing office at Decatur, Georgia, USA, the intention being to achieve FAA certification and assemble some aircraft in that country. Yak-58 production had previously been intended by Tbliaviamsheni (formerly TAM) at Tbilisi, Georgia, CIS, but the project was suspended in 1997. By early 2006, the company was still seeking investors to launch production of the Yak-58, implying no immediate prospect of new deliveries.

Korea, South

KAI

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Model of KT-1C at Seoul Air Show in October 2005 ***(Jane's/Robert Karniol)***
1116778

Korea Aerospace Industries was established on 1 October 1999 by consolidating the aerospace business of Daewoo Heavy Industries, Samsung Aerospace and Hyundai Space & Aircraft to create a single, unified aircraft manufacturer. In 2000, the Korean government designated KAI as the sole specialised aerospace defence industry in Korea, with exclusive and preferential rights in Korean aerospace defence programmes. KAI is headquartered in Sacheon and operates three business sites, including a Seoul office and two research facilities in the Sacheon, Changwon and Daejun areas; total workforce was 2,700 in September 2005. Main Sacheon business site (664,000 m^2; 7,147,230 sq ft) accommodates T-50 production line; manufacture of AH-64D fuselages (first delivery 14 April 2005) and F-15K wings; and will modify three of the four Boeing 737 AEW&Cs ordered for the RoKAF's EX programme under a USD1.59 billion contract announced in November 2006. 123,000 m^2 (1,323,960 sq ft) facility at Changwon produces KT-1 and will house P-3 upgrade programme.

KAI has successfully completed the KFP (Korean Fighter Programme) for RoKAF. It has completed RoKAF production and delivery of the indigenous KT-1 basic trainer, of which seven KT-1Bs have also been sold to the Indonesian Air Force with five more on order.

KAI is continuing its T-50 advanced trainer/lead-in fighter trainer/light combat aircraft development successfully, with the first production examples now delivered. Further, thanks to serial production contracts with RoKAF in 2003, KAI is in a position to develop a Korean state-of-the-art fighter as well as export the supersonic trainer worldwide.

KAI has signed with Bell and Mitsui for developing a new helicopter known as the Bell 429. In addition, it was major contractor for upgrading Lockheed Martin P-3B Orion maritime patrol aircraft for the Republic of Korea Navy in 2005.

KAI is laying the groundwork for a long-term growth through new programmes such as the Korean Helicopter Programme (KHP), as well as expanding commercial business by strengthening partnerships with global airframe manufacturers such as Boeing and Airbus. Replacing the aborted KMH competition, the KHP was confirmed by the RoK government in 2004 as a development programme for a utility helicopter to replace ageing types such as the UH-1H and MD 500 in both the Army and the Air Force. Provisionally designated KUH (Korean Utility Helicopter), it is to be an 8 tonne indigenous aircraft, with KAI as prime contractor, accompanied by an international partner to perform systems integration. Up to 245 KUHs may be acquired under the programme. An RFP was issued in April 2005, attracting bids from AgustaWestland, Bell and Eurocopter, from which the last-named was selected in December 2005.

KAI KT-1 WOONG-BEE

English name: Great Flight

TYPE: Basic turboprop trainer.

PROGRAMME: Started February 1988; built under KTX (Korean Trainer Experimental) programme to design by Daewoo and ADD (Agency for Defence Development); construction of first prototype began June 1991; nine prototypes (01-05 flying and 001-004 for static and fatigue test), of which 01, with 410 kW (550 shp) PT6A-25A engine, rolled out November 1991 and made first flight 12 December that year; 02, identical to 01, made first flight 5 February 1993; 03 (with PT6A-62) made first flight on 10 August 1995; named Woong-Bee in November 1995; 04, which first flew on 10 May 1996, further modified with nose shortened and horizontal tail surfaces remounted lower and farther aft; 03 also modified to this standard. Fifth (preproduction) prototype 05 flew for the first time on 16 March 1998; development and operational testing completed 18 September 1998 after 1,474 flying hours in 1,184 sorties. Series production began 1999; first aircraft handed over to RoKAF at Sacheon AB on 7 November 2000 for use by 217 Tactical Training Squadron. All 92 ordered had been delivered by June 2004. Development of KT-1C continuing in 2004-06.

CURRENT VERSIONS: **KT-1:** Standard RoKAF basic trainer, *as described*.

KT-1B: Export version for Indonesian Air Force (initially seven); some different avionics to customer's requirements and no Tacan or automatic rudder trim. Further five on order in 2005.

KT-1C: New export version, with enhanced avionics suite integrated by CMC Electronics of Canada, based on that company's 25° field of view SparrowHawk HUD, HOTAS controls and a pair of CMC FV-4000 mission computers. 'All-glass' cockpit also features CMC up-front control panel and (in both cockpits) three 127 × 178 mm (5 × 7 in) MFDs. A cockpit demonstrator was displayed at the Seoul Air Show in late 2003. Other features include ability to carry a FLIR sensor and laser range-finder on the centreline stores station; weapon delivery system (simulated and live); fifth (underfuselage) hardpoint; a vapour-cycle ECS; and OBOGS. Active development started in November 2004; scheduled to be completed in 2008-09.

KO-1: Forward air control (Korean Observer) armed version for RoKAF. Development started in 2000 by modifying aircraft 05 to FAC configuration as XKO-1 with weapon management system, HUD, armament management LCD MFD and four underwing hardpoints; first flight in this configuration 1 November 2001. Development delayed, but contract for 20 awarded December 2003; first delivered August 2005; remainder due by 2008.

CUSTOMERS: Total of 105 production aircraft approved by Republic of Korea Air Force (RoKAF). Contract 9 August 1999 for 85 KT-1 trainers, last of which delivered by June 2004, replacing Cessna T-37s. Follow-on order for 20 KO-1s for forward air control duties.

Indonesian Air Force announced order for seven KT-1Bs on 26 February 2001, first six of which were delivered between 19 June and 26 July 2003; first aircraft (LD-0101) released to Indonesian Air Force 25 April 2003 in advance of official handover; replaced Beechcraft T-34Cs of No. 102 Squadron at Halim Perdanakusuma AB, Jakarta. Five more on order.

COSTS: Reported unit costs of USD5 million for RoKAF, USD3.995 million for Indonesian Air Force (2003).

DESIGN FEATURES: Meets requirements of FAR/JAR 23 (Aerobatic Category) and MIL-F-8785C trainer category Class IV. Able to cover entire primary and basic training syllabus and forward air control missions.

Unswept low wing with NACA 63-218 (root) and 63-212 (tip) aerofoil sections; tandem cockpits; conventional unswept vertical and horizontal tail surfaces; retractable tricycle landing gear. Four or five weapon hardpoints on KO-1 and KT-1C.

FLYING CONTROLS: Primary control surfaces actuated mechanically, with electrically operated trim tab in starboard elevator and port aileron; automatic rudder trim (not on KT-1B)

KAI KT-1 turboprop trainer in RoKAF service
0576527

KAI KO-1 forward air control turboprop

1158179

compensates for propeller-induced yaw to provide jet-like handling; rudder and One-piece elevator are horn-balanced. Airbrake under centre-fuselage and split flaps on wing trailing-edge are hydraulically operated.

LANDING GEAR: Hydraulically retractable tricycle type, with single wheel and oleo-pneumatic shock-absorber on each unit. Mainwheels retract inward; nosewheel is steerable ±18° and retracts rearward. Parker Hannifin mainwheels with 18×5.5 tyres (10 ply), pressure 9.65 bar (140 lb/sq in). Dunlop nosewheel with 5.00 5 tyre (14 ply), pressure 6.90 bar (100 lb/sq in). Parker Hannifin hydraulic mainwheel brakes.

POWER PLANT: One 708 kW (950 shp) (flat rated) Pratt & Whitney Canada PT6A-62 turboprop, driving a Hartzell HC-E4N-2/E9512CB-1 four-blade constant-speed fully feathering propeller. Single-lever combined control for engine fuel and propeller pitch.

Fuel in one 275.5 litre (72.8 US gallon; 60.6 Imp gallon) integral tank in each wing, giving total internal fuel capacity of 551 litres (146 US gallons; 121 Imp gallons). Gravity fuelling point in each wing upper surface. Provision for 189 litre (50.0 US gallon; 41.6 Imp gallon) auxiliary fuel tank on each inboard underwing station. Oil capacity 5.7 litres (1.5 US gallons; 1.25 Imp gallons). Fuel system permits up to 30 seconds of inverted flight.

ACCOMMODATION: Instructor and pupil in tandem cockpits on Martin-Baker Mk 16LF zero/zero ejection seats; rear seat elevated. One-piece canopy with MDC opens sideways to starboard.

SYSTEMS: Compressed bleed air air conditioning system for cockpit ventilation, heating, cooling and demisting; heating and cooling by wheel bootstrap air cycle system driven by engine compressor. Self-pressurised main and emergency hydraulic systems, operating pressure 207 bar (3,000 lb/sq in), flow rate 17.8 litres (4.7 US gallons; 3.9 Imp gallons)/min at 7,650 rpm. Pneumatic back-up system, also 207 bar (3,000 lb/sq in), for landing gear, wheel bay doors and flaps. Electrical power (28 V DC) available from engine-driven starter/generator and built-in battery, or from external power source. Fixed-geometry inertial separator for engine intake anti-icing. Diluter demand oxygen system provides 1,367 litres (48.2 cu ft) gaseous capacity for crew; selected and controlled individually from regulator/control panel in each cockpit.

AVIONICS (KT-1): *Comms:* UHF/VHF radio, IFF, interphone and communication control system; optional ELT.

Flight: AHRS and Tacan; optional VOR/ILS.

Instrumentation: EFIS with standby attitude indicator, flight control management system, electronic engine instruments and standby magnetic compass.

AVIONICS (KT-1B): *Comms:* Commercial instead of MIL-STD UHF/VHF; ATC transponder replaces IFF; Tacan and flight load data recorder deleted.

AVIONICS (KT-1C): *Comms:* VHF radios, interphone and communication control system; optional IFF and ELT.

Flight: GPS/INS, VOR/ILS and ATC; Tacan optional.

Instrumentation: HUD with UFCP; three MFDs; electronic back-up flight instruments.

AVIONICS (KO-1): *Comms:* Integrated UHF/VHF radios, IFF, interphone and control system; optional ELT.

Flight: GPS/INS and Tacan; optional VOR/ILS.

Instrumentation: As KT-1, plus Elop HUD and Astronautics MFDs. Options include mission computer, AVTR and NVG-compatible cockpit lighting system.

ARMAMENT (KO-1 and KT-1C): Two stores stations under each wing for two LAU-3A or LAU-131A seven-round rocket launchers or two 0.50 in machine gun pods; or two LAU-131As and two auxiliary fuel tanks. With fifth (fuselage centreline) station, options can be extended to include Mk 81 or 82 bombs, laser range-finder, FLIR or training AAM.

DIMENSIONS, EXTERNAL:

Wing span	10.59 m (34 ft 9 in)
Wing chord: at root	2.06 m (6 ft 9 in)
at tip	0.97 m (3 ft 2 in)
Wing aspect ratio	7.0
Length overall	10.26 m (33 ft 8 in)
Height overall: KT-1	3.68 m (12 ft 1 in)
KO-1	3.78 m (12 ft 5 in)
Tailplane span	4.17 m (13 ft 8 in)
Wheel track	3.54 m (11 ft 7 in)
Wheelbase	2.57 m (8 ft 5 in)
Propeller diameter	2.44 m (7 ft 11 in)
Propeller ground clearance	0.38 m (1 ft 3 in)

DIMENSIONS, INTERNAL:

Cockpits: Length (total)	3.20 m (10 ft 6 in)
Max width	0.99 m (3 ft 3 in)
Max height	1.52 m (5 ft 0 in)

AREAS:

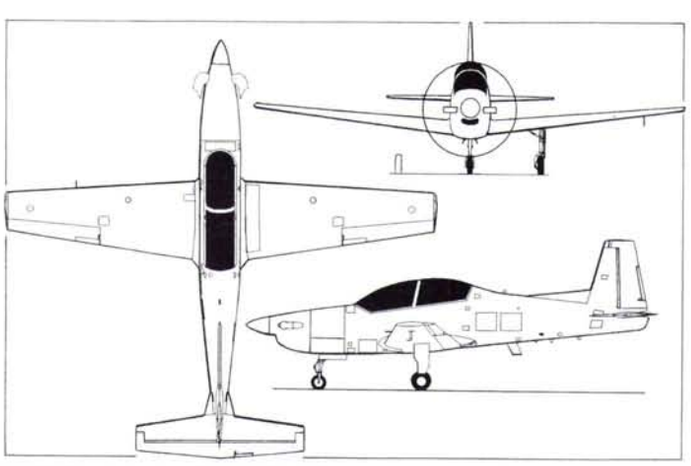
Wings, gross	16.01 m² (172.3 sq ft)
Ailerons (total, incl tabs)	1.11 m² (11.95 sq ft)
Trailing-edge flaps (total)	2.22 m² (23.90 sq ft)
Fin, incl dorsal fin	1.35 m² (14.57 sq ft)
Rudder, incl tab	0.88 m² (9.43 sq ft)
Tailplane	2.32 m² (25.02 sq ft)
Elevators (total, incl tab)	1.19 m² (12.78 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	1,910 kg (4,210 lb)
Max fuel weight	408 kg (900 lb)
Max T-O and landing weight:	
Aerobatic	2,540 kg (5,600 lb)
Utility	3,205 kg (7,065 lb)
with external stores	3,311 kg (7,300 lb)
Max wing loading:	
Aerobatic	158.7 kg/m² (32.50 lb/sq ft)
Utility	200.2 kg/m² (41.00 lb/sq ft)
with external stores	206.8 kg/m² (42.37 lb/sq ft)
Max power loading:	
Aerobatic	3.59 kg/kW (5.89 lb/shp)
Utility	4.53 kg/kW (7.44 lb/shp)
with external stores	4.68 kg/kW (7.68 lb/shp)

PERFORMANCE:

Never-exceed speed (VNE)	350 kt (648 km/h; 402 mph)
Max level speed at 4,570 m (15,000 ft):	
KT-1	280 kt (518 km/h; 322 mph)
KO-1 with external stores	244 kt (513 km/h; 280 mph)
Max operating speed	310 kt (574 km/h; 357 mph) IAS
Stalling speed, flaps down	71 kt (132 km/h; 82 mph) IAS
Max rate of climb at S/L: clean	1,067 m (3,500 ft)/min
Absolute ceiling: clean	11,580 m (38,000 ft)
with external stores	9,140 m (30,000 ft)



KAI KT-1 basic trainer (P&WC PT6A-62A turboprop engine) *(Paul Jackson)*

1158180

T-O run ..... 244 m (800 ft)
T-O to 15 m (50 ft) ..... 494 m (1,620 ft)
Landing from 15 m (50 ft) ..... 727 m (2,385 ft)
Landing run ..... 397 m (1,300 ft)
Range at 7,620 m (25,000 ft), max internal fuel and 30 min reserves ..... 720 n miles (1,333 km; 828 miles)
Ferry range at 6,100 m (20,000 ft) max internal and external fuel, 30 min reserves ..... 900 n miles (1,666 km; 1,035 miles)
Endurance at 6,100 m (20,000 ft), max internal fuel and 30 min reserves ..... up to 4 h
g limits: Aerobatic, clean ..... +7/−3.5
with two LAU-131s and two drop-tanks ..... +4.5/−2.3

KAI T-50 GOLDEN EAGLE

RoKAF designation (LIFT version): A-50

TYPE: Advanced jet trainer/light attack jet.

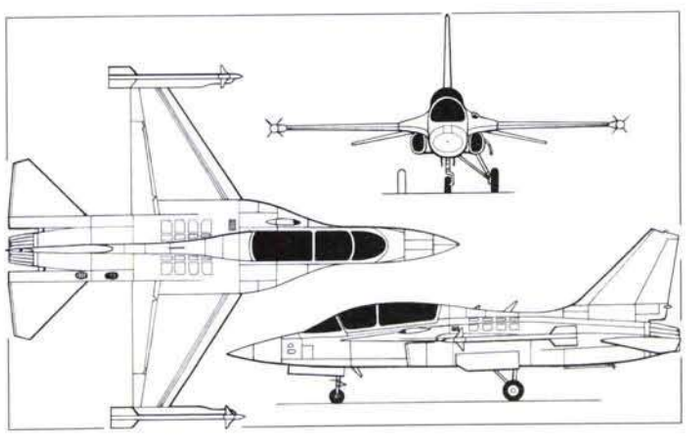
PROGRAMME:

DEVELOPMENT MILESTONES

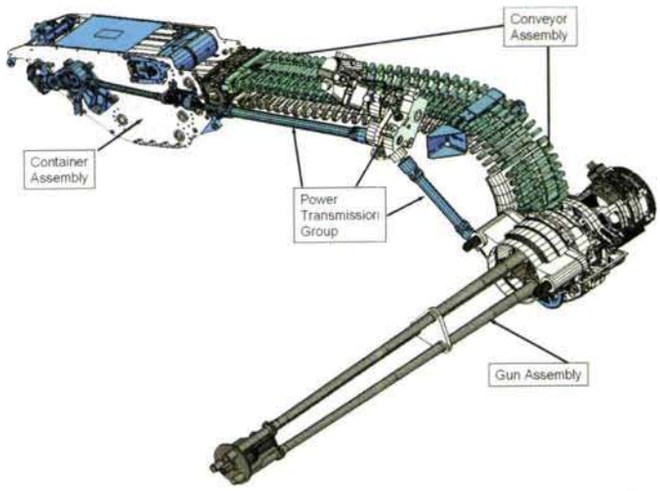
T-50	
Launched	92
Go-ahead	3 Jul 97
Design frozen	Nov 99
Rolled out	31 Oct 01
First flight	20 Aug 02
First order	19 Dec 03
First delivery	4 Jan 06
Subsequent versions	
A-50	
First flight	29 Aug 03

Begun by Samsung Aerospace (SSA) in 1992 under designation KTX-2 (Korean Trainer, Experimental); initial design assistance by Lockheed Martin as offset in F-16 Korean Fighter Programme; early design featured shoulder-mounted wings and twin tail unit; revised later to present configuration; basic configuration established mid-1995; full-scale development originally planned to begin in 1997, subject to finding risk-sharing partner; government go-ahead given on 3 July 1997; Samsung/Lockheed Martin agreement September 1997 to continue joint development until 2005; Lockheed Martin Aeronautics at Fort Worth responsible for wings, flight control system and avionics; development phase funded 70 per cent by South Korean government, 17 per cent by Samsung/KAI and 13 per cent by Lockheed Martin.

FSD contract, signed 24 October 1997, called for two static/fatigue test airframes and four flying prototypes (two T-50 and two A-50). Work split 55 per cent in USA, 44 per cent in South Korea and 1 per cent elsewhere. Preliminary design review (PDR) completed 12 to 16 July 1999; wind tunnel testing completed (4,800 hours) and aerodynamic design frozen November 1999. Critical design review (CDR) passed in August 2000. KTX-2 redesignated T-50 and A-50 in early 2000. T-50 International (TFI) established September 2000 (following July MoU) by KAI and LM Aero to market aircraft outside South Korea.



KAI T-50/A-50 Golden Eagle *(James Goulding)* 0589209



A-50 gun detail *(General Dynamics)* 1039306

First prototype entered final assembly January 2001 and rolled out 31 October 2001; first flights 20 August (001) and 8 November 2002 (002). Static testing began 2 January 2002 and completed in September 2003; fatigue tests began 22 July 2002 and completed first 'lifetime' of 8,334 hours in April 2003; second lifetime (begun August 2003) completed in June 2004. First supersonic flight (M1.05 at 12,200 m; 40,000 ft) 18 February 2003 on 60th sortie; 100th test flight 28 April 2003, on which date M1.2 achieved.

Developmental flight testing (105 flights) and initial integrated logistics assessment completed by first two prototypes by mid-2003; RoKAF initial operational assessment with these two aircraft completed in 26 sorties between 28 July and 14 August 2003. Follow-on operational assessment (approximately 64 flights) to continue until 2005. Third and fourth (lead-in fighter trainer) prototypes first flown on 29 August and 4 September 2003; ground-firing tests of gun started late October 2003; flight test of APG-67 radar began December 2003 (programme of approx 80 flights, ending in mid-2004). Other tasks during 2004 included engine air starts (begun March); high and maximum AoA (June/July); stores carriage (March) and weapon release (October); maximum speed (675 kt CAS) and Mach number (10 December); maximum *g* loading (27-29 December); icing and other climatic trials; and continued avionics testing. By end 2003, prototypes had collectively flown 235 hours in 241 sorties; 300-hour landmark passed by February 2004. Aerial gun-firing tests took place between 26 October and 6 January 2005. By mid-March 2005 the flight test programme had involved more than 800 sorties and was 70 per cent complete, while 1,000th sortie flown 10 May 2005. Main flight test programme (1,146 sorties) completed September 2005, but further tests being flown to expand flight envelope and explore additional weapon capability.

Order for first 25 production T-50s placed 19 December 2003; first of these entered final assembly 17 December 2004; rolled out (05-001) 30 August 2005; first flight 28 September 2005. Deliveries to RoKAF began 4 January 2006 with handover of first two production aircraft to RoKAF No. 52 Squadron.

Preliminary studies completed for possible 'F-50' fighter derivative, to enter development stage in about 2008 and targeted as Northrop F-5 replacement.

CURRENT VERSIONS: **T-50:** Advanced trainer; no internal gun or radar.

T-50 LIFT: Lead-in fighter trainer and light combat version with radar, weapon delivery software and internal gun. RoKAF designation **A-50**.

T-50U: Variant of T-50 LIFT proposed to United Arab Emirates in late 2003. Cockpits modified to include third, larger, MFD for commonality with UAE Air Force F-16s; HUD symbology similar to UAEAF Mirage 2000-9s; Thales TBA-6030 datalink; Terma EW suite controller; and customised mission simulation modes.

First production KAI T-50 Golden Eagle 1158181

CUSTOMERS: Initial RoKAF requirement for 94 (50 T-50s and 44 A-50s), with contracts expected in 2006 for second 25 of former and first 22 of latter, for delivery from 2008. Second 22 A-50s expected to be in A-50+ close air support (CAS) configuration, with enhanced weapon capability. Options for up to 100 more, including further A-50s. Initially to replace RoKAF T-38s and F-5Bs; aimed also at F-5 replacement market. Israel and UAE invited to test-fly T-50 during 2004. Exports (from late 2006) estimated potentially at 600 to 800.

COSTS: Development programme cost estimated at USD2,000 million (1995); but reassessed in 1996 as USD1,500 million, and only USD1,200 million by early 1997. Initial October 1997 FSD contract valued at approximately USD1,270 million. Development phase re-estimated at USD1.8 billion to US$2.1 billion in mid-2000. Unit cost USD18 million to USD20 million for T-50, USD20 million to USD22 million for A-50 (2000).

DESIGN FEATURES: Mid-mounted, variable camber wings, swept back on Leading-edges; Leading-edge root extensions (LERX); all-moving tailplane; sweptback fin Leading-edge. Single turbofan engine, with twin side-mounted intakes. KAI developing fuselage and tail unit. Designed for service life of up to 10,000 hours (8,300 hours for LIFT version).

FLYING CONTROLS: Digital, triple-redundant fly-by-wire control of flaperons, Leading-edge flaps, tailplane and rudder. Parker and Moog hydraulic actuators. Leading-edge manoeuvring flaps; split airbrake at rear of fuselage, between exhaust nozzle and tailplane halves.

STRUCTURE: Conventional aluminium alloy except for GFRP nose radome, control surfaces and some fairings. Lockheed Martin, avionics integration and wings for prototypes; KAI, fuselage, tail unit, production wings and final assembly at Sacheon. No periodic depot maintenance required.

LANDING GEAR: Messier-Dowty WIA hydraulically retractable tricycle type, with single wheel and oleo-pneumatic shock-absorber on each unit. Mainwheels retract into engine intake trunks, steerable nosewheel forward. Runway emergency arrester hook.

POWER PLANT: One General Electric F404-GE-102 turbofan (78.7 kN; 17,700 lb st with afterburning), equipped with FADEC. Seven internal fuel tanks (five in fuselage plus one in each wing); combined capacity 2,707 litres (715 US gallons; 595 Imp gallons). Provision for up to three 568 litre (150 US gallon; 125 Imp gallon) drop fuel tanks on centreline and/or inboard underwing stations.

ACCOMMODATION: Crew of two in tandem; stepped cockpits; Martin-Baker zero/zero ejection seats. Rear-hinged, upward-opening single canopy; one-piece wraparound windscreen.

SYSTEMS: Dual-redundant, independent hydraulic systems (A and B), each at 214 bar (3,100 lb/sq in) pressure and with flow rate of 187 litres (49.4 US gallons; 41.1 Imp gallons)/min; System A has 207 bar (3,000 lb/sq in) emergency back-up system with 100 litres (26.4 US gallons; 22.0 Imp gallons)/min flow rate. Triple-redundant electrical system (30 to 40 kVA primary, 7 kVA for emergencies) powered by three 28 V, 100 A DC converters and one 500 W battery converter. Electrical emergency power system (EEPS) operates System A emergency back-up and 1 kVA emergency generator throughout flight envelope. Hamilton Sundstrand APU provides self-contained engine starting capability on ground and up to 6,100 m (20,000 ft). Digitally controlled Hamilton Sundstrand environmental control system for avionics cooling, capacity 5.6 kW. Northrop Grumman OBOGS self-generating oxygen life support system.

AVIONICS: *Comms:* Raytheon ARC-232 UHF/VHF radio; BAE Systems APX-118 IFF.

Radar: Lockheed Martin AN/APG-67(V)4 in A-50.

Flight: Digital fly-by-wire flight controls with HOTAS; Rockwell Collins VIR-130A VOR/ILS; nav/attack system for fighter lead-in training; Honeywell H-764G embedded GPS ring laser gyro INS; Tacan; HG-9550 radar altimeter.

Instrumentation: BAE Systems wide-angle HUD; two 127 × 127 mm (5 × 5 in) colour MFDs; Honeywell instrumentation displays (eight 76 mm; 3 in displays, including HSI, attitude indicator, electronic altimeter and Mach speed indicator).

Self-defence: A-50 provision for inert gas generation system, chaff/flare dispenser and RWR.

ARMAMENT: A-50 has internal General Dynamics 20 mm three-barrel Gatling-type cannon (modified M61A2) with 205 rounds (port LERX); max firing rate 3,000 rds/min. Both versions have seven external stations (one on centreline, two under each wing and AAM rail at each wingtip) for AAMs, ASMs, rocket pods, bombs, munition dispensers, practice bombs or equipment, and training targets. Includes AIM-9 Sidewinder and TGM-65 Maverick training missiles, CBU-58 and Mk 20 cluster munition, ACMI (Air Combat Manoeuvring Instrumentation) pod, BDU-33 practice bombs and SUU-20 dispenser equipment, AGTS and TIX-3 training targets and Mk 82/83/84 series 500/1,000/2,000 lb bombs.

DIMENSIONS, EXTERNAL:

Wing span: incl wingtip launcher	9.45 m (31 ft 0 in)
excl wingtip launcher	9.11 m (29 ft 10¾ in)
Length overall	13.14 m (43 ft 1¼ in)
Height overall	4.94 m (16 ft 2½ in)

WEIGHTS AND LOADINGS:

Weight empty	6,441 kg (14,200 lb)
Max internal fuel weight	2,220 kg (4,895 lb)
Max external stores	4,309 kg (9,500 lb)
Max T-O weight: clean	9,339 kg (20,589 lb)
with external stores	13,471 kg (29,700 lb)
Max power loading: clean	119 kg/kN (1.16 lb/lb st)
with external stores	171 kg/kN (1.68 lb/lb st)

PERFORMANCE (design):

Max operating Mach No: design	1.5
tested	1.3
Max operating speed	815 kt (1,509 km/h; 937 mph)
Stalling speed	105 kt (195 km/h; 121 mph)
Max rate of climb at S/L	12,070 m (39,600 ft)/min
Absolute ceiling	16,760 m (55,000 ft)
Service ceiling	14,935 m (49,000 ft)
Max rate of roll	200°/s
T-O run	345 m (1,130 ft)
Landing run	707 m (2,320 ft)
Max range	1,400 n miles (2,592 km; 1,611 miles)
Sustained turn load factor at 4,570 m (15,000 ft)	6.5 *g*
g limits	+8/−3

KAI (BELL) 429

TYPE: Light utility helicopter.

PROGRAMME: KAI/Bell MoU of 4 December 2003 provides for co-development of Bell 429 IFR variant with roomier cabin and improved cold-climate performance; confirmed 19 June 2004 by agreement to contribute engineering and detail design input, and cabin/fuselage manufacture, to Canadian production line for Bell 429, for which KAI to have sales rights in South Korea and China. Co-development contract between Bell, KAI and Mitsui Bussan Aerospace (Japan) signed 6 February 2005 at Heli-Expo exhibition in Anaheim, California. Nose and fuselage for 429 prototype produced by KAI, and USD150 million agreement signed 20 February 2006 under which KAI will build airframes for all production aircraft over the next 10 years. KAI also granted rights to assemble aircraft in Korea for customers in Korea and China.

KAI KUH

TYPE: Light utility helicopter.

PROGRAMME: Former KMH (Korean Multirole Helicopter) programme cancelled on cost grounds 2004 and replaced by less ambitious KHP (Korean Helicopter Programme) for purely utility version, provisionally known as KUH (Korean Utility Helicopter); attack element of former KMH to be addresses separately later. Up to 245 KUHs may be acquired.

KAI to be prime contractor for KUH, with additional domestic contributions from KARI and Agency for Defence Development (ADD); KAI to develop 38 component items and purchase 14; respective quantities are 18 and five for KARI, 15 and 12 for ADD. Helicopter to be essentially of indigenous design, but co-developed with international partner as systems integrator. RFP issued April 2005, resulting in bids from AgustaWestland, Bell and Eurocopter, from whom last-named selected in December 2005.

Reports suggest construction of six prototypes, with some USD1.3 billion allocated for initial development phase, beginning in 2006 and aimed for a maiden flight in late 2009 and completion in 2011. Workshare in six-year development phase to be 70 per cent to Korean participants, 30 per cent to Eurocopter. In following 10-year production phase, Korean partners 60 per cent, Eurocopter 20 per cent, others 20 per cent, with overall investment estimated at USD6 to 8 billion.

STRUCTURE: Crashworthy airframe, based on that of Eurocopter Cougar, KAI responsible for fuselage, main and tail rotor gearboxes, rotor brake, instrument panel, flight control computer and hydraulic system. Main and tail rotors, rotor hubs and controls, FADEC, APU and landing gear by KARI. Eurocopter to provide transmission and autopilot subsystems, plus general technical assistance. Overall systems integration by KAI.

POWER PLANT: Two 1,193 kW (1,600 shp) class General Electric T700 turboshafts, with FADEC.

ACCOMMODATION: Two-crew 'glass cockpit'; two other crew members and up to nine armed troops.

AVIONICS: Main avionics (four-axis AFCS, mission computer, MFDs, radar, missile and laser warning receivers, navigational FLIR, radio and radar altimeter) by ADD. Bought-in items to include standby analogue instruments (KAI); and radios, data modem, helmet-mounted display system and chaff/flare dispensers (ADD). Prospective candidates for other items include Elbit Systems (EW management computer) and Thales (IR sensor, central data unit, air data system and cockpit displays).

ARMAMENT: Two 7.62 mm pintle-mounted machine guns.

DIMENSIONS, EXTERNAL (approx):

Main rotor diameter	15.78 m (51 ft 9¼ in)
Tail rotor diameter	3.13 m (10 ft 3¼ in)
Fuslage: Length	15.24 m (50 ft 0 in)
Max width overlanding gear	2.95 m (9 8¼ in)
Max height to rotor head	4.26 m (13 ft 11¾ in)

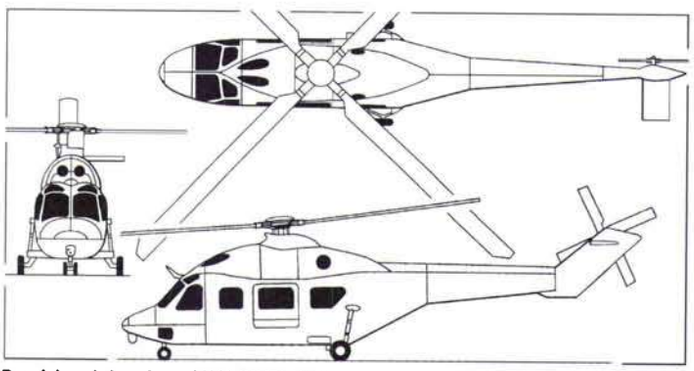
WEIGHTS AND LOADINGS (approx):

Typical mission weight	7,030-7,484 kg (15,500-16,500 lb)
Max T-O weight	8,618 kg (19,000 lb)
Max disc loading	44.07 kg/m² (9.03 lb/sq ft)

PERFORMANCE (design):

Max cruising speed	more than 140 kt (259 km/h; 161 mph)
Endurance	more than 2 h

Model of KUH shown at Asian Aerospace, Singapore, February 2006 *(Paul Jackson)* 1158275



Provisional drawing of KAI (KHP) KUH *(Paul Jackson)* 1158502

KAL

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KAL's Aerospace Division was founded in 1976 and began by producing McDonnell Douglas MD 500MD and 500D helicopters under licence, the first aircraft manufacturing venture accomplished in South Korea. It soon achieved a high level of national defence capability with similar programmes which, since the 1980s, have included military aircraft such as the Sikorsky UH-60P (parts manufacture, component testing, final assembly and subsequent upgrade); Northrop F-5E/F fighter; and GD/Lockheed Martin F-16C/D (main wings and rear fuselages, as a primary contractor for the Korean Fighter Programme); and development of the MD 520K helicopter. KAL-ASD also plays an active role in modifying and maintaining various other military aircraft, supplying wings, fuselage and empennage components to a number of worldwide major manufacturers, currently including centre and rear fuselages for the KAI KT-1 basic trainer. KAL's R&D arm, KIAT, was expected to be involved in development of the new Korean Helicopter Programme (KHP), which has replaced the former Korean Multirole Helicopter (KMH).

With more than 20 years' experience of designing, manufacturing and testing structural and non-structural components, KAL-ASD has also participated in worldwide commercial aircraft development programmes, becoming a major supplier to Boeing (717, 737NG, 747, 777), Airbus (A330/340) and Embraer (170/190). It was selected in October 2005 to supply raked wingtips for the Boeing 787-8 Dreamliner.

Since beginning in 1978 with the F-4 Phantom, KAL has accumulated considerable experience and expertise in depot level maintenance for some 2,500 military aircraft of more than 30 different types on behalf of the Korean Ministry of National Defence and/or the US Defense Department, including the fixed-wing A-10, C-130, F-4, F-15, F-16 and P-3C, and AH-1, CH-47, CH-53, OH-58, UH-60, 500MD and Lynx helicopters. Attention is now focused on service life extension and systems improvement programmes.

KARI

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The Aeronautics Programme Office of KARI is undertaking a study for a stratospheric airship and is engaged in the development of the Firefly four-seat light aircraft. The programme for the Bora, another four-seater, has been discontinued. In 2005, KARI was also developing an unmanned tiltrotor.

KARI FIREFLY

TYPE: Four-seat kitbuilt.

PROGRAMME: Developed by KARI as POC technology demonstrator. Prototype made maiden flight 21 September 2001; reassembled at Velocity facility in Florida June 2002 and registered N2059U, appearing at EAA AirVenture, Oshkosh, in following month. Acted as US demonstrator 2003. Donated to Polar flier Gus McLeod for flight to South Pole, leaving US on 29 December 2003, but abandoned at Marambro Station, Antarctica, in February 2004 because of unfavourable weather; subsequent appearances at Sun 'n' Fun and Oshkosh in 2004. Re-registered N90NS in November 2004; owner Polar Explorer Inc.

Second prototype meanwhile employed in Korea as avionics and equipment testbed. Shin Young Heavy Industries Company appointed by KARI in May 2003 to market kits in USA. Prototype of revised design, with new fuselage and retractable landing gear, scheduled to fly in 2005, but not reported by mid-2006.

DESIGN FEATURES: Modern, high-performance, custom-built long-range aircraft of canard configuration. Fuselage and wings of Velocity XL, but wingtip fins and rudders replaced by twin sweptback vertical tail surfaces on cantilever booms extending from wings at approximately one-third span. Incorporates latest advances in aerodynamics and construction; main objectives good utilisation, economy, comfort, simplicity and flight safety.

Wings have modified Eppler 1230 aerofoil sections, extended forward in strakes at root end, with 0° dihedral, 0° 30' incidence and 2° 30' washout; 18° sweepback on outer leading-edges; 44° 42' sweepback on strake leading-edges. Non-swept foreplane of R1145MS (modified) section, thickness/chord ratio 13.7 per cent. Vertical tail surfaces have NACA 0012 section and 35° 18' leading-edge sweepback.

FLYING CONTROLS: Conventional and mechanical, except for electrical actuation of elevator trim and speed brake. All controls horn-balanced. No flaps.

STRUCTURE: Three-piece composites wing; foreplane and tail structures of styrene foam, glass fibre, carbon fibre and epoxy; fuselage covered with glass fibre inside and out.

LANDING GEAR: Tricycle type; fixed. All units cantilevered from fuselage and fitted with wheel fairings. Toe brakes. Retractable gear version under development.

POWER PLANT: One 186 kW (250 hp) Textron Lycoming IO-540-C4B5 flat six, driving an MT Propeller MTV-9-B/LD178-102 three-blade constant-speed pusher propeller. Fuel in two strake tanks and fuselage sump tank; combined capacity 272.5 litres (72.0 US gallons; 60.0 Imp gallons), of which 266 litres (70.2 US gallons; 58.5 Imp gallons) usable.

KARI Firefly flown by Gus McLeod *(Paul Jackson)* 1158264

ACCOMMODATION: Pilot and three passengers, in tandem pairs. Upward-opening gull-wing door each side. Cockpit layout designed to complement pilot workload, with throttle, mixture control and rpm pedestal in centre console and pitch trim control switch on each control wheel; flyable from either front seat.

SYSTEMS: 24 V DC electrical system.

AVIONICS: VFR only. First prototype has Garmin GNS 430 (VHF, VOR and GPS), GTX 327 transponder and GMA 340 marker beacon receiver.

EQUIPMENT: External power source adaptor.

DIMENSIONS, EXTERNAL:

Wing span	10.27 m (33 ft 8¼ in)
Foreplane span	5.06 m (16 ft 7¼ in)
Length overall	6.76 m (22 ft 2 in)
Height overall	2.20 m (7 ft 2½ in)
Propeller diameter	1.78 m (5 ft 10 in)

DIMENSIONS, INTERNAL:

Cabin: Length	2.13 m (7 ft 0 in)
Max width	1.27 m (4 ft 2 in)
Max height	1.08 m (3 ft 6½ in)

AREAS:

Wings, gross	11.61 m² (125.0 sq ft)
Ailerons, net	0.69 m² (7.40 sq ft)
Foreplane, net	2.10 m² (22.60 sq ft)
Vertical tail surfaces, total	1.58 m² (17.00 sq ft)
Rudder, net	0.49 m² (5.30 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, standard	832 kg (1,835 lb)
Payload with max fuel	220 kg (485 lb)
Max T-O and landing weight	1,247 kg (2,750 lb)
Max wing loading	107.4 kg/m² (22.00 lb/sq ft)
Max power loading	6.70 kg/kW (11.00 lb/hp)

PERFORMANCE:

Max level speed at S/L	180 kt (333 km/h; 207 mph)
Cruising speed at FL 75, 75% power	170 kt (315 km/h; 196 mph)
Foreplane stalling speed	64 kt (119 km/h; 74 mph)
Max rate of climb at S/L	366 m (1,200 ft)/min
Service ceiling	6,100 m (20,000 ft)
T-O to 15 m (50 ft)	381 m (1,250 ft)
Landing from 15 m (50 ft)	305 m (1,000 ft)
Range with max fuel	1,000 n miles (1,852 km; 1,115 miles)
g limits: tested	+6
design	+9/–7

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SKYGEAR

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VICE-PRESIDENT ENGINEERING: Paul Kenneth

Founded by Mr Lee, KLAC, which trades as SkyGear, moved from its original plant in Namwon to larger premises in late 2002. Has also established composites parts manufacturing plant in Qingdao, China. SkyGear's Comet was said to be the first South Korean homebuilt to appear on the US market and it continues to be promoted by Airdale Flyer of Caldwell, Idaho. A pusher design, the Albatross, has been added to the range.

SKYGEAR COMET

TYPE: Side-by-side ultralight/kitbuilt.

PROGRAMME: Design started by Paul Kenneth in mid-1990s; made US debut at Sun 'n' Fun in 2001. Originally promoted as ready to fly aircraft in South Korea. Marketed in US by SkyGear USA of Compton, California; promoted for LSA category. US demonstrator (N5129T) registered 2006.

CURRENT VERSIONS: **Comet 21:** Baseline version. US kit marketing by Airdale Flyer.

Comet UL: Fabric-covered wings for reduced empty weight. Wing span 10.82 m (35 ft 6 in).

Comet SP: LSA (Sport Pilot) version. Aluminium wing and composites fuselage.

COSTS: Comet SP, 200-hour quick-build kit USD19,450; 'firewall back' completely assembled USD24,450; flyaway price on application (2006).

DESIGN FEATURES: Braced high-wing monoplane, similar in appearance to Cessna 152. Available ready to fly or in kit form; quoted build time 200 to 300 hours.

FLYING CONTROLS: Conventional and manual. Frise ailerons; elevator electric trim. Fowler flaps.

STRUCTURE: Prewelded 4130 chromoly steel tube fuselage inside two CFRP half-shells; pop-riveted, single-spar, all-aluminium wing with drooped tips; all-CFRP one-piece tailplane. Wings of fabric-covered composites or all aluminium, according to version.

LANDING GEAR: Tricycle type; fixed. Rubber-sprung, steerable nosewheel; fuselage-mounted cantilever sprung steel main legs. Hydraulic brakes.

POWER PLANT: *Comet 21:* One 59.7 kW (80 hp) Jabiru 2200 engine, driving two-blade propeller.

Comet UL: One 47.8 kW (64.1 hp) Rotax 582 UL.

Usable fuel capacity (two tanks) 38 litres (10.0 US gallons; 8.3 Imp gallons) standard, 76 litres (20.0 US gallons; 16.6 Imp gallons) optional.

Comet SP: One 59.6 kW (79.9 hp) Rotax 912 UL. Total fuel capacity 83 litres (22.0 US gallons; 18.3 Imp gallons).

ACCOMMODATION: Pilot and passenger. Forward-opening window/door each side; one-piece Plexiglas windscreen.

AVIONICS: VFR or IFR instrumentation to customer's choice.

Data follow for Comet SP.

DIMENSIONS, EXTERNAL:

Wing span	9.04 m (29 ft 8 in)
Length overall	5.89 m (19 ft 4 in)
Height overall	2.13 m (7 ft 0 in)

DIMENSIONS, INTERNAL:

Cabin max width	1.12 m (3 ft 8 in)

AREAS:

Wings, gross	11.00 m² (118.4 sq ft)

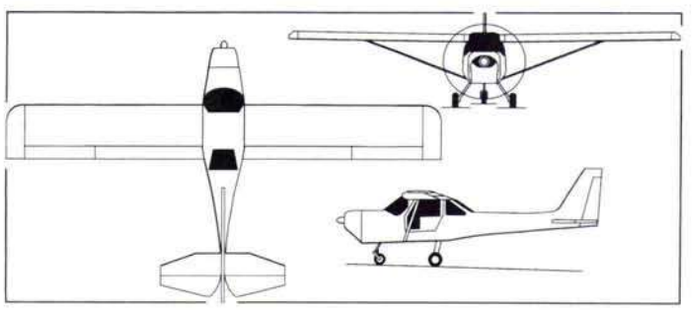
WEIGHTS AND LOADINGS:

Weight empty	258 kg (570 lb)
T-O weight: max	499 kg (1,100 lb)
normal	419 kg (925 lb)

PERFORMANCE:

Max level speed at S/L and VNE:	104 kt (193 km/h; 120 mph)
Max cruising speed at FL70 at 75% power	102 kt (188 km/h; 117 mph)
Stalling speed, flaps down, power on	32 kt (58 km/h; 36 mph)
Max rate of climb at S/L	396 m (1,300 ft)/min
T-O run	92 m (300 ft)
Landing run	61 m (200 ft)

Aspects of SkyGear Comet SP 1158641



SkyGear Comet SP LSA *(Paul Jackson)* 1158578

SKYGEAR ALBATROSS

TYPE: Three-seat kitbuilt.

PROGRAMME: Being promoted in 2006.

COSTS: Kit USD19,950; assembled (minus engine) USD23,950 (2006).

DESIGN FEATURES: High-wing monoplane with V bracing struts; wings fold for transportation and storage. Pod and boom fuselage; mid-set braced tailplane. Large baggage door optional. Aircraft is not designed for aerobatics. Quoted build time 200 hours.

FLYING CONTROLS: Conventional and manual. Primary surfaces pushrod-actuated. Frise-type ailerons; three-position Fowler flaps. Photographs of aircraft show Junkers ailerons.

STRUCTURE: Fuselage is welded chromoly 4130 steel tube truss with carbon fibre reinforced glass fibre outer shell and tail surfaces. Fuselage shell and tail feathers are epoxy primer coated. Wings have aluminium spars, composites (heat-cured epoxy resins) ribs and skin; spars and ribs pre-cut to size to eliminate builder error.

LANDING GEAR: Tricycle type; fixed. Mainwheels have cantilever, self-sprung legs, 800×6 balloon tyres and hydraulic brakes; fully steerable nosewheel. Speed fairings optional.

POWER PLANT: One 48.0 kW (64.4 hp) Rotax 582 or 59.6 kW (79.9 hp) Rotax 912 UL standard; two-blade, fixed-pitch, ground-adjustable, glass fibre pusher propeller. Can also be fitted with suitable Jabiru or BMW alternatives. Fuel tank in each wing, combined capacity 106 litres (28.0 US gallons; 23.3 Imp gallons).

ACCOMMODATION: Two seats side by side, with third seat to rear. Polycarbonate transparencies. Cabin heater optional.

DIMENSIONS, EXTERNAL:

Wing span	10.97 m (36 ft 0 in)
Wing chord, constant	1.22 m (4 ft 0 in)
Wing aspect ratio	8.6
Length: overall	5.69 m (18 ft 8 in)
wings folded	7.21 m (23 ft 8 in)
Width, wings folded	2.51 m (8 ft 3 in)
Height overall	2.235 m (7 ft 5 in)
Tailplane span	3.175 m (10 ft 5 in)
Propeller diameter	1.88 m (6 ft 2 in)

DIMENSIONS, INTERNAL:

Cabin max width	1.14 m (3 ft 9 in)

AREAS:

Wings, gross	13.94 m² (150.0 sq ft)

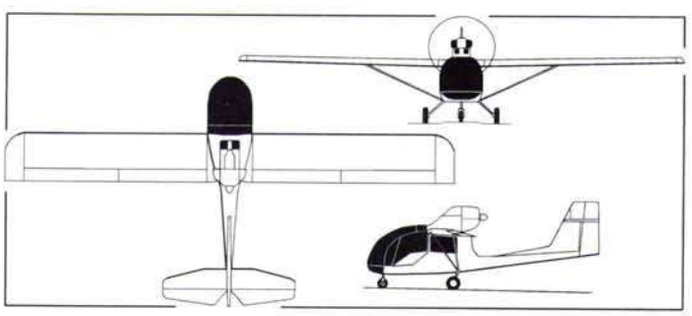
WEIGHTS AND LOADINGS:

Weight empty	249 kg (550 lb)
Max T-O weight: Rotax 582	453 kg (1,000 lb)
Rotax 912 UL	499 kg (1,100 lb)
Max wing loading: Rotax 582	32.55 kg/m² (6.67 lb/sq ft)
Rotax 912 UL	35.80 kg/m² (7.33 lb/sq ft)
Max power loading: Rotax 582	9.45 kg/kW (15.53 lb/hp)
Rotax 912 UL	8.38 kg/kW (13.77 lb/hp)

PERFORMANCE (A: solo at 317.5 kg; 700 lb T-O weight, B: at MTOW):

Never-exceed speed (VNE): A, B	86 kt (160 km/h; 100 mph)
Cruising speed: A, B	70 kt (129 km/h; 80 mph)
Stalling speed: A	35 kt (65 km/h; 40 mph)
B	38 kt (70 km/h; 43 mph)
Best angle of climb speed: A	39 kt (72 km/h; 45 mph)
B	42 kt (77 km/h; 48 mph)
Max rate of climb at S/L: A	305 m (1,000 ft)/min
B	229 m (750 ft)/min
Service ceiling: A, B	3,810 m (12,500 ft)
T-O run: A	37 m (120 ft)
B	92 m (300 ft)
T-O to 15 m (50 ft): A	77 m (250 ft)
B	138 m (450 ft)
Landing run: A	92 m (300 ft)
B	122 m (400 ft)
Range with max fuel, 65% power, no reserves:	
A, B	285 n miles (527 km; 328 miles)
g limits	+5.0/–2.5

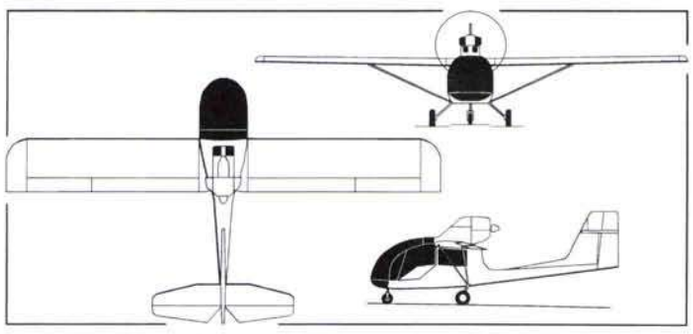
SkyGear Albatross 1158802



SkyGear Albatross general arrangement *(Paul Jackson)* 1158762

SKYGEAR BIKINI

TYPE: Side-by-side ultralight kitbuilt.
PROGRAMME: Being promoted in 2006.
COSTS: Kit USD15,950; fully assembled (minus engine) USD19,950 (2006).
Description and data as for Albatross except for the following:
DESIGN FEATURES: As for Albatross except for shorter-span wings, without flaps, and omission of third seat.
POWER PLANT: Rotax 582 standard; Rotax 503 optional.
DIMENSIONS, EXTERNAL:
Wing span ..... 9.14 m (30 ft 0 in)
Wing aspect ratio 7.2
Length, wings folded ..... 6.30 m (20 ft 8 in)
AREAS:
Wings, gross ..... 11.61 m² (125.0 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 218 kg (480 lb)
Max T-O weight ..... 453 kg (1,000 lb)
Max wing loading ..... 39.06 kg/m² (8.00 lb/sq ft)
PERFORMANCE (A: solo at 317.5 kg; 700 lb T-O weight, B: at MTOW, Rotax 582 engine):
Cruising speed: A, B ..... 70 kt (129 km/h; 80 mph)
Max rate of climb at S/L: B ..... 244 m (800 ft)/min
T-O to 15 m (50 ft): A ..... 199 m (650 ft)
B ..... 229 m (750 ft)
Landing run: A ..... 80 m (260 ft)



SkyGear Bikini general arrangement *(Paul Jackson)* 1158763

Views of SkyGear Bikini and Albatross with Junkers ailerons 1158806

Lithuania

HELISOTA

HELISOTA LAK-X

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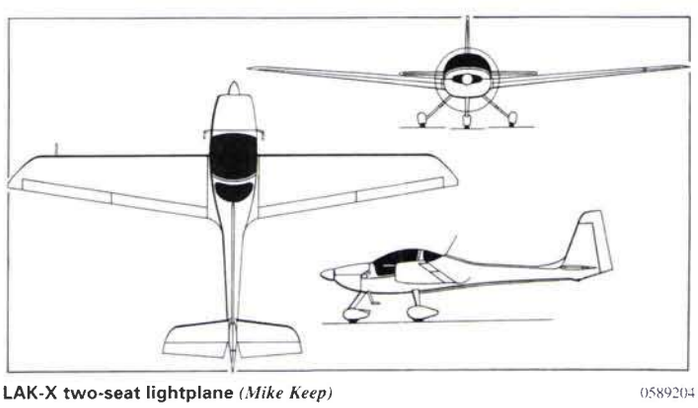
DIRECTOR, COMMERCE: Vladimir Tokmakov
DIRECTOR, INTERNATIONAL SALES: Anatolij Legenzov
DIRECTOR, PRODUCTION: Vaclovas Kliunka

Helisota's principal business is maintenance, repair and overhaul of helicopters and some types of general aviation and light transport aeroplanes. However, in 2004 it announced plans to return to production the indigenous LAK-X lightplane; the company confirmed this was the case in 2006.

HELISOTA LAK-X

TYPE: Side-by-side kitbuilt.
PROGRAMME: Design started by Aeroplastika June 1988; construction of prototype LAK-XE (LY-XMH) begun by Avia Baltika in January 1990; first flight 2 August 1992 with 50.7 kW (68 hp) Limbach L 1700 engine; prototype displayed at Moscow Air Show 1993; later uprated with 65 kW (87 hp) Limbach L 2400; horn balance added to rudder; three (one XE, two XA) completed by January 1996; first customer delivery (second XA prototype) May 1995; Avia Baltika pursued ground and flight test programme for JAR-VLA certification, and intended to produce kits and/or complete aircraft. Programme lapsed in late 1990s; revived in 2004 but as low priority.
CURRENT VERSIONS: **LAK-XA (American):** Continental IO-240 engine, although second LAK-X fitted with PZL-Franklin 4A-235B3 engine to US order.
LAK-XE (European): With choice of three engines, each of less than 74.6 kW (100 hp).
CUSTOMERS: Six reportedly built by Avia Baltika, of which two to USA (currently N8023J and N17EJ).
DESIGN FEATURES: Objectives were short field capability, high L/D range, good fuel economy and cabin comfort. Mid-mounted high-aspect ratio wing; laminar flow NACA 64 series aerofoil, thickness 15 per cent at root, 12 per cent at tip, with 6° dihedral, 4° incidence and 2° twist; fuselage of oval cross-section. Wings detachable for storage.
FLYING CONTROLS: Conventional and manual. Elevators and ailerons actuated by rods/levers, rudder by cables; electrically actuated flaps, maximum deflection 3° up at high cruising speed, 40° down for landing; aileron/flap mixer deflects ailerons 10° down with maximum flap deflection; electrically actuated elevator trim.
STRUCTURE: Wet layup epoxy/glass fibre/foam core composites basic airframe: fuselage moulded in left/right halves with six composites bulkheads and vertical fin webs and ribs; wing moulded in upper/lower shells with root rib, I-beam spar and rear shearweb; tailplane similar.
LANDING GEAR: Tricycle type; fixed. Fuselage-mounted, cantilever self-sprung legs of high-temperature prepreg epoxy/unidirectional glass fibre composites construction; single wheel, with fairing, on each unit; size 115 mm on mainwheels, 100 mm on nosewheel; tyre size 5.00-5 on mainwheels, 300 × 125 mm on steerable nosewheel (±180°); pressures 3.43 bars (50 lb/sq in) on mainwheels, 2.94 bars (43 lb/sq in) on nosewheel; hydraulic disc brakes.
POWER PLANT: *LAK-XA:* One 93.2 kW (125 hp) Teledyne Continental IO-240-B engine driving a Warp Drive ground-adjustable pitch propeller. Fuel capacity 85 litres (22.4 US gallons; 18.7 Imp gallons).
LAK-XE: One 69.4 kW (93 hp) Limbach L 2400 engine driving a Mühlbauer MTV-1 two-blade constant-speed (electric) composites propeller. Fuel in two integral wing tanks each with filler port; combined capacity 110 litres (29 US gallons; 24.2 Imp gallons) of which 100 litres (26.4 US gallons; 22 Imp gallons) are usable.
ACCOMMODATION: Two seats side by side under single-piece forward-hinged bubble canopy; baggage compartment behind seats, capacity 30 kg (66 lb); accommodation is heated and ventilated.
SYSTEMS: Electrical system powered by 12 V engine-driven alternator; 12 V 45 Ah battery.
Data below apply to both versions except where noted:
DIMENSIONS, EXTERNAL:
Wing span ..... 10.68 m (35 ft 0½ in)
Wing chord: at root ..... 1.50 m (4 ft 11 in)
at tip ..... 0.80 m (2 ft 7½ in)
Wing aspect ratio 11.3
Length overall: XA ..... 7.00 m (22 ft 11½ in)
XE ..... 6.95 m (22 ft 9½ in)
Height overall ..... 2.20 m (7 ft 2½ in)
Tailplane span ..... 3.30 m (10 ft 10 in)
Wheel track ..... 2.10 m (6 ft 10¾ in)
Wheelbase ..... 1.55 m (5 ft 1 in)
DIMENSIONS, INTERNAL:
Cabin: Length ..... 1.40 m (4 ft 7 in)
Max width (incl wingroot armrests) ..... 1.10 m (3 ft 7¼ in)
Max height ..... 1.10 m (3 ft 7¼ in)
Baggage compartment volume ..... approx 0.50 m³ (17.7 cu ft)
AREAS:
Wings, gross ..... 12.05 m² (129.71 sq ft)
Ailerons (total) ..... 1.10 m² (11.84 sq ft)

Avia Baltika-built LAK-X 0011109



LAK-X two-seat lightplane *(Mike Keep)* 0589204

Trailing-edge flaps (total) ..... 1.04 m² (11.19 sq ft)
Fin ..... 1.48 m² (15.93 sq ft)
Rudder ..... 0.71 m² (7.64 sq ft)
Tailplane ..... 2.40 m² (25.83 sq ft)
Elevators (total) ..... 0.86 m² (9.26 sq ft)
WEIGHTS AND LOADINGS:
Weight empty, equipped: XA ..... 460 kg (1,014 lb)
XE ..... 400 kg (882 lb)
Max T-O weight: XA ..... 750 kg (1,653 lb)
XE ..... 650 kg (1,433 lb)
Max wing loading: XA ..... 62.2 kg/m² (12.75 lb/sq ft)
XE ..... 53.9 kg/m² (11.05 lb/sq ft)
Max power loading: XA ..... 8.05 kg/kW (13.22 lb/hp)
XE ..... 9.38 kg/kW (15.41 lb/hp)
PERFORMANCE:
Max level speed at S/L:
XA ..... 135 kt (250 km/h; 155 mph)
XE ..... 108 kt (200 km/h; 124 mph)
Max cruising speed: XA ..... 118 kt (220 km/h; 136 mph)
XE ..... 97 kt (180 km/h; 111 mph)
Econ cruising speed: XA ..... 108 kt (200 km/h; 124 mph)
XE ..... 86 kt (160 km/h; 99 mph)
Stalling speed:
flaps up: XA ..... 51 kt (95 km/h; 59 mph)
XE ..... 46 kt (85 km/h; 53 mph)
flaps down: XA ..... 44 kt (82 km/h; 51 mph)
XE ..... 40 kt (75 km/h; 47 mph)
Max rate of climb at S/L: XA ..... 300 m (984 ft)/min
XE ..... 240 m (787 ft)/min
Service ceiling: XA, XE ..... 2,000 m (6,560 ft)
T-O run: XA, XE ..... 150 m (495 ft)
Landing run: XA ..... 150 m (495 ft)
XE ..... 100 m (330 ft)
Range with max payload and max fuel:
XA, XE ..... 459 n miles (850 km; 528 miles)
g limits: XA ..... +4/–2

Malaysia

AERONIMBUS

AERONIMBUS AIRCRAFT SDN BHD

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Web: www.aeronimbus.com
CEO: Ma. Yee Choong
SENIOR VICE-PRESIDENT: Rohisan bin Abdul Rehaman

AeroNimbus is international partner with Dirgantara of Indonesia in development of the NMX-1 six-passenger light business jet (which see). Company was formed in 2003, and by late 2005 had workforce of over 100 (80 at factory in Indonesia, 25 in Malaysia and small numbers in Singapore and Thailand).

CTRM

COMPOSITES TECHNOLOGY RESEARCH MALAYSIA SDN BHD

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CEO: Col (Retd) Rosdi bin Mahmud
COO: Francis Hiew Nyuk Fah
HEAD OF CORPORATE MARKETING: Mohd Hezri Ashraf
CORPORATE COMMUNICATIONS MANAGER: Mrs R Charmaine

Incorporated in November 1990, CTRM became an investor in Eagle Aircraft of Australia, via its subsidiary CTRM Aviation, formerly known as Eagle Aircraft (M) Sdn Bhd; component production for the two-seat Eagle 150B began in 1997, subsequently progressing to full local manufacture. This was undertaken in a 20,903 m² (225,000 sq ft) facility at Melaka (Malacca) by CTRM's wholly owned subsidiary CTRM Aero Composites (CTRM AC), formerly known as Aero-Composites Technologies Sdn Bhd. All Eagle production was transferred to Malaysia following closure of the Australian factory at the end of February 2002, but ceased at the end of 2005. CTRM also had an 18 per cent investment in The Lancair Company, USA, for which CTRM AC produced composites fuselages for the Lancair Columbia 300; however, this work also ended in late 2005 after CTRM transferred more than half its holding in Lancair to the Malaysian government, reducing its own stake to less than 7 per cent. It also is under contract to BAE Systems to produce composites wing leading- and trailing-edge panels for the Airbus A300, A318/319/320/321 and A380, the 1,000th set being handed over to BAE on 8 December 2005. A EUR12.7 million contract was received from Sonaca on 22 June 2006 for main landing gear doors for the Airbus A400M.

CTRM's associate company Excelnet Sdn Bhd offers engineering solutions ranging from conceptual design to digital mockups and strength/stress analysis. It was involved, with CTRM and BAE Systems, in developing the optionally piloted Eagle 150 Airborne Reconnaissance Vehicle (ARV), details of which are given in *Jane's Unmanned Aerial Vehicles and Targets*. Other work has included wing life extension (spar modification) for the Scottish Aviation Bulldog, for which it has worldwide type certificate maintenance. In late 2003, CTRM and Eurocopter signed an agreement under which the former is overhauling and modifying up to 80 former German Army BO 105 helicopters for EMS and various military roles over the ensuing five years. Initial batch comprises 30 aircraft.

CTRM AVIATION SDN BHD

(Subsidiary of CTRM)
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Formerly known as Eagle Aircraft (Malaysia) Sdn Bhd, CTRM Aviation was established in the mid-1980s to develop and manufacture a new light aircraft, also named Eagle, for the general aviation market. In 1993 it became a wholly owned subsidiary of CTRM, and overall owner (28 May 1993) of Eagle Aircraft Pty Ltd of Australia, where the aircraft was initially produced and/or assembled. Responsibility for the Eagle reverted to Malaysia following February 2002 closure of the Australian factory. Malaysian factory, completed March 1996, has floor area of 24,080 m² (259,200 sq ft).

CTRM EAGLE 150

TYPE: Two-seat lightplane.
PROGRAMME: Launched 1981 with objective of producing first all-composites light aircraft in Australia; single-seat POC (proof-of-concept) aircraft now displayed at Power House Museum, Sydney; construction of two-seat preproduction prototype Eagle X started fourth quarter 1987; first flight (VH-XEG) second quarter 1988, with 58 kW (78 hp) Aeropower engine, replaced later by 74.5 kW (100 hp) Continental O-200; 200 hour test programme, meeting all original design criteria, completed by October 1988; plans for 1989 production start aborted; component manufacture began March 1991; production prototype (PPT1/VH-XEP) made first flight 6 November 1992; weight-restricted certification by Civil Aviation Safety Authority of Australia (CASA) 21 September 1993; European JAR-VLA certificate not awarded at that time and aircraft consequently redesigned with changes including increased span and chord on foreplane and mainplane flaps; redesigned and repositioned wing cuffs, with leading-edge extension outboard; vortex generators and redesigned horizontal stabiliser aerofoil section.

Series production in Australia, as Eagle X-TS, launched August 1993; first flight (VH-AHH) 23 October 1993 and first customer delivery December 1993 (VH-FPO to Department of Conservation and Land Management in Western Australia). Initial production in Australia only, but using some components manufactured by Eagle Aircraft (Malaysia) of which Eagle Aircraft Pty Ltd was a wholly owned subsidiary. First Series 150 (converted production prototype VH-XEP) rolled out August 1997; certified on 13 November 1997 by CASA to JAR-VLA standards at MTOW of 640 kg (1,411 lb); this certification also valid in Malaysia. FAA certification achieved 11 February 1999, followed by New Zealand approval in mid-1999; also approved in Thailand. First night VFR instrumented aircraft certified and delivered in December 2000.

First aircraft completed from Malaysian components (VH-PMI, c/n MA 00001) made maiden flight 27 March 2001. In December 2001 it was announced that production was moving to Malaysia and operations in Australia were being run down; this was achieved in late February 2002 and type certificate transferred to Eagle Aircraft Malaysia on 30 May 2002 and CTRM Aviation on 1 January 2004. Malaysian production ceased in late 2005.
CURRENT VERSIONS: **Series 100:** Retrospective designation of former Eagle X-TS: production completed. Ten Series 100/Eagle X-TS built, including two for Malaysia (c/n 0003 and 0005) and one for John Roncz in USA (c/n 0010): five conversions (c/n 0002/3/5/7/8) to Series 150.

Series 150: Main production version, designated **150A** with IO-240-A engine and **150B** with IO-240-B. Engines have same maximum power of 93.2 kW (125 hp), but B version has increased mid-range power of almost 29 per cent to 69.4 kW (93 hp) and is 3.7 per cent quieter than A model. Available in Basic, Training and Executive variants, as below. US promotion devoted to 150B version only, this being sole variant with FAA certification.

Basic: Standard Series 150 version; *as described*.

Training: As Basic, with addition of tachometer, turn co-ordinator, directional gyro, digital clock, cockpit internal lighting, transponder, nav/com/VOR, navigation and landing lights and Eagle external pinstriping and decals.

Executive: As Training, plus GPS moving map display, mainwheel spats, leather upholstery, cabin heater, baggage bins, sun visor and chart pocket.

CTRM Eagle 150 *(Paul Jackson)* 1159170

Eagle ARV: Optionally piloted surveillance version (Aerial Reconnaissance Vehicle), co-developed by CTRM with BAE Systems Controls of California, which supplied complete modification kit including flight management system, sensor payload, datalink and ground control station. One four-aircraft system delivered to Royal Malaysian Air Force in late 2001. Further details in *Jane's Unmanned Aerial Vehicles and Targets*.

CUSTOMERS: Series 150 operators in Australia, Malaysia, New Zealand, USA and elsewhere. By January 2003, production (including Eagle X-TS) totalled 46 in Australia (including two prototypes), of which 42 to customers in Australia, New Zealand and USA (two). At least 14 from Malaysian production by early 2005, comprising four ARVs for RMAF, seven Series 150s for Malaysian Flying Academy and four for ESB Flying Club.

TAG

THE AIRSHIP GROUP

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Web: www.airships.ec
PRESIDENT: Philip Yiin

TAG established on Sarawak in 1988 and is now a diversified high-technology industry group with four divisions, including two in aerospace services:

Airship Group: Comprising Airship Systems Sdn Bhd, Airship Concepts Sdn Bhd and Airview Services Sdn Bhd

Aerospace City: Comprising LTA Solutions Sdn Bhd, Airview Services Sdn Bhd and Academy Sdn Bhd

Alom Group: Construction projects

Technology Incubators: R&D

Development of new projects is responsibility of Airship Concepts; manufacture by Airship Systems; support by Airview Services.

LTA sector of Aerospace City, planned by TAG's Airship Group 1121900

In October 2003, TAG acquired (for EUR13,500) the former CargoLifter 'Joey' prototype which, in 2004, was being modified to serve as a publicity vehicle. No further news of this had emerged by mid-2006. Other products include inflatable hangars and aerostats for various applications.

TAG AG SERIES

TYPE: Helium semi-rigid airship.
PROGRAMME: Range of new-generation airships under development, as described below.
CURRENT VERSIONS: **AG22U:** Remotely piloted, 22 m (72.2 ft) long unmanned airship. In flight test by April 2004 and expected to enter service by mid-year.

AG33mu: Manned technology demonstrator, 33 m (108.3 ft) long, with pilot-controlled mooring system and other innovative capabilities. Under construction in 2004, but no news of any progress by mid-2006.

AG45: Under consideration in late 2004; possibly as alternative manned technology demonstrator to AG33. Length 45 m (148 ft).

AG90: 90 m (295.3 ft) long semi-rigid, able to carry up to 50 passengers. Design under way in early 2004; said then to be built later that year for 'a regional government' but apparently not accomplished.

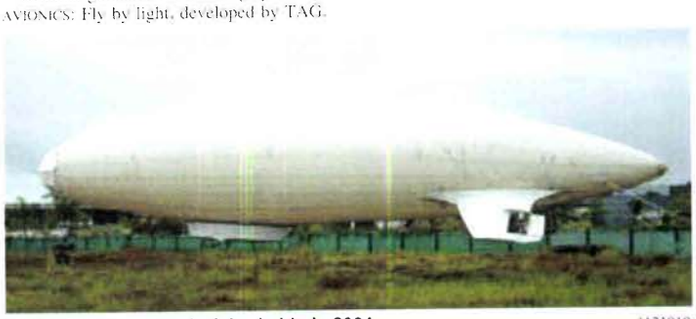
AG90DB: Hybrid, twin-hull vehicle project for ultra-large payloads and with partial aerodynamic lift.

AG100L: Lenticular design for logging industry and other aerial crane roles.

AG180: Projected heavy-lift semi-rigid, 180 m (590.6 ft) long and having 50 tonne payload capacity.

AG300: Projected stratospheric airship with ultra-long endurance.

DESIGN FEATURES: Conventional-shape envelope (except AG100L), and twin tailfins with elevators. Twin rear-mounted propulsion engines, located within tailfins. Third engine, mounted within bow, provides multidirectional thrust vectoring for directional control and terminal guidance for mooring system.
AVIONICS: Fly by light, developed by TAG.



TAG AG22 unmanned trials airship in 2004 1121918

Netherlands

DAC

DUTCH AEROPLANE COMPANY VOF

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Web: www.dac-ranger.nl
DIRECTORS:
Evert-Jan Cornet (Information)
Jan Laurier (Technical)

DAC was established in 1999 to produce what is now known as the RangeR.

DAC RANGER

TYPE: Side-by-side kitbuilt.
PROGRAMME: Based on Opel-powered Dieselis PL2 (F-PTDI), built in France by Paul Lucas and Serge Pennec, first flown September 1998, and shown at PFA International Rally, Cranfield, UK, in July 1999, where selected as basis of DAC venture. Martin Hollmann of US company ADI contracted by DAC to transform wood/composites Dieselis into RangeR, with changes to structure, fuselage size and wing section. Alex Swagemakers of TTE redesigned Opel 1.7 litre turbo-diesel engine for aeronautical use. Incomplete RangeR prototype (PH-DAC) exhibited at Aero '03, Friedrichshafen, April 2003; first flight then due in USA later in 2003 but this still had not taken place by late 2004 due to design change requirements; in September 2004 the company announced that flight testing would take place in the Netherlands. Taxying tests at de Kooij began on 24 September 2005, and first flight followed on 15 September 2006.
COSTS: Marketed as fast-build kit, with customer's build-assistance option. Estimated kit cost EUR45,000 (2006), including engine and propeller, but excluding avionics.
DESIGN FEATURES: Objectives of RangeR redesign included JAR-VLA conformity, low construction cost, Diesel power, long range and easily disconnected wings for road transport and storage. Low, moderately tapered wing and tailplane; sweptback fin; upturned wingtips; fuselage tapers sharply forward and rear of cockpit. Ventral strake.
FLYING CONTROLS: Conventional and manual. Horn-balanced rudder and single-piece elevator. Flaps; maximum deflection 30°.
STRUCTURE: Composites throughout. Fuselage in left and right halves bonded together, with fin ribs, wing spar bulkheads and firewall pre-installed. Wing main spars glued to bottom skin; forward ribs pre-positioned. Metal engine mount.
LANDING GEAR: Tricycle type; fixed. Cantilever main legs; speed fairings on all wheels.
POWER PLANT: Initially to be one Opel Corsair Y17DT Diesel engine, with turbocharger and intercooler, rated at 67.1 kW (90 hp) at 4,000 rpm, driving a GT GT-2/174/VQS two-blade, wood/composites, fixed-pitch propeller via a 1:1.67 reduction gear. Later changed to 67.1 kW (90 hp) Isuzu 1686 CCM turbo-diesel engine with turbocharger and intercooler driving a three-blade fixed-pitch propeller via 1:1.66 reduction gear; variable-pitch propeller optional. Fuel capacity 100 litres (26.4 US gallons; 22.0 Imp gallons).
ACCOMMODATION: Two persons, side by side beneath single-piece canopy/windscreen; two rear windows.
AVIONICS: To customer's specification.
DIMENSIONS, EXTERNAL:

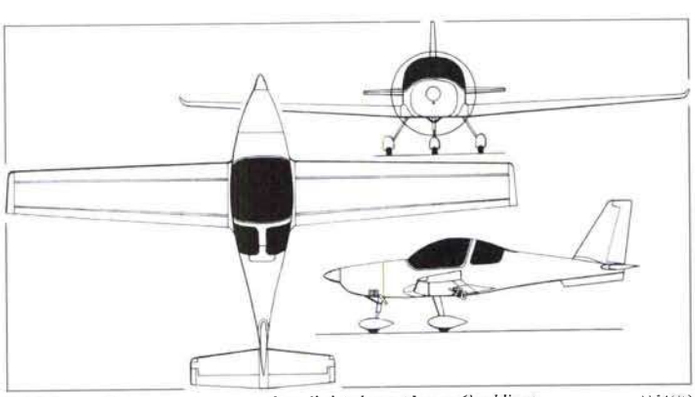
Wing span	9.75 m (31 ft 11¾ in)
Wing aspect ratio	9.3
Length overall	5.87 m (19 ft 3 in)
Propeller diameter	1.74 m (5 ft 8½ in)

DIMENSIONS, INTERNAL:

Cabin max width	1.15 m (3 ft 9¾ in)

AREAS:

Wings, gross	10.24 m² (110.2 sq ft)



DAC RangeR two-seat composites lightplane *(James Goulding)* 1154683

WEIGHTS AND LOADINGS (estimated):
- Weight empty ..... 500 kg (1,102 lb)
- Max T-O weight ..... 750 kg (1,653 lb)
- Max wing loading ..... 73.2 kg/m² (15.00 lb/sq ft)
- Max power loading ..... 11.18 kg/kW (18.36 lb/hp)

PERFORMANCE (estimated):
- Max level speed at FL120 ..... 150 kt (278 km/h; 173 mph)
- Cruising speed at FL80 ..... 132 kt (244 km/h; 152 mph)
- Stalling speed: flaps up ..... 49 kt (89 km/h; 56 mph)
- flaps down ..... 44 kt (81 km/h; 51 mph)
- T-O run ..... 153 m (500 ft)
- Landing run ..... 134 m (440 ft)
- Range ..... 1,241 n miles (2,300 km; 1,429 miles)

DAC RangeR making its first flight 1040557

SSVOBB

STICHTING STUDENTEN VLIEGTUIGONTWIKKELING -BOUW EN -BEHEER

FOUNDATION FOR STUDENT AIRCRAFT DEVELOPMENT, MANUFACTURING AND OPERATION
Kluyverweg 1, NL-2629 HS Delft
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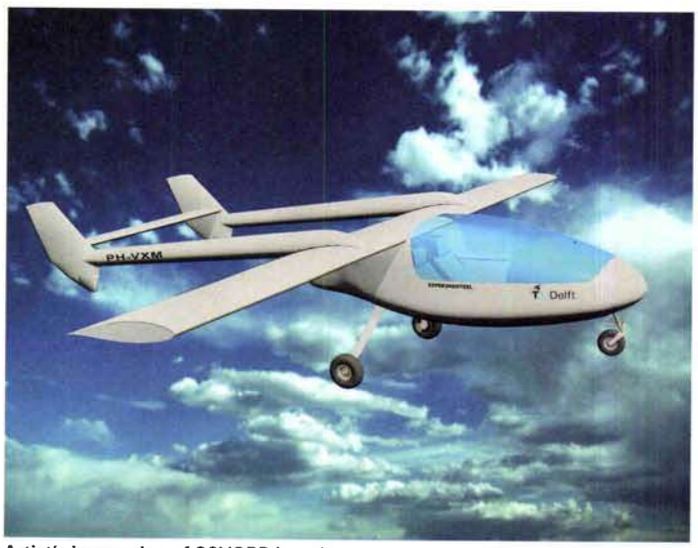
Web: www.lr.tudelft.nl
CHAIRMAN: Thomas van de Lagemaat
SECRETARY: Jasper van 't Hoff
TREASURER: Flip Sondervan

IMPULS PROJECT:
PRODUCTION CO-ORDINATOR: Bastiaan Konneman
ENGINEERING CO-ORDINATOR: Kim Rogiers

SSVOBB was formed in 1990 by The Society of Aerospace Students 'Leonardo da Vinci' of the Delft University of Technology, Faculty of Aerospace Engineering. Its main objective is to co-ordinate the design, manufacture and maintenance of aircraft by students. A replica of the 1937 Lambach HL II aerobatic biplane was constructed between 1989 and 1995, and work is proceeding on an original lightplane design, the Impuls. The projects are financed by funds and sponsorship; in January 2006 Pratt & Whitney donated USD15,000 to the project.



Artist's impression of SSVOBB Impuls 1139053

SSVOBB IMPULS

TYPE: Two-seat lightplane.

PROGRAMME: Preliminary design started early 1994. Registration PH-VXM reserved March 1997. Main fuselage moulds completed early 1999. Main wings due to be completed by mid-2001, but this has slipped to 2005 due to redesign work; by early 2004 wing covering samples were being produced, with intention of producing final version in 2005. The landing gear was completed by Grove Aircraft, California. In mid-2004 a new wind tunnel model was under construction; this is being redesigned and was to have been completed by end 2005. Certification to CS 23 being undertaken under supervision of Prof dr ir Theo van Holten (flight performance); Prof dr ir J A Mulder (stability/control); and Prof dr ir MJL van Tooren (systems and structures).

DESIGN FEATURES: Twin-boom layout with pod-type fuselage and high wing of parallel chord; swept fins.

FLYING CONTROLS: Conventional and manual. Actuation by pushrods (ailerons and elevator), with cable and pushrod interconnected twin rudders. Servo-actuated electric pitch trim and electrically operated single-slotted flaps.

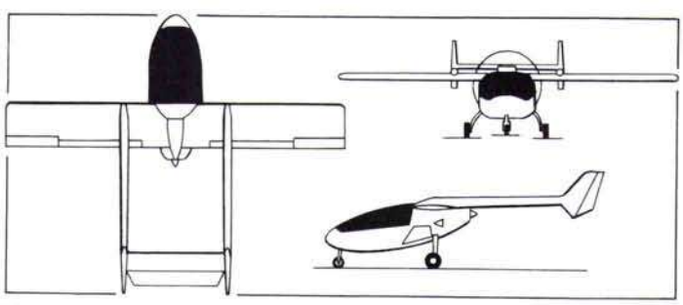
STRUCTURE: All-composites wing with GFRP sandwich skin and spars; GFRP tail unit. Some GFRP parts will be produced by vacuum assisted resin injection process. Fuselage steel tube frame with glass fibre shell will be used to finalise design of cockpit and control systems. Wing section NACA 63$_3$415 with RA163CW3 flaps; twin tailbooms joined by NACA 0012 section horizontal stabiliser.

LANDING GEAR: Non-retractable tricycle type; aluminium cantilever sprung mainwheels. Non-steerable nosewheel; mainwheels have 45 cm (17¾ in) tyres pressurised to 3.14 bar (45.5 lb/sq in). Hydraulically operated brakes on mainwheels.

POWER PLANT: One 74.6 kW (100 hp) Diamond GIAE110R rotary engine driving a three-blade fixed-pitch propeller. Fuel capacity 65 litres (17.2 US gallons; 14.3 Imp gallons) in single tank located between cockpit and engine. Oil capacity 3.0 litres (0.8 US gallon; 0.7 Imp gallon).

ACCOMMODATION: Side-by-side seating for pilot and passenger under one-piece, Perspex canopy. Baggage space behind seats.

DIMENSIONS, EXTERNAL:
- Wing span ..... 7.75 m (25 ft 5 in)
- Wing chord, constant ..... 1.03 m (3 ft 4½ in)
- Wing aspect ratio 7.5
- Length overall ..... 6.37 m (20 ft 10¾ in)
- Fuselage: Length ..... 3.32 m (10 ft 10¾ in)
- Max width ..... 1.20 m (3 ft 11¼ in)
- Height overall ..... 2.15 m (7 ft 0¾ in)
- Tailplane span ..... 2.10 m (6 ft 10¾ in)
- Wheel track ..... 2.20 m (7 ft 2½ in)
- Wheelbase ..... 1.75 m (5 ft 9 in)
- Propeller diameter ..... 1.50 m (4 ft 11 in)



SSVOBB Impuls (Diamond rotary engine) *(Paul Jackson)* 0051122

AREAS:
- Wings, gross ..... 8.00 m² (86.1 sq ft)
- Ailerons (total) ..... 0.66 m² (7.10 sq ft)
- Flaps (total) ..... 1.06 m² (11.41 sq ft)
- Fins (total) ..... 2.00 m² (21.53 sq ft)
- Rudders (total) ..... 0.24 m² (2.58 sq ft)
- Tailplane ..... 1.51 m² (16.25 sq ft)
- Elevators (total) ..... 0.62 m² (6.67 sq ft)

WEIGHTS AND LOADINGS (estimated):
- Weight empty ..... 375 kg (827 lb)
- Baggage capacity ..... 30 kg (66 lb)
- Max T-O weight ..... 575 kg (1,267 lb)
- Max wing loading ..... 71.9 kg/m² (14.72 lb/sq ft)
- Max power loading ..... 7.71 kg/kW (12.67 lb/hp)

PERFORMANCE (estimated):
- Max level speed at S/L ..... 124 kt (230 km/h; 142 mph)
- Max cruising speed ..... 113 kt (210 km/h; 130 mph)
- Stalling speed ..... 52 kt (96 km/h; 60 mph)
- Max rate of climb at S/L ..... 246 m (807 ft)/min
- T-O to 15 m (50 ft) ..... 340 m (1,115 ft)
- Landing from 15 m (50 ft) ..... 430 m (1,410 ft)
- Range with max fuel ..... more than 378 n miles (700 km; 435 miles)
- Endurance ..... 5 h
- *g* limits ..... +4.4/−2.2

New Zealand

ALPHA

ALPHA AVIATION LTD

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Tony Noun
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Barry Colman
CEO: Murray Dreyer
COO: Graeme Edwards
MARKETING & DISTRIBUTION MANAGER: Steve Lange

Alpha established December 2003 to build Robin R 2120/2160 Alpha primary trainer in 14,000 m² (150,700 sq ft) new plant, employing up to 50 workers, at Hamilton. On 25 June 2004 announced imminent conclusion to purchase of rights, jigs and tools from Apex Aviation in France, anticipating first deliveries in 2005 and production build-up to 100 per year. Transfer of rights effected 8 October 2004 and production jigs and tools arrived in New Zealand in January 2005. Intended completion of first aircraft in April 2005 postponed, manufacture taking place in temporary premises at Ingram Road following rejection of planning application for new site at Middle Road. Izard Pacific Aviation is shareholder, with HA Investments, Hammersmith Holdings and Hansen Aviation Services.

ALPHA 120

TYPE: Primary prop trainer/sportplane.
PROGRAMME: Derived from original Robin HR 200-120B, which had first flown (as HR 200-125 prototype F-WSQP) on 29 July 1971 and was built in France through much of 1970s in several subvariants; returned to production in 1993 with minor modifications as HR 200-120B. Final example of this version built in late 2000, by which time Robin 2120 and 2160 were in production.

R 2120 announced in early 2001. Combines fuselage, vertical tail surfaces, fuel capacity and power plant of Robin HR 200-120B with wings and horizontal tail surfaces of R 2160. Prototype (F-WZZX) completed mid-2000; demonstrator (F-WZZY) shown at Aero '01, Friedrichshafen, April 2001. First production aircraft (EC-HMG) to Spain by early 2001.

At Aero '03, in Friedrichshafen, Robin exhibited a fuselage mockup of an HR200 variant with Thielert Centurion 1.7 diesel engine driving a three-blade MTV-6-A/187-129 propeller; no details of planned production were given.

Design rights acquired in 2004 by Alpha Aviation of New Zealand. R 2120 became Alpha 120. Target production rate up to 100 aircraft per year, with most components being sourced from local suppliers. New Zealand Civil Aviation Authority validated type certificate A-15 on 16 June 2006, covering HR 200 and R 2000-series and replacing EASA TC No. 70.

CURRENT VERSIONS: **HR 200-100:** Lycoming O-235-H2C engine.

HR 200-100S: As -100, but no wheel fairings or propeller spinner.

HR 200-120: As -100, but O-235-J2A engine.

HR 200-120B: As -120, but modified stabilator and disc brakes.

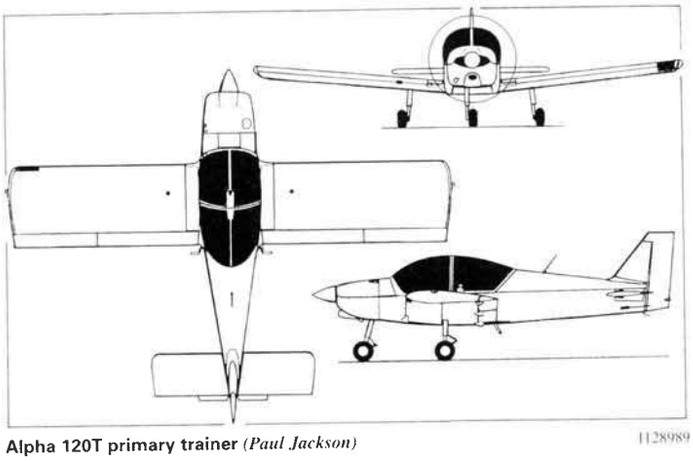
HR 200-160: As -100, but O-320-D engine.

R 2160: Aerobatic. As HR 200-160, but new wing section, ailerons and flaps; enlarged rudder with underfin.

R 2100: Aerobatic. As R 2160, but O-235-H2C engine; no wheel fairings or spinner if fitted with McCaulley 1A-105BCM 70-56 propeller.

R 2100A: Aerobatic. As R 2100, but increased weight and revised propeller; spinner and wheel fairings fitted.

Robin-built HR 200-120 *(Paul Jackson)* 1158290



Alpha 120T primary trainer *(Paul Jackson)* 1128989

R 2160D: Aerobatic; German market. Engine limited to 2,600 rpm for noise reduction.

R 2112: Aerobatic. As R 2100, but O-235-L engine with revised air intake and increased weight.

R 2160i: Aerobatic. As R 2160, but AEIO-320-D2B with inverted fuel and oil systems.

R 2120U: Non-aerobatic. As R 2112, but O-235-L2A, small rudder, no underfin and no wheel fairings.

Alpha 120T: Marketing designation of initial New Zealand version.

CUSTOMERS: Combined 340 HR 200/R 2120/R 2160s built by late 2005, including two in 2004 and one in 2005 (F-HAPC) from remaining French components. French exports in Australia, Belgium, Canada, Denmark, Finland, Germany, Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, Thailand, UK and USA. Alpha Aviation expects to export 90% of its production.

ROBIN HR 200-SERIES PRODUCTION

Version	First aircraft	Year	Quantity	
			First series	Second series
HR 200-125 Club	F-WSQP	1971	1	
HR 200-100 Club	F-WSQR	1975	71	
HR 200-100B Club	F-BVYA	1974	1	
HR 200-100S Club	F-BXJS	1976	10	
HR 200-120 Club	F-BXEV	1975	4	
HR 200-120B	F-WUQB	1974	16	70
HR 200-160 Acrobin	F-WSQS	1974	4	
R 2160 Alpha Sport	F-WZAC	1976	1	
R 2100	F-GAVE	1977	6	
R 2100A Club	F-GAVD	1977	24	
R 2112 Alpha	F-GBAL	1978	10	1
R 2112A	EI-BIU	1980	1	
R 2160 Alpha Sport	F-GAOR	1977	46[1]	24
R 2160 Acrobin	OO-VLU	1977	4	
R 2160D Acrobin	F-GAOL	1977	11	3
R 2160LC	F-WZZX	1996		1
R 2000-120	F-GSIU	1996		1
R 200-160	HB-KFA	1999		3
R 2160i	HS-TPA	1999		7
R 2120U	F-WZZX	2000		18
R 2160U	F-WQPO	2002		1
unknown			1	
Subtotal			**211**	**129**
Total			**340**	

[1] Including 23 assembled in Canada

COSTS: NZD199,000 (2006).
DESIGN FEATURES: Low-mounted, constant-chord wing, sweptback fin and low, all-moving tailplane.

Wing section NACA 23015; dihedral 6° 20'; incidence 3° at root.
FLYING CONTROLS: Manual. Conventional fully balanced slotted ailerons and horn-balanced rudder without tabs. All-moving tailplane with anti-balance tabs each side. Electrically actuated slotted flaps.
STRUCTURE: Aluminium alloy wing spars and skinning; semi-monocoque fuselage. Anti-corrosion treatment standard.
LANDING GEAR: Non-retractable tricycle type with fairing, oleo-pneumatic shock-absorber and tyre (380×150) on each leg. Cleveland disc brakes on mainwheels. Nosewheel steering through rudder bar, self-centering in flight. Parking brake standard.
POWER PLANT: One 88.0 kW (118 hp) Textron Lycoming O-235-L2A flat-four engine, driving a Sensenich 72-CK6-054 two-blade, fixed-pitch aluminium propeller. Provisional design studies completed for installation of 134 to 149 kW (180 to 200 hp) engine. Christen 603 inverted oil system and inverted fuel system standard. Fuselage fuel tank, capacity 120 litres (31.7 US gallons; 26.4 Imp gallons).
ACCOMMODATION: Two seats side by side on fore-and-aft adjustable, six-position bucket seats; four-point harnesses standard. Dual controls (sticks) standard. Dual swivel-type fresh air vents, cabin heating system, windscreen defrost cabin lights, stereo headset sockets and map and storage pockets, all standard. Baggage compartment, with tiedown straps, behind seats, maximum capacity 34 kg (75 lb).
SYSTEMS: 14 V 24 Ah electrical system.
AVIONICS: *Comms:* Garmin GNC 250XL GPS/Com, Garmin GTX 327 transponder, SPA400 intercom and ELT, all standard.

Instrumentation: Artificial horizon, direction indicator, sensitive altimeter, ASI, VSI, magnetic compass, turn co-ordinator, OAT gauge and annunciator light panel, all standard.
EQUIPMENT: Landing, taxi, anti-collision and navigation lights, tinted canopy, tiedown points, towbar and white base coat paint with two trim colours, all standard.
DIMENSIONS, EXTERNAL:

Wing span	8.33 m (27 ft 4 in)
Wing aspect ratio	5.6
Wing chord, constant	1.555 m (5 ft 1¼ in)
Length overall	6.64 m (21 ft 9½ in)
Tailplane span	3.04 m (9 ft 11¾ in)
Tailplane chord	0.725 m (2 ft 4½ in)
Wheelbase	1.43 m (4 ft 8¼ in)
Propeller diameter	1.83 m (6 ft 0 in)

DIMENSIONS, INTERNAL:

Cabin max width	1.07 m (3 ft 6 in)

AREAS:

Wings, gross	12.50 m² (134.5 sq ft)
Ailerons, total	1.06 m² (11.41 sq ft)
Trailing-edge flaps, total	1.34 m² (14.42 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	544 kg (1,199 lb)
Max T-O weight	800 kg (1,764 lb)
Max wing loading	64.0 kg/m² (13.11 lb/sq ft)
Max power loading	9.09 kg/kW (14.94 lb/hp)

PERFORMANCE:

Cruising speed at 75% power at 2,591 m (8,500 ft)	104 kt (193 km/h; 120 mph)
Max rate of climb at S/L	192 m (630 ft)/min
T-O to 15 m (50 ft)	490 m (1,610 ft)

Landing from 15 m (50 ft) ..... 480 m (1,575 ft)
Range with max fuel ..... 510 n miles (944 km; 586 miles)
g limits ..... +6/−3.5

ALPHA 160

TYPE: Aerobatic two-seat lightplane.

PROGRAMME: Certified in France as Robin R 2160 in mid-1978 and in USA (FAR Pt 23 Aerobatic and Utility category) 15 November 1982. Some aircraft assembled in Canada (1983–85). Production then ceased, but restarted in France January 1994; transferred to New Zealand in 2005; initial Antipodean production aircraft (ZK-FXY, c/n 160A-06001) first flew 12 April 2006.

CURRENT VERSIONS: Refer to Alpha 120 entry for evolution of earlier aerobatic versions.

Alpha 160A: Baseline version previously Robin R 2160, *as described below.*

Alpha 160Ai: Original Robin R 2160i certified 8 July 1998, with 119 kW (160 hp) Textron Lycoming AEIO-320-D2B fuel-injected flat-four. First two to CATC training college in Thailand, 1998.

CUSTOMERS: Total of over 133 sold in Europe, Australia, New Zealand, Canada and USA by late 2002, including 97 in first series. No known production in 2003, but one built in France for New Zealand in 2004. New Zealand production began in 2006. First significant order in May 2006 for 12 (plus 14 options) from CTC Aviation Flight School at Hamilton, New Zealand; three others for Waikato Aero Club and two to Southern Wings at Invercargill.

COSTS: NZD249,000 (2006).

DESIGN FEATURES: Generally as Robin R 2120/Alpha 120T, but with extended rudder chord, underfin and other detail changes.

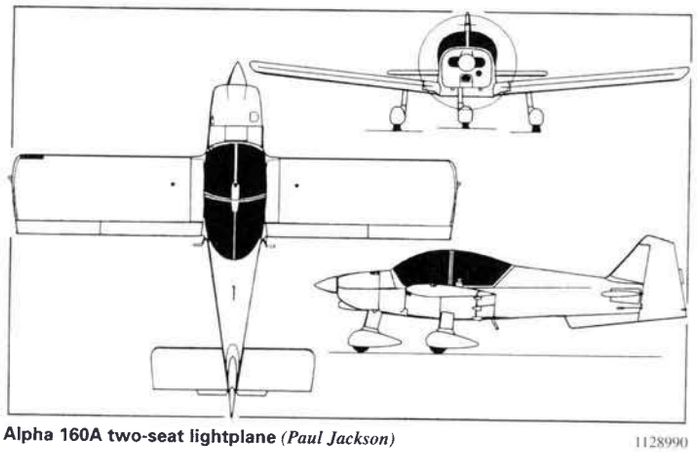
Wing section NACA 23015; dihedral 6° 20'; incidence 3° at root.

FLYING CONTROLS: Manual. Conventional fully balanced slotted ailerons and horn-balanced rudder without tabs. All-moving tailplane with anti-balance tabs each side. Electrically actuated slotted flaps.

STRUCTURE: Aluminium alloy wing spars and skinning; semi-monocoque fuselage. Anti-corrosion treatment standard.

LANDING GEAR: Non-retractable tricycle type with fairing, oleo-pneumatic shock-absorber and tyre (380×150) on each leg. Cleveland disc brakes on mainwheels. Nosewheel steering through rudder bar, self-centering in flight. Wheel fairings on all three wheels standard.

POWER PLANT: One 119 kW (160 hp) Textron Lycoming O-320-D2A flat-four engine, driving a Sensenich 74DM6S5-2-64 two-blade, fixed-pitch aluminium propeller; fuel-injected AEIO-320 in Alpha 160Ai. Christen 603 inverted oil system and inverted fuel system standard on Alpha 160Ai. Fuselage fuel tank, capacity 160 litres (42.3 US gallons; 35.2 Imp gallons). If operated in Utility category, optional fuel tank of 120 litres (31.7 US gallons; 26.4 Imp gallons).



Alpha 160A two-seat lightplane *(Paul Jackson)* 1128990

First Alpha-built Alpha 160, ZK-FXY 1158283

ACCOMMODATION: Two seats side by side on fore-and-aft adjustable, six-position bucket seats; five-point harnesses standard. Dual controls (sticks) standard.

SYSTEMS: 14 V 24 Ah electrical system.

AVIONICS: *Comms:* Garmin GNC 250XL GPS/com; GTX 327 transponder; PS Engineering PMA 4000 audio panel/intercom.

Custom options available.

EQUIPMENT: As for Alpha 120.

DIMENSIONS, EXTERNAL:

Wing span ..... 8.64 m (28 ft 4 in)
Wing chord, constant ..... 1.56 m (5 ft 1¼ in)
Wing aspect ratio 5.8
Length overall ..... 7.10 m (23 ft 3½ in)
Height overall ..... 2.13 m (7 ft 0 in)
Tailplane span ..... 3.03 m (9 ft 11¼ in)
Wheel track ..... 2.91 m (9 ft 6½ in)
Wheelbase ..... 1.44 m (4 ft 8½ in)
Propeller diameter ..... 1.88 m (6 ft 2 in)

DIMENSIONS, INTERNAL:

Cabin: Max width ..... 1.07 m (3 ft 6 in)
Height (seat cushion to canopy) ..... 0.92 m (3 ft 0¼ in)

AREAS:

Wings, gross ..... 13.01 m² (140.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: 160A ..... 585 kg (1,290 lb)
160T ..... 595 kg (1,312 lb)
Max T-O weight: Aerobatic ..... 800 kg (1,764 lb)
Utility ..... 900 kg (1,984 lb)
Max baggage weight ..... 35 kg (77 lb)
Max wing loading: Aerobatic ..... 61.5 kg/m² (12.59 lb/sq ft)
Utility ..... 69.2 kg/m² (14.17 lb/sq ft)
Max power loading: Aerobatic ..... 6.71 kg/kW (11.02 lb/hp)
Utility ..... 7.55 kg/kW (12.40 lb/hp)

PERFORMANCE (O-320 engine at Aerobatic max T-O weight):

Never-exceed speed (VNE) ..... 180 kt (333 km/h; 207 mph)
Max level speed ..... 138 kt (256 km/h; 159 mph)
Cruising speed:
at 75% power ..... 131 kt (241 km/h; 151 mph)
at 65% power ..... 120 kt (222 km/h; 138 mph)
Stalling speed: flaps up ..... 52 kt (96 km/h; 60 mph)
flaps down ..... 46 kt (86 km/h; 53 mph)
Max rate of climb at S/L ..... 314 m (1,030 ft)/min
Service ceiling (30.5 m; 100 ft/min rate of climb) ..... 4,575 m (15,000 ft)
T-O and landing run ..... 230 m (755 ft)
T-O to 15 m (50 ft) ..... 574 m (1,883 ft)
Landing from 15 m (50 ft) ..... 440 m (1,444 ft)
Range at 65% power:
standard fuel ..... 430 n miles (796 km; 494 miles)
optional fuel ..... 558 n miles (1,033 km; 642 miles)
g limits ..... +6/−3

PAC

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CEO: Paul Hebberd
MANAGING DIRECTOR: Brian Hare

Pacific Aerospace Corporation formed 1982 following acquisition of assets and undertakings of New Zealand Aerospace Industries; became wholly owned subsidiary of AeroSpace Technologies of Australia (75.1 per cent) and Lockheed Martin, USA (24.9 per cent). In October 1995, Aeromotive, a privately owned New Zealand company, purchased ASTA's 75.1 per cent share, and became sole shareholder in 2001. PAC maintains production and support facilities for its own aircraft, the CT/4 Airtrainer series, Fletcher FU24 series, Cresco 08–600 and 08–750, and PAC 750XL; by late 2006, almost 600 aircraft had been produced. Cresco continued to be promoted in 2006, but last known aircraft was completed in August 2003. Manufacturing facility also produces items for the Airbus A330/340. Workforce of 165 employed in the company's 24,155 m² (260,000 sq ft) facility in mid-2004.

PAC AIRTRAINER CT/4E

Royal Thai Air Force designation: BF 16

TYPE: Primary prop trainer/sportplane.

PROGRAMME: New Zealand redesign of Australian Victa Aircruiser; first flight 23 February 1972; deliveries began October 1973; 94 (plus two prototypes) built before production ended 1977 (75 CT/4A and 19 special military variants); production line reopened 1991 to build 12 civil CT/4Bs for Ansett Flying College and six for Thailand; last completed August 1992. First flight of CT/4C turboprop prototype (ZK-FXM, converted RAAF CT/4B) 21 January 1991.

CURRENT VERSIONS: **T350:** Turboprop version (previously known as CT/4C) with 313 kW (420 shp) Rolls-Royce 250-B17D (throttle limited to 261 kW; 350 shp) in lengthened nose. Certification was expected 1998 in anticipation of Southeast Asian order for 30, but this failed to materialise. Some interest still being shown in this version.

CT/4E: Developed version of CT/4B with more powerful engine; wing mounted slightly farther forward than on CT/4B; first flight (ZK-EUN, converted from RAAF CT/4A) 14 December 1991; NZ certification (FAR Pt 23 Amendment 36) 8 May 1992.

Detailed description applies to CT/4E.

CUSTOMERS: PAC previously built 75 CT/4As and 38 CT/4Bs; further production of CT/4E began in 1997, of which 13 supplied on 20 year lease to the Royal New Zealand Air Force as replacements for CT/4Bs; contract signed 18 August 1998; first (NZ1985) delivered to Pilot Training Squadron at Ohakea in same month; last (NZ1997) on 8 June 1999; by late 2000 the fleet had accumulated 10,000 flying hours. Also used by Red Checkers aerobatic team. Thailand had requirement for 24 CT/4Es, initial order being for 12, deliveries of which began in July 1999 and were completed in June 2000 (final Thai aircraft of this batch first flew 11 May 2000). Further four Thai aircraft followed in August 2001 and eight more between mid-2004 and March 2005, completing 24 required. Two EFIS-equipped CT/4Es delivered to Singapore Youth Flying Club in June 2002. Total 40 (including demonstrator) built by early 2005; none further by late 2006.

DESIGN FEATURES: Metal translation of 1953-vintage wooden tourer. Conventional, low-wing lightplane. Tapered wings and constant-chord tailplane. Detachable wingtips to allow fitting of optional wingtip fuel tanks.

Wing section NACA 23012 (modified) at root, NACA 4412 (modified) at top; dihedral 6° 45' at chord line; incidence 3° at root; twist 3°; root chord increased by forward sweep of inboard leading-edges; small fence on outer leading-edges.

FLYING CONTROLS: Conventional and manual. Aerodynamically and mass-balanced bottom-hinged ailerons and statically balanced one-piece elevator actuated by pushrods; rudder by rod and cable linkage; ground-adjustable tab on rudder, electric trim control for elevator and rudder; electrically actuated single-slotted flaps.

STRUCTURE: Light alloy stressed skin except for Kevlar/GFRP wingtips and engine cowling; ailerons and flaps have fluted skins.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring steel cantilever mainwheel legs; steerable (±25°) nosewheel carried on telescopic strut and oleo shock-absorber. Main units

PAC CT/4E Airtrainer *(Paul Jackson)* 1040373

have Dunlop Australia wheels and tubeless tyres size 15×6.00, pressure 1.65 bar (24 lb/sq in); nosewheel has tubeless tyre size 14×4.5, pressure 1.24 bar (18 lb/sq in). Single-disc toe-operated hydraulic brakes, with hand-operated parking lock. Minimum ground turning radius 2.90 m (9 ft 6 in). Landing gear designed to shear before any excess impact loading is transmitted to wing, to minimise structural damage in event of crash landing.

POWER PLANT: One 224 kW (300 hp) Textron Lycoming AEIO-540-L1B5 flat-six engine with inverted oil system; three-blade Hartzell HC-C3YF-4BF/FC7663-2R or MT-Propeller MTV-9 series constant-speed metal propeller. Standard fuel capacity of 204.4 litres (54.0 US gallons; 45.0 Imp gallons) of which 200 litres (52.8 US gallons; 44.0 Imp gallons) are usable; wingtip tanks, each of 77.6 litres (20.5 US gallons; 17.1 Imp gallons) capacity, available optionally. Gravity fuelling point in each wing. Oil capacity 11.4 litres (3.0 US gallons; 2.5 Imp gallons).

ACCOMMODATION: Two seats side by side under hinged, fully transparent jettisonable Perspex canopy. Space to rear for optional third seat or 77 kg (170 lb) of baggage or equipment. Dual controls standard.

SYSTEMS: 28 V DC electrical system; ground power receptacle. Air conditioning optional.

AVIONICS: Garmin GNS 430 GPS/nav optional.

DIMENSIONS, EXTERNAL:

Wing span	7.92 m (26 ft 0 in)
Wing chord: at root	2.18 m (7 ft 2 in)
at tip	0.94 m (3 ft 1 in)
Wing aspect ratio	5.2
Length overall	7.16 m (23 ft 5¾ in)
Height overall	2.59 m (8 ft 6 in)
Fuselage: Max width	1.12 m (3 ft 8 in)
Max depth	1.40 m (4 ft 7¼ in)
Tailplane span	3.61 m (11 ft 10 in)
Wheel track	2.97 m (9 ft 9 in)
Wheelbase	1.66 m (5 ft 5½ in)
Min propeller ground clearance	0.20 m (8 in)

DIMENSIONS, INTERNAL:

Cabin: Length	2.74 m (9 ft 0 in)
Max width	1.08 m (3 ft 6½ in)
Max height	1.34 m (4 ft 5 in)

AREAS:

Wings, gross	11.98 m² (129.0 sq ft)
Ailerons (total)	1.07 m² (11.56 sq ft)
Flaps (total)	2.10 m² (22.60 sq ft)
Fin	0.78 m² (8.44 sq ft)
Rudder, incl tab	0.58 m² (6.26 sq ft)
Tailplane	1.51 m² (16.24 sq ft)
Elevator	1.56 m² (16.74 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, equipped	807 kg (1,780 lb)
Max fuel weight	149 kg (328 lb)
Max T-O weight	1,179 kg (2,600 lb)
Max wing loading	98.38 kg/m² (20.15 lb/sq ft)
Max power loading	5.26 kg/kW (8.67 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	209 kt (387 km/h; 240 mph)
Max level speed at S/L	163 kt (302 km/h; 188 mph)
Cruising speed at 2,590 m (8,500 ft) at 75% power	150 kt (278 km/h; 173 mph)
Stalling speed at S/L: flaps up	60 kt (112 km/h; 69 mph)
flaps down	45 kt (84 km/h; 52 mph)
Max rate of climb at S/L, ISA	558 m (1,830 ft)/min
Service ceiling	5,550 m (18,200 ft)
Time to service ceiling	13 min
T-O run at S/L, ISA	183 m (600 ft)
Landing from 15 m (50 ft)	244 m (800 ft)
Landing run	169 m (553 ft)
Range at S/L with max fuel at 75% power, ISA, no reserves	520 n miles (963 km; 599 miles)
g limits	+6/–3

PAC 750XL

TYPE: Light utility turboprop.

PROGRAMME: Wide-body version of Cresco (described separately) with fuselage height overall raised 15 cm (6 in); design started January 2000 and prototype (ZK-XLA) firstflown 5 September 2001. Optimised for parachute jumping. Other fields of use include carriage of freight, passengers and geophysical survey equipment and special operations.

Preliminary tests showed need for leading-edge root glove and increase of maximum flap angle from 30° to 40°. Certification by NZ CAA was achieved on 23 July 2003 with IFR approval granted in July 2006; FAA certification on 10 March 2004, with IFR approval granted in October 2006. EASA certification achieved in April 2006.

In June 2004, PAC entered a joint venture with Mecachrome Inc of Canada whereby partly assembled aircraft will be shipped to Mecachrome's factory at Mirabel, near Montreal, for final assembly and delivery to North American customers. First thus completed was ZK-JPQ (c/n 112); public debut at AirVenture, Oshkosh, in July 2005. Target production rates for the Canadian operation are 12 in 2005, 24 in 2006 and 36 in 2007, rising to a maximum of 100 aircraft per year.

CUSTOMERS: Eighteen firm orders and 260 options held by early 2004. First production aircraft delivered to Great Lakes Skydiving Centre of Tanpo, New Zealand. More than 20 registered by mid-2005 to customers in the Czech Republic, New Zealand, South Africa, Sweden, Switzerland, United Kingdom and US.

COSTS: Approximately USD1,000,000 (2004).

DESIGN FEATURES: Based on Cresco, but optimised for utility market, especially sport parachuting. Design objectives included good visibility from cockpit, ease of handling and high crosswind limit (15 kt). Cargo pod certified in 2006.

Wing section NACA 4415 (constant); no dihedral on inner wing; 8° dihedral on outer wing panels; incidence 2°.

FLYING CONTROLS: Conventional and manual. Mass-balanced ailerons (travel +25/–10°), horn-/mass-balanced elevator (+30/8½°) and rudder; electric elevator trim with manual override; electric aileron trim (port); manual rudder trim; single-slotted flaps, deflection 21° for T-O, 40° for landing. Control surface actuation by cables; movements are ailerons +23°/–9° 30', elevators +10° 30'/–27° 30', rudder 20° port/25° starboard.

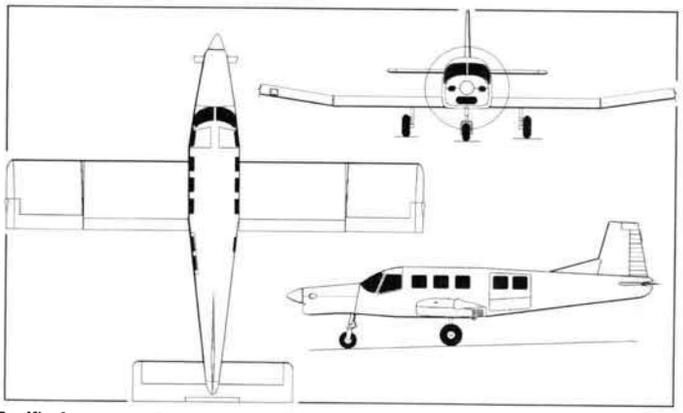
STRUCTURE: Conventional light alloy; single-spar wing; engine cowling of Kevlar and glass fibre; composites wingroot glove. Cockpit area stressed for 25 *g* impact.

LANDING GEAR: Tricycle type; fixed. Wing-mounted cantilever main legs with oleo-pneumatic shock absorption. Cleveland wheels and hydraulic disc brakes on main units. Goodyear tyres, size 8.50–10 (10 ply) on mainwheels, pressure 2.76 Bar (40 lb/sq in). Nosewheel 8.5-6 (6 ply), pressure 2.07 Bar (30 lb/sq in), steerable 20° port/starboard. Minimum turning radius 12.27 m (40 ft 3 in).

POWER PLANT: One 559 kW (750 shp) Pratt & Whitney Canada PT6A-34 turboprop. Hartzell HC-B3TN-3D/T10282NS+4 three-blade constant-speed, fully feathering, reversible-pitch metal propeller. Four integral fuel tanks in wing centre-section, total capacity 861 litres (227 US gallons; 189 Imp gallons), of which 841 litres (222 US gallons; 185 Imp gallons) usable. Individual gross capacities: 284 litres (75.0 US gallons; 62.5 Imp gallons) front left; 293 litres (77.3 US gallons; 64.5 Imp gallons) front right; 142 litres (37.5 US gallons; 31.2 Imp gallons) rear left and same in rear right. Oil capacity 8.7 litres (2.3 US gallons; 1.9 Imp gallons). Four refuelling points in upper surface of each wing.

ACCOMMODATION: Cabin carries nine seated passengers at 86 cm (34 in) pitch or 18 floor-sitting parachutists (plus single pilot) and has 16 floor-mounted tiedown points and seat rails; cabin door, on port side behind wing, either two (fore- and aft-hinged) freight doors or tambour door composed of multiple, transparent, hinged elements, which slides upwards on tracks and can be closed by remote control by pilot; two upward-hinged doors on each side of cockpit for crew entry. Dual controls, but starboard control column

Raeford Parachute Center prepares to jump from a PAC 750XL 1040381



Pacific Aerospace Corporation 750XL general arrangement *(Paul Jackson)*

0552997

removable. Max floor loading 730 kg/m² (150 lb/sq ft). Medevac version can carry two stretchers and three seated passengers, plus two flight crew. Optional ventral baggage pannier.

SYSTEMS: 24 V DC electric system. Air conditioning optional.

AVIONICS: *Comms:* Garmin GMA 340 audio panel, GNC 250 com/nav and GTX 327 transponder.

Flight: Garmin GNS 430 GPS.

DIMENSIONS, EXTERNAL:

Wing span	12.81 m (42 ft 0 in)
Wing chord, constant	2.13 m (7 ft 0 in)
Wing aspect ratio	6.0
Length overall	11.84 m (38 ft 10 in)
Fuselage:	
Max width	1.52 m (5 ft 0 in)
Max height	1.57 m (5 ft 2 in)
Height overall	4.04 m (13 ft 3 in)
Tailplane span	4.95 m (16 ft 3 in)
Wheelbase	3.17 m (10 ft 5 in)
Wheel track	3.68 m (12 ft 1 in)
Min ground turning radius	9.18 m (30 ft 1½ in)
Propeller diameter	2.69 m (8 ft 10 in)
Propeller ground clearance	0.41 m (1 ft 4 in)
Cabin door (port): Height	1.19 m (3 ft 11 in)[1]
Width	1.27 m (4 ft 2 in)
Height to sill	1.12 m (3 ft 8 in)

[1] *Slightly reduced by alternative door for parachuting*

DIMENSIONS, INTERNAL:

Cabin: Length	4.01 m (13 ft 2 in)
Max width	1.37 m (4 ft 6 in)
Max height	1.42 m (4 ft 8 in)
Volume	6.37 m³ (225 cu ft)

AREAS:

Wings, gross	28.34 m² (305.0 sq ft)
Ailerons (total)	2.04 m² (21.94 sq ft)
Trailing-edge flaps (total)	2.95 m² (31.74 sq ft)
Fin	1.80 m² (19.40 sq ft)
Rudder	1.08 m² (11.70 sq ft)
Tailplane (excluding elevators)	3.13 m² (33.64 sq ft)
Elevator, incl tab	2.59 m² (27.92 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, equipped	1,406 kg (3,100 lb)
Max fuel weight	686 kg (1,512 lb)
Typical payload	1,996 kg (4,400 lb)
Max T-O weight	3,402 kg (7,500 lb)
Max landing weight	3,231 kg (7,125 lb)
Max wing loading	120.1 kg/m² (24.59 lb/sq ft)
Power loading at Normal max T-O weight:	6.09 kg/kW (10.00 lb/shp)

PERFORMANCE:

Never-exceed speed (VNE):	
cabin door closed	170 kt (314 km/h; 195 mph)
cabin door open	130 kt (240 km/h; 149 mph)
Max level speed at S/L	169 kt (313 km/h; 194 mph)
Stalling speed: flaps up	69 kt (128 km/h; 79 mph)
flaps down, power off:	
at 3,402 kg (7,500 lb)	58 kt (108 km/h; 67 mph)
at 1,814 kg (4,000 lb)	45 kt (84 km/h; 52 mph)
Max rate of climb at S/L	547 m (1,795 ft)/min
Time to FL120	12 min
Time to S/L from FL120	3 min
Absolute ceiling	6,095 m (20,000 ft)
T-O run	276 m (907 ft)
T-O to 15 m (50 ft)	331 m (1,085 ft)
Landing from 15 m (50 ft)	426 m (1,400 ft)
Landing run	100 m (330 ft)
Range at 75% power with standard fuel, 45 min reserves	582 n miles (1,077 km; 669 miles)
Endurance with standard fuel, no reserves at 75% power	5 h 0 min

SHEARWATER

SHEARWATER INDUSTRIES

c/o Po Box 5211, Christchurch 8021

Web: www.shearwaterindustries.com

DIRECTOR: Ray Hampton

MANAGING DIRECTOR: Steve Hoyle

PROJECT ENGINEER: Paul Schofield

Company formed October 2004 to promote and produce Shearwater amphibian.

SHEARWATER SHEARWATER

TYPE: Four-seat amphibian/kitbuilt.

PROGRAMME: Prototype (ZK-SFA), designed by Bill Townson and built by Seaflight (NZ) Ltd, first flew 28 September 2001; re-registered ZK-TNZ in May 2005; had flown some 30 hours by July 2005, when displayed at AirVenture, Oshkosh. First kits then due for delivery in second quarter of 2006. However, design considerably revised in late 2005 under aeronautical engineer Richard Roake, reducing drag and improving performance, delaying completion of first production aircraft to late 2006/early 2007.

CUSTOMERS: Four kits sold in New Zealand before international launch.

COSTS: Kit USD90,000 less engine and avionics (2006).

DESIGN FEATURES: Mid-wing amphibian with moderate wing leading-edge sweepback. Integral wingtip floats of prototype replaced by tip winglets, with narrow floats repositioned inboard at approx three-fifths of span. Prototype also had two-step hull with ducted steps for cleaner unstick from water; air supplied from intake in mainwheel bays; this replaced by unstepped bottom incorporating forward-hinged, plank-shape hydroski which supports full MTOW at 18 knots (33 km/h; 21 mph). Dished upper fuselage with water drain hole, allowing lower thrust line for pusher propeller, which has 2.5 cm (1 in) fuselage clearance. Sweptback V tail. Leading-edge root extension to wing added after early trials. Kitbuilt to 51 per cent rule, but certifiable to FAR/EASA 23.

FLYING CONTROLS: Manual. Twin ruddervators, each with horn balance and flight-adjustable trim tab. Slotted flaps. Actuation by carbon fibre pushrods.

STRUCTURE: Composites throughout. Glass fibre hull, except carbon fibre upper section. Carbon fibre wing. Stainless steel metal fittings.

LANDING GEAR: Tricycle type; retractable. Electric actuation. Nosewheel retracts forward; mainwheels inward to underside of wing. Main tyres 6.00-6; nosewheel 5.00-5. Retractable water rudder behind second step. Simplified gear (omitting forward strut) to be introduced on production aircraft.

Prototype Shearwater amphibian on display at Oshkosh in July 2005 *(Paul Jackson)*

1129295

POWER PLANT: Prototype with one 157 kW (210 hp) Franklin flat-four, driving an MT-Propeller MT-18-D/LD-183-119 three-blade, variable-pitch pusher propeller. Production aircraft to have 190 kW (255 hp) Innodyn 255TE turboprop with five-blade propeller. Fuel in two wing tanks, combined capacity 104 litres (27.5 US gallons; 22.9 Imp gallons). Alternative power plants in 157 to 186 kW (210 to 250 hp) range. Optional ferry tanks in outer wings; max fuel capacity 520 litres (137 US gallons; 114 Imp gallons), although 455 litres (120 US gallons; 100 Imp gallons) for production version

ACCOMMODATION: Four persons in two forward-facing pairs. Fixed windscreen, plus upward-hinged door each sides. Baggage compartment in nose accessed by external door atop fuselage

DIMENSIONS, EXTERNAL:

Wing span	10.36 m (34 ft 0 in)
Wing aspect ratio	8.0
Length overall	7.87 m (25 ft 10 in)
Height overall	2.98 m (9 ft 10 in)
Propeller diameter	1.83 m (6 ft 0 in)

DIMENSIONS, INTERNAL:

Cockpit: Length	2.39 m (7 ft 10 in)
Max width	1.35 m (4 ft 5 in)
Baggage compartment volume	1.0 m³ (35 cu ft)

AREAS:

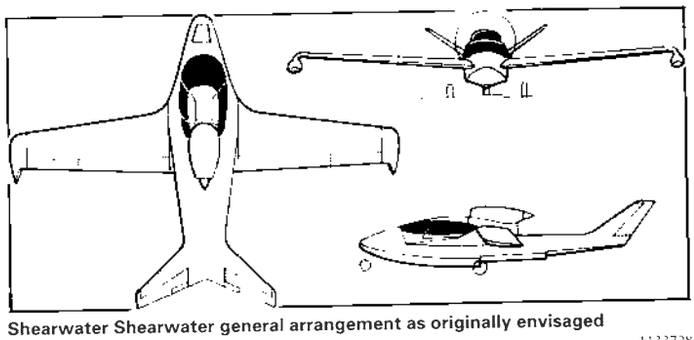
Wings, gross	13.38 m² (144.0 sq ft)
Tail surfaces	2.42 m² (26.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	825 kg (1,819 lb)
Max T.O. weight	1,500 kg (3,306 lb)
Max wing loading	112.1 kg/m² (22.96 lb/sq ft)
Max power loading	7.89 kg/kW (12.96 lb/hp)

PERFORMANCE:

Cruising speed	165 kt (306 km/h; 190 mph)
Stalling speed, flaps down	55 kt (102 km/h; 64 mph)



Shearwater Shearwater general arrangement as originally envisaged
(James Goulding) 1133728

Pakistan

PAC

PAKISTAN AERONAUTICAL COMPLEX

Kamra, District Attock

WORKS: F-6 Rebuild Factory; Mirage Rebuild Factory; Kamra Avionics and Radar Factory; Aircraft Manufacturing Factory (all at Kamra)

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MANAGEMENT BOARD:

Air Marshal Khalid Chaudhry (Chairman)
Air Cdre Javed Khan (Commercial)
Air Cdre Irfan ul Haq (Technical)
Badshah Gul (Finance)

MANAGING DIRECTORS:

Air Cdre Zakir Raja Hafeez (AMF)
Air Cdre Kamral Alam (F-6RF)
Air Cdre Ashfaqe (MRF)
Air Cdre Sherzada Khan (KARF)

SALES AND MARKETING DIRECTOR: Arshad Majeed Khan

CHIEF TEST PILOT: Wg Cdr Ahmed Shujaa

Pakistan Aeronautical Complex (PAC) is the nucleus of the aeronautical industry in Pakistan. Its professional standards and reliability enable domestic customers and foreign agencies alike to undertake joint production with PAC in various fields. PAC Kamra comprises four factories: the Mirage Rebuild Factory (MRF), F-6 Rebuild Factory (F6-RF), Aircraft Manufacturing Factory (AMF) and Kamra Avionics and Radar Factory (KARF). All four are ISO 9000 certified.

Aircraft Manufacturing Factory (AMF): In operation since mid-1981, the AMF spearheads the aircraft manufacturing industry in Pakistan. It is the only aircraft manufacturing concern in Pakistan and is at present engaged in the manufacture of the Mushshak basic trainer-cum-surveillance aircraft; the Super Mushshak — a variant with a more powerful engine, cockpit air conditioning, electric instruments and several other improvements; the Baaz and Ababeel low-speed target drones for anti-aircraft gunnery training; and component manufacture for HAIC (Hongdu) of China of the K-8 (Karakoram) jet trainer aircraft, 12 of which already flying with the Pakistan Air Force. Manufacture of parts for Chengdu FC-1/JF-17 (eight of first 16 production aircraft) began in 2005. First Kamra-assembled JF-17 due for completion in 2006. In addition, the AMF has excellent facilities to rebuild and repair the Mushshak at factory level, along with after-sales spares support to existing Mushshak operators.

AMF also has the skills and capabilities of conventional/CNC machining, sheet metal forming, hand layup, contact suction hot press moulding, stretch moulding, gravity moulding, reaction injection moulding, mould/die and pattern making in woodwork, surface treatment/painting, heat treatment, tig welding (AC and DC), electric arc welding, gas welding, bronzing, soldering, tube banding, material testing, spectroanalysis, tensile testing, precision measurement, chemical analysis, CNS calibration, co-ordinate measurement, mould/dies and fixture designing in tooling facility, CNC copy milling and EDM (spark erosion) milling.

Kamra Avionics and Radar Factory (KARF): KARF, the fourth factory of PAC, came into operation in 1987. It is an electronics centre with proven capabilities for rebuilding of radars, control and reporting centres (CRC), generators, and manufacture and repair of avionics systems. Currently, it is producing ESM equipment and airborne radar systems. All production activities are carried out in large, spaciously built shops equipped with state-of-the-art machinery. Apart from the production of BMJK/8602 RWR and Fiar Grifo 7 radar systems and the overhauling of pulse-Doppler radars, control and reporting centres and generators, KARF offers services in many fields such as surface mount technology, cable repair and manufacturing, inspection/testing of microwave components, testing of gears and synchro bridge, environmental testing, testing hydraulic components, rebuilding of three-phase air conditioning systems and general engineering and painting facilities.

PAC (AMF) MUSHSHAK and SUPER MUSHSHAK

English name: Proficient

TYPE: Three-seat lightplane.

PROGRAMME: Fifteen Mushshaks supplied complete from Sweden; 10 then assembled from SKD kits and 82 from CKD kits at Risalpur between 1975 and 1981; completely indigenous production followed, with 180 delivered by December 1996; 113 repaired at Kamra including 100 from 1980 to 1996; engines, instruments, electrical equipment and radios imported; complete airframe manufactured locally. Shahbaz (prototype 86–5147; first flight July 1987; English name Falcon) received US FAR Pt 23 certification 1989, but only four completed. Super Mushshak introduced 1997, entered production November 2000 and received domestic certification in 2002. Both versions still in production in 2006.

CURRENT VERSIONS: **Mushshak**: Standard production version; used for training, communications and observation; more than half a million hours flown by late 1999. AMF then upgrading first 16 (of 36) to Super Mushshak for PAF; 22 delivered by January 2003.

Super Mushshak: Further increase in power by adopting IO-540 flat-six engine. Prototype 95-5385X made first flight 15 August 1996. Revealed at Dubai Air Show in November 1997, at which time five completed. Pakistan Army has reportedly ordered 150, for delivery after completion of PAF order.

Description applies to above version, except where indicated

CUSTOMERS: See table. Total of 327 accounted for, comprising 15 imported aircraft plus 285 Mushshaks, 24 Super Mushshaks and four Shahbaz acquired/produced by late 2004 (first upgraded Super Mushshak redelivered to Pakistan Air Force 16 May). First aircraft delivered to South Africa was 331st of type. Mushshak deliveries to Iran in 1988–91: six supplied to Syria and three to Oman in 1994. Last-named became first export customer for Super Mushshak in December 2001; these all handed over on 1 August 2002. Iranian Air Force reported to be considering upgrading its existing fleet to Supers. First civilian sale (apart from company demonstrator AP-PAC) to Uni Group Holdings of South Africa in 2004; type approved by SACAA on 24 January 2005; deliveries began May 2006.

MUSHSHAK PRODUCTION
(at January 2005)

Customer	Quantity
At Risalpur	
Pakistan Air Force/Army	92[1]
At Kamra:	
Pakistan Air Force	36[2]
Pakistan Army	117
Pakistan (Air Force and/or Army)	13
Iran (Air Force)	26[3]
Oman (Air Force)	8[4]
Saudi Arabia (Air Force)	20[5]
South Africa (civil)	5[6]
Syria (Air Force)	6
Pakistan Aeronautical Complex	4
Total	**327**[7]

[1] Saab kits (10 SKD, 82 CKD)
[2] First aircraft 83-5116 (numbers 5200–5299 not allocated); equip Nos. 1 and 2 Primary Flying Training Squadrons of PAF Academy and Headquarters Flights of Northern, Central and Southern Air Commands; being upgraded to Super in 2002–03
[3] Plus complete aircraft from Saab to PAF and five Pakistani-built not accounted for
[4] Includes five Super Mushshak; remaining three upgraded to Super and redelivered in 2003
[5] Includes one Super Mushshak donated to Air Force Academy in 2002
[6] Super Mushshak; order announced 31 May 2004; official handover 12 October 2004 (last two of first eight)
[7] First aircraft (ZS-OKR) handed over 30 May 2006 to Falco Aviation and Leasing Company

DESIGN FEATURES: Based on Swedish Saab Safari/Supporter, but without latter's armament option. Optimised for military support (originally including light attack) from semi-prepared airstrips; wing position aids ground observation.

Wing thickness/chord ratio 10 per cent; dihedral 1° 30'; incidence 2° 48'; sweepforward 5° from roots.

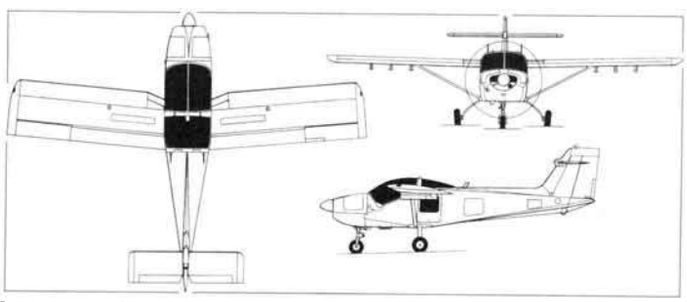
FLYING CONTROLS: Manual, mass-balanced ailerons with servo tab in starboard unit; rudder with trim tab; all-moving mass-balanced tailplane with large anti-balance tab. Electrically actuated plain sealed flaps; leading-edge slots.

STRUCTURE: All-metal, except for GFRP tailcone, engine cowling panels, wing strut/landing gear attachment fairings and fintip.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring composites cantilever main legs; Cessna oleo-pneumatic nosewheel shock strut. Goodyear wheels and Flight Custom tyres, size 6.00-6 (6 ply) on mainwheels and 5.00-5 (6 ply) on steerable (±30°) nosewheel. Tyre pressure (all units) 2.07 bar (30 lb/sq in). Parker Hannifin hydraulic disc brakes on main units.

First PAC Mushshak delivered to South Africa in 2006 *(Patrick Allen)*

1196398



PAC Mushshak *(Dennis Punnett)*

1121731

POWER PLANT: *Mushshak:* One 149 kW (200 hp) Textron Lycoming IO-360-A1B6 flat-four engine, driving a Hartzell HC-C2YK-4F/FC7666A-2 two-blade constant-speed metal propeller.

Super Mushshak: One 194 kW (260 hp) Textron Lycoming IO-540-V4A5 flat-six; Hartzell HC-C2YK-1BF two-blade constant-speed propeller.

Fuel (both versions) in two integral wing fuel tanks, total capacity 178 litres (47.0 US gallons; 39.1 Imp gallons), of which 159 litres (42.0 US gallons; 35.0 Imp gallons) are usable. Oil capacity (both) 7.5 litres (2.0 US gallons; 1.6 Imp gallons). From 10 to 20 seconds inverted flight (limited by oil system) permitted.

ACCOMMODATION: Side-by-side adjustable seats, with provision for back-type or seat-type parachutes, for two persons beneath fully transparent Upward-hinged canopy. Dual controls standard. Space aft of seats for 100 kg (220 lb) of baggage (with external access on port side) or, optionally, a rearward-facing third seat. Upward-hinged door, with window, beneath wing on port side. Cabin heated and ventilated in Mushshak, air conditioned in Super Mushshak.

SYSTEMS: Hydraulic reservoir for mainwheel brakes. 28 V DC electrical system (70 A alternator and 70 Ah battery).

AVIONICS: *Comms:* KT 76A/78A ATC transponder; KA 134 audio panel.

Flight: KX 125 nav/com; KLX 135 GPS/com; KR 87 ADF.

Instrumentation: Provision for full blind-flying instrumentation.

EQUIPMENT: Provision for six underwing attachment points, inner two stressed to carry up to 150 kg (330 lb) each and outer four up to 100 kg (220 lb) each. Options include ULV crop-spraying kit, target towing kit, or underwing supply/relief containers.

DIMENSIONS, EXTERNAL:

Wing span	8.85 m (29 ft 0½ in)
Wing chord: at root	1.21 m (3 ft 11¾ in)
outer panels, constant	1.36 m (4 ft 5½ in)
Wing aspect ratio	6.6
Length overall: Mushshak	7.00 m (22 ft 11½ in)
Super Mushshak	7.15 m (23 ft 5½ in)
Height overall	2.60 m (8 ft 6½ in)
Tailplane span	2.80 m (9 ft 2¼ in)
Wheel track	2.20 m (7 ft 2½ in)
Wheelbase: Mushshak	1.61 m (5 ft 3½ in)
Super Mushshak	1.58 m (5 ft 2¼ in)
Propeller diameter	1.93 m (6 ft 4 in)
Propeller ground clearance	7.62 cm (3 in)
Cabin door (port): Height	0.78 m (2 ft 6¾ in)
Width	0.52 m (1 ft 8½ in)

DIMENSIONS, INTERNAL:

Cabin: Max width	1.10 m (3 ft 7¼ in)
Max height (from seat cushion)	1.00 m (3 ft 3¼ in)

AREAS:

Wings, gross	11.90 m² (128.1 sq ft)
Ailerons (total)	0.98 m² (10.55 sq ft)
Flaps (total)	1.55 m² (16.68 sq ft)
Fin	0.77 m² (8.29 sq ft)
Rudder, incl tab	0.73 m² (7.86 sq ft)
Tailplane, incl tab	2.10 m² (22.60 sq ft)

WEIGHTS AND LOADINGS (Mushshak and Super Mushshak. A: Aerobatic, U: Utility, N: Normal category):

Weight empty, equipped: Mushshak	646 kg (1,424 lb)
Super Mushshak	760 kg (1,676 lb)
Max external stores load (both)	300 kg (661 lb)
Max T-O weight: A (both)	900 kg (1,984 lb)
U (Mushshak)	1,000 kg (2,205 lb)
U (Super Mushshak)	1,030 kg (2,270 lb)
N (Mushshak)	1,200 kg (2,645 lb)
N (Super Mushshak)	1,250 kg (2,755 lb)
Max wing loading: A (both)	75.6 kg/m² (15.48 lb/sq ft)
U (Mushshak)	84.0 kg/m² (17.20 lb/sq ft)
U (Super Mushshak)	86.6 kg/m² (17.73 lb/sq ft)
N (Mushshak)	100.8 kg/m² (20.65 lb/sq ft)
N (Super Mushshak)	105.0 kg/m² (21.51 lb/sq ft)
Max power loading (Mushshak): A	6.04 kg/kW (9.92 lb/hp)
U	6.71 kg/kW (11.02 lb/hp)
N	8.05 kg/kW (13.23 lb/hp)
Max power loading (Super Mushshak): A	4.64 kg/kW (7.63 lb/hp)
U	5.31 kg/kW (8.73 lb/hp)
N	6.45 kg/kW (10.60 lb/hp)

PERFORMANCE (Utility category):

Never-exceed speed (VNE): both	196 kt (363 km/h; 226 mph)
Max level speed at S/L: Mushshak	130 kt (240 km/h; 149 mph)
Super Mushshak	145 kt (268 km/h; 166 mph)
Cruising speed at S/L at 75% power: Mushshak	115 kt (213 km/h; 132 mph)
Super Mushshak	130 kt (240 km/h; 149 mph)
Stalling speed, power off: Mushshak, flaps up	60 kt (111 km/h; 69 mph)
Super Mushshak, flaps up	57 kt (105 km/h; 66 mph)
Mushshak, flaps down	54 kt (100 km/h; 63 mph)
Super Mushshak, flaps down	52 kt (96 km/h; 60 mph)
Max rate of climb at S/L: Mushshak	372 m (1,220 ft)/min
Super Mushshak	518 m (1,700 ft)/min
Time to 1,830 m (6,000 ft): Mushshak	7 min 30 s
Time to 3,050 m (10,000 ft): Super Mushshak	10 min
Service ceiling: Mushshak	4,800 m (15,740 ft)
Super Mushshak	6,705 m (22,000 ft)
T-O run: Mushshak	150 m (495 ft)
Super Mushshak	183 m (600 ft)
T-O to 15 m (50 ft): Mushshak	252 m (825 ft)
Super Mushshak	275 m (900 ft)
Landing from 15 m (50 ft): Mushshak	314 m (1,030 ft)
Super Mushshak	296 m (970 ft)
Landing run: Mushshak	140 m (460 ft)
Super Mushshak	153 m (500 ft)
Range with max fuel: Mushshak	580 n miles (1,074 km; 667 miles)
Super Mushshak	440 n miles (814 km; 506 miles)
Max endurance at 65% power at S/L, 10% reserves:	
Mushshak	5 h 10 min
Super Mushshak	4 h 15 min
g limits (both): A	+6/−3
U	+5.4/−2.7
N	+4.8/−2.4

Poland

3XTRIM

ZAKŁADY LOTNICZE 3XTRIM SP. Z O.O. (3XTRIM AIRCRAFT FACTORY)

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PRESIDENT: Dariusz Pietraszkiewicz
CHIEF DESIGNER: Jerzy Mastek

WORKS
Bielsko-Biała and Szczecin; Warsaw factory planned

Company was formed in 1996 as WNKL Adam Kurbiel (former President, who died in July 2000), changing to its present title (signifying 'triple-trimmed') in November 1999, but has its roots in the SZD-PZL-Bielsko which for more than 40 years has been the major producer of Polish high-performance sailplanes and gliders. Factories at Bielsko-Biała and Szczecin have floor areas of 700 and 1,500 m² (7,535 and 16,145 sq ft) respectively; combined workforce 20 in January 2005. Its main current products are the two-seat lightplanes and ultralights described in this entry; other (non-aerospace) products in composites are also manufactured.

3XTRIM 450 ULTRA, 495 ULTRA PLUS and 550 TRENER

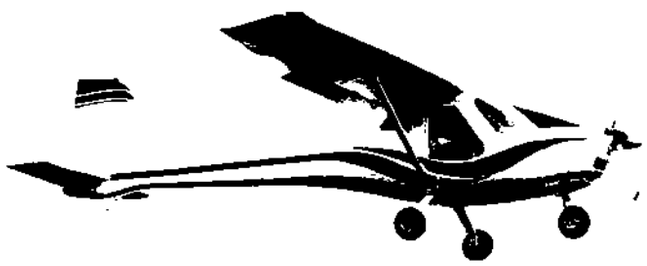
TYPE: Side-by-side ultralight; two-seat lightplane.

PROGRAMME: Development of EOL-2 Racek 2, of which some 20 built. Design started 1996, prototype 450-UL making maiden flight 15 May 1998; construction of first 3X55 Trener began 1997 (prototype SP-PUP made first flight 5 February 2000 and 150 hours flown by May 2001); static/fatigue testing October 1999 to January 2000; JAR-VLA tests completed 16 May 2000. Ultra has Czech ultralight certificate and Polish special certification; German (LFT-UL) certification of Ultra Plus under way February 2005, with completion of static and flight testing forecast for June 2005; one imported into Canada in 2006, seeking Canadian (AULA) approval.

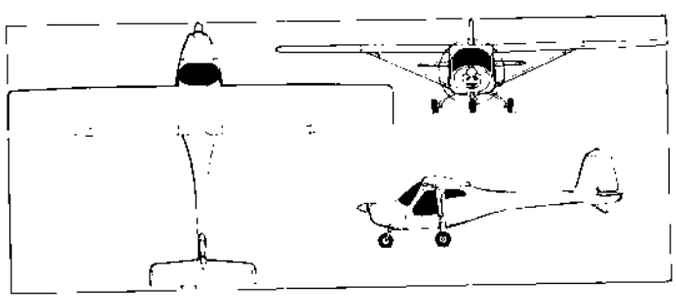
Planned twin-float seaplane had not materialised by mid-2006.

CURRENT VERSIONS: **450 Ultra:** Ultralight version, MTOW 450 kg (992 lb) achieved by wider use of CFRP instead of GFRP and omission of some equipment and furnishing (for example, no door stays).

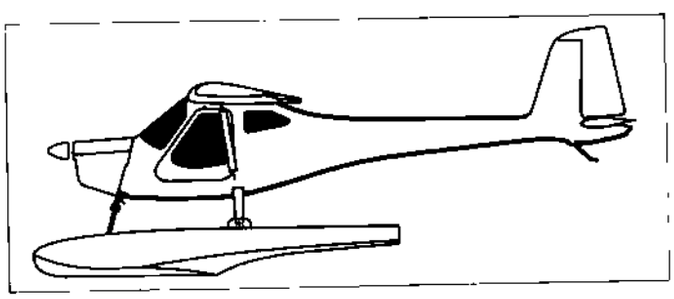
495 Ultra Plus: German ultralight version; as Ultra but permissible MTOW increased to LFT-UL limit of 472.5 kg



3Xtrim two-seat lightplane 1159206



3Xtrim 550 Trener two-seat lightplane *(James Goulding)* 0093619



Projected 3Xtrim floatplane 1121740

550 Trener: VLA version. For aero club and flying school (PPL) training; also available with aerial camera as border patrol and reconnaissance aircraft.

CUSTOMERS: Total 34 Ultras and 14 Treners ordered by December 2004. Customer countries include France. By mid-2006, 55 of all variants (including original Racek) built.

COSTS: Trener EUR44,000; Ultra EUR38,000; Ultra Plus EUR40,000; all excluding VAT (2005).

DESIGN FEATURES: Typical strut-braced high-wing cabin monoplane.

Wing section CAHI (TsAGI) R III (modified); dihedral 1° 30'; incidence 2° 30'; tailplane incidence −2° 30'

FLYING CONTROLS: Conventional and manual (pushrod ailerons and elevator, cable-operated rudder). Elevator deflects 30° up/20° down; rudder 20° left/right. Rudder and one-piece elevator horn-balanced; Ultra has small, inset, electrically actuated trim tab in port half of elevator; tab in Trener is twice as large and protrudes beyond trailing-edge. Slotted flaps, deflection 33° up/15° down.

STRUCTURE: All-composites fuselage (glass and carbon fibre/epoxy cellular construction with plastics foam filling) with integral fin; GFRP sandwich single-spar wing.

LANDING GEAR: Tricycle type; fixed. GFRP, self-sprung fuselage-mounted cantilever mainwheel legs and rubber-sprung, castoring (±15°) 4.00-6 nosewheel. Mainwheels are size 5.00-5, with 350 × 135 tyres on Trener; size 4.00-8 on Ultra. Tyre pressure (all) 2.50 bar (36 lb/sq in); hydraulic disc brakes. Floatplane version planned.

POWER PLANT: *Ultra and Ultra Plus*: One 59,6 kW (79.9 hp) Rotax 912 A flat-four engine, driving a 3Xtrim 170 UL two-blade ground-adjustable pitch propeller.

Trener: One 73.5 kW (98,6 hp) Rotax 912 S flat-four; propeller as for Ultra/Ultra Plus.

Fuel capacity (all) 70 litres (18.5 US gallons; 15.4 Imp gallons) standard (65 litres; 17.2 US gallons; 14.3 Imp gallons usable), in single tank behind pilot's seat; optionally, two 43 litre (11.4 US gallon; 9.5 Imp gallon) tanks in same location. Oil capacity 2.5 litres (0.66 US gallon; 0.55 Imp gallon).

ACCOMMODATION: Two seats side by side; dual controls standard. Fully enclosed, heated and ventilated cabin with upward-opening door on each side. Baggage space behind seats

SYSTEMS: Hydraulic system for brakes only; 12 V 18 Ah battery for electrical power.

AVIONICS: Bendix/King KY 97A or ICOM A-200 radios and Garmin GTX 327 transponder; VFR instrumentation and stall warning system standard

EQUIPMENT: BRS 5 ballistic recovery parachute.

DIMENSIONS, EXTERNAL (A: Ultra, B: Ultra Plus, C: Trener):

Wing span: A	9.60 m (31 ft 6 in)
B, C	10.03 m (32 ft 11 in)
Wing chord, at root (all)	1.30 m (4 ft 3¼ in)
at tip: A	1.00 m (3 ft 3¼ in)
Wing aspect ratio: A	7.8
B, C	8.1
Length overall (all)	6.87 m (22 ft 6½ in)
Fuselage max width (all)	1.18 m (3 ft 10¾ in)
Height overall (all)	2.405 m (7 ft 10¾ in)
Tailplane span (all)	2.75 m (9 ft 0¼ in)
Wheel track (all)	1.895 m (6 ft 2½ in)
Wheelbase (all)	1.48 m (4 ft 10¼ in)
Propeller diameter (all)	1.70 m (5 ft 7 in)
Min propeller ground clearance (all)	0.195 m (7¾ in)

AREAS (A, B and C as above):

Wings, gross: A	11.84 m² (127.4 sq ft)
B, C	12.40 m² (133.5 sq ft)
Ailerons (total)	1.00 m² (10.76 sq ft)
Trailing-edge flaps (total)	1.38 m² (14.85 sq ft)
Fin	0.44 m² (4.74 sq ft)
Rudder	0.38 m² (4.09 sq ft)
Tailplane	1.10 m² (11.84 sq ft)
Elevator, incl tab	0.64 m² (6.89 sq ft)

WEIGHTS AND LOADINGS (A, B and C as above):

Weight empty: (all)	285 kg (628 lb)
Max fuel weight (all)	49 kg (108 lb)
Max T-O weight: (all)	450 kg (992 lb)
Max wing loading: A	38.0 kg/m² (7.78 lb/sq ft)
B, C	36.3 kg/m² (7.43 lb/sq ft)
Max power loading: A, B	7.55 kg/kW (12.41 lb/hp)
C	6.12 kg/kW (10.06 lb/hp)

PERFORMANCE (A, B and C as above):

Never-exceed speed (VNE):	
A	108 kt (200 km/h; 124 mph) IAS
B, C	118 kt (220 km/h; 136 mph) IAS
Max cruising speed at 75% power (all)	94 kt (175 km/h; 109 mph) IAS
Stalling speed, 30° flap (all)	34 kt (63 km/h; 40 mph) IAS
Max rate of climb at S/L (all)	330 m (1,083 ft)/min
Service ceiling (all)	4,000 m (13,120 ft)
T-O run (all)	50 m (165 ft)
T-O to, and landing from, 15 m (50 ft): A, B	250 m (820 ft)
C	220 m (725 ft)
Range (all):	
standard fuel	405 n miles (750 km; 466 miles)
max optional fuel	675 n miles (1,250 km; 776 miles)
g limits (all)	+4.0/−2.0

OPERATIONAL NOISE LEVEL (ICAO Chapter 10, Appendix 16):

Average	67 dBA

AERO

AERO SP. Z O. O.

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Company formed in 1994. An Aerotechnik P.220 Koala kit was ordered that year, being given Polish designation suffix AT-2 (AT-1 having been a single-seat homebuilt design started in 1987). This was fitted with a 64.9 kW (87 hp) Limbach engine (first flight 12 December 1995 by SP-PUL, later SP-FUL). Experience gained in construction and use of AT-1 and AT-2 was utilised in design of the current AT-3.

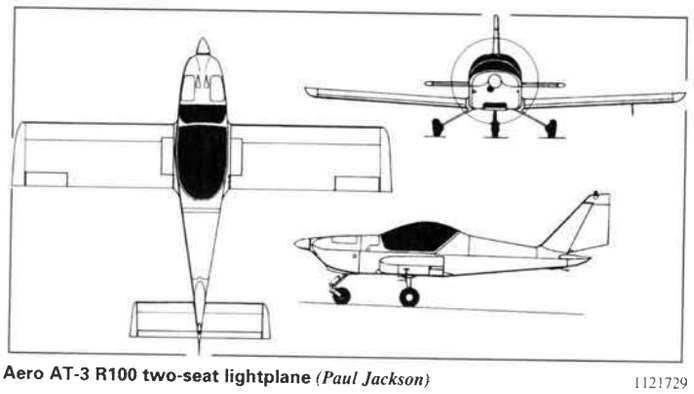
AERO AT-3

TYPE: Side-by-side lightplane/kitbuilt.

PROGRAMME: Completed initially (SP-PUH) as AT-3 with 67.1 kW (90 hp) Limbach L-2400EB3AC engine (basis for initial Type Certificate 14 May 1999) and re-registered SP-GUH; subsequently modified to AT-3 L100 with 74.6 kW (100 hp) Limbach L-2400DF1. Standard power plant then changed to Rotax 912S in 2001, and other modifications introduced; new designation AT-3 R100. This version became first aircraft to be awarded EASA community standard certification (CS-VLA category) in February 2005.

CURRENT VERSIONS: **AT-3 L100:** With 74.6 kW (100 hp) Limbach L-2400DF1 flAT-four engine and MT-160L-120-2C propeller. Four built by 2003, all of which since converted to R100 version; none further expected.

AT-3 R100: With Rotax 912S flAT-four. Otherwise as AT-3 L100. Standard version, *as described.*



Aero AT-3 R100 two-seat lightplane *(Paul Jackson)* 1121729

AT-3SK: Standard kit version.

AT-3AK: Advanced kit version.

CUSTOMERS: Initial customer Aeroclub of Warsaw; first two in service by May 2001. First kitbuilt (G-UKAT) completed April 2005. Two to Brooklands Flying Club, Sywell, UK; third on order. Refer to table.

COSTS: Flyaway: basic EUR81,450, club EUR92,000, tourer EUR100,840; kit from EUR29,800, excluding VAT (2006).

DESIGN FEATURES: Intended for basic training and low-cost touring; designed to absorb piloting errors or effects of landing on unprepared terrain. Low, constant-chord wing and tailplane; sweptback fin. Large rudder cutaway for elevator travel.

Wing section NACA 4415.

Changes from AT-2/P.220 S (retaining only a similar outward appearance) include approximately 1 m^2 (10.8 sq ft) more wing area; 10 cm (4 in) longer cockpit with revised geometry; enlarged (strengthened and thinner) fin and rudder; strengthened landing gear, wings, fuselage; extended wheel track and wheelbase.

FLYING CONTROLS: Manual; piano-type top-hinged ailerons, mass- and horn-balanced rudder and all-moving elevator with central trim tab; three-position split flaps (maximum deflection 40°).

STRUCTURE: Primarily metal, with some skins and fairings of Kevlar, carbon or glass fibre.

LANDING GEAR: Tricycle type; fixed. Cantilever, fuselage-mounted spring main legs with 380×150/15×6.00 wheels and hydraulic disc brakes; levered suspension nose leg with 5.00-4 wheel and rubber-in-compression shock absorption. Wheel fairings optional.

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 S flat-four engine with GT-2/173/VRR-FW101SRTC two-blade, fixed-pitch or three-blade Elprop AS ground-adjustable, carbon composites aeroelastic propeller. Fuel capacity 70 litres (18.5 US gallons; 15.4 Imp gallons).

ACCOMMODATION: Two seats side by side; dual controls standard. Hatrack/baggage shelf behind seats, capacity 30 kg (66 lb). Upward-opening one-piece canopy, hinged at front.

AVIONICS: Bendix/King KY 97A transceiver and VFR instrumentation standard; optional equipment (customer choice) includes KT 76A transponder and directional gyro.

DIMENSIONS, EXTERNAL:

Wing span	7.55 m (24 ft 9¼ in)
Wing chord, constant	1.27 m (4 ft 2 in)
Wing aspect ratio	6.1

AERO AT-3 PRODUCTION
(at April 2005)

c/n	Registration	Type	Remarks
001	SP-TPC	L100	To R100 by 2004; Warsaw Aeroclub
002	SP-TPD	L100	To R100 by 2004; Warsaw Aeroclub
003	SP-TPE	L100	To R100 2005
004	SP-TPF	L100	To R100 in 2005; French demonstrator F-GURT
005	SP-TPG	R100	Private owner: Poland
006/PFA327-14107	G-UKAT	AT-3SK	Kitbuilt; Trevor Archer (UK)
007	VH-	AT-	Kitbuilt; Australian owner
008	SP-EAR	R100	UK demonstrator G-SPAT
009	G-	AT-	Kitbuilt; UK customer
010	SP-KOS	R100	Private owner: Poland
011	G- SYWL	R100	Brooklands Flying Club, UK (delivery November 2005)
012	G- SWLL	R100	Brooklands Flying Club, UK (delivery November 2005)
013		R100	Kitbuilt; awaiting delivery mid-2006
014	EC-	R100	For Spain
015	EC-	R100	For Spain

Aero AT-3 of Brooklands Flying Club

1159179

Length overall ..... 5.88 m (19 ft 3½ in)
Height overall ..... 2.23 m (7 ft 3¾ in)
Tailplane span ..... 2.79 m (9 ft 1¾ in)
Wheel track ..... 2.26 m (7 ft 5 in)
Wheelbase ..... 1.36 m (4 ft 5½ in)
Propeller diameter ..... 1.73 m (5 ft 8 in)

AREAS:
Wings, gross ..... 9.30 m² (100.1 sq ft)

WEIGHTS AND LOADINGS:
Weight empty ..... 350 kg (772 lb)
Max T-O weight ..... 582 kg (1,283 lb)
Max wing loading ..... 62.6 kg/m² (12.82 lb/sq ft)
Max power loading ..... 7.92 kg/kW (13.01 lb/hp)

PERFORMANCE:
Never-exceed speed (VNE) ..... 120 kt (223 km/h; 138 mph) IAS
Max level speed ..... 116 kt (215 km/h; 133 mph) IAS
Max cruising speed ..... 108 kt (200 km/h; 124 mph) IAS
Max manoeuvring speed (VA) ..... 106 kt (197 km/h; 122 mph) IAS
Stalling speed ..... 44 kt (82 km/h; 51 mph) IAS
Max rate of climb at S/L ..... 222 m (728 ft)/min
Service ceiling ..... 3,800 m (12,460 ft)
T-O run ..... 160 m (525 ft)
T-O to 15 m (50 ft) ..... 440 m (1,445 ft)
Landing from 15 m (50 ft) ..... 445 m (1,460 ft)
Landing run ..... 150 m (495 ft)
Max range ..... 488 n miles (904 km; 561 miles)
g limits ..... +3.8/−1.5

EADS PZL

EADS PZL WARSZAWA-OKĘCIE SA

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VICE-PRESIDENT AND OPERATIONS DIRECTOR: Władysław Skorski
CHIEF MARKETING AND SALES EXECUTIVE: Zbigniew Wasiucionek

Oldest aircraft manufacturer in Poland, PZL Warszawa-Okęcie SA was founded in 1928 and has subsequently built 71 different aircraft types, 48 of which went into series production. Currently occupies 279,373 m² (3,007,140 sq ft) site with 88,691 m² (954,660 sq ft) covered area; workforce approximately 500 in 2006. Responsible for light aircraft development and production, and for design and manufacture of associated agricultural equipment for its own aircraft and those built at other Polish factories; became public stock company, entirely owned by Ministry of Industry and Trade, on 2 January 1995; by 2006 had produced some 6,000 aircraft for customers in 30 countries. Manufacturer of the indigenous Wilga 2000 and Turbo Kruk continues.

On 16 October 2001, as part of the contract to supply eight C-295M transports to the Polish Air Force, EADS CASA (which see) acquired a 61 per cent holding in PZL Warszawa-Okęcie. This subsequently increased to 76.4 per cent, with remainder being held by Polish Treasury Ministry (18.31 per cent) and company employees (5.29 per cent). Components for the CASA C-295 and CN-235 transports are being produced (first C-295 shipset delivered 22 May 2003), and integration of PZL into EADS has resulted in facilities being refurnished and modernised for new activities.

The company has been streamlined, and investments of up to EUR13 million and up-to-date technologies by the new owners have made it competitive with other European aviation product manufacturer. Aerostructures activity now consists chiefly of aluminium sheet component manufacture; subassembly of wings, ramp doors, portalons, crew doors and electrical harnesses for the C-295 and CN-235 military transports; and cockpit section floor grids for the Airbus A320 family (first delivery 28 October 2004).

ZUA agricultural services division, which began operations more than 30 years ago, has a fleet of more than 100 M18 Dromaders, An-2s, PZL-106 Kruks and PZL-104 Wilgas, plus crews of experienced pilots and mechanics. These are able to offer services that include crop-spraying and dusting, firefighting, forestry inventories, environmental recovery, forest and pipeline patrol, advertising and charter flights, pilot and mechanic training, aircraft overhaul and technical maintenance.

EADS PZL has recently produced some 'follow-on' aircraft of types previously announced as having completed manufacture:

PZL-106BT Turbo-Kruk: One, SP-WTW c/n 1104269, produced 2005.

PZL-130TC-1 Orlik: Three additional aircraft built in 2004-05, becoming 050, 051 and 052 in Polish Air Force service.

PZL-130TC-1 Orlik 050, one of seven 'post production' aircraft known *(Paul Jackson)* 1159148

EADS PZL PZL-104M WILGA 2000

English name: Oriole

TYPE: Four-seat lightplane.

PROGRAMME: First flight of prototype Wilga 1, 24 April 1962. Polish certification of Wilga 80, 25 February 1980. This and all subsequent versions retrospectively given EASA certification on 16 November 2005. Total of 962 of all earlier versions (except Indonesian licence-built Lipnur Gelatik) built by 1996, some of which stored and later supplied from stock, including one Wilga 80 in 1999.

Wilga 2000, improved version of Wilga 35, developed to appeal to Western markets, principally through use of Western engine and avionics. Wing and nose modifications tested on Wilga 35A SP-CSG. First flight of Wilga 2000 prototype (SP-PHG, later -WHG) 20 August 1996; first production (SP-AHV) in mid-1997; SP-PHG won 1st World Air Games, 1997. FAR Pts 23/36 certification achieved 25 February 2002.

CURRENT VERSIONS: **PZL-104MA Wilga 2000**: Standard landplane version from 2005 : *as described*. Continuing improvements include winglets; ventral strake; axisymmetric engine cooling intakes; increases in cruising speed, payload and range; Garmin avionics. Polish GICA/CAIB certification 25 October 2005; EASA certification 16 November 2005.

PZL-104MF Wilga 2000: Polish Border Guard version. GICA/CAIB Polish certification 25 April 2001.

PZL-104MN Wilga 2000: Designation of nine aircraft built 2001 to 2004. Polish GICA/CAIB certification 8 March 2001; FAR Pt 23 certification 25 February 2002. From 2003, production aircraft had 1,500 kg (3,306 lb) MTOW and approximately 925 kg (2,039 lb) empty weight, reflecting improvements of 100 kg (220 lb) and 50 kg (110 lb), respectively.

PZL-104MW Wilga 2000 Hydro: Twin-float version; first flight 11 September 1999. MTOW of 1,500 kg (3,306 lb); performance generally similar to landplane except T-O run from water 180 m (590 ft) and S/L climb rate 210 m (689 ft)/min. Operated at continuous power rating of 216 kW (290 hp) at 2,575 rpm to decrease noise during T-O and climb. North American demonstrator under conversion in 2003 by Sealand Aviation of Vancouver, Canada; public debut in Anchorage, Alaska, May 2004. Canadian certification 2005. Sealand responsible for all aircraft of this configuration.

CUSTOMERS: First two deliveries in 1997 to Polish Aeroclub and private owner; five built in 1998 and delivered under 1997 contract to Polish Border Guard, first one being handed over 1 June 1998; one built in 1999, delivered to UK as demonstrator in May 2000. None built in 2000. At least five built in 2001; three in 2003 (including exports to Canada and US); one in 2004; two in 2005; and 21st aircraft (including prototype) in early 2006. Total of 25 sold by April 2006 to customers in Canada, Poland, Spain, UK and US; further 10 PZL-104MAs on order at that time.

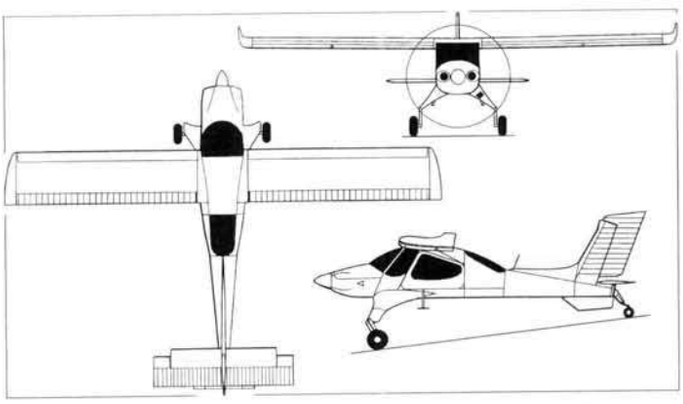
DESIGN FEATURES: Suitable for wide variety of military, general aviation and flying club duties; STOL performance bestowed by flaps and slats allied to heavy-duty landing gear. High-mounted cantilever wings with upturned tips; braced tail unit with small underfin; tall landing gear legs. In addition to Western equipment, Wilga 2000 features increased fuel, strengthened wing with integral fuel tanks and mainwheel legs enclosed in fairings.

Wing section NACA 2415; dihedral 1°; incidence 8° 32'.

FLYING CONTROLS: Conventional and manual. Aerodynamically and mass-balanced slotted ailerons; tab on starboard aileron; aerodynamically, horn- and mass-balanced one-piece elevator and rudder; trim tab in centre of elevator; manually operated slotted flaps; fixed slat on wing leading-edge along full span. Aileron movement 26° up/16° down; elevator 38° up/18° down; elevator tab 20° up and down; rudder 26° left/right; flaps 0° up/21° down/44° down.

STRUCTURE: All-metal, with beaded skins; single-spar wings, with leading-edge torsion box; fuselage in two portions, forward incorporating main wing spar carry-through structure; rear section is tailcone; GFRP cabin floor covered with foam rubber; aluminium tailplane bracing strut.

EADS PZL-104MA Wilga 2000 handed over to Air Cadet League of Canada on 15 December 2005 1159181



PZL-104MA Wilga 2000 (216 kW; 290 hp IO-540 engine) *(Paul Jackson)* 1159136

LANDING GEAR: Tailwheel type; fixed. Semi-cantilever main legs, of rocker type, have faired-in side Vs attached to lower fuselage and oleo-pneumatic shock-absorbers. Cleveland and Goodyear wheels and hydraulic brakes standard on all versions from 2005. Low-pressure tyres; mainwheels 8.00-6; tailwheel 255X110, steerable, carried on rocker frame with oleo-pneumatic shock-absorber. Can be equipped with floats, skis or tundra tyres.

POWER PLANT: One 216 kW (290 hp) Textron Lycoming IO-540-K1B5 or -K1D5 flat-six engine, driving a Hartzell HC-E3YR-1RF/F8068+2 three-blade constant-speed propeller. Fuel in integral wing tanks, total capacity 400 litres (106 US gallons; 88.0 Imp gallons), of which 380 litres (100.4 US gallons; 83.6 Imp gallons) are usable. Oil capacity 11.4 litres (3.0 US gallons; 2.5 Imp gallons).

ACCOMMODATION: Passenger version accommodates pilot and three passengers, in pairs, with adjustable front seats. Baggage compartment aft of seats, capacity 30 kg (66 lb). Rear seats can be replaced by additional fuel tank for longer-range operation. Upward-opening door on each side of cabin, jettisonable in emergency. Braces-type shoulder harnesses, attached to fuselage upper frames, optional.

AVIONICS: *Comms:* Garmin GNS-430 nav/com/GPS or GNC-250XL alternative.

Instrumentation: ASI, VSI; ADF, VOR and twin indicators; artificial horizon; directional gyro; magnetic compass; altimeter; stall warning device; signalling and warning panel; clock; rpm tachometer; standard fuel/pressure/temperature gauges and indicators.

Mission: Ability to carry FLIR system.

EQUIPMENT: Heavy-duty glider-towing hook and release mirrors available as option.

DIMENSIONS, EXTERNAL:

Wing span	11.28 m (37 ft 0 in)
Wing chord, constant	1.40 m (4 ft 7 in)
Wing aspect ratio	8.2
Length overall	8.62 m (28 ft 3½ in)
Height overall	2.58 m (8 ft 5½ in)
Tailplane span	3.70 m (12 ft 1¾ in)
Wheel track	2.81 m (9 ft 2½ in)
Wheelbase	6.39 m (20 ft 11½ in)
Propeller diameter	2.13 m (7 ft 0 in)
Passenger doors (each): Height	0.90 m (2 ft 11½ in)
Width	1.50 m (4 ft 11 in)

DIMENSIONS, INTERNAL:

Cabin: Length	2.20 m (7 ft 2½ in)
Max width	1.20 m (3 ft 10 in)
Max height	1.50 m (4 ft 11 in)
Floor area	2.20 m² (23.8 sq ft)
Volume	2.40 m³ (85 cu ft)
Baggage compartment	0.50 m³ (17.5 cu ft)

AREAS:

Wings, gross	15.50 m² (166.8 sq ft)
Tailplane	3.16 m² (34.01 sq ft)
Elevator, incl tab	1.92 m² (20.67 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	968 kg (2,134 lb)
Max baggage weight	30 kg (66 lb)
Max T-O and landing weight	1,500 kg (3,306 lb)
Max zero-fuel weight	1,427 kg (3,146 lb)
Max wing loading, option	96.8 kg/m² (19.82 lb/sq ft)
Max power loading, option	6.71 kg/kW (11.02 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	131 kt (243 km/h; 151 mph) IAS
Cruising speed at 75% power	113 kt (211 km/h; 131 mph) IAS
Stalling speed: flaps up	54 kt (100 km/h; 63 mph) IAS
flaps down	51 kt (93 km/h; 58 mph) IAS
Max rate of climb at S/L	243 m (797 ft)/min
Service ceiling	3,540 m (11,610 ft)
T-O run	206 m (675 ft)
Landing run	97 m (320 ft)
Max range	755 n miles (1,400 km; 869 miles)

EKOLOT

EKOLOT

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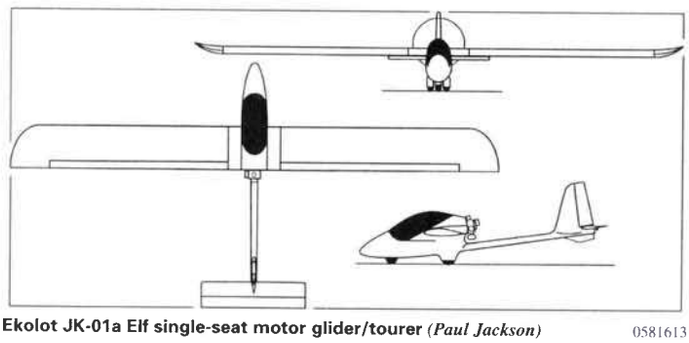
DIRECTOR: Henryk Słowik
DESIGNER: Jerzy Krawczyk

Ekolot's current product range includes the JK-01A Elf, JK-02 Fafik sailplane and JK-05 Junior ultralight. No progress with the JK-04 RS Albatros had been reported by mid-2005, and this aircraft no longer being promoted by mid-2006.



Ekolot JK-01a Elf single-seat motor glider/tourer *(Paul Jackson)* 0581613

EKOLOT JK-01A ELF

TYPE: Single-seat ultralight motor glider/kitbuilt.

PROGRAMME: Designed by Jerzy Krawczyk; initial JK-01 flown in mid-1990s with 9.00 m (29 ft 6¼ in) span and 9.00 m² (96.9 sq ft) wing area.

Revised JK-01a developed to specifications of XC Aviation (www.xcaviation.com) of Glasgow, UK. Prototype registered (in France) as W64-MA and made public debut, complete but not then flown, at International Microlight Exhibition, Popham, UK, on 29-30 April 2006.

COSTS: Kit GBP10,990 excluding engine; or GBP13,750 all carbon fibre. Flyaway GBP3,660 extra. Engine GBP1,725. Instruments not included (2006).

DESIGN FEATURES: Combination of cross-country ultralight and thermal- or ridge-soaring sailplane; intended to incorporate high technology at low cost and meet British BCAR Section S criteria. Uses some components of Ekolot JK-05. Constant-chord wings with upturned tips mounted in mid-position immediately behind pilot; narrow tailboom; low-mounted, single-piece elevator to rear of rudder; underfin.

Aerofoil section MM18-17 to give mild, stable stall, unaffected by rain or insect adhesion.

FLYING CONTROLS: Manual. Flaperons, single-piece elevator and full-height rudder. Actuation by cable (rudder only) and pushrods.

STRUCTURE: Generally of Parabeam glass fibre, plus carbon fibre for main spar, cockpit rovings and tailboom. Optionally, all carbon fibre.

LANDING GEAR: Tricycle type; fixed. Twin mainwheels mounted at fuselage hips to give narrow track; no shock absorption.

POWER PLANT: One 14.9 kW (20 hp) JPX D330 flat-twin, two-stroke piston engine driving a Peszke three-blade folding propeller via toothed belt. Fuel capacity 15 litres (4.0 US gallons; 3.3 Imp gallons).

EQUIPMENT: Optional Alphaparachute ballistic recovery parachute.

DIMENSIONS, EXTERNAL:

Wing span	11.12 m (36 ft 5¾ in)
Length overall	5.65 m (18 ft 6½ in)
Height overall	1.92 m (6 ft 3½ in)
Wheel track	0.30 m (1 ft 0 in)

Prototype Ekolot JK-01a Elf at its unveiling at Popham, UK, on 29 April 2006 *(Paul Jackson)* 0581614

AREAS:
Wings, gross ..... 10.80 m² (116.3 sq ft)
WEIGHTS AND LOADINGS:
Weight empty: carbon fibre ..... 80 kg (176 lb)
composites ..... 145 kg (320 lb)
Max T-O weight ..... 250 kg (551 lb)
PERFORMANCE, POWERED:
Never-exceed speed (VNE) ..... 81 kt (150 km/h; 93 mph)
Normal cruising speed ..... 59 kt (110 km/h; 68 mph)
Max rate of climb at S/L ..... 66 m (216 ft)/min
g limits (ultimate) ..... +6/ 3
PERFORMANCE, UNPOWERED:
Best glide ratio 24
Min rate of sink ..... 1.10 m (3.60 ft)/s

EKOLOT JK-05 JUNIOR

Canadian marketing name: Pathmaker
Spanish marketing name: Ecoflyer

TYPE: Side-by-side ultralight.

PROGRAMME: Design revealed publicly March 1997; composites airframe of JK-03 Junior (also known as Beetle) prototype completed mid-1998; this aircraft made maiden flight 9 November 1999, powered by Suzuki motorcar engine. Public debut mid-2000 at air show in Blois, France, resulting in French orders for four production JK-03s. Improved version then developed as JK-05, making first flight 30 August 2001, powered by Rotax 582 UL engine. Verner 133 M and Rotax 912 UL introduced as alternative power plants in May and October 2002 respectively.

Changes from JK-03 include increased MTOW; higher *g* limits; max flaperon deflection reduced; nosewheel steering via rudder pedals; longer-stroke landing gear legs; and modified window/door opening.

CURRENT VERSIONS: **JK-03 Junior:** Prototype and first four production aircraft.

JK-05L Junior/Beetle: Current production version; *as described*.

Pathmaker: Rotax 912 ULS engine and 65 litres (17.2 US gallons; 14.3 Imp gallons) fuel; max T-O weight 560 kg (1,234 lb); max range 410 n miles (760 km; 472 miles).

CUSTOMERS: Total 43 of Junior/Beetle series built by April 2006, including exports to Canada, France, South Africa, Thailand and US.

COSTS: EUR27,500 plus tax (2003).

DESIGN FEATURES: Braced high-wing monoplane (single I strut each side) with sweptback vertical tail; constant chord, non-swept wings (with leading-edge cutout at root to improve cockpit view) and horizontal tail. Small underfin.

Laminar flow wing section (modified NN 1817).

FLYING CONTROLS: Manual (pushrods and cables). Electrically actuated full-span slotted flaperons (6° up, 15 and 28° down); one-piece elevator, with electrically actuated central trim tab.

STRUCTURE: Stainless steel tube main frame; remainder of GFRP/CFRP-reinforced resin composites. Foam and carbon fibre wing main spar. Fin integral with fuselage. Can be assembled/disassembled for storage and transportation by two people in about 10 minutes.

LANDING GEAR: Tricycle type; fixed. Cantilever, fuselage-mounted, self-sprung composites main gear legs; steel nosewheel strut with rubber-in-compression shock-absorbers. All three wheels size 350×150 and fitted with speed fairings. Mainwheels have Bowden cable brakes; nosewheel steerable by rudder pedals.

POWER PLANT: One 47.8 kW (64.1 hp) Rotax 582 UL or 58.2 kW (78 hp) Verner 133 M flat twin, or 59.6 kW (79.9 hp) Rotax 912 UL flat-four; Aero Sail three-blade propeller.

Two fuel tanks aft of cockpit, combined capacity 60 litres (15.9 US gallons; 13.2 Imp gallons); gravity filler cap aft of wing on port side.

ACCOMMODATION: Window/door each side, hinged on centreline and opening upward; additional transparencies aft of these and in cabin roof. Baggage space aft of seats.

Views of Ekolot JK-05 Beetle/Junior 1159215

AVIONICS: Standard VFR instrumentation and flap position indicator. Options include intercom and ICOM IC-A110 radio.

EQUIPMENT: Galaxy recovery parachute in fuselage top-decking.

DIMENSIONS, EXTERNAL:
Wing span ..... 10.56 m (34 ft 7¾ in)
Length overall ..... 5.95 m (19 ft 6¼ in)
Height overall ..... 2.30 m (7 ft 6½ in)
DIMENSIONS, INTERNAL:
Cabin max width ..... 1.20 m (3 ft 11¼ in)
AREAS:
Wings, gross ..... 11.00 m² (118.4 sq ft)
WEIGHTS AND LOADINGS (A: Rotax 582, B: Rotax 912, C: Verner 133 M):
Weight empty: A ..... 265 kg (584 lb)
B ..... 280 kg (617 lb)
C ..... 290 kg (639 lb)
Max T-O weight: except Pathmaker ..... 480 kg (1,058 lb)
Max wing loading: except Pathmaker ..... 43.64 kg/m² (8.94 lb/sq ft)
Max power loading: A ..... 10.04 kg/kW (16.50 lb/hp)
B ..... 8.05 kg/kW (13.23 lb/hp)
C ..... 8.25 kg/kW (13.55 lb/hp)
PERFORMANCE, POWERED (A, B and C as above):
Never-exceed speed (VNE):
all ..... 113 kt (210 km/h; 130 mph)
Max level speed: A ..... 97 kt (180 km/h; 112 mph)
B ..... 113 kt (210 km/h; 130 mph)
C ..... 103 kt (190 km/h; 118 mph)
Max cruising speed, 75% power:
A ..... 84 kt (155 km/h; 96 mph)
B ..... 97 kt (180 km/h; 112 mph)
C ..... 89 kt (165 km/h; 103 mph)
Stalling speed, flaperons down:
all ..... 31 kt (56 km/h; 35 mph)
Max rate of climb at S/L: A ..... 240 m (787 ft)/min
B ..... 480 m (1,575 ft)/min
C ..... 300 m (984 ft)/min
T-O run: A, C ..... 120 m (395 ft)
B ..... 80 m (265 ft)
T-O to 15 m (50 ft): A, C ..... 220 m (720 ft)
B ..... 150 m (495 ft)
Landing run: all ..... 100 m (330 ft)
Max range: A ..... 243 n miles (450 km; 279 miles)
B ..... 378 n miles (700 km; 435 miles)
C ..... 270 n miles (500 km; 310 miles)
g limits ..... +5/–3
PERFORMANCE, UNPOWERED:
Best glide ratio: power off 13–14
engine idling 9–10

J & AS

J & AS AERODESIGN

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CHIEF DESIGNER: Jaroslaw Janowski

Jaroslaw Janowski designs began with J1 Przablahniczka kitbuilt first flown 30 July 1970; subsequently included similar, but T-tailed, J2 Polonez and J3 Orzel (Eagle); and V-tailed J5 Marco, of which last-named described under Aviation Farm heading in 2000-01 *All the World's Aircraft*. Fregata is essentially a larger and higher-powered version of J5, developed in early 1990s; sales quiescent for several years, but four sold to UK in 2005 and prospect of further six to same customer by end of 2006.

J & AS J6 FREGATA

English name: Frigate Bird

TYPE: Single-seat ultralight/motor glider.

PROGRAMME: Prototype SP-P046 (later SP-0046), piloted by Jerzy Kędzierski, first flew December 1993 with a 29.1 kW (39 hp) Mosler CB-40 engine, and with a 38.8 kW (52 hp) modified Honda BF45 three-cylinder jet-ski engine on 19 July 1995. This lost in accident 16 July 1996, by which time second prototype (SP-P049) had been built with conventional (two mainwheels) landing gear. Completion of c/n 003 and 004 implied by reservation in July 2000 of US registration N105JJ for c/n 005 (taken up 2 March 2004). Planned JAR 22 certification apparently not obtained; aircraft is registered in Experimental category.

No further news until early 2006, when disclosed that BAE Systems in UK had purchased 'principal components' of four aircraft in 2005 for use in its development of HERTI (High Endurance Rapid Technology Insertion) long-range reconnaissance UAV. At that time, BAE planned to acquire kits for a further six Fregatas by end of 2006. One J6 registered in Canada in April 2006.

DESIGN FEATURES: Constant-chord, mid-mounted wings with tapered tips. Pod-and-boom fuselage; pusher engine; V tail.

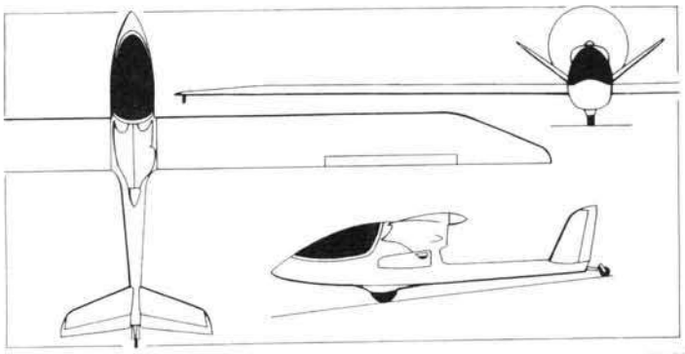
Wortmann FX-67K-170-17 aerofoil section and 1° 30' dihedral.

FLYING CONTROLS: Manual. Twin ruddervators and conventional ailerons. Schempp-Hirth type airbrakes in upper surface of wing.

STRUCTURE: GFRP/epoxy; single-spar wings.

LANDING GEAR: Fixed. Motor glider has single mainwheel, plus tailwheel, and outrigger wheels slightly inboard of wingtips; tyre sizes 350×135 (main), 120×30 (tailwheel). Ultralight has two cantilever sprung mainwheels, plus tailwheel.

J6 Fregata single-seat motor glider *(R J Malachowski)* 0051153



Motor glider version of J6 Fregata *(Paul Jackson)* 1159135

POWER PLANT: One 38.8 kW (52 hp) J & AS 3PZ-800 (Honda BF45A) three-cylinder, liquid-cooled, geared, four-stroke in-line engine; J & AS two-blade fixed-pitch wooden pusher propeller.

First pair for BAE systems fitted with modified BMW motorcar engine; second pair have turbocharged Rotax 914 F.

Fuel capacity 60 litres (15.8 US gallons; 13.2 Imp gallons). Oil capacity 2.5 litres (0.7 US gallon; 0.6 Imp gallon).

DIMENSIONS, EXTERNAL:

Wing span	12.55 m (41 ft 2 in)
Wing aspect ratio	17.2
Length overall	5.11 m (16 ft 9¼ in)
Height overall	1.58 m (5 ft 2¼ in)
Propeller diameter	1.25 m (4 ft 1¼ in)

AREAS:

Wings, gross	9.135 m² (98.3 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	245 kg (540 lb)
Max T-O weight	410 kg (903 lb)
Max wing loading	44.9 kg/m² (9.19 lb/sq ft)
Max power loading	10.57 kg/kW (17.36 lb/hp)

PERFORMANCE, POWERED:

Never-exceed speed (VNE)	135 kt (250 km/h; 155 mph)
Max level speed	103 kt (191 km/h; 118 mph)
Max cruising speed at 75% power	97 kt (180 km/h; 112 mph)
Stalling speed	38 kt (70 km/h; 44 mph)
Max rate of climb at S/L	396 m (1,299 ft)/min
Service ceiling	7,000 m (22,960 ft)
T-O run	120 m (395 ft)
Landing run	140 m (460 ft)
Range	540 n miles (1,000 km; 621 miles)
g limits	+5.3/–2.65

PERFORMANCE, UNPOWERED:

Best glide ratio, depending on propeller fitted	19-23
Min rate of sink	1.20 m (3.94 ft)/s

Fregata modified by BAE Systems as HERTI-1A reconnaissance UAV *(BAE)*

1159201

MMZL

MARGANSKI & MYSLOWSKI ZAKLADY LOTNICZE SP. Z.O.O. (MARGANSKI AND MYSLOWSKI AVIATION EQUIPMENT COMPANY)

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MANAGING DIRECTOR: Edward Margański

Edward Margański has been connected with the design of several Polish light aircraft. His latest designs are the EM-10 Bielik, envisaged as a modern successor to the TS-11 Iskra jet trainer, and EM-11 Orka twin-engined utility aircraft.

Company established October 1986 as first aeronautical private enterprise in Poland, initially inspecting and repairing wooden gliders and later extending capabilities to overhaul and repair of motor gliders and all-composites sailplanes. Co-operated with Krakow Aviation Museum in reconstructing four historical aircraft, followed by Grunau Baby reconstruction for a Swedish customer. Designed, built and flew Swift S-1 and MDM-1 Fox sailplanes under contract to those companies during 1990s, eventually producing more than 30 of each type and modifying latter as motor glider. Bielik programme started 1999 and Orka two years later. Present name adopted in 2005 after acquisition of majority shareholding in Marbet company.

Non-aviation work has included composites components for motorcar bodies and, for Euros GmbH of Germany, 44 m (144.4 ft) diameter rotor blades for wind energy converters (WECs). In 2002, for customer in Belarus, designed and built components for a 1 MW WEC station said to be world's first to be based on the Magnus (rotating cylinder) effect. The factory has a floor area of 1,400 m² (15,070 sq ft) and a workforce (December 2004) of 34.

MMZL EM-10 BIELIK and FENIX

TYPE: Basic jet trainer.

PROGRAMME: Started as private venture under project name Iskra II, but renamed Bielik (a native Polish eagle) after press competition before public debut third quarter 2001 at exhibitions in Katowice and Radom. First flight (prototype SP-YEM) was then anticipated before end of 2001, but delayed by engine installation problems. Transported to Mielec for pre-flight preparation and tests in November 2002; first flight deferred until end of Polish winter; achieved 4 June 2003. Gradual development continuing, but at slow pace, with priority currently being given to Orka programme.

CURRENT VERSIONS: **Bielik:** Military basic and advanced training version, aimed at Polish and foreign air forces as low weight and cost pilot trainer.

Fenix: (English name Phoenix) Civil general aviation version, including aerobatics; intended for export.

DESIGN FEATURES: Low T-O weight achieved by rejection of onboard armament in favour of electronic combat application simulation system. Mid-wing, blended wing/body design with forward-extending curved strakes; twin outward-canted fins and rudders. Designed for high-*g* and high-AoA manoeuvres.

Supercritical wing and tailplane aerofoil section, thickness/chord ratio 6 per cent; wing anhedral 3° 30'; tailplane anhedral 10°.

FLYING CONTROLS: Manual, with hydraulically boosted all-moving slab tailplane, with electrically actuated tabs, for pitch and roll control; twin rudders deflect outwards only. Full-span leading- and trailing-edge flaps.

STRUCTURE: All-composites (carbon fibre and epoxy resin) stressed-skin sandwich over most of airframe. Single-spar wing.

LANDING GEAR: Hydraulically retractable tricycle type, with single wheel on each unit. Wheel sizes: main 49.5 cm (19½ in), nose 15.2 cm (6 in). Mainwheels retract rearward, nosewheel forward. Mainwheel disc brakes.

EM-10 Bielik tandem-seat jet *(Paul Jackson)*

0580829

POWER PLANT: One 12.75 to 17.65 kN (2,866 to 3,968 lb st) class turbojet in production aircraft; prototype has 13.52 kN (3,040 lb st) General Electric CJ610-6. Thrust vector control planned for production aircraft. Two fuel tanks in tandem in centre-fuselage, combined capacity 1,100 litres (291 US gallons; 242 Imp gallons).

ACCOMMODATION: Crew of two in tandem, on zero/zero ejection seats (zero height/150 kt; 278 km/h; 173 mph in prototype), in pressurised cockpit.

SYSTEMS: Hydraulic system, pressure 140 bar (2,030 lb/sq in), for landing gear, flap, airbrake and wheel brake actuation and slab tailplane control booster. Pneumatic system for emergency operation of trailing-edge flaps, landing gear extension and mainwheel brakes. 28 V DC electrical system. Crew oxygen system. Cockpit pressurisation system.

AVIONICS: Bielik basic trainer and Fenix to have standard nav/com avionics. Bielik advanced trainer version planned to be equipped with combat application electronic simulations of armament operation; real or virtual, radar- and IR-based observation and sighting systems; evaluation of sighting and weapon delivery techniques; and hostile air defence facilities.

DIMENSIONS, EXTERNAL:

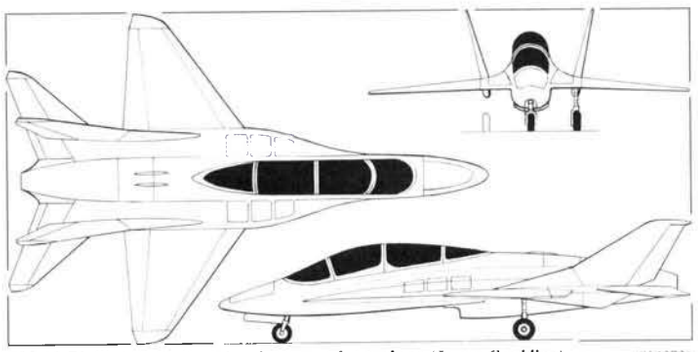
Wing span	6.60 m (21 ft 7¾ in)
Wing aspect ratio	3.7
Length overall	9.00 m (29 ft 6¼ in)
Height overall	2.50 m (8 ft 2½ in)

AREAS:

Wings, gross	11.90 m² (128.1 sq ft)

Bielik cockpit detail *(Paul Jackson)*

0552867



EM-10 Bielik twin-tailed, tandem-seat jet trainer *(James Goulding)* 0143736

WEIGHTS AND LOADINGS:
- Weight empty ..... 1,700 kg (3,748 lb)
- Fuel weight ..... 850 kg (1,874 lb)
- Max T-O weight ..... 2,500 kg (5,511 lb)
- Max wing loading ..... 210.1 kg/m² (43.03 lb/sq ft)
- Max power loading (prototype) ..... 185 kg/kN (1.81 lb/lb st)

PERFORMANCE (estimated):
- Max Mach No. 0.9
- Max level speed ..... 594 kt (1,100 km/h; 684 mph)
- Stalling speed ..... 90 kt (165 km/h; 103 mph)
- Max rate of climb at S/L ..... 2,700 m (8,858 ft)/min
- Ferry range with auxiliary tanks ..... 1,349 n miles (2,500 km; 1,553 miles)

MMZL EM-11 ORKA

English name: Whale

TYPE: Four-seat utility twin.

PROGRAMME: Started October 2001; revealed at Friedrichshafen air show, April 2003; prototype completed at that time; maiden flight achieved (SP-YEN) 8 August 2003; planned certification to JAR 23, Normal category. Seen as progenitor of family of 10 variants which would eventually include six-seat, pressurised, retractable-gear and amphibious versions, some of them with Diesel or turboprop power plants. Prototype of EM-11 C (SP-YEP), described as 'final basic' version, made public debut 10 September 2005 and maiden flight 20 October 2005; has fully retractable landing gear, roomier cockpit with baggage space and other refinements.

CURRENT VERSIONS: **Rotax 912 versions:** Four-seat executive/tourer; executive/cargo; rescue/ambulance; FLIR-carrying reconnaissance.

Diesel versions: Executive tourer; and E-O reconnaissance with radar and data downlink. Twin diesels of 101 to 149 kW (135 to 200 hp).

Turboprop versions: Executive with pressurised cabin and retractable gear; four-seat executive amphibian; stretched, six-seat executive with additional door; and amphibious version of last-named. Twin turboprops of 261 to 298 kW (350 to 400 shp) or turbofans in PW610 class.

Surveillance versions: Optional fitment of various ventral radar fairings, EO turrets and wing leading-edge sensor pods. Taller fin, increasing height overall to 3.06 m (10 ft 0½ in); or with ventral radome 3.16 m (10 ft 4½ in) plus increase of wing span to 16.00 m (52 ft 6 in).

Turbofan versions: Twin overwing P&WC PW610 or similar turbofans.

DESIGN FEATURES: Multirole capabilities and near-STOL runway requirements. High-mounted, tapered wings with twin pusher engines; tadpole-shaped fuselage with sweptback fin and rudder; tapered, low-set horizontal tail surfaces. Underfuselage conformal planing hull attachment on amphibious versions, plus fixed floats underwing.

FLYING CONTROLS: Conventional and manual. Flaps and ailerons each constructed in left and right halves; horn-balanced elevator with flight-adjustable tab; horn-balanced rudder with adjustable tab.

STRUCTURE: All-composites.

LANDING GEAR: Tricycle type; fixed on SP-YEN, retractable on SP-YEP. Fuselage-mounted, self-sprung cantilever legs on SP-YEN. Mainwheels size 6.00-6; trailing-link nosewheel, size 5.00-5.

POWER PLANT:

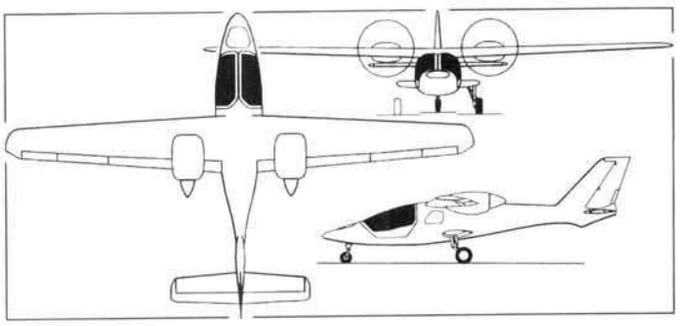
SP-YEN: Two 73.5 kW (98.6 hp), wing-mounted Rotax 912 ULS flat-four engines, each driving a Woodcomp three-blade constant-speed pusher propeller. Two fuel tanks in each wing, combined capacity 240 litres (63.4 US gallons; 52.8 Imp gallons).

SP-YEP: Two 119 kW (160 hp) Textron Lycoming IO-320 flat-four engines.

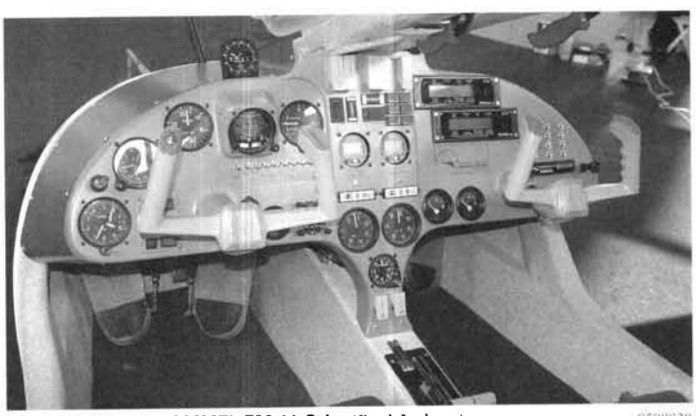
Diesel (101–149 kW; 135–200 hp) and turboprop (261–298 kW; 350–400 shp) engines envisaged for later versions.

ACCOMMODATION: Four seats in tandem pairs. Gull-wing windscreens/doors, hinged on centreline and opening upward. Baggage space aft of seats, expandable by folding or removal of three passenger seats.

Prototype MMZL EM-11 Orka 1159187



MMZL EM-11 C retractable gear Orka *(Paul Jackson)* 1159143



Instrument panel of MMZL EM-11 Orka *(Paul Jackson)* 0580838

AVIONICS: VFR or IFR, according to version.

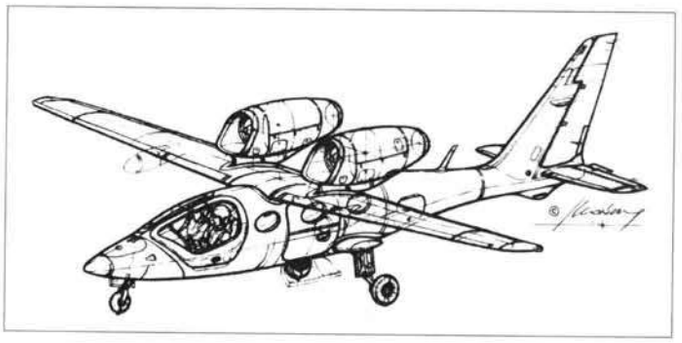
DIMENSIONS, EXTERNAL:
- Wing span ..... 13.50 m (44 ft 3½ in)
- Wing aspect ratio 10.9
- Length overall ..... 8.85 m (29 ft 0½ in)
- Fuselage: Max width ..... 1.30 m (4 ft 3¼ in)
- Max depth ..... 1.25 m (4 ft 1¼ in)
- Height overall ..... 2.62 m (8 ft 7¼ in)
- Tailplane span ..... 3.70 m (12 ft 1¾ in)
- Wheel track ..... 2.42 m (7 ft 11¼ in)
- Wheelbase ..... 3.38 m (11 ft 1 in)
- Distance between propeller centres ..... 2.97 m (9 ft 9 in)

AREAS:
- Wings, gross ..... 16.65 m² (179.2 sq ft)

WEIGHTS AND LOADINGS (A: fixed gear/Rotax 912 prototype, B: retractable gear/IO-320):
- Weight empty: A ..... 960 kg (2,116 lb)
- B ..... 1,050 kg (2,315 lb)
- Max T-O weight: A ..... 1,375 kg (3,031 lb)
- B ..... 1,650 kg (3,637 lb)

EM-11 C Orka retractable gear version 1159188

Max wing loading: A ..... 82.6 kg/m² (16.92 lb/sq ft)
B ..... 99.1 kg/m² (20.30 lb/sq ft)
Max power loading: A ..... 9.35 kg/kW (15.37 lb/hp)
B ..... 13.87 kg/kW (22.78 lb/hp)
PERFORMANCE (estimated; A and B as above):
Max level speed: A ..... 135 kt (250 km/h; 155 mph)
B ..... 189 kt (350 km/h; 217 mph)
Cruising speed: A ..... 113 kt (210 km/h; 130 mph)
B ..... 151 kt (280 km/h; 174 mph)
Min control speed (VMC): A ..... 59 kt (110 km/h; 68 mph)
Stalling speed, flaps down: A ..... 49 kt (90 km/h; 56 mph)
B ..... 52 kt (95 km/h; 60 mph)
Max rate of climb at S/L: A ..... 240 m (787 ft)/min
T-O run: A ..... 300 m (985 ft)
B ..... 250 m (820 ft)
Landing run: A, B ..... 300 m (985 ft)
Max range: A ..... 432 n miles (800 km; 497 miles)
B ..... 809 n miles (1,500 km; 932 miles)



Sketch of projected turbofan EM-11 Orka 1159134

PZL

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COMMERCIAL DIRECTOR: Marian Stachowicz

As the result of a restructuring process carried out by the Polish government, the former WSK-PZL Mielec and its subsidiary PZL Mielec Aircraft Company Ltd were subjected to liquidation proceedings in 1998. To replace the parent company, a new business entity under the above title came into operation on 23 October 1998. With its more than 60 years of history, a 2004 workforce of 1,500, and the production facilities, technology, design and testing capabilities inherited from its predecessor, Polish Aviation Factory LLC remains the largest and best-equipped aircraft manufacturing plant in Poland. It is licensed to operate within the Europark Mielec special economic zone. In July 1999, its production facilities were certified by Poland's General Inspectorate of Civil Aviation under JAR 21 Subsection G, followed in September 1999 by design organisation approval under JAR 21 Subsection A. Quality management system (QMS) certification has been awarded by BAE Systems and Boeing. The factory also has ISO 9001 certification.

PZL's current indigenous aircraft programmes comprise the M18 Dromader, M28B Bryza and M28 05 Skytruck. Four An-2s delivered to the Vietnamese People's Air Force in January 2002 following brief reopening of the Polish production line to complete aircraft abandoned a decade earlier; service support for some 12,000 previously delivered An-2s continues. PZL and Antonov announced in October 2004 joint study of the An-128 (provisional designation An-M128) as an alternative to the Polish company's former Skytruck Plus project for a stretched version of the Skytruck. No further details of this collaboration had emerged by mid-2006.

Subcontract work continues for BAE Systems (Hawk), Boeing (757), Cessna (various), GKN Westland (for Boeing 737), Saab (Gripen) and Pratt & Whitney Canada (PT6).

PZL M18 DROMADER

English name: Dromedary
Iranian designation: AVA-303
TYPE: Agricultural sprayer.
PROGRAMME: Designed to meet requirements of FAR Pt 23; prototype (SP-PBW) first flew 27 August 1976; further two prototypes; M18 awarded Polish type certificate 27 September 1978; eight preproduction aircraft used for operational trials; initial US certification on 23 January 1981; M18A followed on 8 September 1987 and M18B on 19 December 1995. Later certified in Argentina, Australia, Brazil, Canada, China, former Czechoslovakia, France, former East Germany, Italy, Lithuania, New Zealand, Spain, USA and former Yugoslavia. EASA Type Certificate A 056 issued 24 October 2005.

Initial M18 single-seat version produced from 1979 to 1984; followed by M18A two-seater produced 1984 to 1996) and M18AS training version. These superseded from mid-1996 by improved M18B and BS, which remain current standard variants.

In June 1996 PZL Mielec signed an agreement for the assembly of M18Bs from Polish CKD kits by a Brazilian local authority, but this did not take place and deliveries to that country continued to be from Polish production.

Agreement with Aviation Industries of Iran for local production as AVA-303 (which see); first aircraft delivered disassembled on 23 September 2002 and became EP-AVA.

Greek Air Force PZL M18B Dromader 1159180

CURRENT VERSIONS: **M18B:** Standard production version from mid-1996.

Improved performance development of M18A, awarded extension of Polish type certificate 27 January 1994; FAA certification granted 19 December 1995. Elevators have smaller, centrally located trim tabs; spring interconnect between elevators and flaps, and between ailerons and rudder; flaps-down deflection increased from 15 to 30°; maximum payload and overload MTOW increased. Normal category landing run reduced; flaps-down stalling speed reduced; lower control stick force values; enhanced static and dynamic longitudinal stability. Power plant and hopper as for M18A. More recent detail improvements have included 20 cm (8 in) lengthening of tailwheel leg; 20 per cent more efficient oil cooler; hydraulic (instead of multipiston) gear pump; third hinge added to rudder; anti-collision lights at wingtips instead of on fuselage; aerodynamic airscoop for ventilation system; main-gear leg fairings; hopper filling system for liquid chemicals on both sides of fuselage; and foaming agent loading system with special onboard pump.

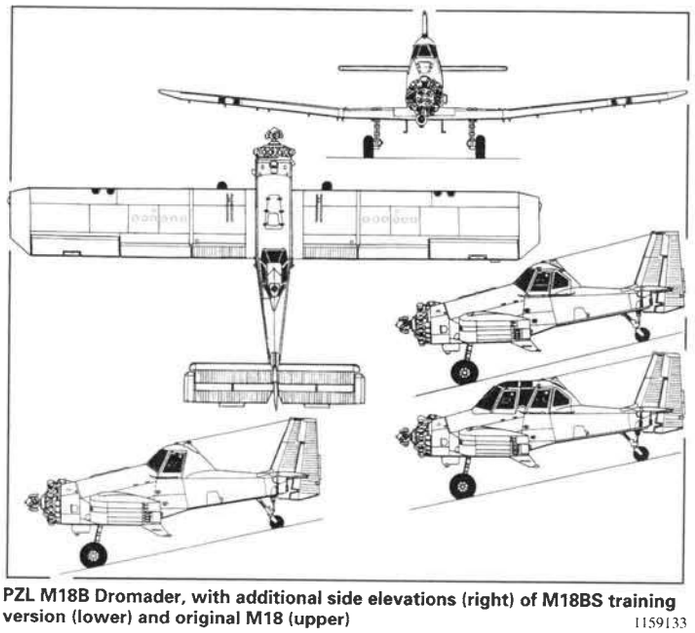
Detailed description applies to M18B except where indicated.

M18BS: Two-seat dual-control trainer, generally as M18AS, but using M18B airframe. Prototype (SP-ZUW, converted from an earlier M18) first flew in November 1997. Polish type certificate awarded early 1998. Front (instructor's) seat reduces hopper capacity to 900 litres (238 US gallons; 198 Imp gallons) or 500 kg (1,102 lb). Two produced for Iranian operator and six for Hellenic Air Force. Improved M18B, with 895 kW (1,200 hp) PZL Kalisz K-9 engine (previously reported as M18C), flown in August 1995; Type Certificate amended for this version 23 March 2005.

Turbine Dromader: Turboprop versions with 761 to 875 kW (1,020 to 1,173 shp) P&WC PT6A-45A/B/R or PT6A-65R/AG/AR engines with Hartzell propeller. Developed initially by James Mills Turbines Inc in USA and continued by Turbine Conversions Ltd. Variants with Honeywell 746 kW (1,000 shp) TPE331-10 or T53-L-7 also available from respective STC holders.

CUSTOMERS: Total of 744 built (all versions) by end of 2005, including six to Brazil. Others to Iran as kits. Approximately 90 per cent for export; sold to operators in Argentina, Australia, Brazil, Bulgaria, Canada, Chile, China, Cuba, former Czechoslovakia and East Germany, Greece (30 for firefighting), Hungary, Iran, Italy, Morocco, Nicaragua, Poland, Portugal, Spain, Swaziland, Trinidad, Turkey, USA (more than 200), Venezuela and former Yugoslavia.

DESIGN FEATURES: Emphasis on crew safety (cockpit located behind large mass concentrations of power plant and hopper; reinforced cockpit structure and roof for higher crashworthiness in case of turnover; wire cutters forward of cockpit; windscreen bird-impact resistant; fuel tanks in outboard wings, away from cockpit; steel cable between cockpit and fin for vertical tail protection against collision with overhead power lines). No members of fuselage load-carrying truss extend through hopper. All major airframe component assemblies interchangeable, with no individual fitting required. Mainwheels not subject to lateral travel during shock-absorbers' deflection, thus reducing tyre wear-off. Expansion mandrels used in centre-section-to-outboard wing attachment joints for facilitated installation and removal. Whole aircraft, in disassembled condition, with operational and ground maintenance equipment, can be carried in a single 12.2 m (40 ft) container. All parts exposed to chemical contact treated with polyurethane or epoxy enamels, or manufactured of stainless steel;



PZL M18B Dromader, with additional side elevations (right) of M18BS training version (lower) and original M18 (upper) 1159133

detachable fuselage side panels for airframe inspection and cleaning; braced tailplane.

Wing sections NACA 4416 at root, NACA 4412 at end of centre-section and on outer panels; incidence 6°.

FLYING CONTROLS: Conventional and manual. Mass and aerodynamically balanced slotted ailerons with trim tabs, actuated by pushrods; aerodynamically and mass-balanced rudder and horn-balanced elevators with trim tabs, actuated by cables and pushrods respectively; hydraulically actuated two-section trailing-edge slotted flaps. Control surface movements: ailerons +21/−17°; elevators +27/−17°; rudder ±23°; flaps max 30°.

STRUCTURE: All-metal; steel-capped duralumin wing spar; fuselage mainframe of helium-arc welded chromoly steel tube, oiled internally against corrosion; duralumin fuselage side panels and stainless steel bottom covering; corrugated inboard flap and tail unit skins.

LANDING GEAR: Non-retractable tailwheel type. Oleo-pneumatic shock-absorber in each unit. Wing-mounted main units have 800×260 tyres and are fitted with hydraulic disc brakes, parking brake and wire cutters. Fully castoring tailwheel, lockable for take-off and landing, with tyre size 380×150.

POWER PLANT: One PZL Kalisz ASz-62IR nine-cylinder radial air-cooled supercharged engine (731 kW; 980 hp at 2,200 rpm), driving a PZL Warszawa AW-2-30 four-blade constant-speed aluminium propeller. Integral fuel tank in each outer wing panel, combined usable capacity 712 litres (188 US gallons; 157 Imp gallons). Gravity feed header tank in fuselage. For ferrying, additional fuel capacity in chemical hopper. Oil capacity 70 litres (18.5 US gallons; 15.4 Imp gallons).

ACCOMMODATION: Single adjustable seat in fully enclosed, sealed and ventilated cockpit stressed to withstand a high *g* impact. Additional cabin located behind cockpit and separated from it by a wall. Latter equipped with rigid, rear-facing seat with protective padding and safety belt, port-side jettisonable door, windows (port and starboard), fire extinguisher and ventilation valve. Communication with pilot provided via window in dividing wall, and by intercom. In M18BS, standard hopper is replaced by smaller one, permitting installation of bolT-On instructor's cabin. Standard hopper of M18B and instructor's cockpit of M18BS interchangeable. Glass fibre cockpit roof and rear fairing, latter with additional small window each side. Front cockpit of M18BS has more extensive glazing. Adjustable shoulder-type safety harness. Adjustable rudder pedals. Quick-opening door on each side of front cockpit; port door jettisonable.

SYSTEMS: Hydraulic system, pressure 98 to 137 bar (1,421 to 1,987 lb/sq in), for flap actuation, disc brakes and dispersal system. Electrical system powered by 28.5 V 100 A generator, with 24 V 28 Ah lead-acid battery and overvoltage protection relay.

AVIONICS: *Comms:* Bendix/King KX 155 or KY 196A com transceiver.

Instrumentation: KI 208 course indicator, VOR-OBS indicator, artificial horizon with turn and bank indicator, gyrocompass, radio compass, transponder and stall warning.

EQUIPMENT: Glass fibre epoxy hopper, with stainless steel tube bracing, forward of cockpit; capacity 2,500 litres (660 US gallons; 550 Imp gallons) of liquid or 2,200 kg (4,850 lb) of dry chemical. Smaller hopper (see Current Versions) in M18BS. Deflector cable from cabin roof to fin.

M18 can be fitted optionally with several different types of agricultural and firefighting systems, as follows: spray system with 54/96 nozzles on spraybooms; dusting system with standard, large or extra large spreader; atomising system with 10 atomisers; water bombing installation; fire-bombing installation with foaming agents; and multifunction firefighting system (water bombing or sequential line-drops). Aerial application roles can include seeding, fertilising, weed or pest control, defoliation, forest and bush firefighting, and patrol flights.

Special wingtip lights permit agricultural flights at night, and aircraft can operate in both temperate and tropical climates. Navigation lights, cockpit light, instrument panel lights and two rotating beacons standard; wingtip positioning/strobe lights optional. Landing lights and taxying light; night working lights optional. Built-in jacking and tiedown points in wings and rear fuselage; towing lugs on main landing gear. Cockpit fire extinguisher and first aid kit.

DIMENSIONS, EXTERNAL:

Wing span	17.70 m (58 ft 0¾ in)
Wing chord, constant	2.29 m (7 ft 6¼ in)
Wing aspect ratio	7.8
Length overall	9.47 m (31 ft 1 in)
Height: over tailfin	3.90 m (12 ft 9½ in)
overall (flying attitude)	4.60 m (15 ft 1 in)
Tailplane span	5.90 m (19 ft 4¼ in)
Wheel track	3.48 m (11 ft 5 in)
Propeller diameter	3.30 m (10 ft 10 in)
Propeller ground clearance (tail up)	0.23 m (9 in)

DIMENSIONS, INTERNAL:

Hopper volume	2.5 m³ (88 cu ft)

AREAS:

Wings, gross	40.00 m² (430.5 sq ft)
Ailerons (total)	4.33 m² (46.61 sq ft)
trailing-edge flaps (total)	5.16 m² (55.54 sq ft)
Vertical tail surfaces (total)	3.60 m² (38.75 sq ft)
Horizontal tail surfaces (total)	7.58 m² (81.59 sq ft)

WEIGHTS AND LOADINGS (M18B, A: Normal category, B: CAM 8):

Max payload	2,200 kg (4,850 lb)
Max fuel weight	510 kg (1,124 lb)
Max T-O weight: A	4,200 kg (9,259 lb)
B	5,300 kg (11,684 lb)
Max wing loading: A	105.0 kg/m² (21.51 lb/sq ft)
B	132.5 kg/m² (27.14 lb/sq ft)
Max power loading: A	5.75 kg/kW (9.45 lb/hp)
B	7.26 kg/kW (11.92 lb/hp)

PERFORMANCE (M18B; A and B as above):

Never-exceed speed (VNE):	
A	151 kt (280 km/h; 174 mph)
B	124 kt (230 km/h; 142 mph)
Max operating speed: A	124 kt (230 km/h; 143 mph)
B	108 kt (200 km/h; 124 mph)
Max airspeed with agricultural equipment:	
A, B	108 kt (200 km/h; 124 mph)
Stalling speed, flaps down: A	59 kt (108 km/h; 68 mph)
B	66 kt (121 km/h; 76 mph)
Max rate of climb at S/L: A	390 m (1,280 ft)/min
B	264 m (866 ft)/min
Service ceiling: A	6,500 m (21,320 ft)
T-O run: A	240 m (790 ft)
B	350 m (1,150 ft)
T-O to 15 m (50 ft): A	530 m (1,740 ft)
B	920 m (3,020 ft)
Landing from 15 m (50 ft): A	360 m (1,180 ft)
B	570 m (1,870 ft)
Max range, no reserves:	
A, normal tankage	523 n miles (970 km; 602 miles)
B, normal tankage	432 n miles (800 km; 497 miles)
A, with hopper fuel	1,079 n miles (2,000 km; 1,242 miles)
g limits: A	+3.4/−1.4
B	+2.8/−1.1

PZL M26 ISKIERKA

English name: Little Spark
Export marketing name: Air Wolf

TYPE: Primary prop trainer/sportplane.

PROGRAMME: Two versions developed; first flight of first prototype (SP-PIA) with PZL-F engine 15 July 1986; first flight of Textron Lycoming-engined prototype (SP-PIB) 24 June 1987. Second prototype used as US demonstrator until destroyed on 17 August 1995. Polish certification obtained 26 October 1991. No production of M26 00 (PZL-F engine and Polish avionics); production of M26 01 launched second quarter 1994 with initial 20 aircraft order from US distributor Melex; deliveries to USA began July 1996 with first production aircraft (N2601M). US FAR Pt 23 certification received 16 April 1998; also has Australian certification (both for Lycoming version). No recent orders, but remains available; EASA Type Certificate A 057 issued 24 October 2005.

CURRENT VERSIONS: **M26 01:** Textron Lycoming AEIO-540-L1B5 engine and Bendix/King avionics; *as described*. Most US aircraft are registered with type designation 'M2601'.

CUSTOMERS: Initial order for M26 01 by Melex USA Inc (20), of which two (fourth and fifth aircraft) delivered to Venezuelan National Guard Training Centre at Porlamar, Isla Margarita, in 1998. Short-listed by Israel Defence Force as Piper Super Cub replacement, but not selected. Sixth production aircraft to USA early 1999. Seventh production aircraft completed in August 2000 and retained in Poland; deliveries up to end of 2002 comprised four (plus second prototype and refurbished first prototype) to USA; two to Venezuela; current demonstrator; two then due for delivery in early 2003 to Aeroclub of Poland, which had option for unspecified number of further deliveries.

PZL M28B BRYZA

English name: Breeze
NATO reporting name: Cash

TYPE: Twin-turboprop transport.

PROGRAMME: Developed by Antonov in former USSR as An-28; robust utility transport for service on Aeroflot's shortest routes, particularly those operated by An-2s into places relatively inaccessible to other fixed-wing aircraft; official Soviet flight testing completed 1972; first preproduction An-28 (SSSR-19723) originally retained same engines as prototype, but re-registered SSSR-19753 April 1975 when flown with current engines; production assigned to PZL Mielec 1978; temporary Soviet NLGS-2 type certificate awarded 4 October 1978 to second Soviet-built preproduction aircraft.

Polish manufacture of An-28 started with initial batch of 15; first flight (SSSR-28800) 22 July 1984; version received full Soviet type certificate 7 February 1986. All recent Polish production for domestic naval and military use only. Potential for future re-engining programme following cessation of PZL-10S production; two with Canadian turboprops to be delivered in 2006.

CURRENT VERSIONS: **M28B Bryza 1RM:** Originally designated An-28RM Bryza 1RM (*Ratownictwa Morskiego*; maritime reconnaissance). Prototype (SP-PDC) first flown June 1992; to Polish Navy June 1993 for evaluation; later upgraded and redelivered (as 0810) March 1999. First production example (serial number 1022) delivered 25 October 1994 and since upgraded; two further examples (1008 and 1017) ordered January 1998 and delivered March 1999 to No. 3 Naval Air Arm Division at Siemirowice. These were supplied, and earlier aircraft upgraded, with Bendix/King Silver Crown avionics. Further four aircraft (1006 and 1114 to 1116) delivered in 2000–01. Upgrade of all eight has continued with introduction of Hartzell five-blade propellers (mid-2000); and semi-retractable landing gear (first flown on 0810 on 29 January 2003) and modified nose housing new (RDR-2000)

Polish Navy Bryza 1RMbis '0810' 1179199

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weather radar. In this configuration, aircraft is redesignated **1RMbis** (see below). Further plans include provision for additional fuel tankage.

M28B Bryza 1RMbis: Configured for special missions such as detection of objects on sea surface; lead-in and call-in search and rescue; maritime patrol and submarine detection. Installed equipment to meet these objectives includes ARS-800 radar coupled with FLIR system; magnetic anomaly detector; radio-buoy airdrop system with data receiving and processing system; and national datalink system. To optimise radar performance, main landing gear retracts sideways and nose gear into fuselage. First flight in this configuration (by 0810), 29 January 2003.

M28B Bryza 1TD: (*Towaru Desantowego*: cargo transport/airdrop): Transport/paradrop version, designated for airdrop of paratroops or cargo containers, with folding seats, static lines and roller floor as appropriate. In medevac configuration, attachment provisions for six stretchers, oxygen mask container, resuscitator and medicare containers. Clamshell rear doors replaced by single door sliding forward under fuselage, similar to that of An-26. Previously known as An-28B1T, then An-28TD.

Prototype (SP-PDE) completed as B1 September 1991; to TD configuration May 1994 and to Air Force (as 0723) for evaluation May 1995; returned to PZL 1996. First production TD (1003) to Polish Air Force October 1994. Further 10 ordered for Polish Air Force in series of contracts beginning 16 May 2001; deliveries began 26 March 2002 with 0203 and 0204; followed by 0205 and 0206 in May 2002, 0207 and 0208 in May 2003; 0209 and 0210 accepted in September 2004, 0211 and 0212 in March 2005. Four of this batch delivered with Litton M949 NVGs.

Polish Navy also operates two TDs (1117 and 1118), plus one aircraft (1007) originally converted from an An-28 as Bryza 2RF elint aircraft but delivered unequipped on 22 November 1996 and operated only in transport role.

M28B/PT: Two aircraft (serials 0301 and 0302) with P&WC PT6A-65B engines; to be delivered to Polish Air Force in 2006.

M28M Bryza E: Two Polish Navy aircraft (0404 and 0405, originally delivered as An-28s in October 1988) equipped in 2000–01 with Swedish Space Corporation (Eriesson) MSS 5000 maritime surveillance system for ecological monitoring; 0405 recommissioned 28 November 2000; both redelivered to Polish Navy 18 January 2002; based at Gdynia. In these aircraft, single rear door is replaced by twin doors opening hydraulically inward, and additional side door installed in forward fuselage.

CUSTOMERS: Bryza deliveries to Polish Navy totalled 13 by May 2002, comprising eight 1RMs, two Es, two TDs and one 2RF; these equip the 3rd Division at Siemirowice. Delivery to Polish Air Force of the 10 Bryza 1TDs ordered in May 2001 was completed in January 2005. Eight of these equip 13th Transport Regiment at Krakow; remaining two operated by 36th Special Air Transport Regiment at Warsaw-Okecie in VIP transport role and are fitted with ventral cargo pannier.

Two Skytrucks equivalent to Bryza 1RMbis ordered by Vietnam People's Army Air Force in October 2003; delivered, minus surveillance radars, 30 December 2004.

COSTS: M28B/PT contract (two aircraft), PLN57.83 million (2005).

POWER PLANT: Two WSK-Rzeszów 716 kW (960 shp) TWD-10B/PZL-10S turboprops, each driving a AW-24AN three-blade or Hartzell HC-B5MP-3D five-blade propeller; first aircraft with latter was 0810, redelivered to Polish Navy on 27 August 2000. M28B/PT has 1,026 kW (1,376 shp) PT6A-65B engines.

Fuel in two 670 litre (177 US gallon; 147.4 Imp gallon) outer wing tanks and one 620 litre (164 US gallon; 136.4 Imp gallon) centre-section tank, giving total capacity of 1,960 litres (518 US gallons; 431 Imp gallons). Programme to install auxiliary tanks on landing gear sponsons was under development in 2002; no recent news of progress with this.

ACCOMMODATION (BRYZA 1RM AND 1RMbis): Pilot, co-pilot, engineer and three systems operators.

AVIONICS (BRYZA 1RM): *Comms:* LS-10 subsystem; SC-10D2 IFF transponder; NATO-compatible IFF.

Radar: PIT (Przemysłowy Instytut Telekomunikacji) ARS-400 360° search and surveillance radar (86 n mile; 160 km; 99 mile range), in underfuselage radome; Honeywell RDR-2000 weather radar in nose.

Flight: Include Bendix/King KNS 81S navigation system and KLN 90B GPS receiver.

Mission: Chelton DF 707-1 emergency locator system.

AVIONICS (BRYZA 1RMbis): *Comms:* SC-10D2 IFF transponder.

Radar: PIT ARS-800 synthetic aperture search radar in underfuselage radome; Honeywell RDR-2000 weather radar in nose.

Flight: Bendix/King KFC 325 AFCS, KLN 900 GPS navigation system and KNR 634A nav receiver; LCR 92 laser gyro platform; Chelton DF system.

Mission: SRM-800 maritime surveillance system; MAG-10 magnetometer; HYD-10 submarine detection (sonobuoy) system; ŁS10M (Link 11) automatic data transmission system; Star SAFIRE II FLIR turret in redesigned nose.

Self-defence: ESM-10 ESM system.

EQUIPMENT (BRYZA 1RMbis): ACR/RLB-14 radio marker buoys; two 100 kg (220 lb) SAB-100NM illumination flares; five six-seat Mewa-6 dinghies, including two for crew.

DIMENSIONS, EXTERNAL: As M28 Skytruck except:

Propeller diameter: AW-24AN	2.80 m (9 ft 2¾ in)
Hartzell	2.82 m (9 ft 3 in)
Cargo door: Height	2.60 m (8 ft 6¼ in)
Width	1.20 m (3 ft 11¼ in)

DIMENSIONS, INTERNAL:

Cabin: Length (excl flight deck)	5.26 m (17 ft 3 in)
Max width	1.74 m (5 ft 8½ in)
Max height	1.72 m (5 ft 7¾ in)

WEIGHTS AND LOADINGS:

Basic weight empty	4,050 kg (8,929 lb)
Weight empty, equipped	4,350 kg (9,590 lb)
Max fuel weight	1,766 kg (3,893 lb)
Max payload	2,000 kg (4,409 lb)
Max T-O and landing weight	7,500 kg (16,534 lb)
Max power loading	5.24 kg/kW (8.61 lb/shp)

PERFORMANCE:

Max operating speed (VMO)	189 kt (350 km/h; 217 mph)
Unstick speed	73 kt (135 km/h; 84 mph)
Touchdown speed	76 kt (140 km/h; 87 mph)
Stalling speed, flaps up	57 kt (104 km/h; 65 mph)
Max rate of climb at S/L	540 m (1,772 ft)/min
Time to 3,000 m (9,840 ft)	6 min 43 s
Service ceiling	6,000 m (19,680 ft)
Service ceiling, OEI	3,500 m (11,480 ft)
T-O run	440 m (1,445 ft)
T-O to 10.7 m (35 ft)	570 m (1,870 ft)
Landing from 15 m (50 ft)	750 m (2,460 ft)
Landing run	330 m (1,085 ft)
Max range, 45 min reserves	809 n miles (1,500 km; 932 miles)
Max endurance at 3,000 m (9,840 ft)	6 h 30 min

PZL M28 05 SKYTRUCK

TYPE: Twin-turboprop transport.

PROGRAMME: Westernised development of the Antonov An-28, with Polish power plant and avionics replaced by P&WC PT6A-65B turboprops, Hartzell five-blade propellers and Bendix/King nav/com, weather radar and other equipment. Prototype conversion (SP-PDF) begun early 1991; first flight July 1993; Polish temporary type certificate to FAR Pt 23 Amendment 34 granted March 1994; permanent certificate March 1996, permitting MTOW increase to 7,000 kg (15,432 lb) for M28 01 and 02; Indonesian certification for M28 02, 14 April 2004. M28 05 certified to FAR Pt 23 Amendment 42 on 18 April 2002 for increased gross weight version (7,500 kg; 16,534 lb), a prototype of which was completed in 1996. Full FAA certification of M28 05 received 19 March 2004. US distributor is Skytruck Company LLC of Naples, Florida. Indonesian Type Certificate superseded by EASA A 058 on 24 October 2005.

CURRENT VERSIONS: **M28 05 Skytruck:** *As described.*

M28 05-SG Skytruck: Maritime patrol/search and rescue version for Polish Border Guard. Surveillance system comprises Polish multifunction maritime radar; FLIR; MSS 6000 pollution detection system; searchlight; direction finder; special communication systems; still photo camera and video camera; NVGs (flight deck; external navigation lights compatible with night vision imaging system; and emergency beacon. Additional onboard equipment includes four liferafts, lifejackets and personal radio transmitters. Passenger/patrol seating and stretchers optional.

M28B Bryza: Amended designation of current production military derivatives of An-28; *described separately.*

M28 03/04 Skytruck Plus: Provisional designation for projected stretched version.

CUSTOMERS: Total 39 built and delivered by April 2006. First customer delivery (HK-4066X to Latina de Aviación of Colombia) made in January 1996; firm orders totalled 12 at that time, including six for Venezuelan National Guard (deliveries to which began in December 1996); equip Air Detachment 5 at Caracas (four), AD 3 at Maracaibo (one) and AD 9 at Puerto Agoucho (one). One delivered to Aerogryf in Poland in mid-1996; and one to USA (subsequently to Honduras) in 1997; one to Venezuelan civil operator in 2000, but lost in July 2001. Venezuelan National Guard order subsequently (1997) increased to 12, second-batch deliveries beginning mid-1999 and completed (with single M28 02 Executive) in 2000. Twelve M28 05 ordered by Venezuelan Army; first deliveries April 2000; completed in 2001.

One (RAN-41) delivered to Royal Nepal Army on 7 November 2002 for 11th Brigade at Kathmandu; second ordered October 2003, with further two then in prospect.

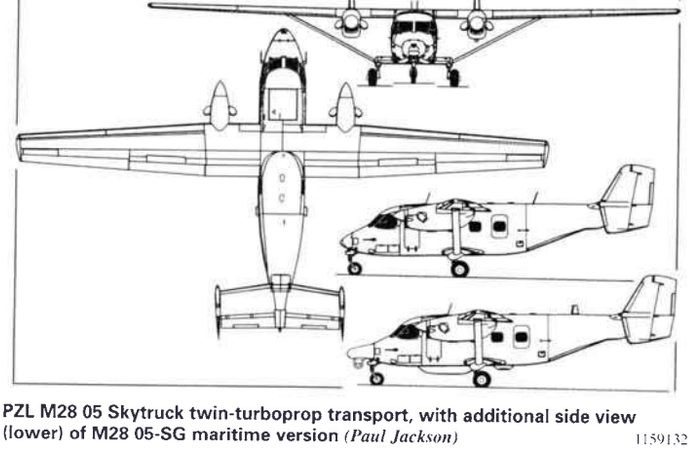
In late October 2003, Vietnamese Coast Guard ordered first two of 'at least eight to 10' Skytrucks required for maritime surveillance and border control missions; delivered in late December 2004, initially in mixed, passenger/transport configuration but later to be equipped with maritime surveillance system.

Indonesian government announced intention to buy Skytrucks for Navy on 4 May 2004, this following a late 2003 contract for four for Indonesian Police, delivered by end of 2004 in passenger/transport configuration. Contract for former batch (10 aircraft) signed 18 August 2005; these to comprise three passenger/cargo transports, generally similar to Bryza 1TD, and seven in maritime patrol configuration with surveillance system, including ARS-400M radar and L-3 Wescam MX-15 EO/IR sensor turrets. Deliveries of all 10, to Indonesian Navy base at Juanda, were due to be completed by end of 2006.

COSTS: Indonesian Navy contract (10 aircraft, plus crew training) reportedly valued at approximately USD75 million.

DESIGN FEATURES: Inherited An-28's ability to operate from short, austere airfields; added Western engines and avionics to improve export sales prospects. Braced wings; will not stall

M28 Skytruck of Indonesian Police 1179198



PZL M28 05 Skytruck twin-turboprop transport, with additional side view (lower) of M28 05-SG maritime version *(Paul Jackson)* 1159132

because of action of automatic slats. Short stub-wing extends from lower fuselage to carry main landing gear and support wing bracing struts, curving forward and downward at front to serve as mudguards; underside of rear fuselage upswept, incorporating clamshell doors for passenger/cargo loading; twin fins and rudders, mounted on inverted-aerofoil, no-dihedral fixed incidence tailplane.

Wing section CAHI (TsAGI) R-B-14; thickness/chord ratio 14 per cent, constant chord, non-swept, no-dihedral centre-section, with 4° incidence; tapered outer panels with 2° dihedral, negative incidence and 2° sweepback at quarter-chord.

FLYING CONTROLS: Manual. Single-slotted mass and aerodynamically balanced ailerons (port aileron has trim tab), designed to droop with large, hydraulically actuated, two-segment double-slotted flaps; electrically actuated trim tabs in elevator have manual back-up; twin rudders each with electrically actuated trim tab; automatic leading-edge slats over full span of wing outer panels, slab-type spoiler forward of each aileron and each outer flap segment at 75 per cent chord; fixed slat under full span of tailplane leading-edge. If an engine fails, patented upper surface spoiler forward of aileron on opposite wing is opened automatically, resulting in wing bearing dead engine dropping only 12° in 5 seconds instead of 30° without spoiler; patented fixed tailplane slat improves handling during high angle of attack climb-out; under icing conditions, if normal anti-icing system fails, ice collects on slat rather than tailplane, to retain controllability.

STRUCTURE: Mostly metal; duralumin ailerons with fabric covering, duralumin slats with CFRP skins; CFRP spoilers and trim tabs. Air intakes lined with epoxy laminate. Two-spar wing with integral fuel tanks between spars.

LANDING GEAR: Non-retractable tricycle type, with single wheel and PZL oleo-pneumatic shock-absorber on each unit. Main units, mounted on small stub-wings, have wide tread balloon tyres, size 720×320, pressure 5.50 bar (80 lb/sq in). Steerable (±50°) and self-centring nosewheel, with size 6.5-10 Goodyear tyre, pressure 6.00 bar (87 lb/sq in) or 595×185-280 Stomil (Poland) tyre, pressure 3.50 bar (51 lb/sq in). Multidisc, anti-lock hydraulic brakes on main units, and inertial anti-skid units. Reinforced landing gear and brakes optional. Minimum ground turning radius 16.00 m (52 ft 6 in). Ski and float gear under development.

POWER PLANT: Two 820 kW (1,100 shp) Pratt & Whitney Canada PT6A-65B turboprops, each driving a Hartzell HC-B5MP-3D10876ASK five-blade, fully feathering propeller with reverse pitch. Two main fuel tanks in outer wings, each 660 litres (174 US gallons, 145 Imp gallons); two auxiliaries in wing centre-section, each 290 litres (76.6 US gallons; 63.8 Imp gallons); two auxiliary tanks in outer wings, each 189 litres (49.9 US gallons; 41.6 Imp gallons); total wing fuel thus 2,278 litres (602 US gallons; 501 Imp gallons). Auxiliary tanks gravity-filled; main tanks by pressure or gravity. For self-ferry only, additional fuel can be carried in tank in main cabin. Oil capacity 16 litres (4.2 US gallons, 3.5 Imp gallons) per engine.

ACCOMMODATION: Pilot and co-pilot on flight deck, which has bulged side windows and electric anti-icing for windscreens, and is separated from main cabin by bulkhead with connecting door. Dual controls standard. Jettisonable emergency door on each side. Standard cabin layout of passenger version has seats for 19 people, with seven single seats on port side and six double seats on starboard side of aisle, at 72 cm (28 in) pitch. All seats easily foldable or removable for carriage of cargo. Aisle width 35.4 cm (13.9 in). Five passenger windows each side of cabin. Seats fold back against walls when aircraft is operated as a freighter or in mixed passenger/cargo role, seat attachments providing cargo tiedown points. Hoist of 500 kg (1,102 lb) capacity able to deposit cargo in forward part of cabin. Alternative interior configurations for 17 parachutists, or six stretchers, eight seated casualties and two medical attendants.

Entire cabin heated, ventilated, soundproofed and, optionally, air conditioned. Inward/upward-opening, hydraulically operated doors for passenger and cargo loading. Emergency exit on each side, plus a third an at flight deck. Optional ventral pannier, increasing baggage/cargo capacity by 300 kg (661 lb).

SYSTEMS: No pressurisation or pneumatic systems. Hydraulic system powered by two engine-driven pumps, pressure 147 bar (2,132 lb/sq in), for flap, spoiler and (where fitted) cargo ramp actuation, mainwheel brakes and nosewheel steering, with emergency back-up system for spoiler extension and mainwheel braking. Optional air conditioning system, electrically powered with ground power supply back-up, reduces ambient temperatures of up to 40°C (104°F) by 10 to 12°C (18 to 22°F).

Primary electrical system is three-phase AC, with two 28 V DC 12 kW engine-driven starter/generators; two 200/115 V, 400 Hz, 1,500 VA inverters as secondary supply for windscreen heating. Two 26 Ah Ni/Cd batteries.

Electric anti-icing of flight deck windscreens, propellers, spinners and pitot heads, sufficient for short exposure to icing conditions. Oxygen system standard for crew, optional for passengers. No APU.

AVIONICS: Standard Gold Crown suite by Bendix/King.

Comms: Two KTR 908 VHF radios; two KMA 24 H70 audio selector intercoms; MST 67A transponder and encoding altimeter. Optional KHF 950 HF radio.

Radar: Optional RDR-2000 digital weather radar.

Flight: Navigation system based on two KNR 634 VOR/LOC/GS/MKR receivers for VOR/DME navigation, with two EFS 50 EHSI; two KDF 806 ADF; LCR 92S12 laser gyro; two EFS 50 EADI. Optional KLN 900 GPS and EDR, KFC 325 AFCS, KCP 220 computer and Mk VI EGPWS.

DIMENSIONS, EXTERNAL:

Wing span	22.06 m (72 ft 4½ in)
Wing chord: at root	2.20 m (7 ft 2½ in)
mean aerodynamic	1.885 m (6 ft 2¼ in)
at tip	1.10 m (3 ft 7¼ in)
Wing aspect ratio	12.3
Length overall: standard	13.10 m (42 ft 11¾ in)
maritime patrol version	13.72 m (45 ft 0¼ in)
Fuselage: Length	12.68 m (41 ft 7¾ in)
Max width	1.90 m (6 ft 2¾ in)
Max depth	2.14 m (7 ft 0¼ in)
Height overall	4.80 m (15 ft 9 in)
Tailplane span	5.14 m (16 ft 10¾ in)
Wheel track	3.39 m (11 ft 1½ in)
Wheelbase	4.36 m (14 ft 3¾ in)
Propeller diameter	2.82 m (9 ft 3 in)
Propeller ground clearance	1.06 m (3 ft 5¾ in)
Distance between propeller centres	5.20 m (17 ft 0¾ in)
Rear hydraulic doors:	
Length	2.60 m (8 ft 6¾ in)
Total width: at top	0.90 m (2 ft 11½ in)
at sill	1.20 m (3 ft 11¼ in)
Emergency exits (each):	
Height	0.92 m (3 ft 0¼ in)
Width	0.62 m (2 ft 0½ in)

DIMENSIONS, INTERNAL:

Cabin (level flight deck): Length	5.26 m (17 ft 3 in)
Max width	1.74 m (5 ft 8½ in)
Max height	1.72 m (5 ft 7¾ in)
Floor area	approx 7.5 m² (80.7 sq ft)
Volume	approx 14.0 m³ (494 cu ft)
Pannier (optional): Height	0.38 m (1 ft 3 in)
Width	1.53 m (5 ft 0¼ in)
Volume	1.35 m³ (47.7 cu ft)

AREAS:

Wings, gross	39.72 m² (427.5 sq ft)
Ailerons (total)	4.33 m² (46.61 sq ft)
Trailing-edge flaps (total)	7.99 m² (86.00 sq ft)
Spoilers (total)	1.67 m² (17.98 sq ft)
Fins (total)	10.00 m² (107.64 sq ft)
Rudders (total, incl tabs)	4.00 m² (43.6 sq ft)
Tailplane	8.85 m² (95.26 sq ft)
Elevators (total, incl tabs)	2.56 m² (27.56 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: passenger version	4,398 kg (9,696 lb)
cargo version	4,260 kg (9,392 lb)
maritime patrol version	4,700 kg (10,362 lb)
Max fuel load	1,766 kg (3,893 lb)
Max payload: in cargo/passenger cabin	2,000 kg (4,409 lb)
in ventral baggage pod	300 kg (661 lb)
total	2,300 kg (5,070 lb)
Fuel with max payload	1,085 kg (2,392 lb)
Payload with max fuel	1,319 kg (2,908 lb)
Max T-O and landing weight	7,500 kg (16,534 lb)
Max zero fuel weight	6,600 kg (14,550 lb)
Max wing loading	188.8 kg/m² (38.67 lb/sq ft)
Max power loading	4.57 kg/kW (7.52 lb/shp)

PERFORMANCE (at 7,000 kg; 15,432 lb AUW):

Max operating speed (VMO)	191 kt (355 km/h; 220 mph)
Econ cruising speed at FL984	146 kt (270 km/h; 168 mph)
Max manoeuvring speed (VA)	132 kt (244 km/h; 152 mph)
Min control speed (VMCA)	83 kt (153 km/h; 96 mph)
Finstick speed	73 kt (135 km/h; 84 mph)
Approach speed	70 kt (130 km/h; 81 mph)
Stalling speed, flaps up	67 kt (123 km/h; 77 mph)
Max rate of climb at S/L	690 m (2,264 ft)/min
Time to FL984: air bleed off	6 min
air bleed on	9 min
Service ceiling	7,620 m (25,000 ft)
Service ceiling, OEI	3,750 m (12,300 ft)
T-O run	255 m (835 ft)
T-O to 10.7 m (35 ft)	325 m (1,065 ft)
Landing from 15 m (50 ft)	560 m (1,835 ft)
Landing run	260 m (855 ft)
Range at FL984, 45 min reserves:	
with max payload	432 n miles (800 km; 497 miles)
with max fuel	809 n miles (1,500 km; 932 miles)
self-ferry, with additional tanks in cabin	1,673 n miles (3,100 km; 1,926 miles)
Endurance	6 h 12 min
g limits	+3/−1

PZL

PZL-ŚWIDNIK SA

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HEAD OF SALES: Marzena Siwek
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PZL-Świdnik factory recently completed 55 years of aircraft manufacture, having been established 1 January 1951, engaged initially in manufacturing wings and control surfaces for LiM-1 (MiG-15) jet fighter, began licensed production of Soviet Mi-1 helicopter in 1954 (first flight March 1956), building some 1,594 as SM-1s, followed by 86 Świdnik-developed SM-2s; design office formed at factory to work on variants/developments of SM-1 and original projects such as SM-4 Latka. More than 7,300 helicopters of all types built to date, including four pre-series and 5,418 production Mi-2s from 1965; in addition, further six Mi-2 static test airframes produced. Indonesian Police ordered nine upgraded Mi-2plus helicopters in 2004, for delivery in 2005. One PZL Kania was delivered to the Polish Border Guard during 2003; further contracts in 2004 from same customer for four more Kanias and one W-3 Sokół.

Świdnik works named after famous pre-war PZL designer Zygmunt Pulawski in September 1957; became a joint stock company on 4 January 1991, with Polish Treasury the major shareholder. Main shareholder from 2003 (87.61 per cent) is Industrial Development Agency, a Treasury-owned joint stock company. Workforce of 3,448 in April 2006. Production of own designs concentrates on W-3 Sokół variants and SW-4. ISO 9001 status was achieved in 1994, and on 15 June 2000 Świdnik was granted AQAP-110 certification, having fully met NATO quality assurance requirements for design, development and production.

Świdnik manufactures PW-5 Smyk (from 1994) and PW-6 composites sailplanes and (also since 1994) central wing box for ATR 72; manufacturing fuselages for AgustaWestland since 1996 (now includes A 109 E Power, A 109 LUH, A 109 S Grand, A 119 Koala and AW139; over 100 delivered in 2005 and 300th on 9 June 2006); also fuselage components for Bell/Agusta AB139, cockpit modules for Dassault Mirage 2000-5, aircraft components for

Ratier-Figeac, and baggage doors for Airbus A300/A320/A340. Co-operation agreement with Cessna, and start of Bell 412 tailboom production, announced in 2002. February 2004 MoU with Dirgantara to study feasibility of latter becoming components supplier for W-3 Sokół. In all, PZL-Świdnik is involved in some 20 international aerospace manufacturing programmes, and co-operates with 11 world aerospace companies, including Boeing, Eurocopter, GKN, Latécoère, Stork Fokker and Textron in addition to those already mentioned.

Subsidiaries include Heliseco, which operates over 100 helicopters on agricultural and similar tasks at home and in Egypt, Greece, Oman, Portugal, Spain and elsewhere.

PZL W-3 SOKÓŁ

English name: Falcon

TYPE: Multirole medium helicopter.

PROGRAMME: Developed under 1970 joint Polish/Soviet agreement; preliminary design by engineers from both countries at Mil OKB in Moscow 1972, where preliminary mockup completed 1975. Detail design and definitive mockup by Świdnik 1976; static/fatigue ground test airframe of 1978 followed by five flying prototypes, first of which (SP-PSA) made first flight 16 November 1979, and used in subsequent tiedown tests; remaining prototypes embodied changes resulting from tests; Soviet participation ended 1980. Manufacturer's flight trials resumed 6 May 1982 with second prototype (SP-PSB); third, fourth and fifth prototypes all made first flights in 1984, on 24 July (SP-PSC), 4 June (SP-PSD) and 26 November (SP-PSE) respectively; certification trials carried out in wide range of operating conditions, including heavy icing and extreme temperatures of –60 and +50°C. Provisional Polish certification 26 September 1988, followed by full certification in Poland 10 April 1990, and to Russian NLGW-1 and –2 regulations 17 December 1992; production started in 1985 and 20 early aircraft supplied to Aeroflot from 10 August 1988, but subsequently returned to Świdnik, most being reallocated to Heliseco for firefighting in Spain.

Manufacture ended in 2001, the final aircraft being sold to Krasnodar in 2003. However, USD132 million contract signed 15 December 2004, under which PZL-Świdnik to supply Iraqi Army with 20 Sokóły: 12 W-3Ws, four VIP transports and four for medevac use. First deliveries planned for November 2005.

Polish (26 March), Spanish, US (31 May) and German (6 December) FAR Pt 29 (VFR) certification of W-3A received 1993; Spanish certification followed on 20 December 2000. Polish ICAO-standard noise certification 1995; 100th example completed 1996. MoU 13 April 1996 with Daewoo, South Korea (now part of KAI), for purchase of 35 Sokóły with marketing rights in Asia, but payments (and hence deliveries) delayed due to regional economic difficulties and only a few sales in the region. Korean agreement expired April 2003 and not renewed.

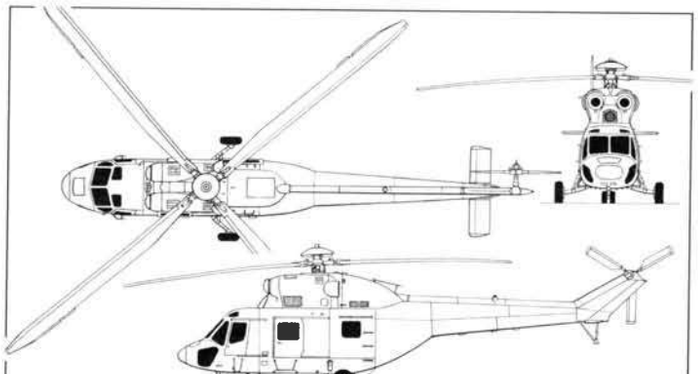
Under a Polish MoD contract of October 2002, valued at approximately USD22.8 million, PZL-Świdnik is to upgrade 16 W-3W and 12 W-3WA Sokóły from 1994/2000 production to NATO-compliant (STANAG 4555) standard with Rockwell Collins AN/ARC-210 U/VHF radios, Bendix/King KLU 709 Tacan, and cockpit instrumentation compatible with the pilot's Litton M927 NVGs. The contract was due for completion in 2006.

CURRENT VERSIONS: **W-3 Sokół:** Initial civil and military version; production (52) completed. Two W-3s (0501 and 0502) upgraded by WZL 1 as **W-3RL** for combat SAR role in 1999 as part of Polish qualification for NATO membership; based at Bydgoszcz. New equipment includes Rockwell Collins search radar, Bendix/King com radios and intercom, Tacan, GPS, radio compass, IFF, searchlight, rescue hoist, stretchers (two) and auxiliary fuel tanks; standard crew of five. One conversion to **S-1RR** prototype (which see below); one other converted as **W-3U Salamandra** armed prototype but reverted to W-3 and delivered to Myanmar.

W-3W: Armed W-3 (W for *Wielozadaniowy*: multipurpose) with starboard-mounted 23 mm GSz-23 twin-barrel gun; Mars-2 launchers for sixteen 57 mm S-5 or 80 mm S-8 unguided rockets, ZR-8 bomblet dispensers, Platan minelaying packs, and six cabin window-mounted AK 47, 5.45 mm Tantal or PKM machine guns. Twenty-two delivered to Polish Ministry of National Defence; entered service with Polish Air Force 47 Szkolny Pulk Smiglowcow (Helicopter School Regiment) at Nowe Miasto (five) and Polish Army (17).

W-3A: Improved (and final standard) version for Western certification; redesign started 1989; first flight 30 July 1992; FAA type approval to FAR Pt 29 received 31 May 1993, German LBA certification 6 December 1993. Dual hydraulic systems, new de-icing system, Western instrumentation. First delivery, to Saxony Police Department, Germany, 20 December 1993.

Trio of W-3WA Sokóły of the Polish Army *(Grzegorz Holdanowicz)* 0532728



PZL-Świdnik W-3A Sokół twin-turboshaft helicopter *(Dennis Punnett)* 0507182

W-3A2: One aircraft (c/n 370508, SP-PSL) fitted in early 1998 with Smiths Industries AFCS (SN-530 four-axis digital autopilot); obtained Polish (GILC) single-pilot IFR certification 7 January 2003. Two built: one to Spain and one to South Korea.

Detailed description applies to W-3A, except where indicated.

W-3AM: Version of W-3A with six inflatable flotation bags. Thirteen, mostly for South Korea, produced by January 2002.

W-3AS: Modernised to FAR Pt 29 standards. Polish certification 24 April 2003; EASA 17 March 2005. Fourteen W-3As upgraded to W-3AS by end of 2004; further nine planned by June 2005.

W-3WA: Combat support armed version of W-3A; weapons include GSz-23L gun, Strzala-2 AAMs and Polish Gad fire-control system. Total of 27 delivered to Polish armed forces by January 2002: Air Force five, Army 18, Navy three and MoD one. Three in combat SAR configuration (presumably based on W-3RL) delivered in second quarter 2000 to 7th Cavalry Regiment at Tomaszów Mazowiecki; new comms, NVG-compatible instrumentation, new IFF, classified ESM and armoured crew seats. Four adapted in 2001 for Polish Army smoke-laying role, equipped with PWD Pylia smoke generation system developed by WSK-PZL Rzeszów and the Polish Armed Forces' Chemistry and Radiometry Military Institute; equip 66th Air Squadron, which deployed to Iraq as part of coalition forces in 2003. Avionics and armament upgrade of Polish Army W-3WAs planned to start in 2004 under programme name Gluszec (wood grouse); to include INS/GPS nav, mission computer, head-down colour MFDs, FLIR turret, new ECM suite, NATO-standard weapon carriers and MIL-STD-1553B databus.

W-3WB: (*wsparcia bojowego:* combat support): Armed prototype (c/n 360318), equipped 1993–94 by Kentron (hence alternative designation **W-3K**) with South African weapon systems. Returned to Świdnik 1994 and became HOT/Viviane testbed (see W-3H paragraph below).

W-3PPD Gipsowka: Airborne command post (*powietrzny punkt dowodzenia*) version of W-3A. Four conversions to be procured by Polish Army as Mi-2PPD replacements by 2006, first of which (0816) was delivered to 66th Air Squadron in first half of 2001. Specialised command, control and communications (C^3) avionics include Thales RRC-9500 UHF (two) and RRC-3500 HF (one) radios, Totem 300 INS and a MIL-STD-1553B databus. Crew includes four operator workstations, each with a 40.6 cm (16 in) flat-panel colour display; flight deck is NVG-compatible. Also to have EW suite (as in W-3), including Thales SPS-H RWR and chaff/flare dispenser. Defensive armament is carried on external outriggers.

W-3RM Anakonda: Offshore search and rescue (*ratowniczy morski*: sea rescue) version of W-3; watertight cabin, six inflatable flotation bags, additional window in lower part of each flight deck door. In service with Polish Navy (five delivered, of which two since lost; retrofit with folding main rotor blades from late 2000); Ministry of Interior (one) and for Świdnik trials (one). Latest examples, with US FSI Ultra 4000 FLIR, are designated **W-3WARM** (first aircraft, 360813, delivered 21 May 1998; second, 360815, 15 March 1999; third, 360906, 18 January 2002), the A indicating American (FAA) certification standard and W indicating armament. Upgrade under test from 2000 includes a more advanced engine control system and a deck lock for shipboard deployment.

S-1RR Procjon: Electronic combat reconnaissance (*rozpoznanie radioelektronicznego*) version of W-3; prototype (c/n 310203) converted from W-3, first flown 1996 and delivered to Polish Air Force by 1 January 1997. Subsequent aircraft designated **SRR-10 Procjon-3** (alternative designation **W-3RR**); first of these (c/n 370720) first flown in 1998 and fully equipped in 1999. ECR suite includes two-place console and chaff/flare dispensers; large external antenna housings include one on nose, one on cabin roof and one on starboard side of fuselage; last-named can be rotated downwards for full 360° scan capability. Second aircraft (c/n 360907) subsequently completed.

W-3H: Unofficial designation for armed support helicopter, derived from W-3WA; pursued as upgrade under now-abandoned **Huzar** programme. Local requirement for 96. Avionics and weapons fit decided in favour of Israeli (Elbit avionics and Rafael NT-D ATM) equipment in October 1997, but selection immediately overturned by new Polish government; rival avionics offered by Boeing and Sextant, partnered by Hellfire II and HOT 3, respectively. Programme reinstated October 1998 but foundered due to inability to demonstrate NT-D in Poland within deadline of 30 November, and Israeli deal cancelled by Polish government on 8 December 1998.

September 1998 co-operation agreement between Świdnik and Euromissile led to integration of HOT 3 ATM on Sokół, followed by successful firing tests during demonstration of HOT/Viviane system at Polish firing range in Nowa Deba on 4 March 1999, using Świdnik trials aircraft SP-SUW (c/n 360318). This aircraft utilised in 2000 as prototype to test new main rotor blades with modified leading-edges and increased damage tolerance. Świdnik continues to offer W-3/HOT 3 variant as potential export version, but domestic requirement for W-3H now shelved in favour of a 50-aircraft support role upgrade of existing Sokóły, attack requirement instead being met by upgrading Mi-24 fleet.

SW-5: Provisional designation for improved version under study in late 1990s but not pursued.

CUSTOMERS: See tables. Total of 147 (excluding five flying prototypes and three static test airframes) completed, of which 128 in service in March 2006. Iraq order for 20 in December 2004, with deliveries planned to begin in November 2005, later reduced to two, to be delivered in VIP transport configuration in mid-2006. According to a Świdnik spokesman in mid-2005, these are new-build aircraft.

DESIGN FEATURES: Conventional utility helicopter of pod-and-boom layout and with engines above cabin. Four-blade fully articulated main rotor and Three-blade tail rotor; main rotor has pendular Salomon-type vibration absorber for smooth flight and low vibration levels. Transmission driven via main, intermediate and tail rotor gearboxes. Tailfin integral with tailboom; fixed incidence horizontal stabiliser, not interconnected with main rotor control system.

Main rotor blades have NACA 23012M aerofoil section and (on Polish Navy W-3RM) manual folding. Rotor brake standard. Rotor rpm 268.5 (main) and 1,342 (tail); main rotor blade tip speed 220.7 m/s (724 ft/s). Main rotor movement +25° 20'/–4° 30'.

FLYING CONTROLS: Three hydraulic boosters for longitudinal, lateral and collective pitch control of main rotor; one booster for tail rotor control. Constant-speed rpm control for continuous operation (manual rpm control also available). Two-axis stability augmentation system with pitch and roll hold. Three- and four-axis AFCS available from late 1994.

STRUCTURE: Rotor blades (main and tail) and single-spar horizontal stabiliser of laminated GFRP impregnated with epoxy resin; tail rotor driveshaft of duralumin tube with splined couplings; duralumin fuselage; GFRP fin trailing-edge.

LANDING GEAR: Non-retractable tricycle type, plus tailskid beneath tailboom. Twin-wheel castoring and self-centring nose unit; single wheel on each main unit. Oleo-pneumatic shock-absorber in each unit. Mainwheel Stomil Poznań tyres size 700×250; nosewheel tyres size 400×140. Tyre pressures 4.90 and 4.40 bar (71 and 64 lb/sq in) respectively. Pneumatic disc brakes on mainwheels. Max ground speed (paved surface) 32 kt (59 km/h; 37 mph). Metal ski landing gear optional. Six inflatable flotation bags on Anakonda and W-3AM.

POWER PLANT: Two WSK PZL-Rzeszów PZL-10W turbo-shafts, each with rating of 671 kW (900 shp) for T-O and emergency ratings of 746 kW (1,000 shp) and 858 kW (1,150 shp) for 30 and 2½ minutes OEI respectively.

Particle separators on engine intakes, and inlet de-icing, standard. Power plant equipped with advanced electronic fuel control system for maintaining rotor speed at pilot-selected value amounting to ±5 per cent of normal rpm, and also for torque sharing as well as for supervising engine limits during start-up and normal or OEI operation. Engines and main rotor gearbox mounted on bed frame, eliminating drive misalignment due to deformations of fuselage. Transmission rating 1,342 kW (1,800 shp) maximum for T-O, 1,163 kW (1,560 shp) maximum continuous and 857 kW (1,150 shp) OEI. Engine input rpm 23,615.

Four bladder fuel tanks beneath cabin floor, with combined capacity of 1,720 litres (454 US gallons; 378 Imp gallons). Auxiliary tank, capacity 1,100 litres (291 US gallons; 242 Imp gallons), optional (not FAA approved). Oil capacity 14 litres (3.7 US gallons; 3.1 Imp gallons) per engine.

ACCOMMODATION: Pilot (port side), and co-pilot or flight engineer, side by side on W-3 flight deck, on adjustable seats with safety belts. W-3A can be flown by single pilot in VFR, with extra passenger in co-pilot seat. Dual controls and dual flight instrumentation optional. Accommodation for 12 passengers in main cabin or up to eight survivors plus two-person rescue crew and doctor in Anakonda SAR version. Seats removable for carriage of internal cargo. Medevac version can carry four stretcher cases and medical attendant (EMS version, one stretcher; three medical personnel and intensive care suite). Baggage space, capacity 180 kg (397 lb), at rear of cabin.

Door with bulged window on each side of flight deck; large sliding door for passenger and/or cargo loading on port side at forward end of cabin; second sliding door at rear of cabin on starboard side. Optically flat windscreens, improving view and enabling wipers to sweep a large area. Accommodation soundproofed, heated (by engine bleed air) and ventilated.

SYSTEMS: Two independent hydraulic systems, working pressure 100 bar (1,450 lb/sq in), for controlling main and tail rotors, unlocking collective pitch control lever, and feeding damper of directional steering system; automatic power changeover if one system fails. Max flow rate 11 litres (2.9 US gallons; 2.4 Imp gallons)/min in each system. Vented gravity feed reservoir, at atmospheric pressure. Pneumatic system for actuating hydraulic mainwheel brakes. Electrical system providing 200/115 V three-phase AC power at 400 Hz and 28 V DC power. Electric anti-icing of all rotor blades. Fire detection/extinguishing system. Air conditioning and oxygen systems optional. Neutral gas system optional, for inhibiting fuel vapour explosion.

AVIONICS: Standard VFR and IFR nav/com avionics permit adverse weather operation by day or night. Bendix/King avionics standard; alternatives at customer's option.

Comms: Chromi (NATO 'Pui Heal') HF transponder in military versions.

Radar: Bendix/King RDS 82 weather radar in W-3A; 5A-813 radar in W-3RM; RDR-2000 weather radar in c/n 310801.

Flight: Stability augmentation system standard.

Mission: SPOR search and detection system in W-3RM.

Self-defence: Modified Syrena RWR in military versions initially; to be replaced by Thales FWR-99 (SPS-II in W-3PPD).

EQUIPMENT: Cargo version equipped with 2,100 kg (4,630 lb) capacity external hook and 150 kg (331 lb) capacity rescue hoist. W-3RM has 272 kg (600 lb) capacity electric hoist, stretchers, two-person rescue basket, rescue belts, two six-person liferafts, rope ladder, portable oxygen equipment, electric blankets and vacuum flasks, various types of buoy (flight, smoke and radio) and marker, binoculars, flare pistol and searchlights. Firefighting

W-3 SOKÓŁ PRODUCTION
(to 1 January 2006)

Version	Lot 1 1986–89	Lot 2 1989–93	Lot 3 1990–93	Lot 4 1992–98	Lot 5 1994–95	Lot 6 1996–98	Lot 7 1997–98	Lot 8 1999-	Total
W-3	10[1]	22[2]	17	3[3]					52
W-3A			1	4		12		2	19
W-3PPID							1		1
W-3AM				2		5	6		13
W-3RM			1	6					7
W-3W		1		5	17				23
W-3WA					3	2	10	8	23
W-3WARM							2	1	3
SRR-10						1			1
Unidentified							1		1
Static test		2[4]	1						3
Totals	**10**	**25**	**20**	**20**	**20**	**20**	**20**	**11**	**145**

[1] One converted as S-1RR Procjon prototype
[2] One to W-3U prototype; reverted to W-3 before delivery
[3] Two upgraded to W-3RL by WZL 1
[4] Israel Aircraft Industries and Instytut Lotnictwa

W-3 SOKÓŁ CUSTOMERS
(at 1 March 2006)

Country	Customer	Qty	Version	First aircraft	First delivery
Czech Republic	Air Force	11	W-3A	0709	Sep 96
Germany	Saxony Police	2	W-3A	D-HSNA	Mar 94
Iraq	Air Force	2	W-3A	-	due mid-06
Korea, South	Choong Nam Fire Dept	1	W-3A	119	Dec 99
	CitiAir	4	W-3AM	HL-9220	Dec 95
	Daegu Fire Dept	1	W-3AM	[5]	Nov 01
	Daewoo	1	W-3A	SP-FSU	not delivered
		1	W-3AM	HL-9257	Oct 96
	Heli Korea	4	W-3AM	HL-9259	Jul 97
Myanmar	Air Force	13	W-3	6501	Nov 90
Nigeria	Okada Air	1	W-3	5N-UYI	Dec 91
Poland	Air Force	7	W-3	0415	Jul 93
		5	W-3W	0516	Apr 94
		5	W-3WA	0618	[5]
	Army	17	W-3W	0601	Sep 94
		18	W-3WA	0806	97
	Heliseco	2	W-3	SP-SUB	Feb 97
		1	W-3AM	SP-SYI	Jul 96
	Lublin Medical Aviation Centre	2	W-3	SP-SXU[3]	Feb 94
	Ministry of Defence	1	W-3/S-1RR	0203	96
		1	W-3RR/SRR-10	0720	98
		1	W-3PPID	0816	01
	Ministry of Interior	2	W-3	0315	Apr 90
		1	W-3A	0420	Jun 94
		1	W-3RM	0510	Apr 93
	Navy	2	W-3	0209	Jul 89
		5	W-3RM	0505	Jul 92
		3	W-3WARM	0813	Aug 98
	Polish Telecom	1	W-3	SP-SUI	Apr 92
	PZL Swidnik	1[2]	W-3	SP-SUA	Jan 89[1]
		1	W-3W prot	SP-SUW	Mar 93[1]
		1	W-3RM prot	0411/SP-SYG	Sep 95[1]
		5[4]	W-3A2	SP-PSL	May 98[1]
	Zakopane Mountain Rescue	1	W-3	SP-SXT	Feb 93
		2	W-3A	0507	Jan 96
Russia	Aeroflot	20[4]	W-3	SSSR-04101	Aug 88
	Krasnodarski Kray	1	W-3	RA-10801	Jul 03
UAE	Ministry of Internal Affairs	2	W-3A	[5]	02
Vietnam	SFC Vietnam	1	W-3AM	VN-417	Jan 98
Total		**147**			

[1] Date of registration
[2] Firefighting demonstrator
[3] Smiths Industries SN-530 four-axis AFCS
[4] 18 transferred to Heliseco from January 1996

version: one 1,590 litre (420 US gallon; 350 Imp gallon) 'Bambi bucket' on cargo sling or 1,500 litre (396 US gallon; 330 Imp gallon) expandable underbelly tank.

ARMAMENT: As described under Current Versions.

DIMENSIONS, EXTERNAL:

Main rotor diameter	15.70 m (51 ft 6 in)
Tail rotor diameter	3.03 m (9 ft 11¼ in)
Main rotor blade chord	0.44 m (1 ft 5¼ in)
Distance between rotor centres	9.50 m (31 ft 2 in)
Length: overall, rotors turning	18.79 m (61 ft 7¾ in)
fuselage	14.21 m (46 ft 7½ in)
Fuselage max width	1.75 m (5 ft 9 in)
Height: to top of rotor head	4.20 m (13 ft 9½ in)
overall, rotors turning	5.135 m (16 ft 10¼ in)
Stabiliser span	2.385 m (7 ft 10 in)
Wheel track	3.15 m (10 ft 4 in)
Wheelbase	3.55 m (11 ft 7¾ in)
Passenger/cargo doors:	
Height (each)	1.18 m (3 ft 10½ in)
Width: port	0.94 m (3 ft 1 in)
starboard	1.25 m (4 ft 1¼ in)
Height to sill	0.86 m (2 ft 10 in)

DIMENSIONS, INTERNAL:

Cabin: Length	3.21 m (10 ft 6½ in)
Max width	1.55 m (5 ft 1 in)
Max height	1.38 m (4 ft 6¼ in)
Floor area	4.80 m² (51.7 sq ft)
Volume	6.9 m³ (243 cu ft)

AREAS:

Main rotor disc	193.6 m² (2,083.8 sq ft)
Tail rotor disc	7.21 m² (77.6 sq ft)
Main rotor blades (each)	2.90 m² (31.22 sq ft)
Tail rotor blades (each)	0.28 m² (3.01 sq ft)
Fin	1.00 m² (10.76 sq ft)
Elevator	2.16 m² (23.25 sq ft)

WEIGHTS AND LOADINGS:

Min basic weight empty	3,300 kg (7,275 lb)
Basic operating weight empty (multipurpose versions)	3,850 kg (8,488 lb)
Max baggage weight	180 kg (397 lb)
Max fuel weight	1,326 kg (2,923 lb)
Max cargo payload, internal or external	2,100 kg (4,630 lb)
Normal T-O weight	6,100 kg (13,448 lb)
Max T-O weight	6,400 kg (14,110 lb)
Max disc loading	33.1 kg/m² (6.78 lb/sq ft)
Transmission loading at max T-O weight and power	4.77 kg/kW (7.84 lb/shp)

PERFORMANCE (A: at normal T-O weight, B: at max T-O weight, ISA, except where indicated):

Never-exceed speed (VNE):	
A, B	140 kt (260 km/h; 161 mph)
Max cruising speed: A	129 kt (238 km/h; 148 mph)
B	127 kt (235 km/h; 146 mph)
Econ cruising speed: A	121 kt (225 km/h; 140 mph)
B	120 kt (222 km/h; 138 mph)
Max rate of climb at S/L: A	558 m (1,831 ft)/min
B	510 m (1,673 ft)/min
Service ceiling: A	4,910 m (16,100 ft)
B	4,520 m (14,820 ft)
Hovering ceiling IGE:	
A at ISA	3,020 m (9,900 ft)
B at ISA	2,550 m (8,360 ft)
A at ISA + 20°C	2,150 m (7,050 ft)
B at ISA + 20°C	1,690 m (5,540 ft)
Hovering ceiling OGE:	
A at ISA	1,900 m (6,220 ft)
B at ISA	660 m (2,160 ft)
A at ISA + 20°C	1,020 m (3,340 ft)
B at ISA + 20°C	400 m (1,310 ft)
Max range at econ cruising speed, no reserves:	
A (standard tanks)	402 n miles (745 km; 463 miles)
B (standard tanks)	396 n miles (734 km; 456 miles)
A (with ferry tank)	622 n miles (1,152 km; 715 miles)
B (with ferry tank)	671 n miles (1,244 km; 773 miles)
Max endurance at 67 kt (125 km/h; 78 mph), no reserves:	
A (standard tanks)	4 h 18 min
B (standard tanks)	4 h 12 min
A (with ferry tank)	6 h 42 min
B (with ferry tank)	6 h 24 min

PERFORMANCE (W-3RM at typical mission T-O weight of 5,500 kg; 12,125 lb):

Never-exceed speed (VNE)	140 kt (260 km/h; 161 mph)
Max cruising speed	131 kt (243 km/h; 151 mph)
Max rate of climb at S/L	672 m (2,205 ft)/min
Service ceiling	5,830 m (19,120 ft)
Hovering ceiling: IGE	4,000 m (13,120 ft)
OGE	2,970 m (9,740 ft)
Max range, no reserves	411 n miles (761 km; 473 miles)
Max endurance, no reserves	4 h 20 min

PZL SW-4

TYPE: Light utility helicopter.

PROGRAMME: Development began 1985; full-scale mockup completed 1987; major redesign undertaken 1989–90, using Allison (now Rolls-Royce) 250 engine in more streamlined fuselage with modified tail unit. Prototype (c/n 600102), rolled out December 1994, is non-flying testbed for ground and equipment tests; '101 is static test airframe, '103 and '104 are flying prototypes. First flight made by 600103 (red overall; later registered SP-PSW) on 26 October 1996 ('official' flight three days later).

Trials in 1997 demonstrated requirement for a new rotor head design, enlarged horizontal stabiliser and more efficient hydraulic system. Following 70 hours of test-flying, SP-PSW was grounded in late 1997 for installation of SAMM-designed hydraulic flight control system, with which it was then due to return to flying in 1998. Second flying prototype (yellow overall), with improved skids, exhibited statically at Paris Air Show, June 1997; registered as SP-PSZ in October 1998, but not flown until early 2001. Some 640 hours (total) flown by July 2002, when certification programme almost complete; domestic certificate to JAR 27 awarded 14 November 2002. First five production aircraft started in July 2002. Second prototype flown at Paris Air Show in June 2001; first at Berlin in May 2002. First production SW-4 ordered in 20 November 2003 contract; second aircraft ordered later. Polish Air Force accepted first aircraft (0201) on 15 November 2004; first pair scheduled to replace Mi-2s at PAF Academy, Deblin; second aircraft (0202/SP-PSY) is company demonstrator.

Świdnik is considering re-engining SW-4 with 485 kW (650 shp) -C30 version of Rolls-Royce 250 turboshaft.

CUSTOMERS: Polish Air Force requirement confirmed for purchase of 30 by 2010, of which first (serial number 0201) was handed over 15 November 2004 for use in training role. Four of first five production aircraft scheduled for Polish Air Force Academy; fifth is for commercial operation. Four more scheduled for completion in 2007; delivery completion due in 2010.

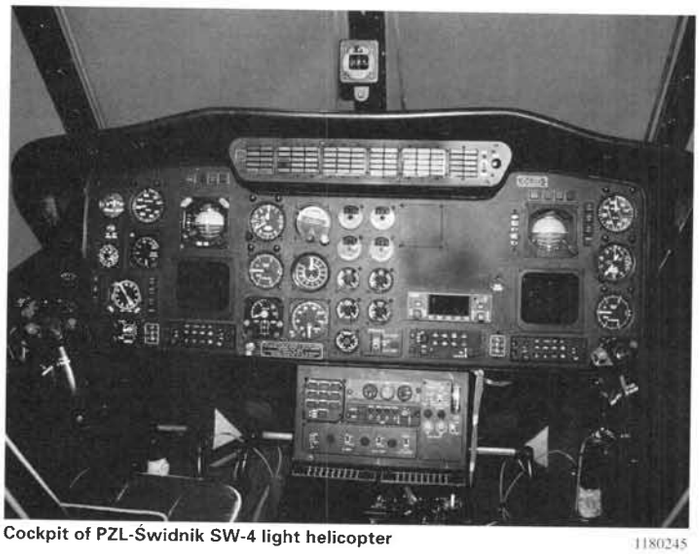
COSTS: USD950,000 (2006).

DESIGN FEATURES: Intended applications include passenger and cargo transport, VIP, medevac, border patrol, law enforcement, armed scout and training use.

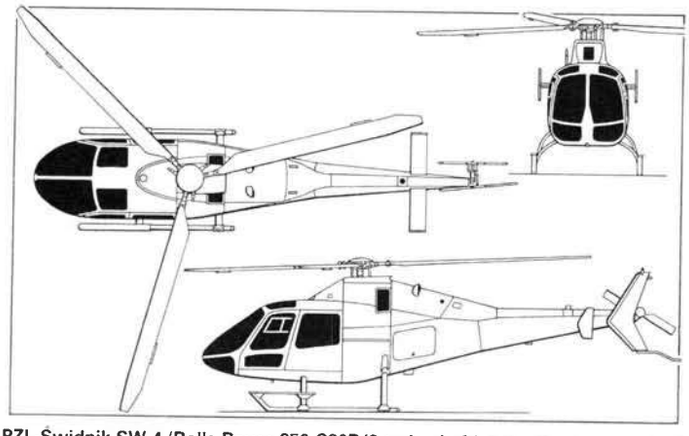
Three-blade main rotor; arrowhead tailfin on port side, with two-blade tail rotor to starboard; narrow tailplane with small endplate fins; skid landing gear.

STRUCTURE: Main structural components of aluminium alloys and glass fibre epoxy. Cabin of foam-filled carbon and glass fibre panels in epoxy matrix; centre-fuselage is stressed box of honeycomb sandwich panels, to which fuel tank and main gearbox are attached. Glass fibre/epoxy main and tail rotor blades.

LANDING GEAR: Skid type; able to accommodate heavy landing sink rate of 3.1 m (10 ft)/s by elastic deflection of cross-tubes.



Cockpit of PZL-Świdnik SW-4 light helicopter 1180245



PZL-Świdnik SW-4 (Rolls-Royce 250-C20R/2 turboshaft) *(Mike Keep)* 1133246

PZL SW-4 of Polish Air Force 1158621

jawa.janes.com

POWER PLANT: One 336 kW (1450 shp) Rolls-Royce 250-C20R/2 turboshaft. Transmission rating 336 kW (1450 shp) for T-O, 283 kW (380 shp) maximum continuous; 30 minute run-dry capability. Standard fuel capacity 500 litres (132 US gallons; 110 Imp gallons) in tank below main gearbox.

ACCOMMODATION: One or two pilots plus three or four passengers, or one stretcher patient and a medical attendant. Dual controls can be added for training role. One front-hinged and one rearward-sliding door on each side of cabin. Baggage compartment, capacity 150 kg (331 lb), to rear of cabin, with external access on port side.

AVIONICS: *Instrumentation:* Bendix/King or Garmin VFR standard. IFR optional. Latter include VSI, attitude indicator, gyro-compass, ADF, ICS, 155XI GPS, VHF/AM, VOR/LOC/GS, radar altimeter, transponder, encoder and clock.

EQUIPMENT: In law enforcement role, can be equipped with thermal imaging and TV cameras, searchlight, loudspeaker, special intercom and radio, and external hoist. For military roles, can be fitted with external support bars for up to 440 lb (970 lb) of specialist equipment.

Military training version available with extended instrument panel, hydraulically powered dual controls, crashworthy seats, flight data recorder, emergency situation switches unit (ESSU) provides simulated failures of hydraulic system, attitude indicator and gyro-compass) and NVG equipment.

DIMENSIONS, EXTERNAL:

Main rotor diameter	9.00 m (29 ft 6¼ in)
Tail rotor diameter	1.50 m (4 ft 11 in)
Distance between rotor centres	5.25 m (17 ft 2¾ in)
Length:	
overall, both rotors turning	10.55 m (34 ft 7¼ in)
fuselage: incl tailskid	9.075 m (29 ft 9¼ in)
excl tailskid	8.25 m (27 ft 0¾ in)
Max width: cabin	1.515 m (4 ft 11⅝ in)
over tail unit endplates	1.83 m (6 ft 0 in)
over skids	2.28 m (7 ft 5⅝ in)
Height to top of rotor head	3.13 m (10 ft 3¼ in)
Skid track	2.28 m (7 ft 5⅝ in)
Fuselage ground clearance	0.55 m (1 ft 9⅝ in)
Sliding door:	
Width: at top	0.82 m (2 ft 8¼ in)
at bottom	1.08 m (3 ft 6½ in)
Max height	1.25 m (4 ft 1¼ in)
Baggage door: Max width	0.81 m (2 ft 8 in)
Max height	0.535 m (1 ft 9 in)

DIMENSIONS, INTERNAL:

Cabin: Length	2.14 m (7 ft 0¼ in)
Max width	1.41 m (4 ft 7½ in)
Max height	1.27 m (4 ft 2 in)
Volume	3.85 m³ (136 cu ft)
Baggage compartment: Length	1.475 m (4 ft 10 in)
Height: at front	0.89 m (2 ft 11 in)
at rear	0.535 m (1 ft 9 in)
Volume	0.85 m³ (30.0 cu ft)

AREAS:

Main rotor disc	63.62 m² (684.8 sq ft)
Tail rotor disc	1.77 m² (19.05 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	1,050 kg (2,315 lb)
Max payload: internal	473 kg (1,043 lb)[1]
on external sling	550 kg (1,213 lb)
Max T-O weight	1,800 kg (3,968 lb)
Max disc loading	26.7 kg/m² (5.47 lb/sq ft)
Transmission loading at max T-O weight and power	5.07 kg/kW (8.33 lb/shp)

[1] *323 kg (712 lb) in main cabin, 150 kg (331 lb) in baggage compartment*

PERFORMANCE (A: at 1,600 kg; 3,527 lb AUW, ISA. B: at 1,800 kg; 3,968 lb):

Never-exceed speed (VNE):	
A, B	140 kt (260 km/h; 161 mph)
Cruising speed:	
A, B	113 kt (209 km/h; 130 mph)
Econ cruising speed:	
A	102 kt (188 km/h; 117 mph)
B	103 kt (190 km/h; 118 mph)
Max rate of climb at S/L: A	628 m (2,060 ft)/min
B	494 m (1,620 ft)/min
Service ceiling: A	5,200 m (17,060 ft)
B	4,200 m (13,780 ft)
Hovering ceiling IGE:	
A	3,300 m (10,825 ft)
B	2,150 m (7,050 ft)
Hovering ceiling OGE:	
A	2,200 m (7,220 ft)
B	910 m (2,980 ft)
Range with max standard fuel, no reserves:	
A	426 n miles (790 km; 490 miles)
B	409 n miles (758 km; 471 miles)
Max endurance: A	5 h 35 min
B	5 h 12 min

SSH

SERWIS SAMOLOTOW HISTORYCZNYCH-JANUSZ KARASIEWICZ (JANUSZ KARASIEWICZ HISTORIC AIRCRAFT SERVICE)

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SSH is certified by the Polish Aviation Authority as an approved production organisation under JAR 21, Subpart G.

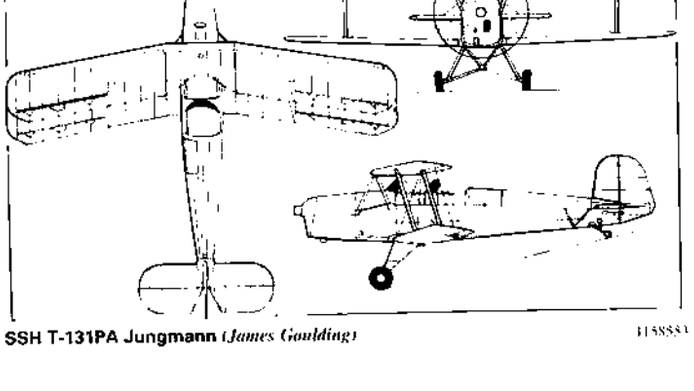
Founder, Janusz Karasiewicz was killed when the B&F FK 12 Comet in which he was a passenger crashed on 26 August 2006. Continued operation of the company is in doubt.

SSH (BÜCKER) T-131 JUNGMANN

TYPE: Aerobatic two-seat biplane.

PROGRAMME: Original German design first flew 27 April 1934, civil certification 3 October 1938; name ('young man') refers to naval cadet, in addition to some 3,000 by parent firm (ending March 1944), licensed manufacture undertaken in Japan (339 K9W floatplanes and 1,037 Ki-86/Ass), Spain (555 CASA 1.131s), Czechoslovakia (10 Tatra 131s and 300 Bü 131s, plus 260 Aero C.104s after 1945) and Switzerland (130 by Dornier). Last of some 5,700 were those produced in Spain, 1960.

SSH T-131 launched in March 1990, based on engineering drawings of Czech Bü 131D version (T and P in designations indicate Tatra and Poland). First of four pre-series aircraft flew 8 July 1994; first production aircraft exported to Austria in kit form December 1994 and made maiden flight 7 June 1997.



SSH T-131PA Jungmann *(James Goulding)* 1158583

CURRENT VERSIONS: **T-131P**: Early version, with 78.3 kW (105 hp) Walter Minor 4-III four-cylinder inverted in-line engine and Hoffmann HO-40AHM-180 two-blade fixed-pitch metal propeller. Production complete.

T-131PA: More powerful version, with 103 kW (138 hp) LOM M 332AK four-cylinder, in-line engine. Prototype (SP-FPY) first flew 9 August 1995. Current baseline version; Polish certification under way in 2001 (latest information received), as step towards main objective of full standard certification in Germany.

Description applies to T-131PA.

CUSTOMERS: Three (including prototype) T-131Ps built 1994-95, of which two exported to Sweden. At least 25 T-131PAs registered by mid-2006, including five in Austria; at least 10 to German owners, but retaining Polish registrations, three in Poland and one each to Brazil, Czech Republic, Netherlands and Switzerland. Total 23 production aircraft and three kit versions completed and flown by April 2005.

COSTS: Development EUR70,000 to EUR80,000 (2004). Flyaway EUR103,000; kit (standard or fast-build) EUR51,500 (2005).

DESIGN FEATURES: Single-bay biplane with interchangeable upper and lower wings, braced by pair of I-struts each side. This version based on Bü 131D, with ball bearings in control pivots and tailwheel, although Hirth 504A-2 engine replaced.

Wings have Göttingen aerofoil section (thickness/chord ratio 10.5 per cent) and 11° leading-edge sweepback; dihedral 3° 30' (upper), 1° 30' (lower); incidence +1° 30'; twist −1° 30'.

FLYING CONTROLS: Conventional and manual. Mass-balanced ailerons on all four wings; non-balanced rudder; trim tab in each elevator. No flaps.

STRUCTURE: Welded 4130 chromoly steel tube fuselage and tail unit; wooden wing spars (two) and ribs. Mostly Ceconite fabric covering except for metal engine cowling and around cockpit area. Fuel tank of glass fibre and carbon fibre.

LANDING GEAR: Tailwheel type; fixed. Two forward-raked, faired-in side Vs, each with oleo-pneumatic shock absorber in forward element, hinged to lower longerons, plus half-axles attached to compression frame; sprung 200x50 tailwheel; mainwheels 420x150. Tyre pressures: main 1.50 bar (53 lb/sq in), tail 2.50 bar (88 lb/sq in). Hydraulic brakes.

POWER PLANT: One 104 kW (140 hp) LOM M 332AK four-cylinder in-line engine, driving an MT32.H0/12 two-blade fixed-pitch wooden propeller. Fuselage fuel tank, capacity 85 litres (22.5 US gallons; 18.7 Imp gallons), of which 80 litres (21.1 US gallons; 17.6 Imp gallons) are usable. Oil capacity 8.5 litres (2.25 US gallons; 1.9 Imp gallons).

ACCOMMODATION: Two persons in tandem, open cockpits.

SYSTEMS: 24 V DC electrical system (generator and two batteries).

AVIONICS: Basic VFR standard; other avionics to customer's requirements.

DIMENSIONS, EXTERNAL:

Wing span	7.40 m (24 ft 3¼ in)
Wing chord (each, constant)	1.00 m (3 ft 3½ in)
Wing aspect ratio	4.1
Length overall	6.62 m (21 ft 8½ in)
Height overall	2.25 m (7 ft 4½ in)
Tailplane span	2.50 m (8 ft 2½ in)
Wheel track	1.75 m (5 ft 9 in)
Wheelbase	4.10 m (13 ft 5½ in)
Propeller diameter	1.88 m (6 ft 2 in)
Propeller ground clearance	0.63 m (2 ft 0¾ in)

AREAS:

Wings, gross	13.50 m² (145.3 sq ft)
Ailerons (four, total)	2.00 m² (21.53 sq ft)
Fin	0.50 m² (5.38 sq ft)
Rudder	0.80 m² (8.61 sq ft)
Tailplane	1.25 m² (13.45 sq ft)
Elevators (total, incl tabs)	1.15 m² (12.38 sq ft)

SSH T-131PA Bücker Jungmann *(Paul Jackson)*

1158596

WEIGHTS AND LOADINGS (approx):

Weight empty	470 kg (1,036 lb)
Fuel weight	63 kg (139 lb)
Max T-O and landing weight: Normal	720 kg (1,587 lb)
Utility	670 kg (1,477 lb)
Aerobatic	590 kg (1,300 lb)
Max wing loading	53.3 kg/m² (10.92 lb/sq ft)
Max power loading	6.90 kg/kW (11.33 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	151 kt (280 km/h; 174 mph)
Max level speed	102 kt (190 km/h; 118 mph)
Max cruising speed at S/L	97 kt (180 km/h; 112 mph)
Econ cruising speed at S/L	86 kt (160 km/h; 99 mph)
Stalling speed, engine idling	46 kt (85 km/h; 53 mph)
Max rate of climb at S/L	210 m (689 ft)/min
Service ceiling	4,000 m (13,120 ft)
T-O run	180 m (590 ft)
T-O to 15 m (50 ft)	400 m (1,315 ft)
Landing from 15 m (50 ft)	300 m (985 ft)
Landing run	150 m (495 ft)
Max range, 30 min reserves	283 n miles (525 km; 326 miles)

SSH (BÜCKER) Bü-133P JUNGMEISTER

English name: Young Champion

TYPE: Aerobatic single-seat biplane.

PROGRAMME: Entered service in 1936; also licence-built in Spain and Switzerland. Small number of replicas built in late 1960s by Bitz at Augsburg and Hirth at Nabern. SSH project initiated in late 1990s; prototype (SP-PUV) planned to fly in second quarter 2004 but not reported by mid-2006, although new registration (SP-YBK) reserved in mid-2005. Perpetuates original German Bü 133C of 1935 except for replacement of the original's 119 kW (160 hp) Hirth 506 engine. (Correct German designation is unhyphenated.)

DESIGN FEATURES: Generally similar to those of Jungmann.

FLYING CONTROLS: As Jungmann.

STRUCTURE: Fabric-covered steel tube fuselage and tail unit, except for wooden turtledeck; two-spar wooden wings with composites leading-edges and metal interplane struts.

LANDING GEAR: Tailwheel type; fixed. Mainwheel tyres size 6.00–6.

POWER PLANT: One 160 kW (215 hp) LOM M 337AK six-cylinder inline engine and MT two-blade variable-pitch propeller.

ACCOMMODATION: Pilot only, in open cockpit.

DIMENSIONS, EXTERNAL:

Wing span	6.60 m (21 ft 7¾ in)
Length overall	6.02 m (19 ft 9 in)
Height overall	2.20 m (7 ft 2½ in)

AREAS:

Wings, gross	12.00 m² (129.2 sq ft)

WEIGHTS AND LOADINGS:

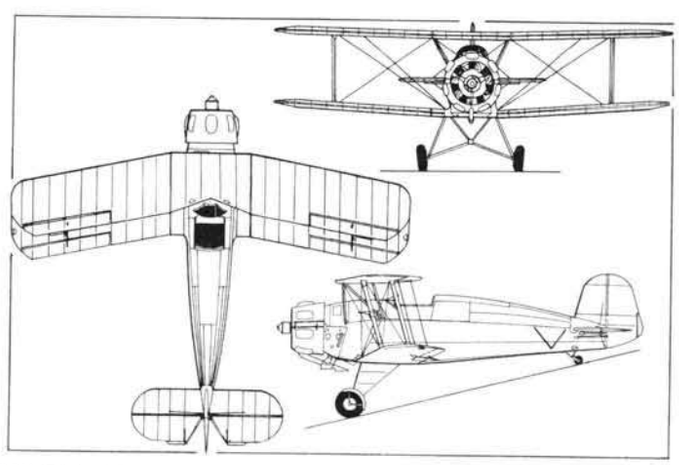
Weight empty	450 kg (992 lb)
Max T-O weight	600 kg (1,322 lb)
Max wing loading	50.0 kg/m² (10.24 lb/sq ft)
Max power loading	3.74 kg/kW (6.15 lb/hp)

PERFORMANCE (estimated):

Max level speed	216 kt (400 km/h; 248 mph)
Cruising speed	145 kt (270 km/h; 167 mph)
Time to 1,000 m (3,280 ft)	1 min
Service ceiling	7,000 m (22,965 ft)
Range	324 n miles (600 km; 372 miles)

First SSH-built Jungmeister before covering and re-engining *(Paul Jackson)*

0110937



SSH (Bücker) Bü-133P Jungmeister as initially intended

1158552

Romania

AEROSTAR

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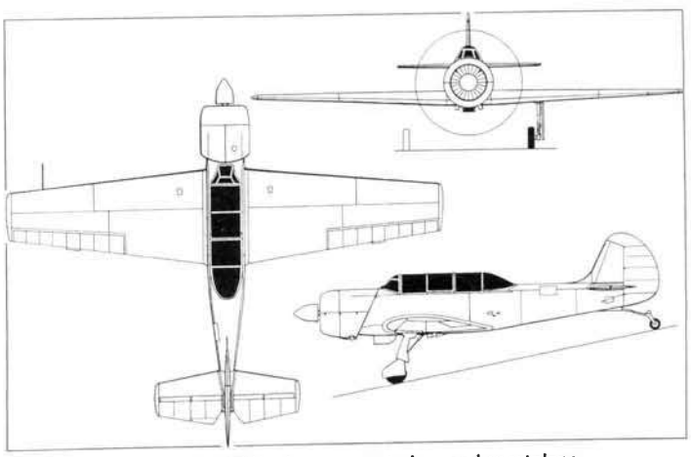
Factory celebrated 50th anniversary in 2003, having been founded 17 April 1953 as URA (later IRAv, then IAv Bacau), originally as repair centre for Romanian Air Force Yak-17/23, MiG-15/17/19/21 and Il-28/H-5 front-line military aircraft and Aero L-29/L-39 jet trainers; built first Romanian prototype of IAR-93 between 1972 and 1974. As of April 2006, Aerostar industrial group was organised in five divisions: Systems, Aeronautical Products, Special Products, Technological and Logistics. Main lines of business are: manufacture of aircraft and aerostructures; production of hydraulic and pneumatic equipment, landing gears and aviation spare parts; maintenance, overhaul and upgrade of aircraft and aero-engines; electronic systems and equipment; ground defence systems; and supply of integrated logistic support. Site area 45 ha (111.2 acres), including 25 ha (61.8 acres) of covered workshop space. Workforce 1,735 in April 2006.

Romanian State Ownership Fund (SOF) originally owned 69.99 per cent of Aerostar. In preparation for full privatisation, Aerostar reorganised 1997 into three semi-autonomous divisions: systems, commercial, and technology support, reporting to a strategic fourth division. Creation of a joint venture (Aerothom Electronics) with Thomson-CSF (now Thales) Communications announced June 1999; Aerostar owns 60 per cent of this company, formed to supply IFF equipment to Romanian MoD. Aerostar became fully privatised company 11 February 2000 as part of Aerostar-PAS-IAROM, a consortium of Aerostar management and employees (PAS) with IAROM, acquiring Aerostar stock previously held by SOF. The current shareholdings are IAROM 71.09 per cent; SIF 'Moldova' (financial investment company) 11.14 per cent; others 17.77 per cent. In 2003, SOF renounced the 'golden share' entitling it to veto matters affecting company's defence production capability, following harmonisation with EU regulations. Consortium agreed to take over all Aerostar's obligations and debts; not to dissolve company for 10 years; and to keep its core business intact for at least five years. Company turnover in 2005 was RON102.7 million, of which exports accounted for more than 34 per cent. Net profit for the year was RON6.8 million.

Aerostar's main product for many years has been Iak-52 trainer, joined in 2001 by Festival. Manufactures airframes for German ULBI Wild Thing ultralight (more than 80 in decade 1994 to 2003) and components for Flug Werk replicas of Focke-Wulf Fw 190. North American P-51 Mustang replica available 2003 from Fighter Factory LLC, 13545 Sycamore Avenue, San Martin, California 95046, USA (*tel:* +1 408 683 25 31; *fax:* +1 408 683 25 33). Responsible for Lancer and Sniper Romanian Air Force upgrade programmes for, respectively, MiG-21s (completed April 2003) and MiG-29s. Also performing MRO and upgrades of Aero L-39ZA.

Landing gears and/or hydraulic/pneumatic equipment have been produced for IAR-316B (Alouette III), IAR-330 (Puma), IAR-93, IAR-99, Romaero (BAC) One-Eleven and Iak-52. From 2003, producing sheet metal for Stork-Fokker Aerospace contribution to manufacture of components for Airbus and Cessna. Engines include M-14P for Iak-52, M-14V26 for Ka-26 and RU-19A-300 APU for An-24; reduction gears include R-26. Avionics factory produces radio altimeters, radio compasses, marker beacon receivers, IFF and other radio/radar items.

Aerostar (Yakovlev) Iak-52TW *(Paul Jackson)* 1158583



Aerostar (Yakovlev) Iak-52TW primary prop trainer and sportplane *(Dennis Punnett)* 1127527

AEROSTAR (YAKOVLEV) Iak-52

TYPE: Primary prop trainer/sportplane.

PROGRAMME: Design of Yak-52 in USSR began 1975; series production assigned to Comecon programme (Council for Mutual Economic Assistance), following Romanian-USSR intergovernmental agreement of 1974; designation is transliteration of 'Yak' in Romanian alphabet, but civil aircraft are registered as Yaks.

Construction began 1977 and first Romanian prototype (c/n 780102) made first flight May 1978; series production began 1979; first deliveries (to DOSAAF, USSR) 1975; 1,000th aircraft delivered in 1986 and 1,500th in 1990. After cessation of deliveries to USSR in 1991, production had almost come to a standstill, but interest reawakened by improved Iak-52W (first flight April 1999, debut at Paris Air Show, June 1999). Iak-52W began development 1998 and first flew (12201) March 1999; currently offered as alternative to standard version, but no recent production known. Aerostar planned five-year programme of 30 per year; deliveries started August 1999. Tailwheel (TW) version announced early 2000; first flew ('26', c/n 0112226, later N52SD) 2 July 2001; launched at EAA AirVenture, Oshkosh, 24 to 30 July 2001; is now the only Romanian production version.

CURRENT VERSIONS: **Iak-52TW:** New-build tailwheel version of Iak-52W, revealed early 2000. Production aircraft available from July 2001 (four sold by end of first day of promotion at Oshkosh); US marketing by GeSoCo Industries of Swanton, Vermont, USA. Features include mainwheel legs mounted farther forward, extended (rounded) wingtips, uprated engine with underslung oil radiator and modified front shutters; each cockpit lengthened by 10 cm (4 in).

Detailed description applies to this version.

CUSTOMERS: Following some 1,815 Iak/Yak-52s, Iak-52W/TW production began with 122nd batch; total 12 Iak-52Ws (including prototype) built 1999-late 2000. Deliveries have included at least nine to USA and one to Australia.

Iak-52TW deliveries began in mid-2001; some 34 built by mid-2005; most to US but four to Australia; none known in following 12 months to mid-2006.

COSTS: Standard Iak-52TW USD150,000 (2003).

DESIGN FEATURES: Tandem-cockpit variant of Yak-50, with unchanged span and length, but with mainwheels fully retractable. Simple, robust, low-wing design with long landing gear legs to accommodate large propeller. Moderately tapered wings and tailplane; curved fin; 'glasshouse' canopy. Current production aircraft lack wingtip fairings. Strengthened wingtips for optional fitment of tip-tanks. Increased wing span compared with earlier versions.

Wing section Clark YH; thickness/chord ratio 14.5 per cent at root, 9 per cent at tip. Dihedral 2° from root; incidence 2°. Tailplane 0° dihedral, 1° 30' incidence.

FLYING CONTROLS: Conventional and manual. Actuation of mass-balanced slotted ailerons by pushrods; mass-balanced elevators by pushrods/cables; and horn-balanced rudder by cables; manually operated trim tab in port elevator; ground-adjustable tab on rudder and each aileron. Pneumatically actuated trailing-edge split flaps.

STRUCTURE: All-metal, including primary control surfaces. Single-spar wings; modified spar, post-1986 (and some retrofits), permits higher load factors. Wingtips strengthened, enabling tip-tanks to be carried (not a factory configuration). Airframe life 5,000 hours.

LANDING GEAR: Tailwheel type; single wheel and oleo-pneumatic shock-absorber on each retractable main unit. Mainwheels (size 6.00-6) fully retractable, on Aerostar pneumatically actuated legs, retracting inward; flush doors. Cleveland wheels and Western tyres; fixed Scott steerable tailwheel, with 10×3.50–4 tyre.

POWER PLANT: One 298 kW (400 hp) Aerostar-built VOKBM (Bakanov) M-14P-XDK nine-cylinder air-cooled radial, driving a three-blade constant-speed MT-Propeller MTV-9-B-C/CL250-27 propeller. Two aluminium alloy fuel tanks, in wingroots forward of spar; collector tank in fuselage supplies engine during inverted flight.

Total internal fuel capacity 280 litres (74.0 US gallons; 61.6 Imp gallons). Oil capacity 10 litres (2.6 US gallons; 2.2 Imp gallons).

ACCOMMODATION: Tandem seats for pupil (at front) and instructor under long 'glasshouse' canopy, with separate rearward-sliding hood over each seat. Hooker Harness seat belts for both occupants. Dual controls standard. Seats and rudder pedals adjustable. Heating and ventilation standard. Externally accessible baggage and battery compartments on port side, aft of rear cockpit, plus permanently mounted retractable ladder for cockpit access.

SYSTEMS: Independent main and emergency pneumatic systems, pressure 50 bar (725 lb/sq in), for flap and landing gear actuation, engine starting and brake control. Electrical system (27 V DC) supplied by 3 kW engine-driven generator and two 27 V 23 Ah ASAM batteries; two static inverters in fuselage for 36 V AC power at 400 Hz. Oxygen system available optionally.

AVIONICS: *Comms:* Western instruments including Garmin IC-AQ200 com radio and GTX transponder, AmeriKing ELT and altitude encoder, and NAT AA80-20 intercom.

Flight: ARK-15M automatic radio compass, eight-channel ADF and GMK-1A gyrocompass.

Other avionics available at customer's option.

EQUIPMENT: Strobe and navigation lights, recessed landing and taxying lights; roll bar.

DIMENSIONS, EXTERNAL:

Wing span	9.90 m (32 ft 5¾ in)
Wing chord: at root	2.10 m (6 ft 10¾ in)
mean aerodynamic	1.64 m (5 ft 4½ in)
at tip	1.08 m (3 ft 6½ in)
Wing aspect ratio	6.4
Length overall	7.98 m (26 ft 2¼ in)
Height overall, propeller turning	2.70 m (8 ft 10¼ in)
Wheel track	2.70 m (8 ft 10¼ in)
Propeller diameter:	2.40 m (7 ft 10½ in)

DIMENSIONS, INTERNAL:

Cockpit: Max width	0.74 m (2 ft 5¼ in)
Max height	1.12 m (3 ft 8 in)

AREAS:

Wings, gross	15.42 m² (166.0 sq ft)
Ailerons (total)	1.98 m² (21.31 sq ft)
Flaps (total)	1.03 m² (11.09 sq ft)

Aerostar Iak-52TW in US ownership *(Paul Jackson)*

1127639

Fin	0.61 m² (6.57 sq ft)
Rudder	0.87 m² (9.36 sq ft)
Tailplane	1.32 m² (14.21 sq ft)
Elevators (total)	1.53 m² (16.47 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, equipped	980 kg (2,160 lb)
Max T-O weight	1,320 kg (2,910 lb)
Max wing loading	85.6 kg/m² (17.53 lb/sq ft)
Max power loading	4.43 kg/kW (7.27 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	226 kt (420 km/h; 261 mph)
Max level speed: at S/L	162 kt (300 km/h; 186 mph)
at 1,000 m (3,280 ft)	172 kt (320 km/h; 198 mph)
Stalling speed, flaps down	46 kt (85 km/h; 53 mph)
Max rate of climb at S/L	360 m (1,181 ft)/min
Service ceiling	4,000 m (13,120 ft)
T-O run	140 m (460 ft)
Landing run	270 m (885 ft)
Range with max fuel at 500 m (1,640 ft) at cruising speed, 20 min reserves	540 n miles (1,000 km; 621 miles)
g limits	+7/–5

AEROSTAR FESTIVAL

TYPE: Side-by-side ultralight; two-seat lightplane.

PROGRAMME: Illustrated (as project) in 1999 company brochure, but no details then given. Made debut (as Aerostar 01) at Paris Air Show, June 2001, following first flight (YR-6138) on 31 May. Certification programme flown between 5 November 2001 and 9 February 2002, resulting in award of domestic certificate April 2002. Aircraft named Festival later that year. Improved design (see Design Features below) introduced 2003, first example (YR-6107) making maiden flight in September; also now certified by Romanian Airclub. Aircraft certified 12 July 2004 as Advanced Ultralight in Canada and (with designation **R40S**) as Light Sport Aircraft (LSA) on 14 September 2005 in US.

CUSTOMERS: Initial orders received at time of debut (four for Romanian Airclub); planned eventual worldwide sales and output of 40 to 50 per year. First two production aircraft registered in USA (N1062N and N1062M) in July 2001; further four to US by early 2006, at least four flying with private customers in Romania in addition to prototypes.

COSTS: USD55,000 as LSA in US; USD40,000 as advanced ultralight in Canada; USD45,000 in Australia (all 2004).

DESIGN FEATURES: Designed to Canadian standard DS10141E; derivative of ULB1 Wild Thing (see under Germany), originally utilising wings, nose, rear fuselage and tail unit from that aircraft. Principal differences are enlarged cabin, nosewheel landing gear, and relocation of wing in low-mounted position, without strut bracing, but still foldable alongside fuselage for transportation and storage. Horizontal tail also foldable. Subsequently improved with much-revised cockpit layout, upward-opening single-piece canopy and optional three-blade propeller.

Wing aerofoil section NACA 4415.

FLYING CONTROLS: Conventional and manual. Flaps and Frise-type ailerons pushrod-actuated, elevators and horn-balanced rudder by cables; mechanically or electrically actuated elevator trim tab. Flap settings 0, 15 and 30°. Dual controls standard.

STRUCTURE: Aluminium alloy (6061), except for fabric-covered (aluminium in US) flaps and ailerons. Three-spar wings. Flush-riveted wing skins from YR 5050 (first flight October 2005).

LANDING GEAR: Tricycle type, fixed. Fuselage-mounted spring cantilever mainwheel legs. Matco hydraulic disc brakes and 5.00-5 tyres; steerable, trailing-link nosewheel with 5.00-5 tyre and rubber shock absorption.

POWER PLANT: One 59.6 kW (79.9 hp Rotax 912 UL engine standard, driving a three-blade adjustable-pitch wooden propeller. Options include 59.7 kW (80 hp) Jabiru 2200 or 73.5 kW (98.6 hp) Rotax 912 ULS with two- or three-blade, ground-adjustable pitch propeller. Rotax 912 S or ULS and three-blade propeller in LSA version.

Fuel tank capacity (two wing tanks) 80 litres (21.1 US gallons; 17.6 Imp gallons). Oil capacity 2.5 litres (0.7 US gallon; 0.55 Imp gallon).

ACCOMMODATION: One-piece upward-opening canopy. Baggage compartment aft of seats.

AVIONICS: Basic VFR instrumentation (ASI, altimeter, variometer, turn-and-slip indicator and compass) standard; Bendix/King KY 92 radio optional.

Aerostar R40S Festival employed as a US demonstrator *(Paul Jackson)*

1158600

DIMENSIONS, EXTERNAL:

Wing span	9.17 m (30 ft 1 in)
Wing mean aerodynamic chord	1.525 m (5 ft 0 in)
Length overall: standard	6.74 m (22 ft 1¼ in)
LSA	6.46 m (21 ft 2¼ in)
Height overall: standard	2.47 m (8 ft 1¼ in)
LSA	2.31 m (7 ft 7 in)
Propeller diameter: standard	1.50 m (4 ft 11 in)
LSA	1.70 m (5 ft 7 in)

DIMENSIONS, INTERNAL:

Cockpit max width	1.07 m (3 ft 6 in)

AREAS:

Wings, gross	13.97 m² (150.4 sq ft)

WEIGHTS AND LOADINGS (A: Jabiru 2200/Rotax 912 UL, B: Rotax 912 ULS, C: LSA):

Weight empty: A	351 kg (774 lb)
B	354 kg (780 lb)
C	400 kg (882 lb)
Max T-O weight: A, B	535 kg (1,179 lb)
C	598 kg (1,320 lb)
Max wing loading: A, B	38.30 kg/m² (7.84 lb/sq ft)
C	42.85 kg/m² (8.78 lb/sq ft)
Max power loading: A	8.96 kg/kW (14.72 lb/hp)
B	7.28 kg/kW (11.96 lb/hp)
C	8.15 kg/kW (13.39 lb/hp)

PERFORMANCE (A, B and C as above):

Never-exceed speed (VNE):	
A, B, C	116 kt (215 km/h; 133 mph)
Max level speed: A	99 kt (185 km/h; 115 mph)
B	105 kt (195 km/h; 121 mph)
C	101 kt (187 km/h; 116 mph) IAS
Cruising speed: A	92 kt (170 km/h; 106 mph)
B	94 kt (175 km/h; 109 mph)
Stalling speed, flaps down: A	36 kt (66 km/h; 41 mph)
B, C	39 kt (71 km/h; 45 mph)
Max rate of climb at S/L: A	240 m (787 ft)/min
B	330 m (1,083 ft)/min
C	229 m (750 ft)/min
Service ceiling: A, B	4,000 m (13,120 ft)
C	3,500 m (11,500 ft)
T-O run: A	85 m (280 ft)
B	80 m (265 ft)
C	130 m (427 ft)
Landing run: A, B	90 m (295 ft)
C	160 m (525 ft)
Range with max fuel, 20 min reserves:	
A, C	432 n miles (800 km; 497 miles)
B	405 n miles (750 km; 466 miles)
g limits: A, B	+4/–2 (max)
	+6/–4 (ultimate)

AVIOANE

AVIOANE CRAIOVA SA

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Founded 1 February 1972 as Intreprinderea de Avioane Craiova, beginning aircraft manufacture with joint Romanian/Yugoslav IAR-93/Orao attack aircraft; changed to present name 17 December 2001; range of products and services for military and civil aviation includes equipment and parts manufacture for Stork-Fokker and SABCA. Aircraft and equipment design and manufacture, repair and overhaul, life cycle management and integrated logistics support. Granted ISO 9001 status 1998. Site area 1,70 ha (4,20 acres), including 47,500 m² (511,275 sq ft) shop floor area. Workforce had dwindled from 1,300 in April 2002 to about 870 by mid-2004. At that time, privatisation of the company was expected to begin in the following September, after transfer of 40 per cent of its assets to the Dolj County Administration Authority to repay earlier debts. However, by mid-2006 company still 99,95 per cent Romanian-owned, including 91,45 per cent by Ministry of Industry and Resources.

Company turnover was EUR5,5 million in 2005. Workforce had decreased to about 700 by mid-2006.

AVIOANE IAR-99 ŞOIM

English name: Hawk

TYPE: Advanced jet trainer/light attack jet.

PROGRAMME: Design by Institutul de Aviatie at Bucharest started 1975; three prototypes, of which S-001 made first flight 21 December 1985; S-003 second flying prototype. Initial production batch of 17 (serial numbers 701-717), deliveries of which began 1988; two of these (708 and 709) completed for proposed avionics upgrade programme with Jaffe Aircraft of USA in 1991, which not pursued; one (712) equipped with Collins avionics in 1992; similar venture with IAI resulted in upgraded IAR-109 Swift prototype (7003, converted S-003), flown in November 1993, but no production of this version ensued.

Requirement for 24 new aircraft with Elbit modernised avionics announced in September 1998 and received Romanian MoD approval in 2000, following first flight of prototype (serial number 718) on 22 May 1997. First upgraded aircraft (718; actually constructed 1994) served as development demonstrator. Four (serials 719 to 722) ordered September 2001; deliveries began with 719, which was rolled out on 31 July 2002 and handed over 1 August, and were completed in February 2003. Defence cuts subsequently reduced new-build order, although some earlier aircraft will be upgraded to new standard. Latest contract, announced 10 November 2004 and valued at USD43 million, calls for three more new-build IAR-99Cs and Elbit Systems upgrade of five Standard IAR-99s, to be completed by mid-2008. First of this Lot 2 batch rolled out 26 April 2006.

CURRENT VERSIONS: **Standard IAR-99**: Initial production version (17) for Romanian Air Force; in service with 67th Fighter-Bomber Group at Craiova.

IAR-99C: Elbit (Israel) teamed with Avioane to produce this version as lead-in fighter trainer for Romanian Air Force and to offer for export. USD21 million contract for 24 aircraft announced in September 1998 and contained options for further 16 to follow. Order reduced in September 2001 to four, of which first two (719 and 720) flown in August and October 2002; 721 and 722 had followed by February 2003, but 721 lost in landing accident on 22 September 2004. Further three ordered in November 2004.

Following description applies to this version.

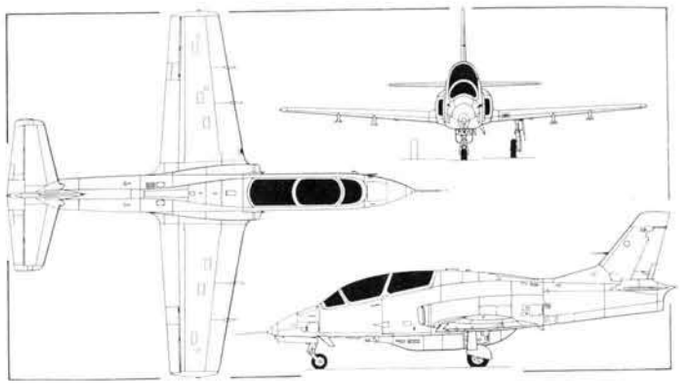
CUSTOMERS: Total of 17 of original production version delivered to Romanian Air Force, of which about 13 remain, although eight reported to be in store in late 2004, awaiting overhaul and/or upgrading. Deliveries of four IAR-99Cs (719 to 722) as lead-in fighter trainers (LIFT) for RomAF MiG-21 Lancer completed February 2003.

COSTS: IAR-99C approximately USD6 million (2002).

DESIGN FEATURES: Typical basic/advanced jet trainer with tandem, stepped cockpits and moderately tapered wings. Provision for armament increases versatility.

Wing section NACA 64_1A-214 (modified) at centreline; 64_1A-212 (modified) at tip; dihedral 3° from roots; quarter-chord sweepback 6° 35'; incidence 1° at root. Tail unit sweepback at quarter-chord 34° on fin, 9° 8' on tailplane.

Main feature of Elbit avionics suite is a data transfer system that processes navigational information received via datalink from other aircraft or from a ground station equipped with the same system. This information is presented on a simulated 'virtual radar' display in the front cockpit, so that the pilot can be trained in the use of radar without a need for the IAR-99 itself to be fitted with a radar. IAR-99C can be identified by large blade antenna beneath nose on port side.



Antenna detail identifies the current IAR-99C Şoim *(Dennis Punnett)* 0079327

FLYING CONTROLS: Conventional and partly assisted. Statically balanced ailerons hydraulically actuated with manual reversion; mass-balanced elevators and rudder actuated mechanically by push/pull rods; servo tab in port aileron, trim tabs in rudder and each elevator, all operated electrically; ailerons deflect 15° up/15° down, elevators 20° up/10° down, rudder 25° to left and right. Hydraulically actuated single-slotted flaps, deflecting 20° for T-O and 40° for landing, retract gradually when airspeed reaches 162 kt (300 km/h; 186 mph); twin hydraulically actuated airbrakes under rear fuselage.

STRUCTURE: All-metal; aluminium honeycomb ailerons/elevators/rudder; semi-monocoque fuselage includes honeycomb panels for fuel tank compartments; machined wing skin panels form integral fuel tanks.

LANDING GEAR: Retractable tricycle type, with single wheel and oleo-pneumatic shock-absorber on each unit, main-wheels retract inward, castoring nosewheel forward, all being fully enclosed by doors when retracted. Landing light in port wingroot leading-edge. Mainwheels fitted with tubeless tyres, size 552×164–10, pressure 7,5 bar (109 lb/sq in), and hydraulic disc brakes with anti-skid system. Nosewheel has tubeless tyre size 445×150–6, pressure 4,0 bar (58 lb/sq in).

POWER PLANT: One Turbomecanica Romanian-built Rolls-Royce Viper Mk 632-41M turbojet, rated at 17,79 kN (4,000 lb st). Fuel in two flexible bag tanks in centre-fuselage, capacity 900 litres (238 US gallons; 198 Imp gallons), and four integral tanks between wing spars, combined capacity 470 litres (124 US gallons; 103 Imp gallons). Total internal fuel capacity 1,370 litres (362 US gallons; 301 Imp gallons). Gravity refuelling point on top of fuselage. Provision for two drop tanks, each of 280 litres (74,0 US gallons; 61,5 Imp gallons) capacity, on inboard underwing stations. Maximum internal/external fuel capacity 1,930 litres (510 US gallons; 424 Imp gallons).

ACCOMMODATION: Crew of two in tandem, on Martin-Baker Mk 10L zero/zero ejection seats in pressurised and air conditioned cockpit. Rear (instructor's) seat elevated 35 cm (13,8 in). Dual controls standard. One-piece canopy with internal screen, opening sideways to starboard.

SYSTEMS: Engine compressor bleed air for pressurisation, air conditioning, anti-g suit and windscreen anti-icing system, and to pressurise fuel tanks. Hydraulic system, operating at pressure of 206 bar (2,990 lbf/sq in), for actuation of landing gear and doors, flaps, airbrakes, ailerons and main-wheel brakes. Emergency hydraulic system for operation of landing gear doors, flaps and wheel brakes. Main electrical system, supplied by 9 kW 28 V DC starter/generator, with 28 V 36 Ah Ni/Cd battery, ensures operation of main systems, in case of emergency, and engine starting. Two static inverters (one 3 kVA and one 750 kVA) supply two secondary AC networks: 115 V/400 Hz and 26 V/400 Hz. Oxygen system for two crew for 2 hours 30 minutes.

AVIONICS: Elbit Systems integrated suite, based on MIL-STD-1553B.

Comms: Dual VHF/UHF com; voice-activated intercom; IFF.

Flight: VOR/ILS; DME; ADF; Litton Italia INS with Trimble GPS nav.

Instrumentation: Modular multirole computer; HOTAS controls; head-up display with up-front control panel (HUD/UFCP), plus one LCD MFD and one CRT MFD, in front cockpit; two CRT MFDs (one as ASHM, or aft station HUD monitor) in rear (instructor's) cockpit; dual ADIs with HSIs; radar altimeter; Elta data transfer system (DTS) with pilot's virtual radar display; pilot's and instructor's display and sight helmets (DASH).

Self-defence: Elta RWR and ECM (jammer) pod; chaff/flare dispenser.

Avioane IAR-99C Şoim *(Romanian Air Force)* 1158618

ARMAMENT: Five external stores stations. Centreline station can be occupied by ECM, laser designator or aerial reconnaissance pod, a drop fuel tank, or by a twin-barrel 23 mm GSh-23 gun pod with 200 rounds. All armament controlled by stores management system slaved to avionics mission computer. Four underwing hardpoints stressed for loads of 250 kg (551 lb) each. Typical underwing stores can include four 250 kg bombs; four triple carriers each for three 50 kg bombs (or two 100 kg and one 50 kg); laser- or IR-guided bombs (inboard pylons only); R-3, R-13, R-60 or Python 3 AAMs (outer pylons only); four L-16–57 launchers each containing sixteen 57 mm air-to-surface rockets; and auxiliary fuel tanks (see under Power Plant) on inboard pylons.

DIMENSIONS, EXTERNAL:

Wing span	9.85 m (32 ft 3¾ in)
Wing chord: at root	2.305 m (7 ft 6¾ in)
mean	1.965 m (6 ft 5¼ in)
at tip	1.30 m (4 ft 3¼ in)
Wing aspect ratio	5.2
Length overall	11.01 m (36 ft 1½ in)
Height overall	3.90 m (12 ft 9½ in)
Elevator span	4.12 m (13 ft 6¼ in)
Wheel track	2.685 m (8 ft 9¾ in)
Wheelbase	4.38 m (14 ft 4½ in)

AREAS:

Wings, gross	18.71 m² (201.4 sq ft)
Ailerons (total)	1.56 m² (16.79 sq ft)
Flaps (total)	2.54 m² (27.34 sq ft)
Fin, incl dorsal fin	1.92 m² (20.67 sq ft)
Rudder	0.63 m² (6.78 sq ft)
Tailplane	3.125 m² (33.63 sq ft)
Elevators (total)	1.25 m² (13.45 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, equipped	3,200 kg (7,055 lb)
Max fuel weight: internal	1,100 kg (2,425 lb)
external	350 kg (772 lb)
Max T-O weight: trainer	4,400 kg (9,700 lb)
ground attack	5,560 kg (12,258 lb)
Max wing loading: trainer	235.2 kg/m² (48.17 lb/sq ft)
ground attack	297.2 kg/m² (60.86 lb/sq ft)
Max power loading: trainer	247.5 kg/kN (2.42 lb/lb st)
ground attack	312.7 kg/kN (3.06 lb/lb st)

PERFORMANCE:

Max operating Mach number (MMO)	0.76
Max level speed at S/L:	
trainer, clean	467 kt (865 km/h; 537 mph)
Max speed for landing gear actuation	135 kt (250 km/h; 155 mph)
Max rate of climb at S/L	2,100 m (6,890 ft)/min
Service ceiling	12,900 m (42,325 ft)
Min air turning radius	330 m (1,083 ft)
T-O run: trainer	450 m (1,477 ft)
ground attack	960 m (3,150 ft)
T-O to 15 m (50 ft): trainer	750 m (2,461 ft)
ground attack	1,350 m (4,430 ft)
Landing from 15 m (50 ft): trainer	740 m (2,428 ft)
ground attack	870 m (2,855 ft)
Landing run: trainer	550 m (1,805 ft)
ground attack	600 m (1,969 ft)

Typical combat radius (one pilot, ventral gun, internal fuel only):

lo-lo-lo, four 16-round rocket pods, AUW 5,000 kg (11,023 lb) ..... 189 n miles (350 km; 217 miles)

hi-lo-hi, two 16-round rocket pods, two 50 kg and four 100 kg bombs, AUW 5,280 kg (11,640 lb) ..... 186 n miles (345 km; 214 miles)

hi-hi-hi, four 250 kg bombs, AUW 5,480 kg (12,081 lb) ..... 208 n miles (385 km; 239 miles)

Max range with internal fuel:	
trainer	593 n miles (1,100 km; 683 miles)
ground attack	522 n miles (967 km; 601 miles)
Max endurance with internal fuel: trainer	2 h 40 min
ground attack	1 h 46 min
g limits	+7/−3.6

GM&T

GM&T INTERNATIONAL 2000 SA

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GENERAL MANAGER: Mihai Mantescu

Formed in 2000, GM&T obtained production rights of Pretty Flight ultralight from PC Aero of Germany. This manufactured in 460 m² (4,950 sq ft) premises in Bucharest and marketed in Europe by Aero Service Albert Dietrich (www.pilot-ul.de) of Germany. The company also produces and markets doors and windows for the construction industry.

GM&T PRETTY FLIGHT

TYPE: Side-by-side ultralight/kitbuilt.

PROGRAMME: Designed by Calin Gologan. Prototype (D-MNPF, c/n 01) first flew in Germany in November 1996, having been assembled by Nitsche Flugzeugbau from Romanian components fabricated by Star Tech Impex Srl. First flight of production aircraft (D-MOOI, c/n 001) 10 November 1997; German certification achieved 25 September 1998; three pre-series aircraft then completed; manufacture of first batch of 10 series production aircraft began in November 1998, but programme suspended until taken over by GM&T; first GM&T aircraft (D-MMPF) built by Peter Kuehnl in Germany and exhibited at Aero '05, Friedrichshafen, in April 2005.

Current version considerably modified, including new engine and propeller; ailerons and flaps replacing flaperons; modified all-moving tailplane with revised trim; reprofiled rear fuselage using one-piece frames; reprofiled front fuselage with rounded surfaces and new engine cowling; nosewheel steering; and revised instrumentation and interior outfitting.

CURRENT VERSIONS: **Ultralight:** *As described.*

Kit: Quoted build time 300 hours.

COSTS: EUR72,500 (Sport version) or EUR75,980 (Elite), including German taxes, flyaway (2006).

DESIGN FEATURES: High-wing braced monoplane with upturned wingtips and sweptback fin. Wing section GAW PC-1.

FLYING CONTROLS: Manual. Conventional ailerons and horn-balanced rudder; all-moving tailplane with anti-balance tabs. Electrically-actuated flaps.

STRUCTURE: Predominantly metal, with fabric-covered rear wing panels and control surfaces.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring cantilever mainwheel legs; optional wheel fairings. Steerable nosewheel with compressed rubber shock-absorber.

GM&T Pretty Flight assembled by Peter Kuehnl *(Paul Jackson)* 1159366

POWER PLANT: One 55.2 kW (74 hp) Parma-Technik Mikron IIIB in-line, four-cylinder engine driving a Woodcomp two-blade, fixed-pitch wooden propeller. Fuel in two tanks, combined capacity 105 litres (27.7 US gallons; 23.1 Imp gallons).

EQUIPMENT: BRS 1050 or USH 520 parachute recovery system.

DIMENSIONS, EXTERNAL:

Wing span	10.00 m (32 ft 9¾ in)
Length overall	6.03 m (19 ft 9½ in)
Height overall	2.57 m (8 ft 5¼ in)

DIMENSIONS, INTERNAL:

Cabin max width	1.16 m (3 ft 9¾ in)

AREAS:

Wings, gross	13.50 m² (145.3 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, excluding parachute	287 kg (633 lb)
Max T-O weight	472.5 kg (1,041 lb)

PERFORMANCE:

Max level speed	111 kt (206 km/h; 128 mph)
Cruising speed at 75% power	97 kt (180 km/h; 112 mph)
Stalling speed	36 kt (65 km/h; 41 mph)
Max rate of climb at S/L	240 m (787 ft)/min
T-O run	200 m (660 ft)
Landing run	150 m (495 ft)
Range	up to 567 n miles (1,050 km; 652 miles)

IAR

SC IAR SA

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Web: www.iar.ro
PRESIDENT AND CEO: Ion Georgescu
COMMERCIAL AND FINANCIAL DIRECTOR: Ion Dumitrescu
DEVELOPMENT AND PRODUCTION DIRECTOR: Andrei Lorincz
SALES AND CUSTOMER SUPPORT MANAGER: Aurel Sultana

Factory, established 1925 and fully rebuilt 1968, continues work begun by IAR-Brasov; occupies 134 ha (331 acre) site, including 76,000 m² (818,060 sq ft) factory area, andhad 2006 workforce of about 1,200. Now the sole Romanian manufacturer of helicopters, it has produced more than 200 Alouette IIIs and over 165 Pumas under French licence.

IAR SA has the experience and capacity to develop and produce aeronautical products, and is a major supplier to the Romanian MoD. Currently, it performs upgrading programmes; revisions and overhauls; flight testing; extensive after-sales services; maintenance; spare parts and replacements; technical services and assistance; pilot and crew training; and IAR-330 Puma follow-on support. Other work includes co-operation programmes with worldwide manufacturers of tooling, subassemblies and parts for a variety of aircraft.

As a first stage in progress towards privatisation, IAR SA was restructured in 2004 into three separate companies, two-thirds of each being owned by the Romanian government and the balance by private shareholders. One of these new companies, also known as IAR SA,

specialises in work involving Alouette III and Puma helicopters and owns 49 per cent of the shares in the Eurocopter Romania SA joint venture created in June 2001. Its recent and current main programmes are the Puma SOCAT upgrade to meet Romanian MoD requirements for an advanced armed helicopter; 25th and last was delivered 9 June 2005; and Puma SM, an advanced multirole helicopter for the UAE armed forces, which involves Makila 1A1 re-engining, advanced avionics, new autopilot and new optional equipment. The latter programme is a co-operative one with Eurocopter SAS and other major companies.

IAR also designed and produced IAR-46S very light aircraft; has produced more than 830 IS-28M2/GR motor gliders and IS-28/29/35 series gliders; spares for IAR-330 Puma and IAR-316 B Alouette III helicopters; aircraft components.

ROMAERO

SC ROMAERO SA

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Web: www.romaero.ro
PRESIDENT AND CEO: Viorel Manole
DIRECTORS:
Valeriu Adamache (Production)
Constantin Dinischiotu (Commercial)
Andrei Elena (Finance)
Lucian Popescu (Strategic Planning)
PUBLIC RELATIONS: Carmen Gheorghiu

Romaero is an EASA- and FAA-approved airframe manufacturer and aircraft maintenance organisation with a reliable reputation as a partner of Western integrators. It was known initially for its production of the Britten-Norman/BNG Islander and Defender, which began in 1968. This was suspended in 1997 (more than 520 built), but was resumed in July 2002 with new contract for 24 aircraft during ensuing two years.

As a JAR/FAR 21-approved supplier, Romaero has manufactured and delivered items to Boeing (737/757/767/777 major subassemblies and components); Bombardier (415 water bomber cabin subassemblies and floats, Challenger 604 auxiliary fuel tanks and Learjet 45 tail units); BAE Systems (ATP and Avro RJ85/RJX detail parts and subassemblies); and IAI/Gulfstream (Astra SPX/G100 cabins and Galaxy/G200 rear fuselages). More recently, it entered into co-operation with BAE Systems to manufacture Nimrod subassemblies and parts and ATP large freight doors (LFD); AgustaWestland for A 109 Power tailboom assemblies; and Sabca to produce structural assemblies and subassemblies for the Airbus A380 programme. In 2004, it installed LFDs in three ATP freighter conversions for Emerald Airways under BAE Systems subcontract.

In addition, Romaero's JAR/FAR 145-approved maintenance, repair and overhaul (MRO) status currently covers such work on various aircraft types, including the Islander, BAC One-Eleven, Boeing 727/737/757, Hawker 800 XP, Lockheed Martin C-130, McDonnell Douglas/Boeing DC-9 and MD-80 series, and Airbus A320.

Romaero's 364,347 m² (3,921,800 sq ft) site includes a 163,670 m² (1,761,725 sq ft) production facility and a further 147,096 m² (1,583,325 sq ft) of covered space. Workforce was approximately 1,300 in January 2003.

Russian Federation

AERO-ASTRA

AVIATSIONNYY NAUCHNO-YEKHNICHESKIY TSENTR AERO-ASTRA

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e-mail: aero-astra@newmail.ru
Web: www.aero-astra.ru
DIRECTOR: Viktor V Shumeiko
EXECUTIVE DIRECTOR: Maksim V Ipatov

Company formed in 1979 to develop autogyros, most recently the first three-seat vehicle in Russia.

AERO-ASTRA OKHOTNIK

English name: Hunter
TYPE: Three-seat autogyro.
PROGRAMME: Prototype constructed and flown in 2001-02, powered by 97 kW (130 hp) Subaru EJ-25 engines and with 8.53 m (28 ft) Dragon Wings rotor; later Rotary Air Force rotor. Initial flight with pilot and three passengers achieved on 16 October 2002. Second prototype flew 28 March 2003 with RAF 9.14 m (30 ft) rotor; intended to test 9.75 m (32 ft) SportCopter. Production version, Okhotnik 3, with windscreen and part-enclosure for occupants, shown at Moscow Salon in August 2005.
CUSTOMERS: Three of two-seat version delivered between late 2005 and early 2006.
COSTS: Flyaway EUR45,000 (2003). Kit version available later.
DESIGN FEATURES: Pusher autogyro with V tail and automatic gust-compensating vane mounted at rear of rotor pylon, immediately below hub. Hydraulic pre-rotator for RAF 2000 (optionally SportCopter) two-blade main rotor.
LANDING GEAR: Tricycle type; fixed.
POWER PLANT: Twin Subaru motorcar engines, combined output 157 kW (210 hp), driving a five-blade, KievProp pusher propeller.
ACCOMMODATION: Pilot and two passengers; latter seated each side of rotor mast.
AVIONICS: Stratomaster combined engine and flight instrumentation display.

Aero-Astra Okhotnik three-seat autogyro *(Yefim Gordon)* 1159016

WEIGHTS AND LOADINGS:
Weight empty ..... 395 kg (871 lb)
Max T-O weight ..... 700 kg (1,543 lb)
PERFORMANCE (provisional):
Max level speed ..... 86 kt (160 km/h; 99 mph)
Cruising speed ..... 54 kt (100 km/h; 62 mph)
Max rate of climb at S/L ..... 120 m (395 ft)/min
T-O run ..... 15 to 50 m (50 to 165 ft)
Landing run ..... 0 to 3 m (0 to 10 ft)
Range ..... 216 n miles (400 km; 248 miles)

AEROPRAKT

AEROPRAKT OOO (AEROPRACT JSC)

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Web: www.aeropract.ru
GENERAL DIRECTOR: Andrey G Pozdnyakov
CHIEF CONSTRUCTOR: Vladimir V Gaslov

Formed in 1974 to design and build gliders, small aircraft, flying-boats and amphibians, OKB Aeroprakt established a second centre at Kiev in 1986, only to be divided on dissolution of the USSR. Became LM Aeropract Samara, a joint Russo-Finnish venture, in 1991; KB Aeropract in 1993; Aeropract JSC in 1997 and Aeropract-Samara JSC in 2000.

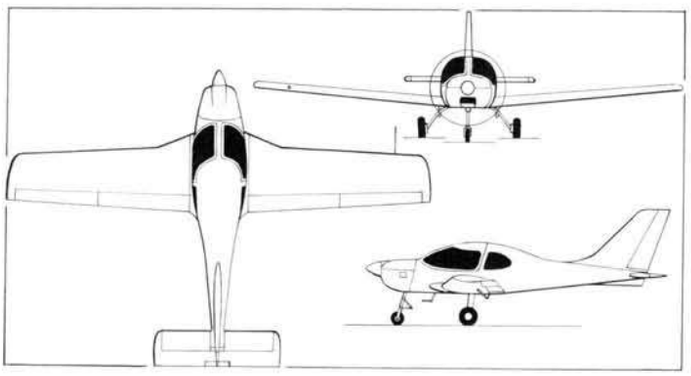
The Russian Aeropract adopts a -ct ending in transliteration to differentiate it from the Aeroprakt now in Ukraine (which see). The two companies are no longer connected. Chief designer Igor Vakhrushev was killed in the crash of an Aeropract-23M in June 2000, after which production was suspended temporarily and the company split into two: Avantazh which continued with the modified version of Aeropract-27, the 27M, shown at Moscow in August 2001 and Aeropract-Samara, which is responsible for the Aeropract-33, first flown at Moscow in August 2001. In 2005, preliminary details of the A-37 were revealed.

In addition to aircraft, the company also manufactures floats for aircraft in the 700 to 1,400 kg (1,540 to 3,085 lb) range.

AEROPRACT A-33

TYPE: Side-by-side lightplane/kitbuilt.
PROGRAMME: Prototype (FLARE-01033) first flown 14 November 2001.
CUSTOMERS: Total of nine built by September 2006.
DESIGN FEATURES: Light tourer and sportplane with low-mounted, tapered wings, constant-chord tailplane and large, sweptback fin with small underfin. Meets JAR-VLA certification requirements.
FLYING CONTROLS: Conventional and manual. Horn-balanced elevator with central, flight-adjustable tab. Ailerons with external mass balances. Three-position (0, 20, 40°) flaps.
STRUCTURE: Generally of composites.
LANDING GEAR: Tricycle type; fixed. Cantilever mainwheel legs; leaf-sprung steerable nosewheel, main wheels 4.00×150; nosewheel 300×125. Hydraulic brakes, optional floats and skis.
POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS flat-four driving a three-blade flight adjustable Kievprop propeller; three aircraft have 84.6 kW (113.4 hp) Rotax 914 UL fitted. Fuel capacity 130 litres (34.3 US gallons; 28.6 Imp gallons).
ACCOMMODATION: Two persons, side by side, beneath two-piece, centreline-hinged canopy. Baggage stowage behind seats.
SYSTEMS: Electrical system with 12 V 25 Ah battery and PR-A12-24 transformer.
AVIONICS: *Comms:* Briz radio.
Instrumentation: Standard VFR. Optional GPS.
EQUIPMENT: MVEN KC-700 parachute recovery system.
DIMENSIONS, EXTERNAL:
Wing span ..... 9.575 m (31 ft 5 in)
Wing chord: at root ..... 1.745 m (5 ft 8¾ in)

Aeropract-33 demonstrator 1159712



Aeropract-33 (Rotax 912 ULS engine) *(James Goulding)*

at tip ..... 1.00 m (3 ft 3¼ in)
Wing aspect ratio 7.3
Length overall ..... 6.64 m (21 ft 9½ in)
Height overall ..... 2.61 m (8 ft 6¾ in)
Tailplane span ..... 2.84 m (9 ft 4 in)
Tailplane chord (constant) ..... 0.80 m (2 ft 7½ in)
Wheel track ..... 2.00 m (6 ft 6¾ in)
Wheelbase ..... 1.65 m (5 ft 5 in)
Propeller diameter ..... 1.85 m (6 ft 0¾ in)

DIMENSIONS, INTERNAL:
Cabin width ..... 1.16 m (3 ft 9½ in)
Baggage volume ..... 0.8 m³ (28 cu ft)

AREAS:
Wings, gross ..... 12.56 m² (135.2 sq ft)
Ailerons (total) ..... 1.28 m² (13.78 sq ft)
Flaps (total) ..... 1.92 m² (20.67 sq ft)
Fin (incl dorsal fin) ..... 2.01 m² (21.64 sq ft)
Rudder, incl tab ..... 0.52 m² (5.60 sq ft)
Tailplane ..... 2.24 m² (24.11 sq ft)
Elevator, incl tab ..... 1.08 m² (11.63 sq ft)

WEIGHTS AND LOADINGS:
Weight empty ..... 433 kg (955 lb)
Max payload ..... 294 kg (648 lb)
Max T-O weight ..... 750 kg (1,653 lb)
Max wing loading ..... 59.7 kg/m² (12.23 lb/sq ft)
Max power loading: Rotax 912 ..... 10.20 kg/kW (16.76 lb/hp)
Rotax 914 ..... 8.87 kg/kW (14.58 lb/hp)

PERFORMANCE:
Never-exceed speed (VNE) ..... 135 kt (250 km/h; 155 mph)
Max operating speed: Rotax 912 ..... 116 kt (215 km/h; 134 mph)
Rotax 914 ..... 119 kt (220 km/h; 137 mph)
Cruising speed at 75% power ..... 103 kt (190 km/h; 118 mph)
Econ cruising speed ..... 81 kt (150 km/h; 93 mph)
Stalling speed, power off, flaps down ..... 46 kt (85 km/h; 53 mph)
Rate of climb at S/L: Rotax 912 ..... 360 m (1,181 ft)/min
Rotax 914 ..... 240 m (787 ft)/min
Service ceiling ..... 3,500 m (11,480 ft)
T-O run: Rotax 912 ..... 150 m (492 ft)
Rotax 914 ..... 100 m (330 ft)
Range ..... 809 n miles (1,500 km; 932 miles)
g limits ..... +4/–2

AEROPRACT A-37

TYPE: Four-seat utility twin.
PROGRAMME: Development began in 2003, although aircraft not revealed until 2005. Prototype first flown 29 November 2005.
DESIGN FEATURES: High-wing lightplane with design elements of A-33 apparent.
FLYING CONTROLS: Conventional and manual. Flaps.
STRUCTURE: Strut-braced, constant-chord wing. Sweptback fin and underfin.
LANDING GEAR: Tricycle type; fixed. Optional twin floats.
POWER PLANT: Two 84.6 kW (113.4 hp) Rotax 914 UL engines driving three-blade propellers. Fuel capacity 265 litres (70.0 US gallons; 58.3 Imp gallons).
ACCOMMODATION: Door on port side of fuselage; baggage door on port side of fuselage behind cockpit.
All data are provisional.

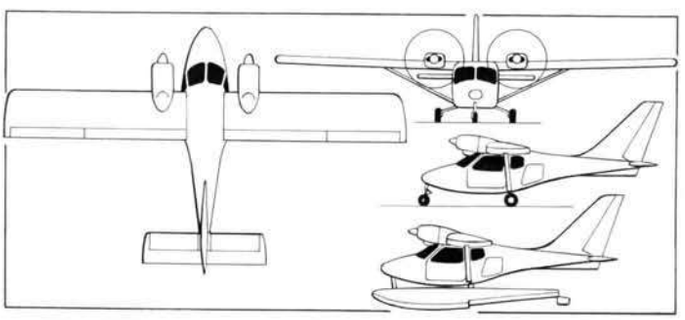
DIMENSIONS, EXTERNAL:
Wing span ..... 12.00 m (39 ft 4½ in)
Length overall ..... 7.20 m (23 ft 7½ in)
Height overall ..... 3.70 m (12 ft 1¾ in)

AREAS:
Wings, gross ..... 17.40 m² (187.3 sq ft)

WEIGHTS AND LOADINGS:
Weight empty ..... 850 kg (1,874 lb)
Max T-O weight ..... 1,400 kg (3,086 lb)

PERFORMANCE:
Normal cruising speed ..... 119 kt (220 km/h; 137 mph)
Service ceiling ..... 3,500 m (11,480 ft)
Range with max fuel ..... 809 n miles (1,500 km; 932 miles)
g limits ..... +4/–2

Prototype Aeropract A-37 1159713



Aeropract A-37, with additional profile of optional seaplane *(James Goulding)* 1133248

AEROPROGRESS/ROKS-AERO

AEROPROGRESS/ROKS-AERO

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DEPUTY GENERAL DESIGNER: Arnold I Andrianov
DEPUTY GENERAL DESIGNER, FOREIGN ECONOMIC RELATIONS: Alexander V Andreev
DESIGN BUREAU MANAGER: Sergei M Zhiganov

Known initially as ROS-Aeroprogress, this organisation was founded in 1990 to design and manufacture utility, commuter, amphibian, aerobatic, agricultural, firefighting, training and attack aircraft, WIG (wing-in-ground-effect) vehicles, replicas and other vehicles. ROKS-Aero Inc is the design bureau of Aeroprogress. No new programmes have been announced for several years.

AEROPROGRESS/ROKS-AERO T-101 GRACH

English name: Rook
TYPE: Light utility turboprop.
PROGRAMME: Design started by Utility Aircraft Division in September 1991, as monoplane successor to Antonov An-2/3 biplane; construction of prototype started April 1992; first flight (FLARF-01466) 7 December 1994; no evidence of reported four additional prototypes, all of which are presumed to have been used for static testing.

Series manufacture by Moscow Aviation Production Organisation (MAPO) initiated January 1993; initial production aircraft shown unpainted at Lukhovitsy factory, August 1999; further seven then substantially complete. One T-101 delivered to Yakutia region in July 2000 on six-month lease, representing initial revenue-earning use; second supplied to undisclosed operator in early 2001 and third being prepared for delivery by late 2001. A Westernised version, developed via the Aeroprogress ROKS/Aero T-201, was unsuccessfully marketed as the Khrunichev T-201. In March 2002 Aeroprogress suggested it was looking for certification by 2004, but in June of that RSK 'MiG' admitted it was unable to provide the USD2 million needed to complete certification, even though several aircraft then partly complete on production line at LAPIK, Lukhovitsy, and Yakutia regional government interested in buying 10. In 2005, work on the T-101 appeared to have ceased as the factory concentrated on MiG-29 production.

Prototype Aeroprogress T-101 Grach on display at Lukhovitsy in 2004 *(Yefim Gordon)*

1044773

AERO-VOLGA

AERO-VOLGA OOO NPO

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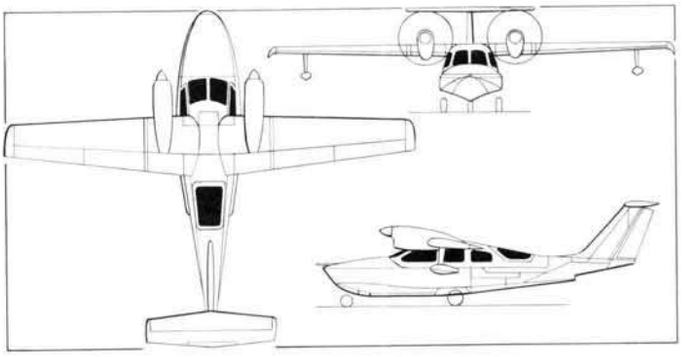
CHIEF ENGINEER: Sergey Seryogin
PRODUCTION DIRECTOR: Vladimir Shish
MARKETING DIRECTOR: Matvey Shchelochkov

Two prototypes of this company's twin-engined proof-of-concept L-6 amphibian have been flown: the original aircraft in June 2000 and a modified L-6M in September 2003, the company having meanwhile (2002) been officially constituted. In 2003, AeroVolga announced the similar LA-8 Flagman, which intended as the production version. In 2005, AeroVolga was evaluating an offer from Siberian city of Megion to establish LA-8 production in new plant. Agreement signed at Moscow Air Show 17 August 2005 with Diamond Aircraft of Austria covering Russian promotion and assembly at Samara of Katana lightplane, while Diamond to promote LA-8 in West.



AeroVolga LA-8 Flagman amphibian *(James Goulding)*

AEROVOLGA LA-8 FLAGMAN

TYPE: Utility amphibian.
PROGRAMME: Project announced 2003 as development of L-6. Certification application lodged 27 April 2004; first flight 20 November 2004 (RA-0344G); exhibited at Moscow Salon in August 2005. Certification to AP-23 and international equivalents and launch of production planned in 2006.
CUSTOMERS: Interest reported from potential buyers in Canada, Denmark, Norway and Sweden.
DESIGN FEATURES: High-wing amphibian. Wings strut-braced and with engines mounted on upper surface; stabilising floats at approximately three-quarter span. T-type tail. Downturned wingtips.
FLYING CONTROLS: Conventional and manual. Flaps.
STRUCTURE: Composites, with monocoque hull.
LANDING GEAR: Nosewheel type; retractable. Mainwheels, size 476×168, nosewheel 400×150. Minimum ground turning radius 14.0 m (46 ft).
POWER PLANT: Two LOM M337AK petrol engines, each 158 kW (212 hp), driving Avia V546 variable-pitch propellers. Optionally two 173 kW (232 hp) LOM M337B or 184 kW (247 hp) M337C six-cylinder piston engines and MT-Propeller or Hartzell variable-pitch propellers. Fuel capacity 380 litres (100 US gallons; 83.6 Imp gallons); provision for two long-range tanks with combined capacity of 300 litres (79.3 US gallons; 66.0 Imp gallons).
ACCOMMODATION: Eight persons, including up to two pilots. Main access hatch at rear of cabin, top; auxiliary hatch above pilots; two emergency exits, port and starboard.
AVIONICS: Garmin equipment standard.
EQUIPMENT: Optional ballistic parachute.
DIMENSIONS, EXTERNAL:

Wing span	13.08 m (42 ft 11 in)
Length overall	11.10 m (36 ft 5 in)
Max width of fuselage	2.00 m (6 ft 6¾ in)
Height overall	3.40 m (11 ft 1¾ in)
Wheel track	1.78 m (5 ft 10 in)
Wheelbase	3.43 m (11 ft 3 in)
Main hatch (upper rear):	
Length	1.69 m (5ft 6½ in)
Width	1.29 m (4 ft 2¾ in)
Auxiliary hatch (upper front):	
Length	0.45 m (1 ft 5¾ in)
Width	0.58 m (1 ft 10¾ in)
Emergency exits (two):	
Length	0.68 m (2 ft 2¾ in)
Width	0.68 m (2 ft 2¾ in)

DIMENSIONS, INTERNAL:

Cabin: Length	3.45 m (11 ft 3¾ in)
Max width	1.64 m (5 ft 4½ in)
Max height	1.24 m (4 ft 0¾ in)
Volume	3.7 m^3 (131 cu ft)

AREAS:

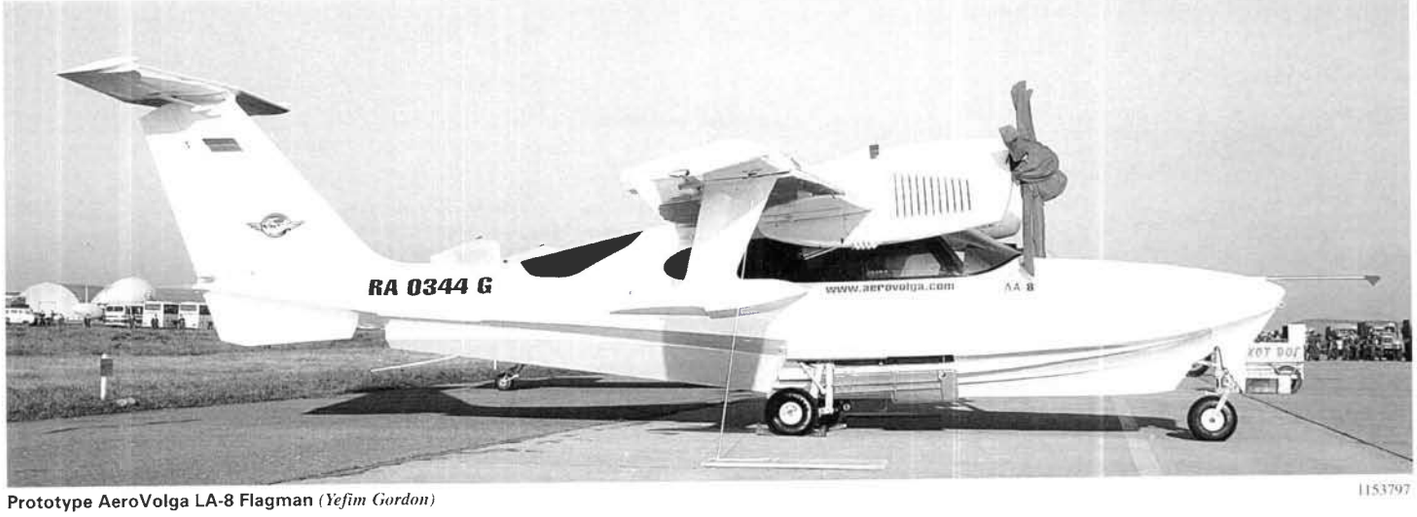
Wings, gross	18.60m^2 (200.2 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	1,400 kg (3,086 lb)
Payload: max	670 kg (1,477 lb)
for max range	463 kg (1,020 lb)
Max fuel weight (normal)	274 kg (604 lb)
Max T-O and landing weight	2,300 kg (5,070 lb)
Max wing loading	123.7 kg/m^2 (25.33 lb/sq ft)
Max power loading	7.28 kg/kW (11.96 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	164 kt (305 km/h; 189 mph)
Max level speed	140 kt (260 km/h; 164 mph)
Normal cruising speed	119 kt (220 km/h; 139 mph)
Stalling speed, power off: flaps up	69 kt (127 km/h; 79 mph)
flaps down	52 kt (95 km/h; 59 mph)



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Prototype AeroVolga LA-8 Flagman *(Yefim Gordon)*

Max rate of climb at S/L ..... 336 m (1,102 ft)/min
Max certified altitude ..... 3,000 m (9,840 ft)
T-O run: land ..... 300 m (985 ft)
water ..... 350 m (1,150 ft)
Range ..... 647 n miles (1,200 km; 745 miles)
Endurance ..... 5 h 40 min
g limits ..... +3.8/–1.9

ALBATROS

TSENTR NAUCHNO-TEKHNICHESKOGO TVORCHESTVA ALBATROS (ALBATROS SCIENTIFIC-TECHNICAL WORKS)

ulitsa Tsentral'naya 22/126, 142092 Troitsk, Moskovskaya oblast
Tel/Fax: (+7 096) 601 66 76
GENERAL DIRECTOR: Valery Daryin

Original Aviacomplex company established in 1990 to build prototypes of the AS-2 two-seat lightplane. Renamed Albatros on 16 June 1991. Testing of the AS-2 was completed in collaboration with CAHI (TsAGI) and LII Flight Research Institute. Production by Aviacomplex and Myasishchev Engineering Bureau, with participation by other Russian companies. At 1999 Moscow Air Show (MAKS), a production AS-2 was shown under new designation of Albatros AS-3A and first details were revealed of a development, the Sigma-4, but no further details of either aircraft have been received from Albatros. However, the Sigma-4 was shown at the 2003 MAKS, credited to Elitar and is now being marketed in US.

The AS-3A designation appears to have been re-applied to a considerably revised design, incorporating a pusher propeller, of which basic details have been received. In addition, Albatros produces plans for a variety of light engineering equipment, as well as lathes for home use.

ALBATROS AS-3A

TYPE: Tandem-seat ultralight.
PROGRAMME: Production aircraft built at Kazan.
CUSTOMERS: At least two flying with aero club at Podolsk, Moscow region. No further information received.
COSTS: USD9,800 with engine; USD6,800 without engine (2004).
DESIGN FEATURES: High wing, open cockpit (with optional enclosure), pusher configuration with constant-chord, V-strut braced wings and strut-braced tailboom. Rear occupant's seat is raised.
FLYING CONTROLS: Conventional and manual. Flaps.
STRUCTURE: Duralumin tube and fabric; composites nacelle.

Albatros AS-3A tandem-seat ultralight 0561694

LANDING GEAR: Tricycle type; fixed.
POWER PLANT: One 44.7 kW (60 hp) piston engine driving a two-blade, pusher propeller.
EQUIPMENT: Ballistic parachute.
DIMENSIONS, EXTERNAL:
Wing span ..... 9.80 m (32 ft 1¾ in)
Length overall ..... 6.80 m (22 ft 3¾ in)
AREAS:
Wings, gross ..... 14.85 m² (159.8 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 240 kg (529 lb)
Max T-O weight ..... 420 kg (925 lb)
PERFORMANCE:
Max level speed ..... 65 kt (120 km/h; 75 mph)
Normal cruising speed ..... 49 kt (90 km/h; 60 mph)
Max rate of climb at S/L ..... 180 m (591 ft)/min
T-O run ..... 60 m (200 ft)
Range: with max fuel ..... 540 n miles (1,000 km; 621 miles)
with two crew ..... 162 n miles (300 km; 186 miles)

ARSENYEV

ARSENYEVSKOYE AVIATSIONNOYE PROIZVODSTVENNOYE PREDPRIYATIE IMENI N I SAZYKINA (ARSENYEV AVIATION PRODUCTION ENTERPRISE 'PROGRESS' NAMED FOR N I SAZYKIN)

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Web: www.aacprogress.da.ru
GENERAL DIRECTOR: Vladimir Pechyonkin

Established in 1936 and originally designated GAZ 116, Arsenyev plant previously built the Mil Mi-24/25/35 series of combat helicopters, in parallel with Rostvertol, and was also manufacturer of the Yak-55 aerobatic lightplane; a modified version of the last-mentioned, the Technoavia SP-55, was nominally returned to production in 1999. Overhaul facilities for Mi-24 are available.

Arsenyev is responsible currently for the Kamov Ka-50, Ka-52 and Mil Mi-34 helicopters, as well as Moskit missiles. It was reportedly assigned the new Kamov Ka-60, but that programme has been reallocated to RSK 'MiG'. Russian government shareholding is 51 per cent. Ka-50 deliveries to Russian Air Forces were expected to begin with three helicopters in 2005, but these still on production line in January 2006.

A government decree of 31 December 1997 authorised the Arsenyev plant to offer the Ka-50 for export and supply spares and support for existing Mi-24/25/35 helicopters. Overseas delivery of P-15U, P-20, P-21 and P-22 cruise missiles is also covered.

Official plans announced on 12 May 2001 called for the Arsenyev plant to be incorporated in the proposed grouping to include RSK 'MiG', Tupolev and Kamov.

In December 2005, Arsenyev was reported to be preparing for production in 2006 of six Yak-54s (*sic*), representing part of an initial batch of 30 for ROSTO and other customers.

AVANTAZH

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BRANCH DIRECTOR: Viktor T. Kuznetsov
GENERAL DIRECTORS:
Aleksandr A. Markov
Yuri A. Chondrukov

Avantazh, which adopts the English transliteration 'Avantage' (advantage), was formed on 21 August 2000 to market the former Aeropract A-21, A-23, A-25 and A-27 light aircraft. In 2002, it added the A-29 to its product line, followed by the A-31 And A-35. Production is set at 10 to 12 aircraft per year.

In addition, the company also carries out modification work on Il-62, Tu-134, Tu-154 and Yak-42 airliners.

AVANTAGE A-27

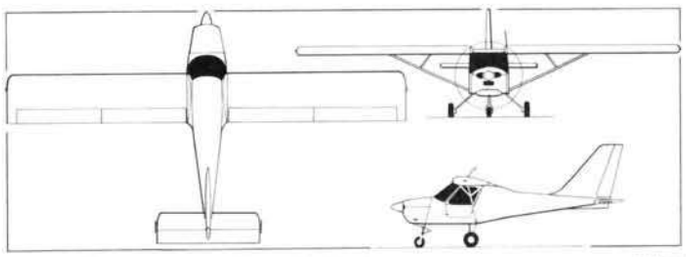
TYPE: Side-by-side lightplane/kitbuilt.
PROGRAMME: Prototype (FLARF-02647) first flew (in floatplane configuration) 22 June 1998; public debut at Gelendzhik 98 seaplane show, and in landplane version at MAKS, Moscow, August 1999; evaluated during 1999 and 2000 by AvtoZavod Flying Club in Togliatti. Seventh production airframe, under construction in mid-2001, is first with Rotax 914 engine.
CURRENT VERSIONS: **A-27:** Baseline version with Hirth engine.

A-27M Advantage: Version with 73.5 kW (98.6 hp) Rotax 912 ULS engine driving a Kiev ground-adjustable pitch propeller or 84.6 kW (113.4 hp) Rotax 914 ULS, driving a variable-pitch propeller. Several minor design changes, including more rounded forward lower fuselage surfaces, but description generally as for A-27, except where indicated.

Aeropract-27M Advantage two-seat lightplane *(Paul Jackson)* 0547744

CUSTOMERS: In early 2004, it was disclosed that the A-27M had been chosen by the government of Kyrgizia for a joint venture, with development of the aircraft for the Ministry of Ecology and Emergency Situations, the Border Service and the Agency for the Control of Narcotics. One aircraft was reported to have been tested; further development was contingent on the necessary funding being available.

In March 2005, company announced sale of one A-27-24 to OOO Agroalliance.
COSTS: Kit USD14,000, excluding instruments (USD700), landing gear and Rotax 912 engine (USD14,000). Ex-works, complete, with wheels, USD35,500 (1999). Wheel landing gear USD1,000; skis USD250 to USD350; floats USD1,200 and USD1,650.
DESIGN FEATURES: Braced, high-wing monoplane with single main and two jury struts each side. Sweptback fin and rudder; unswept wings and horizontal tail. Meets JAR-VLA certification requirements.
FLYING CONTROLS: Manual. Ailerons, rudder and all-moving tailplane with anti-balance tab. Flaps. A-27M has fixed tailplane with elevators, and ailerons with external mass balances.
STRUCTURE: Tube metal fuselage with composites skin.



Aeropract-27M Advantage *(James Goulding)* 0121662

LANDING GEAR: Tricycle type; fixed. Cantilever, metal mainwheel legs; telescopic, leaf-sprung nosewheel leg. Mainwheel size 400×150; nosewheel size 300×125. Optional floats or skis.
POWER PLANT (A-27): One 70.8 kW (95 hp) Hirth F30 flat-four driving a four-blade, ground-adjustable pitch propeller. Fuel capacity: 80 litres (21.1 US gallons; 17.6 Imp gallons); (A-27M) 100 litres (26.4 US gallons; 22.0 Imp gallons).
ACCOMMODATION: Two persons, side by side; forward-hinged door each side. Luggage space behind seats.
AVIONICS: Standard VFR.

Data refer to both versions, except where indicated.

DIMENSIONS, EXTERNAL:

Wing span: A27	10.60 m (34 ft 9¼ in)
A-27M	10.00 m (32 ft 9¾ in)
Wing chord, constant	1.35 m (4 ft 5¼ in)
Length overall: A-27	6.30 m (20 ft 8 in)
A-27M	6.50 m (21 ft 4 in)
Height overall	2.22 m (7 ft 3½ in)

WEIGHTS AND LOADINGS:

Weight empty: A-27	335 kg (739 lb)
A-27M	325 kg (717 lb)
Max T-O weight: A-27	600 kg (1,322 lb)
A-27M	650 kg (1,433 lb)
Max power loading: A-27	8.47 kg/kW (13.92 lb/hp)
A-27M	8.84 kg/kW (14.53 lb/hp)

PERFORMANCE:

Max level speed: A-27	95 kt (175 km/h; 109 mph)
A-27M	97 kt (180 km/h; 112 mph)
Normal cruising speed: A-27	70 kt (130 km/h; 81 mph)
A-27M	70–81 kt (130–150 km/h; 81–93 mph)
T-O run	100 m (330 ft)
Range: A-27	324 n miles (600 km; 372 miles)
A-27M	540 n miles (1,000 km; 621 miles)

AVANTAGE A-29

TYPE: Two-seat lightplane.
PROGRAMME: Introduced in 2002. Marketed in a range of roles, including flight training, pipeline patrol and agricultural applications.
DESIGN FEATURES: Braced high-wing monoplane with single strut each side. Sweptback fin.
FLYING CONTROLS: Conventional and manual. Electromechanical flaps.
STRUCTURE: Fuselage, wing and flying controls of glass fibre reinforced composites.
LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring metal cantilever mainwheel legs; telescopic, leaf-sprung nosewheel leg. Drum brakes. Optional floats and skis.
POWER PLANT: One 96.9 kW (130 hp) Limbach 2400 flat-four engine driving a wooden two-blade MT-Propeller MTV-1A/L170-05 propeller.
ACCOMMODATION: Two persons, side by side.
SYSTEMS: MVEN KC-700 ballistic parachute.
DIMENSIONS, EXTERNAL:

Wing span	10.12 m (33 ft 2½ in)
Wing aspect ratio	7.5
Length overall	6.63 m (21 ft 9 in)
Height overall	3.07 m (10 ft 0¾ in)
Propeller diameter	1.70 m (5 ft 7 in)

AREAS:

Wings, gross	13.66 m² (147.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	540 kg (1,190 lb)
Max T-O weight	770 kg (1,697 lb)
Max wing loading	56.4 kg/m² (11.55 lb/sq ft)
Max power loading	7.95 kg/kW (13.06 lb/hp)

PERFORMANCE:

Never exceed speed (VNE)	124 kt (230 km/h; 142 mph)
Max operating speed	121 kt (224 km/h; 139 mph)
Normal cruising speed	86 kt (160 km/h; 99 mph)
Stalling speed, flaps down	46 kt (85 km/h; 53 mph)
Max rate of climb at S/L	300 m (984 ft)/min
Service ceiling	3,500 m (11,480 ft)
T-O run	80 m (263 ft)
Landing run	90 m (295 ft)

Avantage A-29 1159709

AVANTAGE A-31 SPECTRUM

TYPE: Agricultural sprayer.
PROGRAMME: Go-ahead for prototype issued 12 May 2004; prototype has flown. Aircraft designed to meet AP-23 airworthiness standard.
DESIGN FEATURES: Low-wing cantilever monoplane.
FLYING CONTROLS: Conventional and manual.
STRUCTURE: Composites fuselage; metal tube wing and tail, latter with glass fibre skin.
LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted, spring cantilever mainwheel legs.
POWER PLANT: One 157 kW (210 hp) LOM Praha M337AK six-cylinder four-stroke engine driving a three-bladed Avia V-546 propeller.
ACCOMMODATION: Pilot only in ventilated cabin.
EQUIPMENT: Spraying equipment fitted on bar under wings; swath width 25 to 30 m (82 to 98 ft), coverage 150 ha (371 acres) per hour.
DIMENSIONS, EXTERNAL:

Wing span	13.60 m (44 ft 7½ in)
Wing aspect ratio	8.9
Length overall	7.91 m (25 ft 11½ in)
Height overall	2.66 m (8 ft 8¾ in)
Wheel track	2.50 m (8 ft 2½ in)
Wheelbase	4.90 m (16 ft 1 in)

AREAS:

Wings, gross	20.88 m² (224.75 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	820 kg (1,808 lb)
Max payload	364 kg (802 lb)
Max T-O weight	1,350 kg (2,976 lb)
Max wing loading	64.7 kg/m² (13.24 lb/sq ft)
Max power loading	8.60 kg/kW (14.13 lb/hp)

PERFORMANCE:

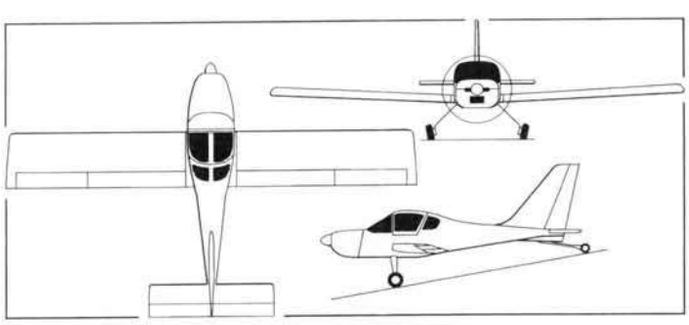
Never exceed speed (VNE)	135 kt (250 km/h; 155 mph)
Max operating speed	125 kt (232 km/h; 144 mph)
Normal cruising speed	108 kt (200 km/h; 124 mph)
Spraying speed	70–81 kt (130–150 km/h; 81–93 mph)
Stalling speed, power off: flaps up	53 kt (97 km/h; 61 mph)
flaps down	42 kt (77 km/h; 48 mph)
Max rate of climb at S/L	312 m (1,024 ft)/min
Service ceiling	4,400 m (14,435 ft)
T-O run	84 m (276 ft)
Landing run	114 m (374 ft)
Range	302 n miles (560 km; 348 miles)

Avantage A-31 Spectrum 1159710

AVANTAGE A-35 SCANNER

TYPE: Two-seat lightplane.
PROGRAMME: Go-ahead for prototype issued 12 May 2004; prototype has flown. Marketed as suitable for a range of tasks, including flight training and cropspraying.
DESIGN FEATURES: Low-wing cantilever monoplane. Similar to Aeropract-33.
FLYING CONTROLS: Conventional and manual.
STRUCTURE: Wing and fuselage of three-part composites.

Avantage A-35 Scanner 1159711



Avantage A-35 Scanner general arrangement *(Paul Jackson)* 1159695

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted, spring titanium cantilever mainwheel legs; drum brakes.
POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS flat four driving a Kiev 284/1800 three blade propeller.
ACCOMMODATION: Pilot and passenger side-by-side.
DIMENSIONS, EXTERNAL:
Wing span ..... 10.215 m (33 ft 6¼ in)
Wing aspect ratio 7.6
Length overall ..... 6.70 m (21 ft 11¾ in)
Height overall ..... 3.07 m (10 ft 1 in)
Wheel track ..... 2.305 m (7 ft 7 in)
AREAS:
Wings, gross ..... 13.67 m² (147.14 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 477 kg (1,052 lb)
Max T-O weight ..... 750 kg (1,653 lb)
Max wing loading ..... 54.86 kg/m² (11.24 lb/hp)
Max power loading ..... 10.20 kg/kW (16.77 lb/sq ft)
PERFORMANCE:
Never exceed speed (VNE) ..... 118 kt (220 km/h; 136 mph)
Max operating speed ..... 97 kt (180 km/h; 112 mph)
Normal cruising speed ..... 81 kt (150 km/h; 93 mph)
Stalling speed, power off, flaps down ..... 41 kt (75 km/h; 47 mph)
Max rate of climb at S/L ..... 300 m (984 ft)/min
Service ceiling ..... 3,500 m (11,480 ft)
T O run ..... 80 m (263 ft)
Landing run ..... 90 m (296 ft)
Range ..... 486 n miles (900 km; 559 miles)

AVGUR

AVGUR VOZDUKHOPLAVATELNYI TSENTR (AUGUR AERONAUTICAL CENTRE)

ulitsa Stepana Shutova 4, 109380 Moskva
Tel/Fax: (+7 095) 359 10 01 and 359 10 65
Web: www.augur.pbo.ru
WORKS: St Petersburg and Ulyanovsk
Tel/Fax (St Petersburg): (+7 812) 173 61 75
GENERAL DIRECTOR (ST PETERSBURG): Stanislav Vladimirovich Fedorov

Formed 29 October 1991 by the Moscow Aviation Institute and a group of private shareholders, this company is successor to AIG Kovanko, established in November 1986 by Mr Fedorov. Early achievements included first hot-air balloon flight over Moscow (AIGK Aist) in September 1989 and first Russian advertising aerostat (unmanned AP-60) in December 1989. Became joint stock company on 22 January 1993; St Petersburg division formed 4 November 1993, Ulyanovsk division 15 May 1996.

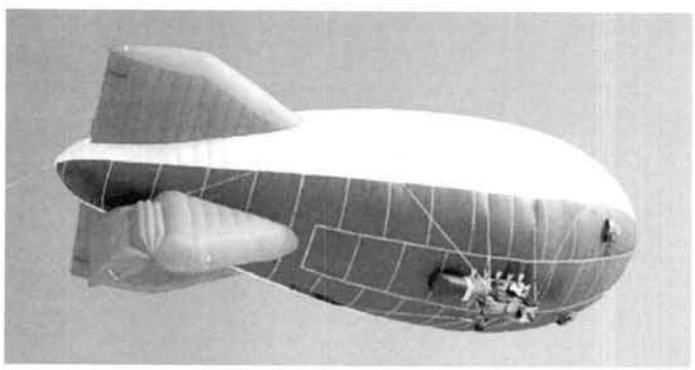
Current range of inflatables comprises BB, Au-2250 and VB hot-air balloons; Au-8 captive manned aerostat; Au-900 manned aerostat; Au-2, Au-5, Au-6 and Au-10 captive advertising aerostats; a range of small geostats; for RD-1.5, RD 2 and RD-2.5 remotely piloted small airships, see *Jane's Unmanned Aerial Vehicles and Targets*. Latest design is Au-29 Zyablik, revealed early 2005 and planned for series production in 2006 or 2007. Other activities include rental and leasing of airships and manufacture of ground-based inflatables of all kinds.

In 1997, Avgur became a founder member, with MAI, of the RosAeroSystems consortium.

AVGUR Au-29 ZYABLIK

English name: Chaffinch

TYPE: Hot air non-rigid airship.
PROGRAMME: Based on Au-26 hot-air tethered aerostat. First flight 18 December 2003. Smallest known airship in its class. On 2 April 2005 set, subject to ratification, a BX-02 Class duration record of 46 minutes 38 seconds at Klisheva, piloted by Valery Shkulenko. Intended for production in 2006 or 2007.
COSTS: USD40,000 (2005).
DESIGN FEATURES: Non-rigid, cruciform, inflatable tailfins, with rudder on lower vertical fin. Internal chambers of fins connected with main envelope volume, enabling air in fins to be heated and thus generating additional lift. Horizontal fins have adjustable deflection angle.
STRUCTURE: Envelope formed from 12 tapered gores of heat-resisting, ripstop polyamide fabric with silicone polyurethane coating, and pressurised from propeller slipstream via airscoop aft of gondola. Latter has a welded aluminium tube framework with four-point suspension from envelope.
POWER PLANT: One 20.9 kW (28 hp) MZ 35 piston engine with two blade pusher propeller. Fuel capacity 10 litres (2.6 US gallons; 2.2 Imp gallons).
ACCOMMODATION: Single-seat.
DIMENSIONS, EXTERNAL:
Envelope: Length ..... 23.42 m (76 ft 10 in)
Max diameter ..... 8.73 m (28 ft 7¾ in)
Span over tailfins ..... 9.20 m (30 ft 2¼ in)
Height overall ..... 10.60 m (34 ft 9¼ in)
Propeller diameter ..... 1.45 m (4 ft 9 in)
DIMENSIONS, INTERNAL:
Envelope volume ..... 855 m³ (30,194 cu ft)
WEIGHTS AND LOADINGS:
Envelope weight ..... 60 kg (132 lb)
Max payload ..... 150 kg (331 lb)
Gondola weight ..... 70 kg (154 lb)
PERFORMANCE:
Max level speed ..... 21 kt (40 km/h; 24 mph)



Avgur Au-29 prototype single-seat non-rigid 1127696

AUGUR Au-35

TYPE: Hot-air non-rigid airship.
PROGRAMME: First-stage prototype, named Polar Goose (*polyarnyy gus*), in science and technology development programme known as Altitude Launch, with eventual goal of using aerostats as high-altitude launch platforms for spacecraft. Subsequent stages will progress towards larger and more complex airships able to launch rockets carrying scientific and commercial payload experiments from stratosphere. Programme is supported by Russian Air Forces, Rosto (Society for Army, Aviation and Navy Support), Roscosmos, Russian Aeronautics Federation and Arctic Projects Foundation.

On 17 August 2006, piloted by Stanislav Fedorov and sponsored by Metropol investment company, Au-35 prototype took off from Moscow and flew to altitude of 8,150 m (26,740 ft), which claimed as new FAI absolute world record (previous record, 6,614 m; 21,700 ft, set in 2004). Airship is in BX 04 class (1,600 to 3,000 m³; 56,500 to 105,940 cu ft volume); no other data had emerged by press time.

Augur Au-35 being readied for its record attempt on 17 August 2006 1158803

AVIA

NAUCHNO-PROIZVODSTVENNOE OBEDINENIE AVIA LTD (AVIA SCIENTIFIC-PRODUCTION ASSOCIATION JSC)

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e-mail: gse.srl@agora.it
Web: www.g-s-e.it
DIRECTOR: Roberto Salmoni
GENERAL MANAGER: Alfredo Romano

The Avia company was established on 20 February 1995 to design, manufacture and support light aircraft. Its associated design bureau (itself part of the Sokol plant) is responsible for the Accord range of light twin-engined aircraft. GSE of Italy was appointed as sales agent in 2000 and in 2005 Avia announced that rights to the Italian version to be known as Aermar-2001, had been transferred to the latter company.

AVIA ACCORD-201

TYPE: Light utility twin-prop transport.

PROGRAMME: Original (lightweight) Accord design began May 1991; first flew 18 April 1994. Production version is Accord-201; prototype flew 18 August 1997 at Nizhny Novgorod, initially with only VFR avionics and without floats. Demonstrations to prospective customers began December 1997; series of 12 flights from water, using floats, undertaken mid-1998. By early 1999, four more aircraft, including static test specimen, under construction and tooling in place for maximum possible production of 10 per month; by May 2004 when prototype had accumulated 200 hours, Russian AP-23 certification anticipated October 1999, but delayed, eventually beginning on 20 April 2000. Experimental category certificate, granted mid-2000 with expiry date of 19 June 2001. Hartzell propellers received Russian certification in October 2000. Full certification expected mid-2002, using Becker avionics in place of original Bendix/King equipment. However, certification had not been completed by May 2004 but was then expected by year-end; this revised to mid-2005. Second prototype had been due to fly in December 2001; this was eventually achieved on 20 July 2004.

CURRENT VERSIONS: Offered for a variety of roles, including SAR (**201P**), aerial survey (**201AFS**), ecological monitoring (**201EM**), sigint (**201RC**) and jamming (**201REP**). Latest provisional version is the 201TDI, to be powered by two 172 kW (230 hp) SR-305 turbo diesels and due to fly in September 2004, later revised to mid-2005 with intention of exhibiting at MAKS-2005 that August. The Italian version is to be known as the Aermar-2001.

CUSTOMERS: First firm order received in May 1998 from Almazy Rossii-Sakha diamond mining company, which ordered two to be used for geomagnetic survey and exploration. Customers in Abu Dhabi and Liechtenstein by 2000; however, because of certification delays, former contract under renegotiation and latter cancelled by late 2001. No further sales reported, although in 2004 the company was forecasting production of 12–15 aircraft per year, at which time five were under construction; this was increased to 25 per year by 2006.

COSTS: Standard aircraft USD298,000 on wheels; USD328,000 on floats; USD400,000–D500,000 for 201 TDI. Operating cost USD44 per hour (2000).

DESIGN FEATURES: High-wing monoplane with single bracing strut each side; unswept, high-lift wing section and blown flaps; pod and boom fuselage; cruciform tail surfaces with sweptback fin and rudder; mainwheels at tips of short stub-wings that support bracing struts. Constant-chord main wing panels, with engines on leading-edge; tapered outer panels.

Service life 15,000 hours/15 years. Wing section CAHI (TsAGI) P-II, with 12 per cent thickness/chord ratio at root, CAHI (TsAGI) P-III at tip; tip sweepback 45°; no dihedral, incidence 1°, no twist.

FLYING CONTROLS: Conventional and manual. Ailerons and elevators 100 per cent balanced; twin horn-balanced rudders; all cable actuated. Three-axis electric trim. Two-section slotted flaps each side.

STRUCTURE: All-metal; D16 aluminium alloy and high-strength stainless steel. Fuselage based on welded rectangular-section cabin frame of steel tubing; remainder of airframe conventional light alloy construction.

LANDING GEAR: Tricycle type; fixed. Mainwheel legs levered, with oleo-pneumatic shock absorbers, mounted on sponsons attached to lower fuselage at attachment of wing bracing struts; single wheel on each unit. Cleveland wheels and brakes; mainwheels type 40–142 with 8.00-6 tyres; nosewheel type 40–140 with 6.00-6 tyres; type 30–127 disc brakes. Minimum turning circle 3.2 m (10 ft 6 in). Maximum nosewheel steering angle ±60°. Optional floats (additional to, not replacing, fixed landing gear) retract upward electrically, outside mainwheels.

POWER PLANT: Two 157 kW (210 hp) Teledyne Continental IO-360-ES7B flat-six engines; Hartzell PHC-H3YF-2UF/FC7453 three-blade, constant-speed, fully feathering propellers. Fuel tank in each engine nacelle; total capacity 750 litres (200 US gallons; 165 Imp gallons). Total oil capacity 15.2 litres (4.0 US gallons; 3.3 Imp gallons).

In April 2004, two 169 kW (227 hp) SMA SR305 turbo-diesel engines were delivered for installation in one of the aircraft on the production line; in May 2006, it was announced that all amphibious versions would be diesel-powered.

ACCOMMODATION: Pilot and up to six passengers in 2-3-2 seating, at 80 cm (31.5 in) pitch. Alternatively, pilot and three passengers and cargo, or all-cargo, or one stretcher patient, one or two attendants and medical equipment. Optional dual controls. Two large upward-hinged side doors. Baggage/cargo hold at rear of cabin, with door.

SYSTEMS: SAU-201 autopilot. Webasto Air Top 32 cabin heater. Electrical system includes two 27 V Teledyne N653344 DC generators and one 19 Ah Gill G-247 battery. Elipos-3 pneumatic de-icing system for wing, fin and tailplane leading-edges; Goodrich electric propeller de-icing. Janitrol cabin heater.

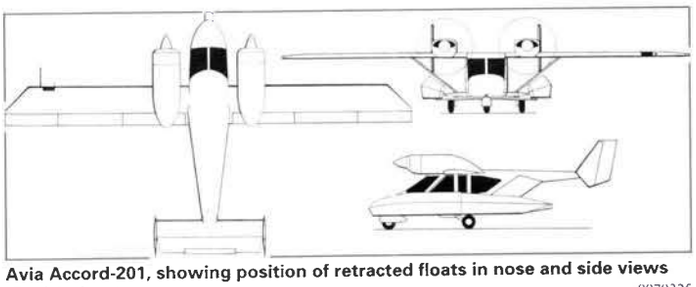
AVIONICS: Mainly Becker equipment:

Radar: Weather radar optional.

DIMENSIONS, EXTERNAL:

Wing span	13.75 m (45 ft 1¼ in)
Wing chord, constant	1.30 m (4 ft 3¼ in)
Wing aspect ratio	11.1
Length overall: landplane	8.12 m (26 ft 7¾ in)
amphibian	8.73 m (28 ft 7¾ in)
Height overall: landplane	2.94 m (9 ft 7¾ in)
amphibian	3.455 m (11 ft 4 in)
Span over tailfins	3.66 m (12 ft 0 in)
Wheel track	2.34 m (7 ft 8¼ in)
Float track	2.90 m (9 ft 6¼ in)
Wheelbase	2.845 m (9 ft 4 in)
Propeller diameter	1.93 m (6 ft 4 in)
Propeller ground clearance	1.25 m (4 ft 1¼ in)
Distance between propeller centres	2.80 m (9 ft 2¼ in)
Cabin doors (each): Height	1.10 m (3 ft 7¼ in)
Width: at top	0.75 m (2 ft 5½ in)
at bottom	1.50 m (4 ft 11 in)
Baggage/airdrop door: Height	0.90 m (2 ft 11½ in)
Width: at top	0.85 m (2 ft 9½ in)

Avia Accord 201 second prototype 1159715



Avia Accord-201, showing position of retracted floats in nose and side views *(Paul Jackson)* 0079325

at bottom	1.20 m (3 ft 11¼ in)
DIMENSIONS, INTERNAL:	
Cabin: Length	3.50 m (11 ft 5¾ in)
Max width	1.31 m (4 ft 3½ in)
Max height	1.20 m (3 ft 11¼ in)
Floor area	3.50 m² (37.7 sq ft)
Volume	4.0 m³ (141 cu ft)
Baggage hold volume:	
pilot and six passengers	0.50 m³ (17.7 cu ft)
pilot and four passengers	1.5 m³ (53 cu ft)
pilot and cargo	2.5 m³ (88 cu ft)
AREAS:	
Wings, gross	17.00 m² (183.0 sq ft)
Ailerons (total)	1.17 m² (12.59 sq ft)
Trailing-edge flaps (total)	3.23 m² (34.77 sq ft)
Fins (total)	1.36 m² (14.64 sq ft)
Rudders (total)	1.36 m² (14.64 sq ft)
Tailplane	2.18 m² (23.47 sq ft)
Elevators (total)	1.78 m² (19.16 sq ft)
WEIGHTS AND LOADINGS:	
Operating weight empty: landplane	1,350 kg (2,976 lb)
amphibian	1,530 kg (3,373 lb)
Max T-O weight	2,200 kg (4,850 lb)
Max wing loading	129.4 kg/m² (26.51 lb/sq ft)
Max power loading	7.03 kg/kW (11.55 lb/hp)
PERFORMANCE: (estimated):	
Never-exceed speed (VNE)	202 kt (375 km/h; 233 mph)
Max level speed at S/L:	
landplane	161 kt (299 km/h; 186 mph)
amphibian	150 kt (277 km/h; 172 mph)
Max cruising speed at 75% power at 1,000 m (3,280 ft):	
landplane	148 kt (275 km/h; 170 mph)
amphibian	138 kt (255 km/h; 158 mph)
Econ cruising speed at 3,000 m (9,840 ft):	
landplane	119 kt (220 km/h; 137 mph)
amphibian	111 kt (205 km/h; 127 mph)
Stalling speed, flaps down, power off:	
landplane	58 kt (106 km/h; 66 mph)
Max rate of climb at S/L:	
landplane	445 m (1,460 ft)/min
amphibian	420 m (1,378 ft)/min
Service ceiling: landplane	6,100 m (20,020 ft)
amphibian	5,800 m (19,020 ft)
T-O run:	
on land: landplane	240 m (790 ft)
amphibian	250 m (820 ft)
on water	360 m (1,185 ft)
Landing run on land:	
landplane, amphibian	220 m (725 ft)
on water	190 m (625 ft)
Range with max fuel at 3,000 m (9,840 ft):	
landplane	1,592 n miles (2,950 km; 1,833 miles)
amphibian	1,339 n miles (2,480 km; 1,541 miles)
g limits	+3.8/−1.6

AVIACOR

AVIAKOR AVIATSIONNOYE ZAVOD OAO (AVIACOR AVIATION DEPOT JSC)

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GENERAL DIRECTOR: Sergey K Likharev
MARKETING DIRECTOR: Aleksey V Gusev

Founded in Voronezh during the 1930s and evacuated to Kuybishev (Samara) during Second World War, Aviacor (formerly GAZ 18) has built 22,100 aircraft of 19 versions and 23 subvariants, including Il-2, Tu-4 Tu-95, Tu-114 and Tu-154 three-turbofan transport. In early 2006 it had three Tu-154Ms nearing completion for customers and a further six in early stages of assembly. One Tu-154M completed in late 2005 was for Russian Federation Security Service. It has manufactured the Molniya-1 six-seat light aircraft and an air cushion vehicle derivative, and will produce the Tupolev Tu-354, if ordered. In late 2005 17 Molniya-1 airframes remained in storage because of delays in transferring production of upgraded version to Smolensk plant in wake of restructuring at Molniya and loss of its light aircraft design department. It was also earmarked to build the Ukrainian Antonov An-70 and An-140 in Russia and to assist RSK 'MiG' with the Tu-334. The first An-140-100 (of six in initial batch) was rescheduled for construction in first quarter of 2002, but detailed discussions on a production timetable and contracts for delivery were not held with Antonov until 5 December 2001. First aircraft was eventually rolled out on 25 December 2003, having to wait until 2 August 2005 for first flight. Marketing is by International Aviation Project 140 (MAP-140), which formed 15 September 2003 as joint venture with Inter-AMI (subsidiary of KhGAPP at Kharkov).

It was announced in September 2001 that An-70 assembly had been reallocated to Polyot because of Aviacor's inability to provide start-up funding. Subsidiary businesses are Aviacor-Service and Aviacor Repair. Company overhauls Tu-95MS strategic bombers and Tu-154 airliners (11 in 2004) including VIP conversions; makes Tu-154 spares; repaints Il-76s; supports An-72 and An-24. Group members employ Westernised form of company name in place of direct transliteration, Aviakor.

Russian government shareholding is 25.5 per cent; controlling interest held by Siberian Aluminium Group (Sibal) since 1998. Undertakes subcontract work for Airbus and Boeing.

AVIAPROM

AVIAPROMSERVIS

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GENERAL DIRECTOR: Sergey Fateev
SALES MANAGER: Aleksandr Lisovsky

AviaPromServis formed in 2001 as supplier of spares and equipment to CIS and rest of world notably in airliner galleys and freight pallets, and ground servicing equipment. Formed partnership with Promaks in December 2004 to market M-12 three-seat light twin.

AVIAPROM M-12

TYPE: Three-seat lightplane; three-seat kitbuilt.

PROGRAMME: Kasatik M-12 designed by Feniks OKB (Phoenix Design Bureau; a division of Promax) and built by Aviacor plant at Samara; exhibited at Moscow in 1995, powered by two 25.7 kW (34.5 hp) Vikhr 30 piston engines. Intermittent promotion (interrupted by flight test crash on 14 October 1997) continued for further decade within CIS until Western launch at Paris Air Show in June 2005. Certification under way to FAR/EASA 23, day VFR.

CUSTOMERS: Several sales in CIS and one in Germany prior to 2005. US marketing began in July 2006, with exhibition at AirVenture, Oshkosh.

COSTS: USD96,280 flyaway with Jabiru engine; kit USD53,380, less engines and instruments (2006).

DESIGN FEATURES: High, constant-chord wing with single bracing strut each side and two pusher piston engines close inboard; cockpit pod with narrow rear fuselage and low-mounted tailplane braced to sweptback fin by single strut each side. Rudder trailing-edge sweptback from base to tip; earlier versions had trapezoidal vertical tail. Wings foldable for storage and transport. Service life 4,000 landings, 2,000 hours or 10 years.

Mainplane dihedral 1° 30'; no sweepback. Tailplane: no incidence or dihedral. Fin leading-edge sweepback 35°.

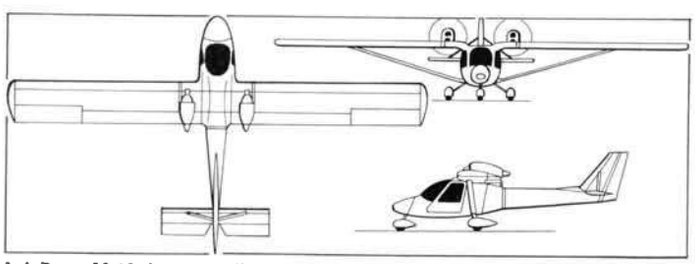
FLYING CONTROLS: Conventional and manual. Mass-balanced ailerons. Balanced rudder and elevator, latter with flight-adjustable trim tab, port. Slotted flaps.

STRUCTURE: Riveted aluminium monocoque with bolted joints; composites for some non-load-bearing items; welded steel engine mounting.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring aluminum cantilever mainwheel legs with 6.00-6 tyres and cable brakes (alternatively 360×135 or 400×150 tyres). Steerable nosewheel 300×12.5. Composites speed fairings on all wheels. Optional floats or skis. Turning circle 3.1 m (11 ft) about nosewheel; 2.9 m (10 ft) about mainwheel; taxiway width for U-turn 10 m (33 ft).

POWER PLANT: Two four-stroke, flat-four piston engines driving two-blade, variable-pitch pusher propellers: 59.6 kW (79.9 hp) Rotax 914 or 59.7 kW (80 hp) Jabiru 2200. Optionally, two-stroke 48.0 kW (64.4 hp) two-cylinder Rotax 582 driving three-blade, fixed-pitch propellers. Fuel capacity 150 litres (39.6 US gallons; 33.0 Imp gallons). Two pneumatic fuel pumps.

AviaProm M-12 three-seat lightplane *(Paul Jackson)* 1158271



AviaProm M-12 three-seat light twin *(James Goulding)* 1133723

ACCOMMODATION: Pilot (front) and two passengers (rear). Baggage compartment behind seats. Forward-hinged door each side. Optional second set of controls for port rear seat. Cockpit heated and ventilated.

SYSTEMS: Electric system 12 V and 24 V provided by engine-mounted generators and 55 Ah motorcar battery, plus 9 Ah auxiliary battery.

AVIONICS:

Comms: Garmin GNS 400 nav/com and GTX 320 transponder.

EQUIPMENT: Optional ballistic recovery parachute occupying part of baggage compartment.

DIMENSIONS, EXTERNAL:

Wing span	10.20 m (33 ft 5½ in)
Wing chord, constant	1.20 m (3 ft 11¼ in)
Wing aspect ratio	8.5
Width, wings folded	1.95 m (6 ft 4¾ in)
Length overall	6.80 m (22 ft 3¾ in)
Height overall	2.30 m (7 ft 6½ in)
Tailplane span	3.00 m (9 ft 10 in)
Wheel track	1.60 m (5 ft 3 in)
Wheelbase	2.05 m (6 ft 8¾ in)
Propeller diameter: Rotax 582	1.60 m (5 ft 3 in)
Jabiru 2200, Rotax 912	1.55 m (5 ft 1 in)

DIMENSIONS, INTERNAL:

Cockpit: Length	2.76 m (9 ft 0½ in)
Max width	1.15 m (3 ft 9¼ in)
Max height	1.14 m (3 ft 9 in)

AREAS:

Wings, gross	12.20 m² (131.3 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: Rotax 912	474 kg (1,045 lb)
Jabiru 2200	448 kg (988 lb)
Max baggage weight: normal	40 kg (88 lb)
with BRS parachute	24 kg (53 lb)
Max payload	280 kg (617 lb)
Max fuel weight	108 kg (238 lb)
Max T-O weight: Rotax 912	860 kg (1,895 lb)
Jabiru 2200	848 kg (1,869 lb)
Max zero-fuel weight, Jabiru 2200	750 kg (1,653 lb)
Max wing loading: Rotax 912	70.5 kg/m² (14.44 lb/sq ft)
Jabiru 2200	69.5 kg/m² (14.24 lb/sq ft)
Max power loading: Rotax 912	7.22 kg/kW (11.86 lb/hp)
Jabiru 2200	7.11 kg/kW (11.68 lb/hp)

PERFORMANCE:

Max level speed: Rotax 912	127 kt (235 km/h; 146 mph)
Jabiru 2200	124 kt (230 km/h; 143 mph)
Normal cruising speed: Rotax 912	103 kt (190 km/h; 118 mph)
Jabiru 2200	97 kt (180 km/h; 112 mph)
Max rate of climb at S/L	480 m (1,575 ft)/min
Service ceiling	4,000 m (13,120 ft)
Range with max payload: Rotax 912	637 n miles (1,180 km; 733 miles)
Jabiru 2200	518 n miles (960 km; 596 miles)
Endurance: Rotax 912	6 h 20 min

AVIASTAR

AVIASTAR, ULYANOVSKY AVIATSIONNYI PROMYSHLENNYI KOMPLEKS OAO (ULYANOVSK AVIATION INDUSTRIAL COMPLEX 'AVIASTAR' JSC)

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MARKETING DIRECTOR: Valery D Sherstyanov

Founded on 10 June 1976, this 1.5 million m² (16.5 million sq ft) production facility, known as Plant 25 and named for D F Ustinov, flew its first aircraft, an Antonov An-124 ultra-large airlifter, on 30 October 1985, following with the Tupolev Tu-204 transport in 1987 (first flight 17 August 1990) and the related Tu-234 in 1996. It now takes the style Aviastar-SP. Its biennial production certificate was renewed on 3 November 2004, entitling manufacture of

Tu-204, Tu-204-100, Tu-204-120, Tu-204-120C, Tu-204C and An-124, plus modification of An-124 and upgrade to An-124-100. Tu-204-300 added on 26 May 2005.

In mid-1997, Aviastar agreed to merge with Tupolev design bureau and Aviacor. Tupolev merger effected 30 June 1999, forming Tupolev OAO with inputs from Russian government (51 per cent), Aviastar (43.6 per cent) and Tupolev Design Bureau (5.4 per cent). Aviastar now owned 74 per cent by Tupolev. Under Russian government plans announced on 12 May 2001, Aviastar will be incorporated in major grouping also including RSK 'MiG', Tupolev, Kamov, Aviacor and Sokol. Also in 1997, Aviastar Asia was formed in Taipei, Taiwan, as a joint venture with Asian interests to promote the Tu-204 in the Far East. Finance is provided by Aviastar Financial International, formed by Aviastar, Perm Motors and Moscow International Bank.

After five-year break, production of An-124 resumed with August 2000 delivery of one to Volga-Dnepr. State financing (Rb20 million) was received in 2000 for construction of a second assembly hall for An-124 production; company delivered its 36th and last An-124 in 2004 and was then in consultation with Ukraine regarding resumption of manufacture of An-124-100M version. By late 2001, Aviastar was urgently seeking new financial support to clear its debts. This reportedly achieved in early 2002 when Cato Avomatic (Egypt) and Leader Group (Russia) agreed to fund between 30 and 50 new Tu-204 airframes in 2003–05 initial step being batch of 25 agreed in December 2002. In October 2002, Ilyushin Finance announced intention of ordering 46 Tu-204s over six years; first three confirmed almost immediately. Further orders against these large commitments have been slow in arriving. In September 2003 the plant agreed to accelerate production of five Tu-204s for China, which were required before the end of 2004, these being part of the Cato contract. However, none was completed, although Tu-204/234 No. 38 (35th flyable, Aviastar-built aircraft) first flew 25 November 2004, at which time Nos. 39 and 40 were nearing completion. Schedule for 2005 was four Tu-204s delivered to Vladivostok Avia airline and two to China, fourth Vladivostok machine departed on delivery on 25 December 2005, but no production for China up to that time.

BERIEV

BERIEVA AVIATSIONNYI KOMPANIYA (BERIEV AVIATION COMPANY)

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CHAIRMAN: A I Fyodorov
HEAD OF MARKETING: Andrei Shishko
HEAD OF INFORMATION: Andrei I Salinkov

Original Beriev design bureau (OKB) founded in October 1934 by Georgy Mikhailovich Beriev (1902–79); except during part of the Second World War, 1942–45, it has been based at Taganrog, in northeast corner of Sea of Azov; since 1948 has been primary centre for Russian seaplane development. Beriev has manufactured more than 20 types of aircraft, most of which have entered series production. In 1990 was redesignated Taganrogsky Aviatsionnyi Nauchno-Tekhnichesky Kompleks imeni G M Berieva (TANTK: Taganrog Aviation Scientific-Technical Complex named for G M Beriev); became part of AVPK Sukhoi in 1996. As a consequence of this merger, the bureau's products are often manufactured at factories traditionally associated with Sukhoi, the Be-103 Bekas, for example, at Komsomolsk. On 1 January 1998 adopted style, 'Beriev Aviation Company' for international promotion, retaining TANTK in Russia. State shareholding is 38 per cent.

Beriev company now includes the experimental design bureau, experimental production facilities, a flight test complex, economic, financial and logistics support services, with test bases and proving grounds at the Black Sea and Sea of Azov. Its products are experimental prototypes of amphibious aircraft and wing-in-ground-effect (WIG) vehicles, together with test reports and technical documentation for their series production. It undertakes design and development of unconventional aircraft in response to requests for proposals from other companies, testing of aircraft and assemblies in maritime conditions, and training of aircrew and ground personnel for seaplane operation.

Beriev began development of a twin-turboprop, multirole amphibian designated **Be-112** in 1995. The project is, reportedly, still active, although the company declines to publish a likely first flight date. Beriev continues to promote the Be-32K twin-turboprop commuter airliner, A-40 jet flying-boat and Be-12P amphibious water bomber, none of which has immediately obvious production prospects.

BERIEV A-42

Similar to the Beriev A-40, this aircraft project was pursued during the 1990s before being suspended. Prototype 85 per cent complete at TANTK, Taganrog, by September 2000, at which time only Rb19.5 million assigned of Rb307 million required to complete development. By January 2002, Beriev was reporting that this prototype was an A-42P patrol and SAR variant; power plant quoted as two Progress D-27 propfans, each rated at 109.8 kN (24,690 lb st), which description applies to Beriev **A-45**. In this form, A-42P has MTOW of 96,000 kg (211,650 lb), combat load of 8,500 kg (18,739 lb) and range of 6,209 n miles (11,500 km; 7,145 miles). Main sensor suite to be Leninets Novella (Sea Dragon). Domestic needs are up to eight for military use and up to four for MChS civil protection agency; export interest (A-42PEh) from Canada, Chile, China, Finland, South Korea and Thailand. Announced in April 2002 that funding of A-42 to completion would begin in 2005, at earliest, although a September 2003 announcement predicted completion of the first aircraft in 2006. Intended avionics include Sea Snake search and attack radar and Aria-V flight and navigation system. Promotion of A-42 continued into 2006, but with no known signs of progress.

In mid-2002, Beriev was continuing promotion of an A-40Eh export version of the original aircraft as well as predicting a return of official interest to the A-40, which the Russian Navy abandoned in 1996, in favour of a maritime patrol version of Tupolev Tu-204 airliner.

BERIEV Be-101

TYPE: Four-seat amphibian.

PROGRAMME: In November 2005, Beriev disclosed that it was shortly to begin construction at Taganrog of a new light amphibian; first flight was then scheduled for mid-2006 with a public debut at the Gelendzhik air show in September of that year.

DESIGN FEATURES: High wing, with downturned tips acting as water stabilisers, mounted to rear of cabin; pusher propeller; sweptback fin and cruciform tailplane; parallel beam, single-step hull. No dihedral.

FLYING CONTROLS: Conventional and manual. Horn-balanced rudder and elevators; tab in each elevator.

LANDING GEAR: Tricycle type; retractable. Mainwheels stowed in hull sides. Operable in Sea State 2, wave height 0.45 m (1 ft 6 in); maximum required water depth 0.9 m (3 ft).

POWER PLANT: One 231 kW (310 hp) Teledyne Continental IO-550-N flat-six driving an MT-Propeller MTV-12 pusher propeller. Fuel capacity 195 litres (51.5 US gallons; 42.9 Imp gallons).

ACCOMMODATION: Pilot and three passengers in side-by-side pairs. Fixed windscreen, plus upward-hinged door each side. Baggage compartment behind seats.

DIMENSIONS, EXTERNAL:

Wing span	12.20 m (40 ft 0¼ in)
Wing aspect ratio	8.9
Length overall	8.90 m (29 ft 2½ in)
Height overall	3.01 m (9 ft 10½ in)
Wheelbase	3.20 m (10 ft 6 in)
Wheel track	2.36 m (7 ft 9 in)

DIMENSIONS, INTERNAL:

Cabin: Length	2.765 m (9 ft 0¾ in)
Max width	1.28 m (4 ft 2½ in)
Max height	1.30 m (4 ft 3¼ in)
Baggage compartment volume	0.60 m³ (21.2 cu ft)

AREAS:

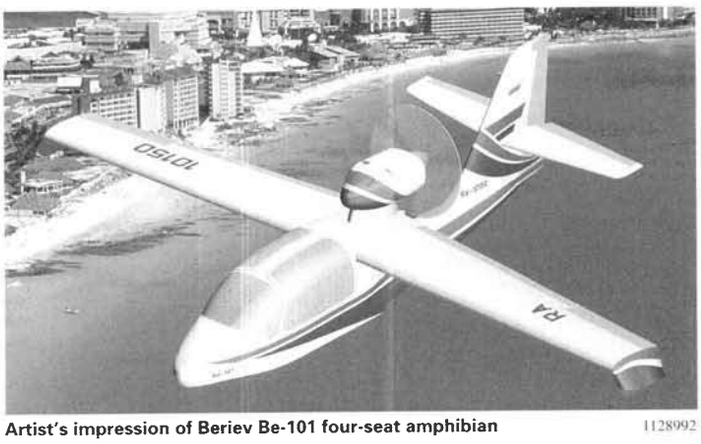
Wings, gross	16.675 m² (179.5 sq ft)

WEIGHTS AND LOADINGS:

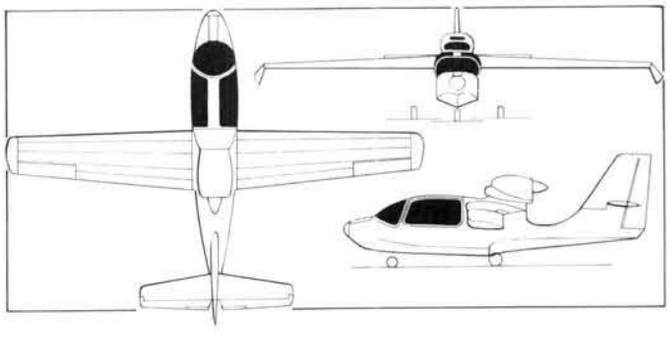
Max payload	255 kg (562 lb)
Max fuel weight	140 kg (309 lb)
Max T-O weight	1,450 kg (3,196 lb)
Max wing loading	87.0 kg/m² (17.81 lb/sq ft)
Max power loading	6.27 kg/kW (10.31 lb/hp)

PERFORMANCE (estimated):

Max level speed at FL98	151 kt (280 km/h; 174 mph)
Econ cruising speed at FL98	132 kt (245 km/h; 152 mph)
Service ceiling	6,000 m (19,680 ft)
T-O run: land	300 m (985 ft)
water	460 m (1,510 ft)
Landing run: land	190 m (625 ft)
water	380 m (1,250 ft)
Range at FL98, 30 min reserves	540 n miles (1,000 km; 621 miles)



Artist's impression of Beriev Be-101 four-seat amphibian 1128992



Beriev Be-101 amphibian *(James Goulding)* 1159818

BERIEV Be-103 BEKAS

English name: Snipe

TYPE: Six-seat amphibian.

PROGRAMME: Design started 1992; model exhibited and initial data released at Moscow Air Show '92; construction of preproduction batch of four began by KnAAPO at Komsomolsk-on-Amur 1994; prototype (RA-37019), with M-17F engines, displayed statically at Gelendzhik Hydro-aviation Show, on the Black Sea, 23 September 1996; first flew at Taganrog on 15 July 1997, but destroyed on its 28th sortie, during practice for Moscow Air Show on 18 August 1997. Second prototype (RA-03002) flew 17 November 1997; made type's first water take-off and landing on 24 April 1998 (aircraft's sixth sortie), but crashed on 29 April 1999 while returning from exhibition at Aero '99, Friedrichshafen; further two structure/static test airframes completed for use at Taganrog by early 1997.

Type certification rescheduled for second half of 1998 and first delivery for 1999, but these dates also not met; development being assisted by three preproduction aircraft, which completed by late 1997, although first of these (believed 03101) did not fly until

Beriev Be-103 c/n 3203, one of three which flew from Komsomolsk to St Petersburg in June 2005

1128940

19 February 1999; 03103 shown at Gelendzhik in August 2000 when seen to have fixed wing leading-edge slats outboard of landing lights (as on 03102); by early 2001, 03103 had received nose radome. Total of five flying and two static test aircraft up to this time.

Be-103 development included, since 1997, in Rostov regional development programme, while funding provided by government's 1999–2000 Light Aircraft Development Programme; KnAAPO paid for VFR certification, which granted by Russian Aviation Register on 26 December 2001, after 161 hours of trials, including 59 water and 204 land take-offs. FAR/JAR 23 certification trials satisfactorily completed by April 2003 and confirmation expected to follow.

Marketed by **Takom Avia** consortium, formed by Beriev, KnAAPO and VO Mashinoexport of Moscow. In late 1999, consideration given to establishing final assembly centre in Malaysia, combining Russian airframes and US avionics and engines. Aerocorp International, appointed US dealer by 2002. Launch of US certification effort announced in September, but KnAAPO simultaneously revealed temporary suspension of production due to lack of orders. Named Bekas in February 2003. First production aircraft (03301) flew 2 July 2003. US certification achieved 11 July 2003 (presented 31 July) and three aircraft air-freighted to Oshkosh by An-124 on 23 July for US distributor, Aerocorp, and immediate US debut at AirVenture '03, first becoming N13KL (03301).

CURRENT VERSIONS: **Be-103:** *As described.*

SA-20P: Described separately.

OSA: In September 2003, Beriev was reported to be working on design of a Be-103 variant with a single turboprop of between 298 and 373 kW (400 and 500 shp) under the provisional designation OSA (*odnodvigatelnyi samolet amfibiya*: single-engined amphibian), of which the SA-20P is regarded as a prototype.

CUSTOMERS: Projected sales of 350 to 450, including exports. Break-even at 250th. First reported order from Russian Border Guards for 20 (out of possible 200 required), originally for delivery from 1999; Forestry Service requires 30 to 40. First export order announced August 1999 in form of 10 for undisclosed customer; however, in January 2002 Beriev was still negotiating first firm orders, comprising possible six for forestry use and others for border patrol. None of these has materialised. By late 2005; five Be-103s operating in Russia, apparently pre-series machines comprising two with Beriev Bureau; two with KnAAPO's own airline; and one with aero club at Kubinka.

Initial production batch of 10; deliveries began July 2003; in form of three to US dealer; second batch of 20 due to have been started by late 2003 and by late 2005, total of 40 in various stages of assembly. Orders then said to be "about 100".

Announced May 2004 that 20 purchased for delivery to China. Chinese certification achieved 22 December 2005, in anticipation of all 20 deliveries in 2006; name, Albatros associated with Chinese version. Initial operator will be Flying Dragon airline at Harbin; Sukhoi group to maintain related service centre in China. Brazilian certification obtained 3 August 2005; initial eight required by local MSA Group.

In January 2006, Colombian ambassador to Russia signed framework agreement with KnAAPO plant covering Be-103 deliveries. Indonesian fisheries ministry interested in eight Be-103s, according to December 2005 report, to combat illegal fishing; Singaporean surveillance equipment, possibly including datalink, to be installed. Canadian certification procedure launched May 2005.

COSTS: Basic price USD650,000 (2003), with IO-360 engines. Total operating costs USD81.27 per hour at 600 hr/year (2004).

DESIGN FEATURES: Low-wing monoplane, with water-displacing wings of moderate sweep with large wingroot extensions; two-step boat hull; no stabilising floats; horizontal strake each side of nose, plus vertical strake ahead of second hull step; wing centre-section increases lift during take-off and landing, partly compensating for absence of flaps. Engine pylon mounted on each side of rear fuselage, aft of wings; engines raised slightly on production version. Sweptback fin and rudder; tailplane mid-set on fin. Designed in compliance with AP-23 and FAR Pt 23 requirements; suitable for passenger and cargo transport, medical evacuation, patrol and ecological monitoring. Operable in wave heights up to 0.5 m (1½ ft) and on water as shallow as 1.25 m (4 ft). Service life 15,000 hours or 20 years, including 5,000 water- and 6,000 land landings.

Wing leading-edge sweep 22°; wing section NACA 2412M; dihedral 5° 3' on outer wings; incidence 1°. Fixed leading-edge slats. Fin leading-edge sweep 33°; tailplane 14° 40'.

FLYING CONTROLS: Manual. All-moving tailplane (with anti-balance tab) and ailerons actuated by pushrods; rudder by cables; two mass balances ahead of tailplane; mass balance (port side only) on rudder, which has flight-adjustable trim tab; electric trim; spring feel in tailplane control; no flaps. Control surface deflections: ailerons ±25°; tailplane +14/–6°; rudder ±27°.

STRUCTURE: All-metal semi-monocoque boat-type fuselage; all-metal single-spar wings. Extensive use of riveted 1446 aluminium-lithium alloy.

LANDING GEAR: Hydraulically retractable tricycle type; single wheel on each unit; mainwheels retract forward into wing centre-section; nosewheel retracts forward; oleo-nitrogen shock-absorbers; brakes on mainwheels; nosewheel tyre size 400×150, pressure 3.92 bar (57 lb/sq in); mainwheel tyres 7.00-6, pressure 3.62 bar (53 lb/sq in); mainwheel disc brakes; self-centring nosewheel steerable ±30°. Turning circle 8.35 m (27 ft 6 in) about nosewheel; 13.55 m (44 ft 6 in) about wingtip.

POWER PLANT: Two 157 kW (210 hp) Teledyne Continental IO-360-ES4 flat-four piston engines, each driving an MT-Propeller MTV-12-D-C-F-R-(M)/CFR183-17 three-blade, variable pitch (hydraulic), metal propeller. Certified for propeller reversal 17 November 2004. Later option will be two 221 kW (296 hp) VAZ-4263 piston engines and Avia AV-103 three-blade, variable-pitch propellers, with optional reversible pitch. Fuel tanks in wingroots, each 136 litres (35.9 US gallons; 29.9 Imp gallons) and in engine pylons, each 35 litres (9.2 US gallons; 7.7 Imp gallons); total 342 litres (90.3 US gallons; 75.2 Imp gallons), of which 316 litres (83.4 US gallons; 69.5 Imp gallons) usable. Oil capacity 8 litres (2.0 US gallons; 1.7 Imp gallons) per engine.

ACCOMMODATION: Pilot and five passengers in pairs; dual controls optional (standard for USA); large upward-opening door on each side, hinged on centreline, starboard side as emergency exit only; folding seats facilitate entry/loading baggage/freight compartment aft of cabin. Optional ambulance configuration for pilot, one stretcher, three seated persons; all-cargo configuration for items up to 2.00 × 0.70 × 0.70 m (6 ft 6¾ in × 2 ft 3½ in × 2 ft 3½ in) in size; patrol; agricultural and ecological monitoring use. Accommodation heated and ventilated.

SYSTEMS: Hydraulic system, capacity 3 litres (6 US pints; 5 Imp pints), pressure 16.1 bar (234 lb/sq in). Electrical system 28.5 V DC, supplied by two 3.4 kW 60 A generators; 17 Ah battery. Fire suppression system. Optional anti-icing.

AVIONICS: Integrated by Bendix/King. VFR standard; IFR optional. Version with Russian avionics may be offered in the future.

Comms: KY 196A VHF com radio, KMA 24 intercom, KX 165 nav/com/glideslope, KT 70 transponder and P-855 emergency locator beacon.

Radar: Optional RDR-2000 or RDR-1400 weather radar in extreme nose.

Flight: KN 63 DME, KR 87 ADF, KCS 55A compass, KEA 130A encoding altimeter, KLN 89B GPS. Optional AP-103 autopilot.

Instrumentation: Conventional.

EQUIPMENT: Landing light in each wing leading-edge.

DIMENSIONS, EXTERNAL:

Wing span	12.72 m (41 ft 9 in)
Wing chord: at root	6.21 m (20 ft 4¾ in)
at tip	0.83 m (2 ft 9 in)
Wing aspect ratio	6.4
Length: overall, no radar	10.65 m (34 ft 11¼ in)
overall with radar	10.875 m (35 ft 8¼ in)
fuselage	9.96 m (32 ft 8 in)
Fuselage max width	1.35 m (4 ft 5¼ in)
Height overall	3.76 m (12 ft 4 in)
Tailplane span	3.90 m (12 ft 9½ in)
Wheel track	2.275 m (7 ft 5½ in)
Wheelbase	4.065 m (13 ft 4 in)
Propeller diameter	1.83 m (6 ft 0 in)
Distance between propeller centres	3.00 m (9 ft 10¼ in)
Passenger door/emergency exit (both): Height	0.80 m (2 ft 7½ in)
Width	1.40 m (4 ft 7 in)

DIMENSIONS, INTERNAL:

Cabin: Length	3.38 m (11 ft 1 in)
Max width	1.25 m (4 ft 1¼ in)
Max height	1.23 m (4 ft 0½ in)
Floor area	4.05 m² (43.6 sq ft)
Volume	4.6 m³ (162 cu ft)
Baggage compartment: Max width	1.08 m (3 ft 6½ in)
Max height	0.88 m (2 ft 10½ in)
Floor area	0.91 m² (9.8 sq ft)
Volume	0.85 m³ (30.0 cu ft)

AREAS:

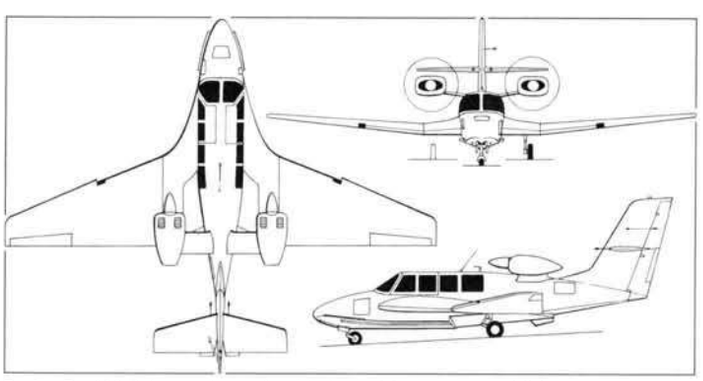
Wings, gross	25.10 m² (270.2 sq ft)
Ailerons, total	0.80 m² (8.61 sq ft)
Fin	2.86 m² (30.78 sq ft)
Rudder	1.54 m² (16.58 sq ft)
Tailplane, total	3.68 m² (39.61 sq ft)

WEIGHTS AND LOADINGS:

Manufacturer's empty weight	1,680 kg (3,703 lb)
Weight empty, equipped	1,834 kg (4,041 lb)
Operational weight	1,902 kg (4,193 lb)
Baggage capacity	50 kg (110 lb)
Payload with max fuel	123 kg (271 lb)
Max fuel weight	245 kg (540 lb)
Max T-O and landing weight	2,270 kg (5,004 lb)
Max ramp weight	2,280 kg (5,026 lb)
Max zero-fuel weight	2,219 kg (4,892 lb)
Max wing loading	90.4 kg/m² (18.52 lb/sq ft)
Max power loading	7.25 kg/kW (11.91 lb/hp)

PERFORMANCE(US version):

Never-exceed speed (VNE)	130 kt (240 km/h; 149 mph)
Max cruising speed at FL98	130 kt (240 km/h; 149 mph)
Econ cruising speed at FL98	108 kt (200 km/h; 124 mph)
Stalling speed	59 kt (109 km/h; 68 mph)
Single-engine minimum control speed	62 kt (115 km/h; 71 mph)
Max rate of climb at S/L	312 m (1,024 ft)/min
Service ceiling	5,020 m (16,460 ft)
Operational ceiling	3,000 m (9,840 ft)
T-O run: on land	350 m (1,150 ft)
on water	560 m (1,840 ft)
T-O to 15 m (50 ft): on land	460 m (1,510 ft)
on water	850 m (2,790 ft)
Landing from 9 m (30 ft): on land	650 m (2,135 ft)
on water	770 m (2,530 ft)



Beriev Be-103 Bekas twin-engined light multipurpose amphibian
(Mike Keep)

0132839

Landing run: on land ..... 400 m (1,315 ft)
on water ..... 360 m (1,185 ft)
Range, with max fuel:
at 500 m (1,640 ft) ..... 637 n miles (1,180 km; 733 miles)
at FL98 ..... 594 n miles (1,100 km; 683 miles)
Endurance, no reserves ..... 6 h 30 min
g limits ..... +3.45/−1.45

BERIEV (KNAAPO) SA-20P OSA

English name: Wasp

TYPE: Six-seat amphibian.

PROGRAMME: Developed by KnAAPO at Komsomolsk as single-engined version of Beriev Be-103 Bekas for Russian Federation market. First aircraft under construction at KnAAPO by September 2001, when designation first announced. Prototype exhibited unflown at Gelendzhik Gidroavia Salon, September 2002. First flight 16 October 2002. Factory trials had been completed by April 2003; certification to Russian AP-23 and FAR Pt 23 due 2003, for first deliveries in 2004, although this timetable not met. Prototype transferred to KnAAPO Sports & Technical Club for experimental service. Reported in 2004 to be undergoing redesign to eliminate buffeting. By early 2006 no production aircraft had been reported, although prototype (by then registered RA-3068K) had completed at least 100 sorties, although only 28 hours.

CURRENT VERSIONS: **SA-20P**: *As described.*

Turboprop: Under study by 2005 with 373 kW (500 hp) version of Progress AI-450 turboprop in pusher configuration on central cabane. Power plant weight saving of 220 to 250 kg (485 to 551 lb) permits addition of two extra seats (pilot and seven passengers); 20 per cent reduction in water take-off run; and increase of operating ceiling to 8,000 m (26,240 ft). MTOW unchanged, but empty weight 1,540 kg (3,395 lb) and 460 kg (1,014 lb) fuel load, giving 734 n mile (1,360 km; 845 mile) range plus 30 minutes, or 324 n miles (600 km; 372 miles) with five passengers and same reserves. Max level speed 146 kt (270 km/h; 168 mph); cruising speed 113 kt (210 km/h; 130 mph); and 61 kt (112 km/h; 70 mph) stall. T-O run 245 m (805 ft) on land and 400 m (1,315 ft) on water.

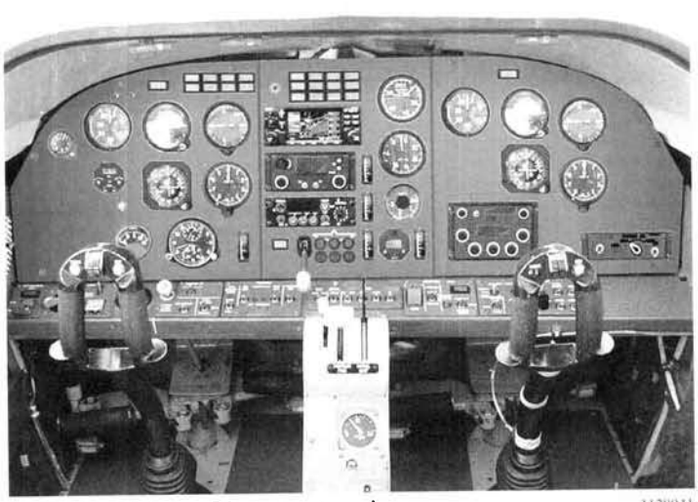
Data generally as for Be-103, except that below.

COSTS: USD500,000 (2003).

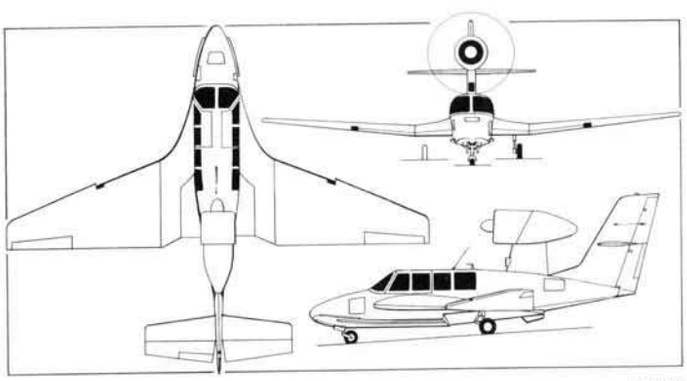
DESIGN FEATURES: Single engine mounted in cabane above fuselage. Service life 12,000 hours or 15 years.

FLYING CONTROLS: Conventional horizontal tail surfaces (tailplane and separate elevator).

Beriev (KnAAPO) SA-20P single-engined amphibian 0576864



Beriev (KnAAPO) SA-20P instrument panel 1128941



Beriev (KnAAPO) SA-20P Osa *(Mike Keep)* 1046947

POWER PLANT: One 265 kW (355 hp) VOKBM M-14P nine-cylinder radial engine.

DIMENSIONS, EXTERNAL:
Length overall ..... 10.45 m (34 ft 3½ in)
Height overall ..... 3.75 m (12 ft 3¾ in)

WEIGHTS AND LOADINGS:
Weight empty ..... 1,670 kg (3,682 lb)
Max payload ..... 400 kg (882 lb)
Max fuel weight ..... 216 kg (476 lb)
Max T-O weight ..... 2,270 kg (5,004 lb)
Max wing loading ..... 90.4 kg/m² (18.52 lb/sq ft)
Max power loading ..... 8.58 kg/kW (14.10 lb/hp)

PERFORMANCE:
Max level speed ..... 113 kt (210 km/h; 130 mph)
Cruising speed ..... 97 kt (180 km/h; 112 mph)
Service ceiling ..... 4,700 m (15,420 ft)
T-O run: on land ..... 300 m (985 ft)
on water ..... 600 m (1,970 ft)
Range, 30 min reserves:
with max fuel ..... 486 n miles (900 km; 559 miles)
with max payload ..... 216 n miles (400 km; 248 miles)

BERIEV Be-112

TYPE: Twin-turboprop amphibian.

PROGRAMME: First details revealed in early 2006; no development/production timetable disclosed.

DESIGN FEATURES: Optimised for both passenger and cargo carrying, with emphasis on opening new air routes to remote locations. Slightly sweptback wings with moderate anhedral mounted on fuselage shoulders; wingtip floats. Barrelled hull cross-section with large sponsons for water stability. Twin, outward-canted fins supporting single-piece tailplane; engine attached to leading-edge of each fin. Rear cargo ramp between fins. Operable in wave heights up to 0.8 m (2 ft 6 in).

FLYING CONTROLS: Conventional and manual. Single-piece elevator with large tab; inset rudder, with tab, in each fin; tab in each aileron. Slotted flaps.

LANDING GEAR: Tailwheel type; retractable. Twin wheels on each main leg retract into sponsons.

POWER PLANT: Two turboprops. Option of 1,044 kW (1,400 shp) RKBM TVD-1500 or 1,062 kW (1,424 shp) Pratt & Whitney Canada PT6A-67R.

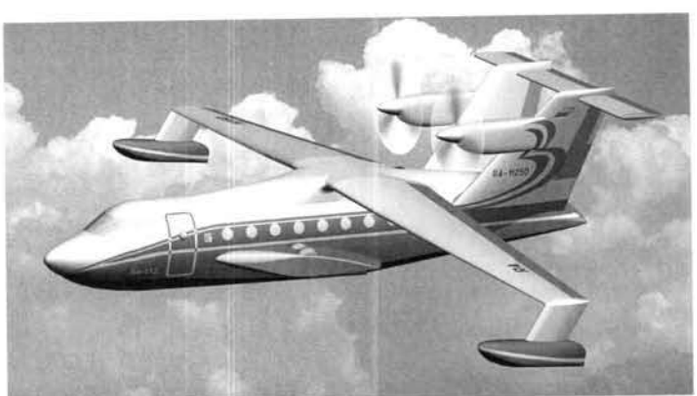
ACCOMMODATION: Nominal seating for 27 passengers at 80 cm (31½ in) pitch; combi interior for cargo, including vehicles loaded via rear ramp.

DIMENSIONS, EXTERNAL:
Wing span ..... 21.20 m (69 ft 6¾ in)
Length overall ..... 17.00 m (55 ft 9¼ in)
Height overall ..... 5.20 m (17 ft 0¾ in)
Wheelbase ..... 8.65 m (28 ft 4½ in)
Wheel track ..... 4.50 m (14 ft 9¼ in)

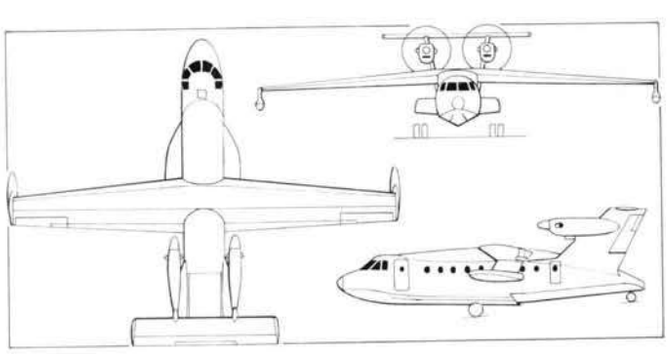
DIMENSIONS, INTERNAL:
Cabin: Length ..... 10.20 m (33 ft 5½ in)
Max width ..... 2.15 m (7 ft 0¾ in)
Max height ..... 1.84 m (6 ft 0½ in)

WEIGHTS AND LOADINGS:
Max payload ..... 2,350 kg (5,181 lb)
Max T-O weight ..... 11,000 kg (24,250 lb)
Max power loading: TVD-1500 ..... 5.27 kg/kW (8,.66 lb/shp)
PT6A-67R ..... 5.18 kg/kW (8.51 lb/shp)

PERFORMANCE (estimated):
Max level speed at FL98 ..... 226 kt (420 km/h; 261 mph)
Econ cruising speed at FL98 ..... 200 kt (370 km/h; 230 mph)
Max certified altitude ..... 7,600 m (24,940 ft)



Artist's impression of Beriev Be-112 twin-turboprop utility amphibian 1128991



Beriev Be-112 amphibious twin *(James Goulding)* 1159819

T-O run: land ..... 850 m (2,790 ft)
water ..... 860 m (2,825 ft)
Landing run, water ..... 515 m (1,690 ft)
Range with 2,100 kg (4,630 lb) payload at FL98, 30 min reserves ..... 540 n miles (1,000 km; 621 miles)

BERIEV (BETAIR) Be-200 ALTAIR

TYPE: Twin-jet amphibian.

PROGRAMME:

DEVELOPMENT MILESTONES

Design began	1989
Announced	Jun 91
Official go-ahead	8 Dec 90
Rolled out	11 Sep 96
First flight	24 Sep 98
Official first flight	17 Oct 98
Public debut	13 Jun 99
First flight, production	17 Jun 03
Certification	29 Dec 03
First delivery (MChS)	31 Jul 03
Entered service (MChS)	21 Jun 04

Initiated 1989 under design leadership of Alexander Yavkin. Russian government approval for purpose-designed water bomber granted 8 December 1990. Details announced, and model displayed, at 1991 Paris Air Show; full-scale mockup constructed 1991; development by Beta Air (Betair: **Be**riev **ta**ganrog **ir**kutsk) consortium, formed 27 November 1991 from Irkutsk Aircraft Production Association (53.5 per cent), Beriev OKB (20.5 per cent), ILTA Trade Finance SA of Geneva, Switzerland (5 per cent) and the Ukrainian bank Prominvest (15 per cent) plus unidentified partner(s) (6 per cent); included in Civil Aviation Development Programme and state forestry protection programme. Named Altair in February 2002.

Beriev responsible for development, design and documentation; systems bench-testing; static-, flight- and fatigue-testing of prototypes; certification and design support of serial production. Irkut duties comprise production preparation; manufacture of tooling; production of four prototypes and series aircraft; and spare parts manufacture. In May 2002, EADS signed joint marketing agreement with IAPO. Initial production and certification supported by Alenia of Italy under USD1.6 million programme financed by European Union. In March 2003, agreement reached on transfer of production to Beriev plant at Taganrog and in following June, EADS, Rolls-Royce Deutschland and Irkut study revealed potential market for 320 BR715-engined Altairs over 20 years, leading to decision to launch this variant.

First prototype (001) rolled out 11 September 1996, at Irkutsk; first flight scheduled 1997, but eventually achieved (from land) 24 September 1998; 'official' first flight 17 October 1998; aircraft transferred from Irkutsk to Taganrog (by then with 19 sorties and 26½ flying hours) on 27 April 1999 to begin certification trials, including water drops; exhibited at Paris (by then registered RA-21511) June 1999; first water landings and take-offs, 10 September 1999. Total 80 sorties, including 18 from water, by November 1999, when water operations ceased for winter. Experimental category certification achieved March 2000. Awarded limited category AP-25 certification for firefighting operations 10 August 2001, by which time had flown 337 sorties (100 from water) and achieved 202 flying hours. Second phase of testing begun October 2001 to certify patrol and passenger operations using BR715 engines, although most of that month occupied by a nine-country Far East sales tour. Prototype had accumulated 650 hours in nearly 600 sorties (216 from water) by May 2002. Demonstrated on Lake Sevran, Armenia, 15 August 2002; set six FAI climb-with-payload records in hydroplane class, 7 September 2002.

Second flying prototype (003) in firefighting configuration (Be-200ChS). Two test airframes, of which first ferried from Irkutsk to Taganrog by An-124 in March 1995, followed by second in 1997; these, respectively, static test (SI: *staticheskiy ispytaniya*) and fatigue test (RI: *resursnye ispytaniya*). Four production aircraft (0101 to 0104) in hand by late 1998; fifth was taking shape in early 2002. On original schedule, second prototype was due for delivery in late 1999 to Russian Emergencies Ministry. Repeated delays resulted in first flight (003/RA-21512) on 27 August 2002, following which it was exhibited at Gelendzhik Gidroavia Salon, 4 to 8 September 2002. Firefighting contract in Italy between 6 July and 17 September 2005 involving 63 sorties (including positioning), 435 scoops and drops totalling 3,500 tonnes, and 150 hours of flying.

Third Beriev Be-200ChS (RF-32517) delivered to MChS Rossii emergencies ministry with original registration *(Yefim Gordon)* 1128942

Passenger cabin of Beriev Be-200 Altair used for personnel transport 1128943

Beriev Be-200 Altair during Italian contract in mid-2005; Bombardier 415 water bomber behind 1128944

First production aircraft (0101/RA-21515) rolled out 26 May and first flew 17 June 2003; Be-200 restricted type certificate issued by Interstate Aviation Committee on 20 June 2003; RA-21515 delivered to MChS 31 July 2003 and based at Zhukovsky, taking part in MAKS '03 air show in following month. Full certificate issued 29 December 2003. Second production aircraft (0102/RA-32516) began land taxying trials on 26 February 2004 and delivered 26 May 2004. Zhukovsky detachment declared operational 21 June 2004. Third delivery (0201/RA-32517; first with IAI/Tamam AOS TV/IR sensor) effected 15 July 2005 (later re-registered RA-32767) and further pairs due in both 2006 and 2007 for total of seven. Initial two machines upgraded to full standard with some 300 modifications, first being redelivered on 1 April 2005.

Avionics development and scoop trials for water bomber version being undertaken by the Beriev Be-12P-200/Be-128 testbed since August 1996. TANTK also produced four Be-12Ps (*Pozharny:* firefighting) for concept and tactics development and two Be-12NKh (*Narodno-Khozyaistvennye:* National Economy) general purpose versions, both of which lost in 1994.

CURRENT VERSIONS: **Firefighting:** TsENTROSPAS/MChS designation **Be-200ChS:** Tanks under cabin floor of centre-fuselage, capacity 12 m^3 (423 cu ft) water; six tanks in cabin for 1.2 m^3 (42 cu ft) liquid chemicals; two retractable water scoops forward of step, two aft; 30 fully equipped smoke jumpers can be carried on seats along sidewalls of cabin, with jump-door at rear of cabin on starboard side; 12 tonnes of water scooped from seas in 14 seconds at speeds up to 103 kt (190 km/h; 118 mph).

Fully fuelled, Be-200 can drop total 310,000 kg (683,420 lb) of water in successive flights when airfield to reservoir distance is 108 n miles (200 km; 125 miles) and reservoir to fire zone distance is 5.4 n miles (10 km; 6.2 miles); or 140,000 kg (308,640 lb) when distances are respectively 108 n miles (200 km; 125 miles) and 27 n miles (50 km; 31 miles). Tank emptying time 0.8 to 1.0 second; avergae dropping speed 119 kt (220 km/h; 137 mph); minimum height 50 m (165 ft). Tanks quickly removable when aircraft carries freight. Flight deck and cargo hold sealed against smoke ingress. ARIA-200M avionics features include water source/drop zone track memory, automatic glideslope and digital flight deck/ground fire crew communications. Also outfitted for SAR, with equipment including Orion 25S inflatable boat, naval radios, 600 W loudspeaker and searchlight, storage for 20 inflatable rafts and two four-seat motorboats, observer's station, 57 seats and attachment for 30 litters.

In 2004, Irkut was promoting a firefighting package of Be-200 assisted by fire reconnaissance Aeronautics Aerostar UAV supplied by Israeli manufacturer.

Cargo: Payload 7,500 kg (16,534 lb) in unobstructed cabin 17.00 m (55 ft 9 in) long, 2.6 m (8 ft 6 in) wide and 1.9 m (6 ft 3 in) high accommodating nine PA 1.5 pallets or seven LD3 containers.

Ambulance: Two flight crew, seven seated casualties/medical personnel, intensive care equipment and 30 stretchers in three tiers.

Patrol: Paramilitary version for possible use of Russian Frontier Guards revealed to be under development in early 2002.

Be-200PS: Search and rescue. Provisions included in Be-200ChS described above. Able to loiter for 6 h 30 min at up to 200 n miles (370 km; 230 miles) from base.

Be-200M: Redesignated Be-210 in 1998.

Be-200P: Projected anti-submarine version; combat radius 2,537 n miles (4,700 km; 2,920 miles); endurance 7 hours.

Be-210: Announced in 1998; development of Be-200 multirole amphibian for airline use in regions of minimal airport infrastructure. Seating for two pilots, two attendants and 72 passengers at 75 cm (29½ in) seat pitch. Other details may be assumed to be similar to Be-200, but airframe strengthened for extra fuel in wing centre-section (42,000 kg; 92,594 lb MTOW) and ferry range increased to 2,483 n miles (4,600 km; 2,858 miles), or 998 n miles (1,850 km; 1,149 miles) with full passenger load.

Be-220: Maritime patrol version offered in 2006 to China and India. Novella (Sea Dragon) detection systems and extended nose radome.

Be-250: Airborne early-warning and control version; first reported as 2006 project. Refuelling probe; sensors scabbed to fuselage shoulders.

CUSTOMERS: Seven ordered (of 20 required) by TsENTROSPAS/MChS (Russian Ministry of Emergency Situations) on 15 January 1997 for firefighting, with further orders to follow for SAR; decision in principle to acquire eighth, funded by cancellation of proposed two Antonov An74s. However, at time of maiden flight, only five orders were being claimed as firm. Will equip four SAR stations on Black Sea and Baltic and two in eastern Russia; first base was to have been Gelendzhik where two Altairs (0101 and 0102) scheduled to be in service by end of 2003. Beriev contracted in 2002 to establish training school at Taganrog for MChS pilots and technicians. However Zhukovsky (Ramenskoye) nominated as central base for MChS Altair fleet.

Russian state forest service/firefighting agency requires up to 54, of which near-term needs total 10 to 15; 50 required by Sakhalin regional administration; five by Irkutsk regional administration.

Potential market foreseen for more than 400 by 2010, of which over 60 per cent for export. South Korea evinced interest in 12 of maritime patrol version for police duties during 1998; China considering licensed production at Harbin; Italian interest in 15 reported mid-2000. Australia, France, Indonesia, Japan and Philippines expressing interest in 2001–02 and Be-200 demonstrated at Marseilles, France, 13 to 15 May 2002, and at Elefsis, Greece. Hawkins & Powers of USA negotiating for eight in early 2004. Croatian plans to acquire two announced 15 August 2004.

COSTS: Basic price USD25 million (2000). Break-even at 46/48th aircraft. Development cost estimated as USD250 million, of which USD190 million expended by 2001.

DESIGN FEATURES: First Russian purpose-designed water-bomber. Derived from Beriev A-40, but underwing stabilising floats moved inboard from tips, twin-wheel main landing gear units, and no booster turbojets. Conforms to FAR Pt 25 criteria. Swept wings of moderate

1158057

Beriev Be-200ChS (RF-32767) exhibited at ILA, Berlin, in May 2006 *(Paul Jackson)*

aspect ratio, with high-lift devices; single-step hull of high length/beam ratio, which reported to provide world's first variable-rise bottom, providing a considerable improvement in stability and controllability in the water, as well as a reduction in *g* loads when landing and taking off at sea; small wedge-shape boxes ('hydrodynamic compensators') aft of step aid 'unsticking' from water in wave heights up to 1.2 m (4 ft); required draught 2.6 m (8 ft 6 in); all-swept T tail; high-mounted engines protected from spray by strakes on each side of nose and by wings; large underwing pod each side of hull, faired into wingroot.

Wing leading-edge sweep 23° 13'; supercritical wing sections, thickness/chord ratio 16 per cent to 11.5 per cent.

FLYING CONTROLS: Fly-by-wire. Entire span of each wing trailing-edge occupied by aileron and two-section area-increasing single-slotted flaps; full-span leading-edge slats in three sections each side; five spoiler/lift dumper sections forward of flaps each side.

STRUCTURE: Hull made primarily of high-strength aluminium/lithium alloys; interior of composites; water tanks of ferric alloys of aluminium in firefighting version.

LANDING GEAR: Hydraulically retractable tricycle type. Twin-wheel main units, tyre size 950×300, pressure 9.80 to 10.30 bar (142 to 150 lb/sq in); twin nosewheels, tyre size 620×180, pressure 7.35 to 7.85 bar (106 to 114 lb/sq in). Mainwheels and nosewheels retract rearwards. Water rudder. Ground turning radius 17.4 m (57 ft 1 in). Nosewheel steering angle±45°.

POWER PLANT: Two ZMKB Progress D-436TP turbofans, each 73.6 kN (16,550 lb st). Rolls-Royce BR715s and others under consideration as alternative engines, but late 2004 study concluded market for R-R version would not cover development costs. Fuel system by Pall (USA). Total oil capacity 22 litres (5.8 US gallons; 4.85 Imp gallons).

ACCOMMODATION: Two flight crew; up to 72 tourist class passengers at 75 cm (29.5 in) seat pitch and two attendants; or 10 to 32 first class and business class passengers at up to 102 cm (40 in) seat pitch, with provision for galley, lavatory and baggage stowage. Up to nine freight containers or, typically, six containers and 19 economy class seats. Cargo door, with integral passenger door, starboard side, forward, opens upwards; passenger door port, forward; emergency exits; forward and rear freight/baggage holds. Interior design by AIM Aviation (UK).

SYSTEMS: MRPC Avionika EDSU-200 electronic flight control system (FBW). Barco Display Systems FMS system. All accommodation pressurised. Three hydraulic systems at 207 bar (3,000 lb/sq in); 150 litres (39.6 US gallons; 33.0 Imp gallons) of MGJ-5U fluid; flow rate 70 litres (18.5 US gallons; 15.4 Imp gallons)/min. Capacity of pneumatic system bottles 29 litres (1.02 cu ft). Three-phase 115/220 V 400 Hz AC electrical system; single-phase 115 V 400 Hz AC system; 27 V DC system; supplied by two engine-driven 60 kVA AC generators and three static inverters; three batteries. Gaseous oxygen bottle, pressure 147 bar (2,135 lb/sq in). Provision for de-icing tail unit, slats, engine air intakes and windscreen. TA-12 APU, operable up to 7,000 m (23,000 ft) in starboard wingroot. Propeller-driven emergency generator at base of fin.

AVIONICS: *Radar:* MN-85 weather radar in nose.

Flight: ARIA-200M digital flight and navigation system by American-Russian Integrated Avionics, a joint venture of AlliedSignal (now Honeywell) and Moscow Research Institute of Aircraft Equipment. INS standard.

Instrumentation: Honeywell EFIS displays, with six 152 × 203 mm (6 × 8 in) LCDs.

Mission: Optional IAI/Tamam AOS (airborne observation system) turret mounted in flap actuator fairing under port wing provides TV and IR imagery for SAR, fire patrol and ecological monitoring missions. Prototype installation April 2005.

DIMENSIONS, EXTERNAL:

Wing span over winglets	32.78 m (107 ft 6½ in)
Wing chord: at root	5.58 m (18 ft 3½ in)
at tip	1.72 m (5 ft 7¾ in)
Wing aspect ratio	9.1
Length overall	31.43 m (103 ft 1½ in)
Fuselage: Length	29.18 m (95 ft 9 in)
Max diameter	2.86 m (9 ft 4½ in)
Height overall	8.90 m (29 ft 2½ in)
Tailplane span	10.115 m (33 ft 2¼ in)
Wheel track (c/l shock-absorbers)	4.30 m (14 ft 1¼ in)
Wheelbase	11.145 m (36 ft 6¾ in)
Width over stabilising floats	25.60 m (84 ft 0 in)
Passenger doors (each): Height	1.70 m (5 ft 7 in)
Width	0.90 m (2 ft 11½ in)
Cargo door: Height	1.76 m (5 ft 9¼ in)
Width	2.05 m (6 ft 8¾ in)
Emergency exits: Height	1.70 m (5 ft 7 in)
Width	0.90 m (2 ft 11½ in)

DIMENSIONS, INTERNAL:

Cabin, excl flight deck:	
Length: passenger	17.00 m (55 ft 9 in)
cargo	18.70 m (61 ft 4¼ in)
Max width: passenger	2.40 m (7 ft 10½ in)
cargo	2.50 m (8 ft 2½ in)
Max height: passenger	1.80 m (5 ft 10¾ in)
cargo	1.89 m (6 ft 2½ in)
Floor area: passenger	39.0 m² (420 sq ft)
cargo	41.0 m² (441 sq ft)
Volume:	
passenger:	
forward baggage hold	8.8 m³ (310 cu ft)
rear baggage hold	4.5 m³ (159 cu ft)
main cabin and freight/baggage holds, total, cargo configuration	84.0 m³ (2,966 cu ft)
cargo	80.8 m³ (2,853 cu ft)

AREAS:

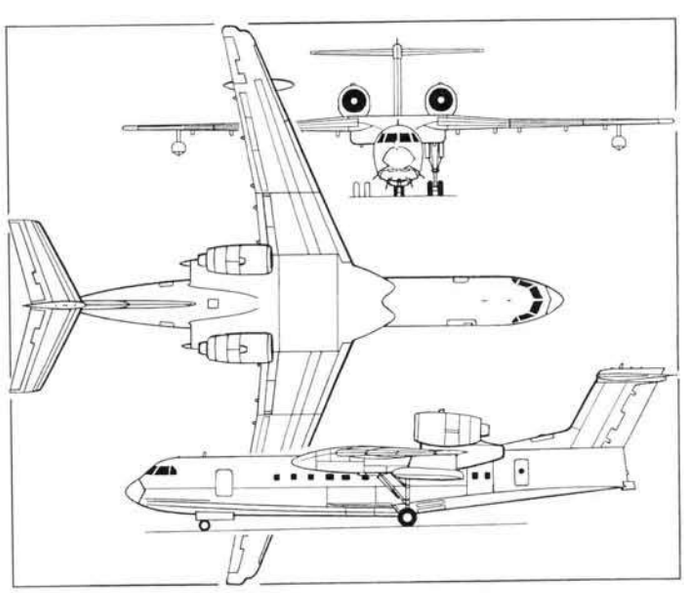
Wings, gross	117.44 m² (1,264.2 sq ft)
Ailerons (total)	3.56 m² (38.32 sq ft)
Flaps (total)	20.43 m² (219.91 sq ft)
Slats (total)	12.61 m² (135.74 sq ft)
Spoilers (total)	4.59 m² (49.41 sq ft)
Fin	12.60 m² (135.63 sq ft)
Rudder	4.60 m² (49.52 sq ft)
Tailplane	17.96 m² (193.33 sq ft)
Elevators (total)	6.96 m² (74.92 sq ft)

WEIGHTS AND LOADINGS:

Max payload as freighter	7,500 kg (16,534 lb)
Weight empty: firefighting	27,600 kg (60,848 lb)
Max fuel weight	12,260 kg (27,025 lb)
Max T-O and ramp weight:	
from land	41,000 kg (90,389 lb)
from water	38,000 kg (83,775 lb)
Max airborne weight (after water scooping)	43,000 kg (94,800 lb)
Max wing loading:	
firefighting	349.1 kg/m² (71.50 lb/sq ft)
max airborne weight	366.1 kg/m² (74.99 lb/sq ft)
Max power loading:	
firefighting	278 kg/kN (2.73 lb/lb st)
max airborne weight	292 kg/kN (2.86 lb/lb st)

PERFORMANCE:

Max Mach No. in level flight	0.69
Never-exceed speed (VNE):	329 kt (610 km/h; 379 mph) EAS
Max level speed at FL230	388 kt (720 km/h; 447 mph)
Max cruising speed	
at FL262	378 kt (700 km/h; 435 mph)
Econ cruising speed at FL262	302 kt (560 km/h; 348 mph)
Stalling speed: flaps up	116 kt (215 km/h; 134 mph)
flaps down	84 kt (155 km/h; 97 mph)
Max rate of climb at S/L: at MTOW	840 m (2,755 ft)/min
at water scooping weight	570 m (1,870 ft)/min
Rate of climb at S/L, OEI	168 m (550 ft)/min



1158061

Beriev (Betair) Be-200 Altair civil utility amphibian *(Mike Keep)*

Max certified altitude ..... 8,000 m (26,240 ft)
Service ceiling, OEI ..... 5,500 m (18,040 ft)
T-O to 11 m (35 ft):
on land ..... 1,270 m (4,170 ft)
on water ..... 1,000 m (3,280 ft)
Landing from 15 m (50 ft):
on land ..... 1,020 m (3,350 ft)
on water ..... 1,300 m (4,265 ft)
Water scooping distance to 15 m (50 ft) ..... 1,450 m (4,760 ft)
Range with 1 h reserves:
with max freight ..... 540 n miles (1,000 km; 621 miles)
C, D with 6,500 kg (14,330 lb) freight, 1 h reserves ..... 675 n miles (1,250 km; 776 miles)
ferry ..... 1,781 n miles (3,300 km; 2,050 miles)
absolute ..... 2,078 n miles (3,850 km; 2,392 miles)
OPERATIONAL NOISE LEVELS:
T-O ..... 96 EPNdB
Climb ..... 90 EPNdB
Landing ..... 98 EPNdB

CHERNOV

OPYTNYI KONSTRUKTORSKOYE BYURO CHERNOV B & M OOO (B & M CHERNOV EXPERIMENTAL DESIGN BUREAU JSC)

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The designs of Boris V Chernov have previously been associated with the No.1 Students' Design Bureau (SKB-1) at Samara. However, in August 1999, the Che-25 amphibian was shown at MAKS '99, credited to Chernov's own design office. The earlier Che-22 is now produced by Gidroplan and has also been built under licence in Vietnam, while the single-engine Che-23 has recently been completed. Other designs have been the Che-10 (1986), Che-15, Che-20 (1989) and Che-30 (1991), while Chernov was also associated with the Delta flex-wing and Albatros surface-skimmer. Work is currently in hand to design the Che-35 twin-engined flying-boat.

Che-30 prototype, a previous creation of Boris Chernov 0137984

CHERNOV Che-23

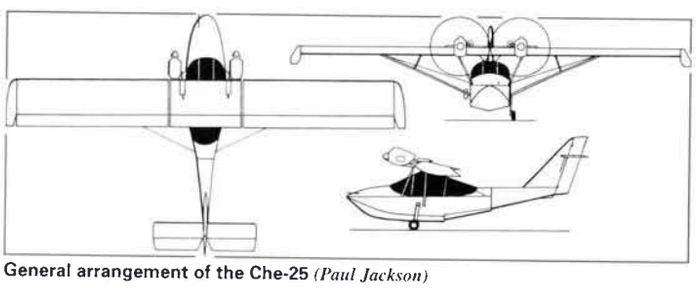
TYPE: Two-seat amphibian.
PROGRAMME: First flown July 2003.
DESIGN FEATURES: Generally as Gidroplan Che-22.
FLYING CONTROLS: Manual.
STRUCTURE: Predominantly of metal.
LANDING GEAR: Optional amphibian configuration. Tailwheel/water rudder immediately to rear of second hull step.
POWER PLANT: One 47.8 kW (64.1 hp) Rotax 582 UL two-cylinder piston engine driving three-bladed propeller. Optionally, one 73.5 kW (98.6 hp) Rotax 912 ULS.
DIMENSIONS, EXTERNAL:
Wing span ..... 11.00 m (36 ft 1 in)
Length overall ..... 6.50 m (21 ft 4 in)
Height overall: Rotax 582 ..... 2.50 m (8 ft 2½ in)
Rotax 912 ..... 2.40 m (7 ft 10½ in)
WEIGHTS AND LOADINGS:
Weight empty: Rotax 582 ..... 295 kg (650 lb)
Rotax 912 ..... 310 kg (683 lb)
Max T-O weight ..... 570 kg (1,256 lb)
PERFORMANCE:
Max level speed ..... 81 kt (150 km/h; 93 mph)
Normal cruising speed ..... 65 kt (120 km/h; 75 mph)
Stalling speed ..... 30 kt (55 km/h; 35 mph)
Max rate of climb at S/L ..... 150 m (492 ft)/min

Chernov Che-23 1159716

CHERNOV Che-25

TYPE: Four-seat amphibian.
PROGRAMME: First flown 1995. Development of Che-22 Corvette, which is now produced by Gidroplan. Prototype (FLARF-17039), built by students' design bureau SKB-1 and first shown at Gelendzhik Hydro-aviation Show, Russia, September 1996. Che-25M shown at MAKS '99, Moscow, had redesigned empennage with raised tailplane and deletion of rudder's horn balance.

Chernov Che-25 moored 1159717



General arrangement of the Che-25 *(Paul Jackson)*

CURRENT VERSIONS: **Che-25:** As described.
BD-205: Shown at Aerospace China, Zhuhai, November 2004, marked in Roman ('BD'), a Chinese version marketed by Harbin Institute of Technology (BaDa Aviation Industry Co).
COSTS: USD44,000 (1997).
DESIGN FEATURES: Generally as Che-22. Operable on water in 0.8 m (30 in) swell.
FLYING CONTROLS: Manual, with full-span slotted flaperons. No tabs.
STRUCTURE: Single-spar wing of riveted duralumin; fuselage, tail unit and wingtip floats of vacuum-moulded GFRP sandwich. Wings braced by struts and wires; strut-braced tailplane. Airframe life 3,000 hours.
LANDING GEAR: Optional amphibian configuration; mainwheel legs, attached to fuselage sides, turn 90° forward for retraction; mainwheel tyre size 300×125; tailskid; cable brakes. Tailwheel/water rudder immediately to rear of second hull step.
POWER PLANT: Two 47.8 kW (64.1 hp) Rotax 582 UL-2V two-cylinder piston engines driving two-blade fixed-pitch propellers. Fuel capacity 130 litres (34.3 US gallons; 28.6 Imp gallons). Version, planned with Rotax 912 ULS of 73.5 kW (98.6 hp) and Subaru EA-71.
ACCOMMODATION: Four persons; dual controls. Gull-wing door each side of cockpit.
DIMENSIONS, EXTERNAL:
Wing span ..... 12.60 m (41 ft 4 in)
Wing chord, constant ..... 1.40 m (4 ft 7¼ in)
Wing aspect ratio 8.4
Length overall ..... 7.70 m (25 ft 3¼ in)
Height overall (on wheels, fuselage horizontal) ..... 2.50 m (8 ft 2½ in)
Tailplane span ..... 2.80 m (9 ft 2¼ in)
Wheel track (optional) ..... 1.42 m (4 ft 8 in)
Propeller diameter ..... 1.84 m (6 ft 0½ in)
Distance between propeller centres ..... 1.84 m (6 ft 0½ in)
AREAS:
Wings, gross ..... 16.38 m² (176.3 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 590 kg (1,301 lb)
Max payload ..... 300 kg (661 lb)
Max T-O weight ..... 1,150 kg (2,535 lb)
Max wing loading ..... 70.2 kg/m² (14.38 lb/sq ft)
Max power loading ..... 12.03 kg/kW (19.77 lb/hp)
PERFORMANCE:
Max level speed ..... 97 kt (180 km/h; 112 mph)
Max cruising speed ..... 76 kt (140 km/h; 87 mph)
Unstick speed ..... 38 kt (70 km/h; 44 mph)
Max rate of climb at S/L ..... 300 m (984 ft)/min
Service ceiling ..... 4,000 m (13,120 ft)
T-O run: on land ..... 100 m (330 ft)
on water ..... 70 m (230 ft)
Range ..... 405 n miles (750 km; 466 miles)
g limits ..... +4/−2

CHERNOV Che-27

TYPE: Five-seat amphibian.
PROGRAMME: First flown 2003.
DESIGN FEATURES: Practically identical to Che-25M but with seating for five.
FLYING CONTROLS: Manual.
STRUCTURE: Predominantly of metal.
LANDING GEAR: Optional amphibian configuration. Tailwheel/water rudder immediately to rear of second hull step.
POWER PLANT: Two 47.8 kW (64.1 hp) Rotax 582 UL two-cylinder piston engines, each driving a three-blade propeller. Optionally, two 73.5 kW (98.6 hp) Rotax 912 ULS.
DIMENSIONS, EXTERNAL:

Wing span	12.60 m (41 ft 4 in)
Length overall	7.70 m (25 ft 3¼ in)
Height overall	2.50 m (8 ft 2½ in)

AREAS:

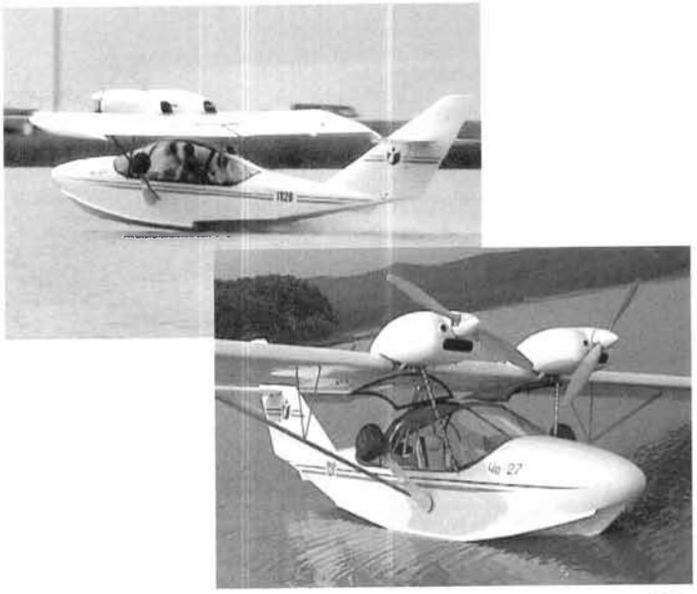
Wings, gross	16.38 m² (176.3 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	590 kg (1,301 lb)
Max T-O weight	1,150 kg (2,535 lb)
Max wing loading	70.2 kg/m² (14.38 lb/sq ft)
Max power loading	12.03 kg/kW (19.76 lb/hp)

PERFORMANCE:

Max level speed	97 kt (180 km/h; 112 mph)
Normal cruising speed	76 kt (140 km/h; 87 mph)
Stalling speed	38 kt (70 km/h; 44 mph)
Max rate of climb at S/L	150 m (492 ft/min
T-O run: on land	100 m (330 ft)
on water	70 m (230 ft)
Range	405 n miles (750 km; 466 miles)
g limits	+4/–2



Views of Chernov Che-27 1159721

DUBNA (DMZ)

PROIZVODSTVENNO-TEKHNICHESKY KOMPLEKS DUBNENSKOGO MASHINOSTROITELNOGO ZAVOD AO (DUBNA MACHINE-BUILDING PLANT PRODUCTION TECHNICAL COMPLEX CO LTD)

ulitsa Zhukovskogo 2, 141980 Dubna, Moskovskaya oblast
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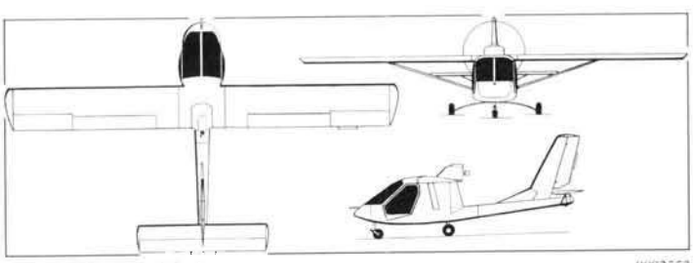
Fax: (+7 09621) 232 99
e-mail: dmz@dubna.ru
Web: www.dmz.ru
GENERAL DIRECTOR: Aleksey Saushkin

Founded on 10 July 1939, the Dubna Plant is an enterprise of the General Department of Aircraft Industry of the State Committee on Defence Industries of the Russian Federation. In the 1960s, it launched airframe production of the MiG- 25 fighter and became a major producer of missiles for Eastern bloc and other countries. As part of its restructuring under the *Konversiya* policy, since reorganisation on current lines in 1994, it has produced components for the Sukhoi Su-29 two-seat aerobatic aircraft and developed the Dubna-1/2 series of light aircraft. Two Su-29 fuselages were built in 2000.

The single-seat Dubna-1 Shmel was similar to the current Osa. Dubna has an agreement to build light aircraft designed by MKB Raduga, whose precision-guided weapons are also manufactured by DMZ. By early 2004, there had been no further reports of the proposed Dubna-4 Raduga four-seat, twin-engine lightplane, although a **Dubna-M** four-seater was reportedly nearing completion in late 2006, powered by a 93.2 kW (125 hp) Subaru piston engine and resembling a Dubna-2 with modified wing, plus 0.33 m (13 in) fuselage stretch. The company had some 1,000 employees in early 2002 and is 60 per cent owned by the State. Other products include the AVP air cushion vehicle, satellite antennae, fabric treatment machines, cardboard box making machines and equipment for filling metal cans.

DUBNA-2 OSA

English name: Wasp
TYPE: Two-seat lightplane.
PROGRAMME: Designed by Taifun Experimental Design Bureau as DMZ-2; prototype (FLARF-01325) displayed at Moscow Air Show '95 and '97 with 59.6 kW (79.9 hp) Rotax 912 engine and two-blade propeller; promoted in China, 1996. By 1999, when definitive **Dubna-2M** FLARF-01268 shown at Moscow, detail changes included increased wheel track; repositioning of landing gear leg to below fuselage and of wing bracing strut to further forward. This aircraft had 89.5 kW (120 hp) Hirth F30/4C engine and 80 litre (21.1 US gallon; 17.6 Imp gallon) fuel tank, whereas standard Dubna-2M equipped with Rotax 912 ULS. Type had not received certification by end of 2004 and little appeared to have changed 12 months later.
CUSTOMERS: Total 11 Dubna-2s, 10 Dubna-2Ms and one Hirth-engined prototype built by late 2004, including two in that year to United Arab Emirates and one each to Bulgaria and Greece; others to Saratov and Orenburg regional governments of Russia in agricultural spraying configuration. By early 2004, no confirmation that these deliveries had taken place, although it was reported in June 2004 that a follow-on batch of Dubna-2s was in the early stages of assembly.
COSTS: USD32,000 (2002).
DESIGN FEATURES: Pod-and-boom configuration, with strut-braced, constant-chord high wing, pusher propeller and sweptback fin with small fillet. Suitable for passenger, freight and mail transport, crop-spraying, forest surveillance, oil/gas pipeline and power line patrol, coastal fishery survey, aerial photography, *ab initio* pilot training and special missions.
FLYING CONTROLS: Conventional and manual. Flight-adjustable tab on elevator; ground-adjustable tabs on starboard aileron and rudder.
STRUCTURE: As Dubna-1.
LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring metal mainwheel legs; trailing-link nosewheel leg. Tyres size 400×150 mm on mainwheels, 310×135 mm on nosewheel. Floats (**Dubna-2P**) and skis optional.



Dubna-2 Osa *(Paul Jackson)* 0092552

Dubna-2A Osa two-seat multipurpose light aircraft *(Paul Jackson)* 0092528

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS flat-four driving three-blade pusher propeller. Fuel tank behind cabin, capacity 70 litres (18.5 US gallons; 15.4 Imp gallons).
ACCOMMODATION: Two seats side by side, with dual controls, in fully enclosed, extensively glazed cabin; forward-hinged window/door on each side; space for baggage/freight in compartment behind cabin.
DIMENSIONS, EXTERNAL:

Wing span	9.92 m (32 ft 6½ in)
Wing aspect ratio	9.0
Length overall	5.97 m (19 ft 7 in)
Width over doors	1.25 m (4 ft 1¼ in)
Height overall	2.91 m (9 ft 6½ in)
Tailplane span	3.30 m (10 ft 10 in)
Wheel track	2.40 m (7 ft 10½ in)
Wheelbase	1.90 m (6 ft 2½ in)

AREAS:

Wings, gross	10.92 m² (117.5 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	296 kg (653 lb)
Baggage capacity	30 kg (66 lb)
Max T-O weight	576 kg (1,270 lb)
Max wing loading	52.7 kg/m² (10.81 lb/sq ft)
Max power loading	9.60 kg/kW (15.88 lb/hp)

PERFORMANCE (Hirth engine):

Max level speed	89 kt (165 km/h; 102 mph)
Nominal cruising speed	62 kt (115 km/h; 71 mph)
Landing speed	41 kt (75 km/h; 47 mph)
Unstick speed	46 kt (85 km/h; 53 mph)
Max rate of climb at S/L	240 m (790 ft)/min
Service ceiling	4,000 m (13,120 ft)
T-O run	120 m (395 ft)
Max range	270 n miles (500 km; 310 miles)
g limits	+4.0/–2.5

DUBNA-4

TYPE: Four-seat utility twin.
PROGRAMME: Designed by MKB Raduga; based on Dubna-2; completion of prototype planned for 2002, but no announcement known by early 2003. Optimised for use by Ministry of Emergency Situations and Forestry Service.
COSTS: Estimated US$55,000 to US$58,000 (2002).

ELITAR

VVV-AVIA

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GENERAL DIRECTOR: Viktor A Tarhov

WORKS:
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e-mail: elitar-avia@mail.ru
Web: www.vvv-avia.ru

DESIGN BUREAU:
Ehlitar — 101 OOO, Korp 2, ulitsa B Cheremushkinskaya, 117448 Moskva
GENERAL DIRECTOR: Aleksey B Kondratev
MANAGER: Igor Bezrodnov

At the August 1999 MAKS air show, Ehlitar (which adopts the Western form, Elitar and was formed in 1997) displayed the newly flown IE-101 high wing lightplane and released initial details of the low-wing IE-201 Senator.

In addition to these light aircraft, Elitar was also developing at that time the E-301 and E-401 high-wing, twin-engined light transports, seating four to five and nine persons, respectively. A four-seat business 'triplane', the Premier, has been under design since 2000.

At Moscow in August 2003, Elitar unveiled the 202 and also displayed the previously known Sigma-4, formerly credited to the Albatros bureau. Company announcements have also mentioned the IE-203 floatplane project.

Members of the Elitar design and production team work for MiG, Molniya and Sukhoi design bureaux and have been responsible for the M-5 Oktyabr and M-9 Marafon ultralights.

Manufacturing of at least some Elitar designs was originally assigned to VVV-Avia, but by 2003 this company appeared to have formed a subsidiary at Samara, known as ZEVS-Avia, specifically to produce the Elitar-202 and Sigma. In 2005, company announced that it had appointed Sportsplanes.com as North American agent for Sigma. The earlier '101 and '201 seem no longer to be promoted.

ELITAR-202

TYPE: Two-seat lightplane.
PROGRAMME: First shown at MAKS '03, Moscow, August 2003. Built by Samara ZEVS-Avia at Samara. Certification then expected in November 2003 but no evidence that this has occurred.
CUSTOMERS: Ten built and 12 more on order by August 2003; company foresees market for 600 aircraft in Russia and will produce up to 25 per month, depending on demand.
COSTS: USD60,000 (2004).
DESIGN FEATURES: Low-wing cabin monoplane of composites construction, optimised for high cruising speed and long range; constant-chord, cantilever mainplanes; sweptback fin with underfin.
LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring metal cantilever mainwheel legs with wheel fairings. Trailing-link nosewheel.
POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS flat-four. Fuel capacity 110 litres (29.0 US gallons; 24.2 Imp gallons).
DIMENSIONS, EXTERNAL:

Wing span	8.30 m (27 ft 2¾ in)
Length overall	5.80 m (19 ft 0¼ in)
Height overall	2.10 m (6 ft 10¾ in)

AREAS:

Wings area, gross	9.10 m² (98.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	476 kg (1,049 lb)
Max T-O weight	730 kg (1,609 lb)
Max wing loading	80.2 kg/m² (16.43 lb/sq ft)
Max power loading	9.93 kg/kW (16.32 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	146 kt (270 km/h; 168 mph)
Max level speed	130 kt (240 km/h; 149 mph)
Normal cruising speed	108 kt (200 km/h; 124 mph)
Econ cruising speed	81 kt (150 km/h; 93 mph)
Stalling speed: flaps up	63 kt (115 km/h; 72 mph)
flaps down	57 kt (105 km/h; 66 mph)
Max rate of climb at S/L	270 m (886 ft)/min
Service ceiling	3,000 m (9,840 ft)
T-O run	220 m (722 ft)
T-O to 15 m (50 ft)	620 m (2,035 ft)
Landing from 15 m (50 ft)	600 m (1,970 ft)
Landing run	180 m (590 ft)
Range	432 n miles (800 km; 497 miles)
g limits	+3.8/–1.9

ELITAR SIGMA-4

TYPE: Side-by-side ultralight.
PROGRAMME: Originated in Albatros design bureau at Zhukovsky; built at Samara. Marketed by Elitar (VVV Avia) from 2003; eighth airframe became first produced under VVV Avia and US demonstrator, 2005; has since achieved LSA compliance.
CUSTOMERS: One aircraft noted with LII experimental department at Zhukovsky, Moscow region; another with Sebastopol Aero Club, Ukraine. Nos. 10 to 12 delivered to New Zealand as kits in 2005.
COSTS: USD55,000 basic, flyaway; USD85,000 with all options; LSA USD79,000 (2006).

Elitar-202 on show at MAKS '03 *(Sebastian Zacharias)*

0567691

Elitar Sigma-4 US demonstrator *(Paul Jackson)* 1159746

DESIGN FEATURES: Wing-and-boom configuration, with underslung crew pod braced to wings by single streamlined strut each side. Small underfin.

FLYING CONTROLS: Conventional and manual.

STRUCTURE: Metal frame with composites skin.

LANDING GEAR: Tricyle type; fixed. Fuselage-mounted spring cantilever mainwheel legs. Horizontal spring cantilever nosewheel leg with castoring wheel.

POWER PLANT: One 75.3 kW (98.6 hp) Rotax 912 ULS flat-four mounted above and ahead of the pod, driving a three-blade propeller. Fuel capacity 65 litres (17.2 US gallons; 14.3 Imp gallons).

ACCOMMODATION: Pilot and passenger side-by-side. Folding throttle control fitted to port side for flying from left-hand seat.

EQUIPMENT: Ballistic recovery parachute standard in Russia.

DIMENSIONS, EXTERNAL:

Wing span	9.80 m (32 ft 1¾ in)
Length overall	6.20 m (20 ft 4 in)
Height overall	2.90 m (9 ft 6 in)

DIMENSIONS, INTERNAL:

Cabin max width	1.22 m (4 ft 0 in)

AREAS:

Wings, gross	10.90 m² (117.3 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	340 kg (750 lb)
Max T-O weight: Normal	540 kg (1,190 lb)
LSA	598 kg (1,320 lb)

PERFORMANCE:

Max level speed	113 kt (210 km/h; 130 mph)
Cruising speed	122 kt (170 km/h; 106 mph)
Stalling speed	50 kt (70 km/h; 44 mph)
Max rate of climb at S/L	360 m (1,181 ft)/min
T-O run	100 m (330 ft)
Landing run	132 m (435 ft)
Range	378 n miles (700 km; 435 miles)

GIDROPLAN

GIDROPLAN OOO (HYDROPLANE LTD)

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EXECUTIVE DIRECTOR: Pavel Piotnitsa
CHIEF DESIGNER: Evgeny Yungerov

Gidroplan Ltd was formed in 1995 and has marketed amphibian lightplanes designed by the Chernov bureau.

This venture was placed on a firmer footing in late 2000 when Gidroplan invested the equivalent of USD500,000 in acquiring 3,500 m² (37,675 sq ft) of working area from the Samara Instrument Bearing Plant and installing production equipment. Manufacturing activities include the Tsikada (Cicada) twin-engined ultralight agricultural aircraft, some six of which were manufactured before production ceased (although it remains available to special order and was shown at Moscow in August 2003) and the Che-22 Corvette amphibian.

In recent years, designers associated with Gidroplan have produced flying prototypes of three lightplanes not promoted outside Russia. These are the **A-17** single-seat ultralight (260 kg; 573 lb MTOW, 22.4 kW; 30 hp engine, believed from SGAU); Chernov **Che-40** flying-boat (two Rotax 582 engines, briefly described in the 1999–2000 edition of *Jane's All the World's Aircraft* and now confirmed to have been built); and **Ul'tralayt** twin-tailboom ultralight (600 kg; 1,322 lb MTOW, Rotax 912 S) built in 1998 by E Yungerov and S Seleznevym.

GIDROPLAN Che-22 KORVET

English name: Corvette
US marketing name: Pelican

TYPE: Three-seat amphibian/kitbuilt.

PROGRAMME: Developed on basis of four earlier amateur-built, Vikhr-engined Che-20s, winners of many light aircraft competitions; design and construction of prototype started 1988, first flight 1989; construction of production aircraft started 1992, first flight 1993; more than 5,000 hours of test and training flights, and more than 120 amateur pilots trained on prototype and production aircraft in first five years. Promotion also undertaken by Refly of St Petersburg; launched as Refly Pelican at EAA AirVenture, Oshkosh, 2000, but no further US promotion known and Gidroplan has disassociated itself from Refly.

Upgraded version under development and certification during 2001 features cantilever wing, strengthened tail unit with increased rudder area, new control system, redesigned engine support and modified instrument panel; flight testing was completed at the end of 2001 and Russian certification was awarded on 26 December 2001, followed by JAR/FAR Pt 23 certification in early 2002.

CURRENT VERSIONS: **Corvette 503:** With two Rotax 503 UL two-cylinder two-stroke engines.

Corvette 582: With two Rotax 582 UL two-cylinder two-stroke engines.

Corvette 912: With one Rotax 912 UL four-cylinder four-stroke engine.

Corvette-L: Shown at Moscow in 2003. Miniature floats suspended from main wingtip floats.

Refly Pelican: Generally as for Corvette 582. Production not authorised by Gidroplan.

CUSTOMERS: First preproduction delivery to a forest control organisation 1990. One (Che-22R-2 c/n 006, RP-X1548 of OVOS WLL Co) sold in Philippines. Others to China, Spain and Vietnam. Total 60 built by February 2002, including 10 in 2000. First Pelican in US (N27NS, ex-RA-02777) registered in March 2001.

COSTS: Standard aircraft USD35,000 to USD55,000 (2002).

DESIGN FEATURES: Designed to JAR-VLA, FAR Pt 23 and AP-23 requirements, for maximum simplicity of design and construction; primarily for forestry applications, but suitable for patrol, inspection and ecological monitoring of hunting and fishing locations, border patrol, training and business operations. Quoted build time 1,500 hours, or 50 hours for fast build kit.

Gidroplan Che-22 Korvet-L (Corvette-L), fitted with suspended hydroplane-type wingtip floats *(Sebastian Zacharias)* 0583379

Braced parasol monoplane, with light central cabane and single main bracing strut and bracing wire each side; downturned wingtips serve as stabilising floats, but each has suspended miniature float to prevent wingtip contacting water at speed. Flying-boat hull with two steps; unswept strut-braced horizontal tail surfaces mounted on fin of sweptback vertical surfaces; engine(s) mounted on leading-edge of wing centre-section. US demonstrator has fin of reduced height. Unswept constant chord wing; CAHI (TsAGI) P-IIIA section, thickness/chord ratio 15 per cent; incidence 4° 30'; dihedral 1° 30'. Airframe life 3,000 flying hours.

FLYING CONTROLS: Conventional and manual, with pushrod actuation. Full-span slotted flaperons, elevators and horn-balanced rudder; fixed tab on port elevator.

STRUCTURE: Single-spar wing of riveted duralumin; fuselage, tail unit and integral wingtip floats of vacuum-moulded GFRP sandwich; flaperons fabric-covered.

LANDING GEAR: Optional amphibian configuration; spring cantilever mainwheel legs, attached to fuselage sides, turn 90° forward for retraction, tyre size 350×120; GFRP skis optional.

POWER PLANT: Two 37 kW (49.6 hp) Rotax 503 UL-2V or two 47.8 kW (64.1 hp) Rotax 582 UL or 59.6 kW (79.9 hp) Rotax 912 UL. Two-blade wooden or three-blade GFRP fixed-pitch propeller(s) of Russian manufacture. Two fuel tanks in wing centre-section, 100 litres (26.4 US gallons; 22.0 Imp gallons); gravity fuelling.

ACCOMMODATION: Pilot and two passengers under large glazed blister canopy, giving exceptional field of view. Detachable windscreen panels. Gull-wing canopy/door each side.

SYSTEMS: 12/24 V electrical system.

AVIONICS: *Comms:* VHF radios.

Flight: Garmin GPS.

EQUIPMENT: Optional BRS parachute.

DIMENSIONS, EXTERNAL:

Wing span	10.53 m (34 ft 6½ in)
Wing chord, constant	1.40 m (4 ft 7¼ in)
Wing aspect ratio	6.8
Length overall	7.25 m (23 ft 9½ in)
Height overall	2.40 m (7 ft 10½ in)
Tailplane span	2.50 m (8 ft 2½ in)
Wheel track	2.00 m (6 ft 6¾ in)
Wheelbase	4.55 m (14 ft 11 in)
Propeller diameter	1.50 m (4 ft 11 in)
Canopy doors (each): Height	0.70 m (2 ft 3½ in)
Width	0.80 m (2 ft 7½ in)
Height to sill	0.63 m (2 ft 0¾ in)

DIMENSIONS, INTERNAL:

Cabin: Length	1.50 m (4 ft 11 in)
Max width	1.10 m (3 ft 7¼ in)
Max height	1.20 m (3 ft 11¼ in)

AREAS:

Wings, gross	16.40 m² (176.5 sq ft)

For details of the latest updates to *Jane's All the World's Aircraft* online and to discover the additional information available exclusively to online subscribers please visit
jawa.janes.com

Flaperons (total) ..... 3.40 m² (36.60 sq ft)
Fin ..... 0.55 m² (5.92 sq ft)
Rudder ..... 0.35 m² (3.77 sq ft)
Tailplane ..... 1.68 m² (18.08 sq ft)
Elevators (total) ..... 0.80 m² (8.61 sq ft)

WEIGHTS AND LOADINGS (A: Corvette 503, B: Corvette 582, C: Corvette 912):
Weight empty: A, B, C ..... 380 to 480 kg (838 to 1,058 lb)
Max fuel: A, B, C ..... 58 kg (128 lb)
Max T-O weight: A, B, C ..... 675 kg (1,488 lb)
Max wing loading: A ..... 21.95 kg/m² (4.50 lb/sq ft)
C ..... 29.27 kg/m² (5.99 lb/sq ft)
Max power loading: A ..... 4.86 kg/kW (7.99 lb/hp)
C ..... 8.05 kg/kW (13.23 lb/hp)

PERFORMANCE:
Max level speed: A ..... 81 kt (150 km/h; 93 mph)
B, C ..... 86 kt (160 km/h; 99 mph)
Cruising speed: A ..... 65 kt (120 km/h; 75 mph)
B, C ..... 70 kt (130 km/h; 81 mph)
Max rate of climb at S/L: A ..... 300 m (985 ft)/min
B ..... 420 m (1,378 ft)/min
C ..... 240 m (787 ft)/min
Service ceiling: A, B, C ..... 3,000 m (9,840 ft)
T-O run: on land: A ..... 90 m (295 ft)
B ..... 80 m (263 ft)
C ..... 110 m (361 ft)
on water: A ..... 110 m (361 ft)
B ..... 90 m (295 ft)
C ..... 120 m (394 ft)
Range with standard fuel:
A ..... 232 n miles (430 km; 267 miles)
B ..... 243 n miles (450 km; 279 miles)
C ..... 324 n miles (600 km; 372 miles)
g limits ..... +3.8/–1.5
Permissible wave height: A, B, C ..... 0.5 m (1 ft 7¾ in)

GRIFFON

GRIFFON AERO

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Griffon was established by a group of aviation enthusiasts who are members of the FLARF group.

GRIFFON 100

TYPE: Two-seat lightplane.

PROGRAMME: At 2005 Moscow Salon, Griffon Aero displayed a light aircraft closely resembling the Zenith STOL CH 701, available in two fuselage lengths and with a variety of engine options.

CURRENT VERSIONS: **Griffon 100:** Shorter fuselage and heavy duty, cantilever landing gear. Standard 52.2 kW (70 hp) Subaru EA-71 water-cooled flat-four engine; options include 59.0 kW (79 hp) Hirth F30K, 61.0 kW (82 hp) F30E, 68.6 kW (92 hp) F30U, 75.0 kW (101 hp) F30ES; 59.6 (79.9 hp) Rotax 912 UL, 73.5 kW (98.6 hp) Rotax 912 ULS; 59.7 (80 hp) Jabiru 2200 and 89 kW (120 hp) Jabiru 3300. By 2006, this no longer appeared to be available.

Griffon 100M on display at Moscow in August 2005 *(Yefim Gordon)* 1158273

Griffon 100M: Longer fuselage and twin-oleo, strut-braced landing gear each side. Increased empty and max T-O weights. Standard 112 kW (150 hp) Subaru EJ-25; optional 97.0 kW (130 hp) LOM M132, 124 kW (166 hp) M332CE, Jabiru 3300 or 149 kW (200 hp) Jabiru 6000.

DESIGN FEATURES: Generally as Zenair STOL CH 701, except increased wing span and area.

POWER PLANT: As under Current Versions. Fuel capacity 80 litres (21.1 US gallons; 17.6 Imp gallons) standard; optionally, 100M only, 160 litres (42.2 US gallons; 35.2 Imp gallons).

DIMENSIONS, EXTERNAL:
Wing span ..... 10.23 m (33 ft 6¾ in)
Length overall: 100 ..... 6.40 m (21 ft 0 in)
100M ..... 7.15 m (23 ft 5½ in)
Height overall ..... 3.12 m (10 ft 2¾ in)
Tailplane span ..... 3.70 m (12 ft ¾ in)
Wheel track ..... 1.80 m (5 ft 10¾ in)

AREAS:
Wings, gross ..... 14.62 m² (157.4 sq ft)
Horizontal tail (total) ..... 2.77 m² (29.82 sq ft)

WEIGHTS AND LOADINGS:
Weight empty: 100 ..... 330 kg (727 lb)
100M ..... 440 kg (970 lb)
Max baggage weight ..... 20 kg (44 lb)
Max T-O weight: 100 ..... 600 kg (1,322 lb)
100M ..... 750 kg (1,653 lb)
Max wing loading: 100 ..... 41.0 kg/m² (8.41 lb/sq ft)
100M ..... 51.3 kg/m² (10.51 lb/sq ft)
Max power loading, Subaru: 100 ..... 11.30 kg/kW (18.57 lb/hp)
100M ..... 6.71 kg/kW (11.02 lb/hp)

PERFORMANCE:
Max level speed: 100 ..... 86 kt (160 km/h; 99 mph)
100M ..... 97 kt (180 km/h; 112 mph)
Normal cruising speed: 100 ..... 54 kt (100 km/h; 62 mph)
100M ..... 70 kt (130 km/h; 81 mph)
Stalling speed, flaps down ..... 33 kt (60 km/h; 38 mph)
Max rate of climb at S/L: 100 ..... 240 m (787 ft)/min
100M ..... 300 m (984 ft)/min
T-O run: 100 ..... 70 m (230 ft)
100M ..... 40 m (135 ft)
Landing run ..... 40 m (135 ft)
g limits ..... +6/–3

ILYUSHIN

MEZHDUNARODNYYI AVIATSIONNYI KOMPANIYA ILYUSHINA (ILYUSHIN INTERNATIONAL AVIATION COMPANY)

Incorporating aircraft design and production companies, Ilyushin MAK formed April 2000 by government decree. Initial members are Ilyushin Aviation Complex and VASO; following negotiations with Uzbekistan, will be expanded to include TAPO as second production plant; previous Russian and Uzbek government agreement of 1998 covered collaboration in developing and marketing the Il-76 and Il-114. These plans overtaken in May 2001 by wider national strategy of merging Ilyushin, Beriev, Mil, Sukhoi and Yakovlev.

AVIATSIONNYI KOMPLEKS IMENI S V ILYUSHINA OAO (Aviation Complex named for S V Ilyushin JSC)

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CHAIRMAN OF THE BOARD OF DIRECTORS AND GENERAL DESIGNER: Genrikh V Novozhilov
GENERAL DIRECTOR AND CEO: Victor V Livanov
HEAD OF INTERNATIONAL RELATIONS AND CHIEF DESIGNER: Igor Ya Katyrev
DEPUTY GENERAL DESIGNER, MARKETING, BUSINESS DEVELOPMENT AND FOREIGN ECONOMIC RELATIONS: Vladimir A Belyakov

Ilyushin OKB is named after Sergei Vladimirovich Ilyushin, who died 9 February 1977, aged 82. Bureau (OKB-240) was founded 17 April 1933; has been headed by Genrikh Novozhilov since 1970. About 60,000 aircraft of Ilyushin design have been built.

Funding problems and bank collapses have affected Ilyushin and some of its suppliers, delaying the establishment of an Il-114 leasing arm and the acquisition of Western systems for the Il-96T, which was eventually abandoned. However, Bureau is jointly designing IRTA-21 (formerly Il-214) twin-jet transport in collaboration with HAL of India and working with Yakolev and Irkut on MS-21 twin-jet airliner. It is a partner, with Boeing and Sukhoi, in the RRJ regional jet programme announced in August 2001 and selected for production in 2003. Collaboration with Boeing began in 1997 and resulted in August 2001 opening of joint design training centre in Moscow to provide engineers, mainly from Ilyushin, for Boeing's design and technical research centres in Russian capital.

ILYUSHIN Il-76

By 1997, the TAPO plant at Tashkent, Uzbekistan, had laid down 960 Il-76s and Il-78s, of which 40 were then in various stages of completeness and available to meet medium-term orders. This 'white tail' stock had reduced to about 30 by July 2004, following purchases by India (six Il-78s), Volga-Dnepr (two Il-76RD-90VDs) and Silk Way of Azerbaijan (two Il-76TDs). In addition, two Il-76MF stretched variants have been ordered for delivery to the Russian Air Forces, and although the 2005 delivery date has slipped, they were confirmed late in that year to be under construction. In early 2006, target was to complete State Tests by end of 2006 and deliver to Russian Air Forces in 2007.

Further commitments by customers have encouraged TAPO to resume assembly of Il-76s, and in 2005 the 961st aircraft (line number 97-01) was noted on the production line. India ordered three aircraft on 5 March 2004, these to be modified with the addition of Phalcon AEW radars. First of these, KW3553, was under assembly in 2005. In September 2005, China reaffirmed a requirement for up to 38 aircraft, including four Il-78 tankers, with NPO Saturn D-30KP engines, over six years. China is pursuing its own AEW programme (KJ-2000) using Il-76 airframes. Unconfirmed report quotes two Il-76s on order for Jordan.

Il-76MF prototype (first flown August 1995) underwent Russian military evaluation in first half of 2003. Tashkent's first-stage flight test report issued on 24 April 2003 prior to immediate transfer of aircraft to Akhtubinsk test centre, although trials there were curtailed, and not due to have resumed until July 2004. Civil counterpart designated Il-76TF.

Associated requirement is transfer of production line from Uzbekistan to Russia (VASO plant at Voronezh). USD130 million cost of which may result in further delay. Some 70 MFs required by Russian Air Forces. Meanwhile, an initial batch of 10 to 14 existing Russian military Il-76MDs may be upgraded by VASO to Il-76MD-90 standard with PS-90A-76 turbofans replacing original D-30KPs, each upgrade costing USD14 million. Russian and Uzbekistani governments agreed joint marketing of Il-76 through Roseboronexport in March 2003.

First Il-76 upgraded with PS-90A-76 turbofans for Volga Dnepr airline as Il-76TD-90VD *(Yefim Gordon)* 1129544

First freighters with PS-90 engines were two Il-76TD-90VDs for Volga-Dnepr, of which RA-76950 first flew on 5 August 2005 (and was exhibited at Moscow Salon later that month) having been produced from new-built 925th Il-76/Il-78 airframe. In late 2005, Silk Way ordered (via Uzavia Leasing) further two aircraft (fourth and fifth), these to be airline's first in -90TD configuration.

Kotlas-Novator (Leninets) has developed a 'glass cockpit' for Il-76TD-90VD as part of 13 new systems in this variant. New engines, rated at 142 kN (31,967 lb st), increase payload to 50,000 kg (110,230 lb) and MTOW to 195,000 kg (429,900 lb).

ILYUSHIN Il-78M

NATO reporting name: Midas

There have been no recent conversions of Il-76 to this airborne tanker configuration. However, India ordered six Il-78MKIs in February 2001 and these were converted from stocks of uncompleted Il-76s held at TAPO in Uzbekistan. First two were officially transferred to India in March 2003 and final pair were transferred in late 2004. All Indian Il-78s have PS-90A-76 engines in place of D-30KPs of earlier aircraft. Russian Air Forces have requirement for additional tankers to be produced by conversion of exisiting transports under new designation Il-76MDK.

ILYUSHIN Il-96-300

TYPE: Wide-bodied airliner.

PROGRAMME: First of two flying prototypes (SSSR-96000) flew at Khodinka 28 September 1988 and exhibited at Paris in June 1989; second (SSSR-96001) first flew 28 November 1989; further airframe used for static and fatigue testing; all three built at GAZ 30, Khodinka; areas of commonality with Il-86 permitted planned test programme to be reduced to 750 flights totalling 1,200 hours; route proving trials by second production Il 96-300 (SSSR-96005) conducted late 1991; production at VAPO (now VASO), Voronezh; certification received 29 December 1992.

Following initially poor reliability, Aeroflot (ARIA) serviceability improved, as evidenced by TBO increase from 1,600 to 4,130 hours between 1997 and 1999. PS-90A engine in-flight shutdown had improved to one per 29,000 hours by 1999. Aircraft delivered from 2005 have 96 per cent despatch reliability and 5,000 flying hours per year minimum guaranteed by manufacturer in first such agreement by Russian manufacturer.

Westernised Il-96M/T versions developed during 1990s, but abandoned in mid-2001.

Two Il-96-300Ms delivered to Cubana from 2005 have latest international standard of navigation avionics and convertible interior from standard 18 business/244 economy to VVIP for President Castro.

CURRENT VERSIONS: **Il-96-300:** *As described.*

Il-96-300V: Extended-range version on order by Vnukovo Airlines, 1999. Increased fuel for additional 1,200 miles (2,222 km; 1,380 miles).

Il-96PU: One aircraft (RA-96012) built for use of Russian president: VIP interior, additional communications facilities by OAO Relero of Omsk and medical centre. Second aircraft, designated Il-96PU(M), authorised by Russian government on 6 May 2000; this has different interior layout; first flown 20 April 2003 with registration RA 96016; delivered to Rossiya 14 May 2003 for internal fitments by UK company Diamonite Aircraft Furnishing; intended 30 August 2003 delivery date as replacement 'Air Force One'.

Il-96-300 Freighter: Design under way by early 2000; development partnership also includes VAPO and Russian banks. To carry 70,000 kg (154,325 lb) payload over 4,859 n miles (9,000 km; 5,592 miles); uprated PS-90 engines each 176.5 kN (39,683 lb st). Estimated unit cost USD30 million (2000).

Il-96-400T: Under development by mid-2000 (when designation Il-96-3XX briefly employed). Equivalent to Il-96M/T, but employing only Russian engines and avionics. Power plant is Aviadvigatel PS-90A1 offering additional 14.67 kN (3,300 lb st) to allow full range at MTOW of 270,000 kg (595,250 lb), including 92,000 kg (202,825 lb) of cargo. Also shown in model form with 177 kN (39,683 lb st) Samara NK-93 turbofans. Span as Il-96-300 with winglets; length overall 63.94 m (209 ft 9¼ in); height overall 15.715 m (51 ft 6¾ in). Range 5,399 n miles (10,000 km; 6,213 miles). Proposed to convert 10 uncompleted Il-96Ms to this standard for lease from Ilyushin Finance by Atlant Soyuz cargo airline; provisional agreement signed February 2001, envisaging 2003 service-entry; however, retrospective installation of cargo door could weaken airframe; Soyuz signed order for four -400Ts in August 2001, first being former Il-96T prototype, due in service early 2002; second -400 to follow 24 months thereafter; contract refinanced by 2005 and reduced to two. Also in 2001, Aeroflot issued letter of intent for four -400Ts to be delivered from 2006, and was considering passenger version. Volga-Dnepr reported in 2003 to have interest in further two.

Ilyushin Finance revealed in December 2004 that devlopment under way of tanker/transport Il-96-400T for offer to Russian Air Forces as Il-78 replacement.

Il-98: Envisaged in late 1990s as Il-96 version with two Western engines (PW4000, RR Trent or GE90). By 2004, was being depicted with Samara NK-93s.

CUSTOMERS: Aeroflot Russian International Airlines (six delivered by 1996); Domodedovo Airlines (four ordered; three delivered by 1999); Russia State Transport Company (two; one delivered 1995; one in 2003); Atlant Soyuz (received first production aircraft in 1999, following trials use and also acquired Il-96T prototype); and Krasnoyarsk Airlines (Kras Air; two; first delivery, RA-96014, 24 June 2004, entered service 21 August 2004; both on lease from Ilyushin Finance under agreement of 10 March 2004). Total 15 production aircraft delivered: 10th in 1996; 11th in April 1999; 12th in 2003; 13th and 14th in 2004; 15th in 2005.

Aeroflot signed lease agreement with Ilyushin Finance in November 1999 for further six -300s, plus sale, refurbishment and leaseback of one of original six; contract involves uncompleted aircraft on production line, with intention of delivery aircraft between 2001 and 2003. Target was not achieved but order remained in place, despite Aeroflot commitment to Il-96-400T. In March 2003, it was announced that VASO had received from Ilyushin Finance Company an initial payment of Rb180 million to fund restart of work on the eight Il-96s then on the assembly line, these comprising six for Aeroflot and two freighters for Atlant-Soyuz. By July 2004, VASO had relaunched production, intending to deliver six Aeroflot aircraft between July and December 2005 and two to Cubana in 2005 as VVIP transports for President Castro, following July 2004 order; sole 2005 production was first Cubana aircraft, rolled out on 26 July, exhibited at Moscow Salon in following month and handed over in December; second for Cubana first flew 14 January 2006. Aeroflot signed leasing agreement with Ilyushin Finance on 30 December 2003 for six to be delivered over a six month period, beginning mid-2005 (which date not achieved).

China Xinjiang Airlines previously was in protracted negotiations for three Il-96-300s. In 2005, China interested in four Il 96-400T freighters, and Syrianair in three Il-96-300s. Cuba decided in January 2006 to purchase third and fourth aircraft.

ILYUSHIN Il-96 PRODUCTION

c/n	Registration	Current Operator
0101	RA-96000	To Il-96M and withdrawn
0102	nil	Static test airframe
0103	RA-96001	In storage at Zhukovsky
01001	RA-96002	Atlant Soyuz
01002	RA-96005	Aeroflot
01003	RA-96006	Domodedovo Airlines
01004	RA 96007	Aeroflot
01005	RA-96008	Aeroflot
01006	RA-96009	Domodedovo Airlines
01007	RA-96010	Aeroflot
01008	RA-96011	Aeroflot
01009	RA-96012	Rossiya
01010	RA-96016	Rossiya (delivered 14 May 03)
01011	RA-96017	Kras Air (delivered 9 Sep 04)
01012	RA-96015	Aeroflot (delivered by Jan 96)
01013	RA-96013	Domodedovo Airlines (delivered 16 Apr 99)
01014	RA-96014	Kras Air (delivered 24 Jun 04)
01015	CU-T1250	Cubana 2005
01016	CU-T1251	Cubana 2006
n/k	RA-96101	Atlant Soyuz (Il-96T)

Notes: Further six aircraft (four -300 and two -400T) under construction

COSTS: Il-96-300 USD9 million (2003), Il-96-400T USD38 million, flyaway (2001), Cubana Il-96-300 in VVIP configuration, USD50 million (2004).

DESIGN FEATURES: Superficial resemblance to Il-86, but new design, with different engines to overcome performance deficiencies of original Il-86; new structural materials and state-of-the art technology intended to provide life of 60,000 hours and 12,000 landings; no lower deck passenger entry. Current development aiming at range of 6,475 n miles (12,000 km; 7,450 miles) with 300 passengers.

Conventional wide-bodied airliner, with low wing (and winglets) and four pod-mounted engines.

Supercritical wings, with 30° sweep at quarter-chord; sweepback at quarter-chord 37° 30' on tailplane, 45° on fin.

FLYING CONTROLS: Triplex fly-by-wire, with manual reversion; each wing trailing-edge occupied by, from root, double-slotted inboard flap, small inboard aileron, two-section single-slotted flaps, and outboard aileron used only as gust damper and to smooth out buffeting; seven section full-span leading edge slats on each wing; three airbrakes forward of each inboard trailing-edge flap; six spoilers forward of outer flaps; inboard pair supplement ailerons, others operate as airbrakes and supplementary ailerons; variable incidence tailplane; two section rudder and elevators, without tabs.

STRUCTURE: Basically all-metal, including new high-purity aluminium alloy, with composites flaps, maindeck floors and underfloor holds of honeycomb and CFRP; inner wings three-spar, outer panels two-spar; each wing has seven machined skin panels, three top surface, four bottom, with integral stiffeners; circular-section semi-monocoque fuselage;

Ilyushin Il-96-300 widebody airliner *(Yefim Gordon)* 1153790

leading- and trailing-edges of fin and tailplane of composites. Some components manufactured by PZL (Polish Aircraft Factory), Poland.

LANDING GEAR: Retractable four-unit type. Forward-retracting steerable twin-wheel nose unit; three four-wheel bogie main units. Two of latter retract inward into wingroot/fuselage fairings; third is mounted centrally under fuselage, to rear of others, and retracts forward after the bogie has itself pivoted upward 20°. Oleo-pneumatic shock-absorbers. Nosewheel tubeless tyres size 1,260×460; mainwheel tubeless tyres size 1,300×480. Tyre pressure (all) 11.65 bar (169 lb/sq in).

POWER PLANT: Four Aviadvigatel PS-90A turbofans, each 156.9 kN (35,275 lb st), on pylons forward of wing leading-edges. Thrust reversal standard. Integral fuel tanks in wings and fuselage centre-section, total capacity 152,620 litres (40,318 US gallons; 33,573 Imp gallons).

ACCOMMODATION: Pilot, co-pilot and flight engineer; two seats for supplementary crew or observer. Ten or 12 cabin staff. Basic all-tourist configuration has two cabins for 66 and 234 passengers respectively, nine-abreast at 87 cm (34.25 in) seat pitch, separated by buffet counter, video stowage and two lifts from galley on lower deck. Two aisles, each 55 cm (21.65 in) wide. Two lavatories and wardrobe at front; six more lavatories, a rack for cabin staff's belongings and seats for cabin staff at rear. Seats recline, and are provided with individual tables, ventilation, earphones and attendant call button. Indirect lighting is standard. 235-seat mixed class version has front cabin for 22 first class passengers, six-abreast in pairs, at 102 cm (40 in) seat pitch and with aisles 75.5 cm (29.7 in) wide; centre cabin with 40 business class seats, eight-abreast at 90 cm (35.4 in) seat pitch and with aisles 56.5 cm (22.25 in) wide; and rear cabin for 173 tourist class passengers, basically nine-abreast at 87 cm (34.25 in) seat pitch, with aisle width of 55 cm (21.65 in).

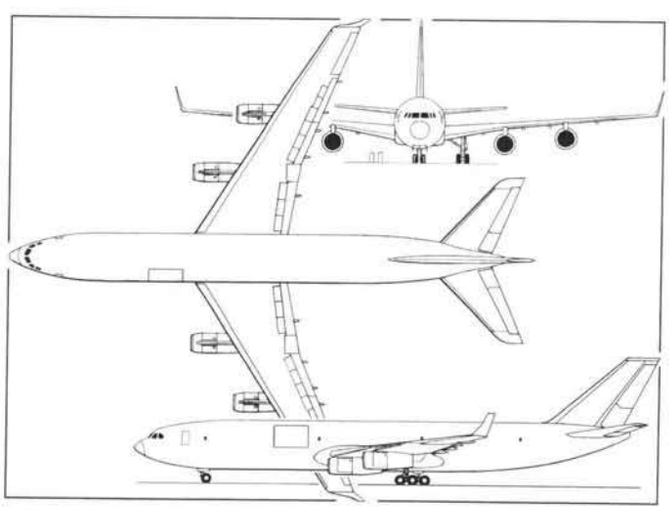
Future Aeroflot standard, defined (for Srs 300s) late 1999 as 12 first class, 21 business class and 180 economy seats, plus complete interior renewal. Refurbishment cost (including some Western avionics) USD1.5 million per aircraft. However, 2005 deliveries configured with 24 business class seats/beds (first on a Russian airliner) and 220 economy seats.

Passenger cabin is entered through three doors on port side of upper deck, at front and rear and forward of the wings. Opposite each door, on starboard side, is emergency exit door. Lower deck houses front cargo compartment for six ABK-1.5 (LD3) containers or igloo pallets, central compartment aft of wing for 10 ABK-1.5 containers or pallets, and tapering compartment for general cargo at rear. Three doors on starboard side provide separate access to each compartment. Galley and lifts are between front cargo compartment and wing, with separate door aft of front cargo compartment door.

SYSTEMS: Four independent hydraulic systems, using fireproof and explosion-proof fluid, at pressure of 207 bar (3,000 lb/ sq in). APU in tailcone for engine starting and air conditioning on ground.

AVIONICS: *Flight:* Triplex flight control and flight management systems, together with a head-up display, permit fully automatic en route control and operations in ICAO Cat. IIIa minima. Duplex engine and systems monitoring and failure warning systems feed in-flight information to both the flight engineer's station and monitors on the ground. Autothrottle is based on IAS, without angle of attack protection.

Instrumentation: Primary flight information is presented on dual twin-screen colour CRTs, fed by triplex INS, a satellite-based and Omega navigation system and other sensors. Another electronic system provides real-time automatic weight and CG situation data.



Ilyushin Il-96-400T international freighter *(Paul Jackson)* 1159830

DIMENSIONS, EXTERNAL:

Wing span: excl winglets	57.66 m (189 ft 2 in)
over winglets	60.105 m (197 ft 2¼ in)
Wing aspect ratio	9.5
Length overall	55.345 m (181 ft 7 in)
Fuselage: Length	51.15 m (167 ft 9¾ in)
Max diameter	6.08 m (19 ft 11½ in)
Height overall	17.55 m (57 ft 7 in)
Tailplane span	20.57 m (67 ft 6 in)
Wheel track	10.40 m (34 ft 1½ in)
Wheelbase	20.07 m (65 ft 10 in)
Passenger doors (three): Height	1.83 m (6 ft 0 in)
Width	1.07 m (3 ft 6 in)
Height to sill: Nos. 1 and 2	4.54 m (14 ft 10¾ in)
No. 3	4.80 m (15 ft 9 in)
Emergency exit doors (three):	
Height	1.825 m (5 ft 11¾ in)
Width	1.07 m (3 ft 6 in)
Cargo compartment doors (front and centre):	
Height	1.825 m (5 ft 11¾ in)
Width	1.78 m (5 ft 10 in)
Height to sill: front	2.34 m (7 ft 8¼ in)
centre	2.48 m (8 ft 1¾ in)
Cargo compartment door (rear):	
Height	1.38 m (4 ft 6¼ in)
Width	0.97 m (3 ft 2¼ in)
Height to sill	2.74 m (9 ft 0 in)
Galley door: Height	1.20 m (3 ft 11¼ in)
Width	0.80 m (2 ft 7½ in)

DIMENSIONS, INTERNAL:

Cabins, excl flight deck: Height	2.60 m (8 ft 6¼ in)
Max width	Approx 5.70 m (18 ft 8½ in)
Volume	350.0 m³ (12,360 cu ft)
Cargo hold volume: front	37.1 m³ (1,310 cu ft)
centre	63.8 m³ (2,253 cu ft)
rear	15.0 m³ (530 cu ft)

AREAS:

Wings, gross	350.00 m² (3,767.4 sq ft)
Vertical tail surfaces (total)	61.00 m² (656.60 sq ft)
Horizontal tail surfaces (total)	96.50 m² (1,038.75 sq ft)

WEIGHTS AND LOADINGS:

Basic operating weight	117,000 kg (257,950 lb)
Max payload	40,000 kg (88,185 lb)
Max fuel weight	122,100 kg (269,185 lb)
Max T-O weight	240,000 kg (529,100 lb)
Max landing weight	175,000 kg (385,800 lb)
Max zero-fuel weight	157,000 kg (346,125 lb)
Max wing loading	685.7 kg/m² (140.45 lb/sq ft)
Max power loading	382 kg/kN (3.75 lb/lb st)

PERFORMANCE:

Normal cruising speed at FL330-FL400	464 kt (860 km/h; 534 mph)
Approach speed	140–146 kt (260–270 km/h; 162–168 mph)
Balanced T-O runway length	3,150 m (10,335 ft)
Balanced landing runway length	2,100 m (6,890 ft)
Range, with UASA reserves: with max payload	4,050 n miles (7,500 km; 4,660 miles)
with 30,000 kg (66,140 lb) payload	4,860 n miles (9,000 km; 5,590 miles)
with 15,000 kg (33,070 lb) payload	5,940 n miles (11,000 km; 6,835 miles)

OPERATIONAL NOISE LEVELS: Il-96-300 is designed to conform with ICAO Chapter 3 Annex 16 noise requirements

ILYUSHIN Il-103

TYPE: Four-seat lightplane.

PROGRAMME: Exhibited in model form at Moscow Aerospace '90; programme go-ahead 1990; first flight (RA-10321) 17 May 1994; second prototype (RA-10302) flew 30 January 1995 at LMZ (now LAPIK), Lukhovitsy, following August 1993 decision to establish a production line there; pre-series batch comprised three flyable and two static test aircraft, former having flown 414 sorties in two years after maiden flight; first production aircraft flew 30 January 1995.

Type certificate by Russian authorities under AP-23 received 15 February 1996; production approval certificates issued 7 March 1996 and 7 April 1998; airworthiness certificate granted 9 July 1997. Amended Russian certification granted 4 December 1997, following addition of GPS, radio compass and AHRS to avionics suite.

FAR Pt 23 certification achieved 9 December 1998 (first by a Russian-built aircraft) after

South Korean Air Force Ilyushin Il-103 *(Peter R Foster)* 1151438

110-hour/208-sortie programme, but with 1,150 kg (2,535 lb) MTOW limit. Annex of 6 September 1999 allows operation from unpaved runways. FAR MTOW increased to 1,310 kg (2,888 lb) on 13 September 2002 (c/n 0501 onwards); retrofit available for earlier aircraft.

International marketing by MGA Ltd of Moscow (www.mga.ru). Initial export order, six for Peruvian Air Force, agreed June 1999 and finalised in April 2000; deliveries had not begun by August 2000, due to lack of payment, but all reported in service by late 2001.

CURRENT VERSIONS: **Il-103-01**: Baseline VFR version for Russian Federation market.

Il-103-10: Export version with fully upgraded avionics suitable for international airways navigation.

Il-103-11: Export version with partly upgraded avionics suitable for local air navigation.

Initial certification is for a max T-O weight of 1,285 kg (2,832 lb), as reflected in weight and performance data below and as supplied to South Korea. The Il-103 will later be certified at 1,310 kg (2,880 lb) and, ultimately, 1,460 kg (3,218 lb).

Il-103LL: Flying testbed (*Letny Laboratoriya*) fitted in mid-2003 with Russkaya Avionika LCD navigation display and imported inertial platform.

Il-103SKh: Crop-sprayer (*selskokhozyaistvenny*: agricultural) version; first flown 29 March 2000.

Il-103P: Surveillance version announced June 2002 in response to interest from Kazakhstan for Caspian Sea patrol. Undisclosed sensors have range of 40 km (64 miles) from cruising height of 3,000 m (9,840 ft). Potential for armament, including two machine guns.

CUSTOMERS: Initial operators (by 1999) included Il-Service at Myachkovo, Cherepovets Aviation Club, Avialesookhrana (forestry), Special Ecological Aviation Centre, Tatarstan National Flying Club, Civil Aviation Academy and St Petersburg Methodological Centre. Sales in 2000 comprised four to GP Bellesavia of Belarus in September for forest firefighting; one to Il-Service; and one for Vladimirsky Aerial Forest Protection. Despite prediction of Russian market for 1,500 and plans to produce 100 per year, sales stagnated in 2001; manufacture by LAPIK was reported, in mid-2000, temporarily to have ceased.

Russian Federal Air Transport service reportedly ordered 30 in 1999 for issue to several flying schools, but these failed to materialise. Total 23 delivered by January 2002, including 10 exports (Belarus, four, and Peru, six). Further sales in 2002 included 23 to South Korean Air Force (signed 16 May 2002) and three to Laos. Korean deliveries began October 2004; Laotian aircraft supplied July 2004. By 2006, over 50 produced.

COSTS: USD164,000 to 210,000 (2000). Korean programme unit cost (2003) USD391,000.

DESIGN FEATURES: Conventional low-wing monoplane, with non-retractable landing gear, originally to meet DOSAAF requirement for 500 military/civil pilot trainers. Designed for daytime VFR flying, in non-icing conditions and ambient air temperature of −35 to +45°C; intended service life 12,000 hours/20,000 landings/15 years.

Wing sweep 0° at quarter-chord, slight dihedral from roots, twist 0°, thickness/chord ratio 16 per cent at root, 15 per cent at tip, taper ratio 1.9.

FLYING CONTROLS: Conventional and manual. Actuation by pushrods, except cable-actuated rudder; horn-balanced rudder and single-piece elevator; single-slotted trailing-edge flaps, 0° or 10° deflection; electrically actuated elevator trim tab. Deflection angles: ailerons +25/−20°, elevator +25/−20°, rudder ±25°. Ground-adjustable trim tabs on starboard aileron and rudder.

STRUCTURE: All-metal, basically aluminium alloy, except for titanium firewall frame and wingroot attachments; bonded GFRP wingtips, elevator and rudder tips and elevator tab; and small amounts of magnesium alloys and Al-Li alloys. Single-spar wings, with front and rear false spars, integral fuel tanks and detachable leading-edge, mounted at sides of fuselage. Main spar is riveted beam with extruded caps; false spars stamped from sheet alloy; rolled sheet stringers. Semi-monocoque front/centre fuselage with inbuilt wing carry-through structure; separate rear fuselage; separate tailcone. Longitudinal fuselage members comprise two reinforced spars in cabin floor, two side-ribs of centre wing section and three beams for landing gear attachment. Two-spar, single-piece tailplane attached to fuselage by four bolts; two-spar fin. Detachable wings, fin and tailplane.

LANDING GEAR: Non-retractable tricycle type, with single wheel on each unit. Cantilever spring nose and mainwheel legs of titanium alloy; castoring nosewheel with shimmy damper; oleo-pneumatic nosewheel leg tested on RA-10300 in 1998. Mainwheel tyres size 400×150-115, pressure 3.95 bar (57 lb/sq in) on KT-214-1 wheels; nosewheel tyre size 310×135-99, pressure 3.43 bar (50 lb/sq in) on K-290 wheels. Optional tyres 6.00-6 and 5.00-5, respectively, on Parker 40-75B and 40-77B wheels. Multidisc hydraulic anti-lock brakes on mainwheels, pedal-actuated. Turning radius (outboard wheel) 4.70 m (15 ft 6 in). Floats and skis optional.

POWER PLANT: One 157 kW (210 hp) Teledyne Continental IO-360-ES2B flat-six engine; Hartzell BHC-C2YF-1BF/F8459A-8R two-blade, constant-speed (hydraulic), metal propeller. (Manual pitch control on three development aircraft; automatic pitch selection on production aircraft.) Alternative 194 kW (260 hp) Textron Lycoming or similarly rated Teledyne Continental engine under consideration. Fuel and oil systems suitable for inverted flight; two main fuel tanks in wingroots, total capacity 200 litres (52.8 US gallons; 44.0 Imp gallons); supply tank, capacity 3 litres (0.8 US gallon; 0.66 Imp gallon), in fuselage forward of wing front spar carry-through; gravity refuelling points in wingroots.

ACCOMMODATION: Two forward-folding seats side by side at front of cabin; bench seat for two adults or three children at rear; optional control wheel in place of standard stick; optional dual controls; optional front seats for parachutes; space for 220 kg (485 lb) freight with rear bench seat removed; two gull-wing window/doors, hinged on centreline, at front of canopy. Rear windows removable for ground emergency exit. Unrestricted access to baggage hold.

SYSTEMS: Cabin ventilated and heated and windscreen demisted electrically by fan heater. Electrical system 27 V DC, with 1,800 W 60 A generator and 25 Ah battery.

AVIONICS: *Comms:* Yurok VHF radio as standard; P-855A1 optional extra. Il-103-11 equipment includes UBD transponder. Il-103-10 has Bendix/King KX 165 nav/com/glideslope (replacing Russian radios) and KT 76A transponder.

Flight: BUR-4 flight data recorder.

Il-103-11 includes MKS-1 compass and Bendix/King KR 87 ADF and KLN 89B GPS (KLN 94 in South Korean aircraft). Il-103-10 additionally equipped with VOR/ILS, KN 63 DME, KMA 24 audio control/MKR, KCS 55A compass (MKS-1 in South Korean aircraft) and encoding altimeter.

DIMENSIONS, EXTERNAL:

Wing span	10.56 m (34 ft 7¾ in)
Wing aspect ratio	7.6
Wing chord: at root	1.825 m (5 ft 11¾ in)
at tip	0.96 m (3 ft 1¾ in)
Length overall	8.00 m (26 ft 3 in)
Fuselage: Length	7.81 m (25 ft 7½ in)
Max height	1.42 m (4 ft 8 in)
Max width	1.40 m (4 ft 7 in)
Height overall	3.135 m (10 ft 3½ in)
Tailplane span	3.90 m (12 ft 9½ in)
Wheel track	2.405 m (7 ft 10¾ in)
Wheelbase	2.045 m (6 ft 8½ in)
Propeller diameter	1.93 m (6 ft 4 in)
Baggage door: Width	0.70 m (2 ft 3½ in)
Height	0.34 m (1 ft 1¼ in)

DIMENSIONS, INTERNAL:

Cabin: Length	2.65 m (8 ft 8¼ in)
Max height	1.27 m (4 ft 2 in)
Max width	1.30 m (4 ft 3 in)

AREAS:

Wings, gross	14.71 m² (158.4 sq ft)
Ailerons (total)	1.137 m² (12.24 sq ft)
Flaps (total)	2.204 m² (23.72 sq ft)
Fin	0.84 m² (9.04 sq ft)
Rudder	0.56 m² (6.03 sq ft)
Tailplane	1.48 m² (15.93 sq ft)
Elevator	1.56 m² (16.79 sq ft)

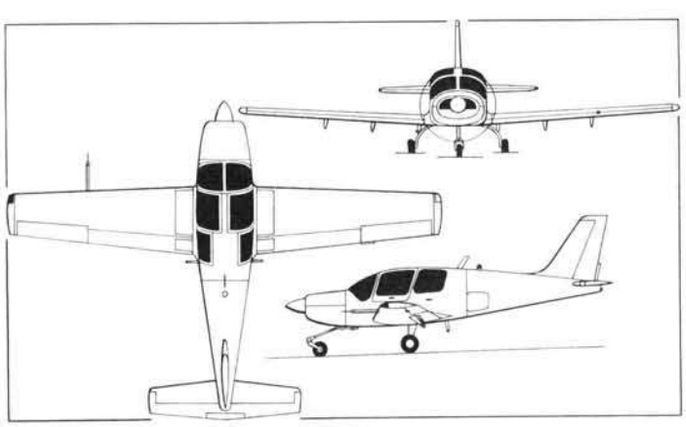
WEIGHTS AND LOADINGS:

Weight empty	900 kg (1,984 lb)
Baggage capacity	60 kg (132 lb)
Max payload	270 kg (595 lb)
Max fuel	150 kg (330 lb)
Max T-O weight	1,310 kg (2,888 lb)
Max wing loading	89.1 kg/m² (18.24 lb/sq ft)
Max power loading	8.37 kg/kW (13.75 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	183 kt (340 km/h; 211 mph)
Max level speed	119 kt (220 km/h; 137 mph)
Cruising speed	97 kt (180 km/h; 112 mph)
Stalling speed: flaps up	64 kt (117 km/h; 73 mph)
10° flap	60 kt (111 km/h; 69 mph)
Max rate of climb at S/L	190 m (623 ft)/min
Max certified altitude	3,000 m (9,840 ft)
T-O run	380 m (1,250 ft)
Landing run	320 m (1,050 ft)
Max range at cruising speed, pilot and 270 kg (595 lb) payload, 30 min reserves	432 n miles (800 km; 497 miles)
g limits: Utility	+4.4/−1.8
Aerobatic	+6/−3

OPERATIONAL NOISE LEVELS: Designed to conform with GOST 23023-85 and ICAO Annex 16



Ilyushin Il-103 two/five-seat multipurpose light aircraft *(James Goulding)* 1158062

ILYUSHIN Il-112

TYPE: Twin-turboprop transport.

PROGRAMME: Initiated 1994, with possibility of Russian government funding as alternative to Ukrainian Antonov An-38; design since enlarged and considerably refined; planned manufacture by KAPP at Kumertau and (Il-112V) VASO at Voronezh.

Revealed July 1999 that Il-112V selected by Russian defence ministry as potential replacement for Antonov An-24/26, Yak-40 and Let L 410; significant performance improvements to be achieved by redesign begun in same month. Presidential approval granted April 2000. First flight originally due in 2002, but revised timetable called only for final decision in that year between Il-112 and competitors. In April 2003, Il-112VT confirmed by Russian Air Forces selection committee as competition winner, overcoming opposition from Sukhoi Su-80-TD, MiG-110VT, Myasishchev M-601.VTS and Tupolev Tu-136T. Four-year development programme launched following 17 November 2003 approval by Air Forces C-in-C of aircraft's technical specification. This called for preliminary design to be complete by early 2004, full scale development to begin in mid-2004 and first Il-112VT to fly in 2006 at VASO plant. Early delays to this timetable experienced when mockup commission postponed six months from planned date of June 2004.

Russian Air Forces C-in-C confirmed continued commitment to Il-112 in January 2006. Development costs funded 30 per cent by Russian government and 70 per cent from private finance. Completion of development phase due in 2008.

VASO at Voronezh to build three flying and two static test prototypes; first of former for

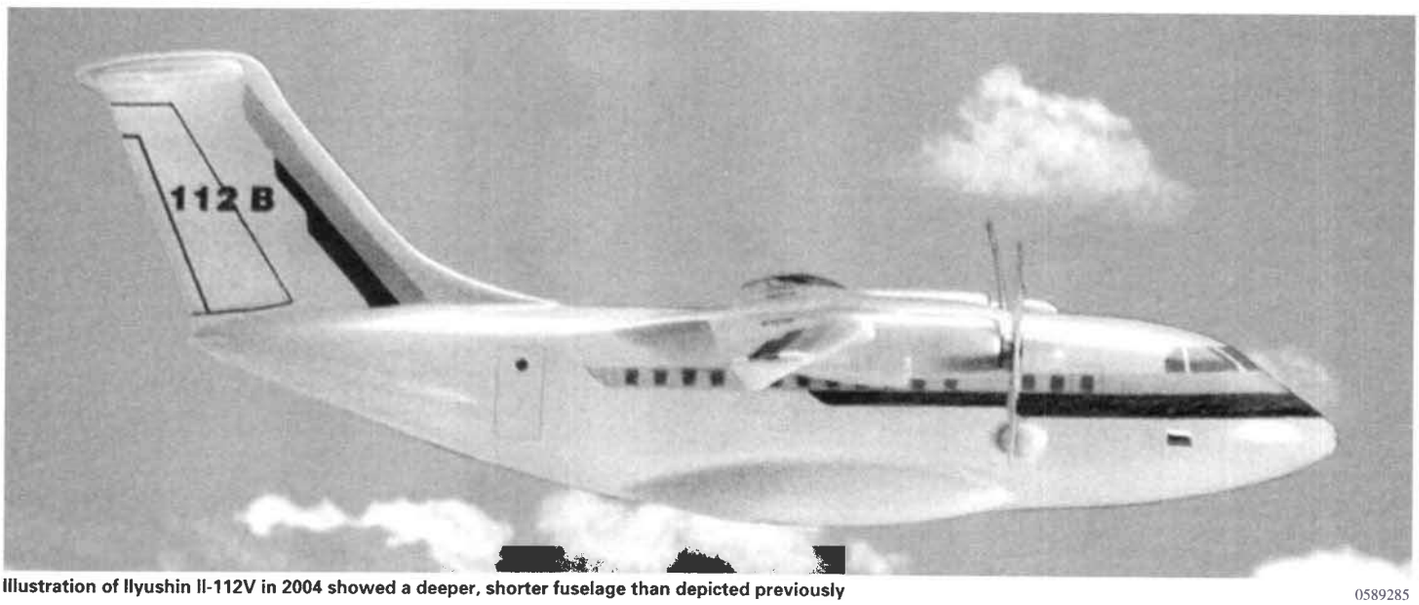


Illustration of Ilyushin Il-112V in 2004 showed a deeper, shorter fuselage than depicted previously

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aerodynamic testing; second for avionics; third in military configuration. Series production to enter service with Russian Air Forces' transport test centre at Ivonovo.

CURRENT VERSIONS: **Il-112:** Passenger transport, *as described in detail.*

Il-112 business transport: Basically as Il-112 airline version, but cabin divided into three sections, separated by curtains. Front cabin contains four pairs of facing seats, with tables between, and centre aisle, a wardrobe on the port side between the door and flight deck bulkhead, inward-opening door to flight deck, and large baggage compartment on starboard side with outside access.

Central compartment has four armchairs on port side, with tables between, three-seat sofa on starboard side to rear of cabinets; aisle width between armchairs and sofa 86 cm (34 in); wardrobe at rear on each side. Rear section contains main passenger door with airstairs on port side, two buffets, seat for attendant, and access to rear baggage compartment and lavatory.

Il-112T: Civil freighter with rear-loading ramp; lavatory and seat for loadmaster at front of unobstructed main hold; ramp forms rear wall of hold when stowed. Typical payloads include four 1AK-1.5 (LD3) or five 3AK-1 containers or five PA-1.5 pallets. Airstair door at front of hold on port side; service door opposite; emergency exit on each side in centre of hold. Certification due 2008.

Il-112VT: (*voennyy transportnyy:* military transport) Passenger/freighter for Russian armed forces. Rear ramp; provision for 35 passengers, or 18 stretchers or 34 paratroops. Patrol/surveillance version also to be produced. Detail design under way by early 2001; selected for production in April 2003.

CUSTOMERS: Requirement by Russian Air Forces could total up to 200, including telecommunications relay; estimated potential for 200 civil sales.

DESIGN FEATURES: Based on Il-114 airframe. Conventional high-wing monoplane with T tail; constant-chord wing centre-section, tapered outer panels; sweptback fin and rudder; circular-section pressurised fuselage.

FLYING CONTROLS: Entire trailing-edge of each wing made up of horn-balanced aileron and two-section, area-increasing flaps; two-section spoilers forward of flap on each side of centre-section. Horn-balanced rudder and elevators; tab in rudder.

LANDING GEAR: Retractable tricycle type; twin-wheel nose unit; single wheel on each main unit, retracting into large fairing outside fuselage pressure cell.

POWER PLANT: Two 2,090 kW (2,803 shp) Klimov TV7-117ST turboprops driving Aerosila AV-112 six-blade propellers in Il-112VT.

ACCOMMODATION: Flight crew of two; standard seating for 40 passengers, with 11 pairs of seats on port side and nine on starboard side of 45 cm (17.7 in) wide centre aisle. Maximum 60 in military version. Baggage/freight compartment with outside access on starboard side at front of cabin. Main airstair passenger door at rear of cabin on port side, with service door opposite; emergency exits at front of cabin on port side, in centre on starboard side. Access to rear baggage compartment and lavatory at rear of cabin; buffet and seat for attendant.

SYSTEMS: Aerosila TA-14 APU.

Following data generally refer to Il-112VT.

DIMENSIONS, EXTERNAL:

Wing span	25.74 m (84 ft 5½ in)
Length overall	23.14 m (75 ft 11 in)
Height overall	8.87 m (29 ft 1¼ in)

DIMENSIONS, INTERNAL:

Cabin freight volume	49.5 m³ (1,748 cu ft)

WEIGHTS AND LOADINGS:

Max payload	6,000 kg (13,227 lb)
Max T-O weight	19,700 kg (43,431 lb)
Max power loading	4.715 kg/kW (7.75 lb/shp)

PERFORMANCE (estimated):

Nominal cruising speed	297–313 kt (550–580 km/h; 342–360 mph)
T-O run	850 m (2,790 ft)
Landing run	550 m (1,805 ft)
Range: with max payload	540 n miles (1,000 km; 621 miles)
with 2 tonne payload	2,699 n miles (5,000 km; 3,106 miles)

ILYUSHIN Il-114

TYPE: Twin-turboprop airliner.

PROGRAMME:

DEVELOPMENT MILESTONES

Design submitted	1986
First flight	29 Mar 90
Certification	26 Apr 97
First flight, production	7 Aug 92

Design finalised 1986, as replacement for aircraft in An-24 class; was scheduled to enter service (with Aeroflot's Tashkent division) in 1992. Prototype (SSSR-54000) first flew at Khodinka 29 March 1990; second prototype (SSSR-54001) flew at Khodinka 24 December 1991, but lost in accident on 5 July 1993, resulting in withdrawal of government funding. Series production by TAPO at Tashkent, Uzbekistan, initial aircraft comprising Nos. 0101, 0103 and 0105 for flight development plus 0102 for static tests and 0104 for dynamic tests; first production aircraft flew 7 August 1992. Certification delayed by loss of second prototype and deferred certification of TV7 engines, but finally achieved on 26 April 1997. Negotiations reportedly under way in 1996 for production at Esfahan by Iran Aircraft Manufacturing Company; this venture lapsed upon selection of rival Antonov An-140. Recent development effort centred on -100 version and upgraded TV7-117SM engine. Latter installed in Il-114 line number 0109 (Il-114LL RA-91003) in June 2004 for flight trials, at which time certification testing under way of modified TsPNK-114M autopilot for -100 version.

In 1998, Russian and Uzbek governments agreed to promote Il-114; Ilyushin and Inkombank signed provisional agreement for production funding (although the bank's trading licence was revoked shortly afterwards, resulting in further delays); and Uzbekistan Airlines took delivery of production aircraft, making first commercial flight on 27 August 1998.

CURRENT VERSIONS: **Il-114:** *As described in detail.*

Il-114T: Cargo version developed for Uzbekistan Airlines; port freight door, size 3.25 × 1.715 m (10 ft 8 in × 5 ft 7½ in) in rear fuselage; removable roller floor; cargo attendants' cabin at forward end of freight hold accommodates up to two persons, is smokeproof and variable in size. MTOW and performance as for Il-114 passenger version, except where otherwise indicated. First production example (RA-91005) flew at Tashkent 14 September 1996. Second (UK-91004) converted by 1998, but lost in accident 5 December 1999. Prototype delivered to LII at Zhukovsky in early 2000 for certification trials; these were continued in Yakutia in early 2002.

Il-114-N200S: Rear loading ramp version; none yet built.

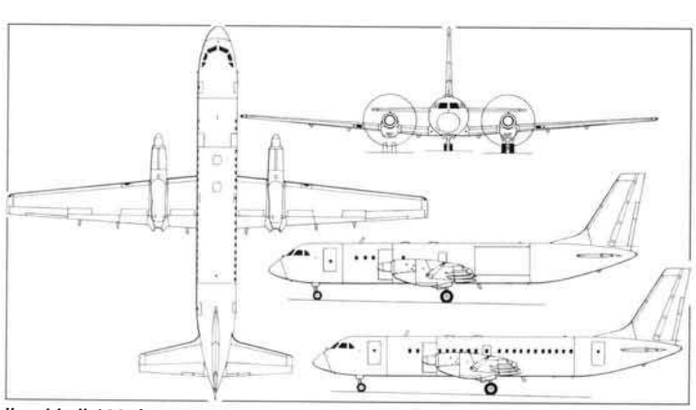
Il-114-100: With 2,051 kW (2,750 shp) P&WC PW127H turboprops, Hamilton Sundstrand 586E-7 six-blade propellers, Sextant avionics and new systems; primarily for export; English inscriptions and Imperial calibration; designated **Il-114PC** until late 1997; passenger and cargo (**Il-114-100T**) versions envisaged. Performance generally as Il-114, but with increased range and economy. Weight empty, equipped (including two crew) 16,100 kg (35,494 lb). Joint venture agreed by Ilyushin and P&WC on 16 June 1997; first flight at Tashkent (UK-91009) 26 January 1999; CIS Interstate Aviation Committee type certificate awarded 27 December 1999.

Il-114-X00: Under development by 2005; generally as Il-114-100 except NIIAO TsPNK-114M upgraded avionics, including some Rockwell Collins equipment and Barco displays (reportedly similar to ARIA suite of Beriev Be-200 Altair). Testbed to fly in 2006.

Il-114LL: Flying laboratory. RA-91003 employed as testbed by Radar MMS company; exhibited at Moscow Salon in 2005. TV7-117SM engines. Reportedly with Aisberg-Razrez survey and mapping radar.

Il-114M: With TV7M-117 turboprops, increased maximum T-O weight and 7,000 kg (15,430 lb) payload.

Il-114MA: Version of Il-114M with P&WC engines to carry 74 passengers at 324–351 kt (600–650 km/h; 373–404 mph) on 1,079 n mile (2,000 km; 1,242 mile) stages.



Ilyushin Il-114 short-range passenger transport, with additional side view (upper) of Il-114T freighter *(Mike Keep)*

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Unique Ilyushin Il-114LL flying laboratory *(Yefim Gordon)*

Il-114P and Il-114MP: Maritime patrol versions. Described in 2001–02 and previous editions of *Jane's All the World's Aircraft*. Development continuing in 2005 and to be completed during that year. MP has Rolls-Royce 2100 engines.

Il-114FK: Military reconnaissance/cartographic survey version. Described in 2001–02 and previous editions.

Il-114PR: Announced October 2000; patrol, electronic intelligence gathering and electronic warfare. TV7-117S Srs 2 or PW127H engines.

Il-114PRP: As Il-114PR but alternative PW150 engines.

Il-140: Tactical air control (Il-140) and maritime patrol/SAR (Il-114M) versions under study by October 2000. No further reports, but at International Maritime Defence Show at St Petersburg in June 2003, Radar-MMS showed a model of an Il-114 with Il-20M style of sigint/LOROP camera fairings, dorsal (Il-22 style) and ventral antenna pods and pylon-mounted SLAR pods.

CUSTOMERS: Uzbekistan Airlines purchased two pre-series aircraft in 1994; later modified with extra lavatory, new galley and accommodation reduced from 64 to 52; each flew 300 hours before engine overhaul time expiry and grounding; airline operated both Il-114Ts on service trials in 1998 and had total requirement for 10 Il-114/Ts, three of which on order in Il-114-100 configuration by April 2000 for delivery in March and April 2001, but failed to appear; first received in December 2002, with remaining two due in second half of that year, although further postponed, with first eventually in service by August 2004. Further two due by late 2004 and balance of six within next three years. Interest expressed by Bulgarian airlines; order for three Il-114-100s from Singaporean purchaser reported early 2000; delivery planned in 2001, although nothing further heard. Vyborg ordered three new aircraft in 2001 for operations from St Petersburg; deliveries planned for 2002 in 64-seat configuration, but first receipts, from August 2002, were two former Uzbekistan Airlines aircraft following their modification for flights in western European airspace. Vyborg services from St Petersburg began early May 2003 and "at least two" new aircraft were rescheduled for 2004 delivery and confirmed under assembly in mid-2004. Three (excluding prototype) owned by Ilyushin Bureau.

Total of 15 flying or substantially complete January 1998, most awaiting orders; delivery totals officially quoted as 1992 two, 1993 one, 1994 one, 1997 one and 1998 one. No further new production by end of 2001, when seven remained on assembly line, including two Il-114Ts; situation similar in late 2005, when "no fewer than 10" airframes, plus other subassemblies said to be present; by early 2002, components sets for first 40 production aircraft had been manufactured wholly or in part. Transaero opened negotiations in 2001 for between five and 10. In January 2006, Ilyushin's general director noted "preliminary orders for 30 aircraft".

COSTS: USD10 million for Il-114; USD8 million for Il-114T (2000).

DESIGN FEATURES: Conventional low-wing monoplane; only fin and rudder swept; slight dihedral on wing centre-section, much increased on outer panels; operation from unpaved runways practical. Service life of 30,000 cycles/30,000 hours/30 years, with overhaul at 6,000 hour intervals.

FLYING CONTROLS: Manual actuation for all except elevator; each wing trailing-edge occupied entirely by aileron, with servo and trim tabs, and hydraulically actuated double-slotted trailing-edge flaps, inboard and outboard of engine nacelle; two airbrakes (inboard) and spoiler (outboard) forward of flaps; spoilers supplement ailerons differentially in event of engine failure during take-off. Elevator control is FBW with back-up cable actuation. Trim and servo tabs in rudder, trim tab in each elevator.

STRUCTURE: Approximately 10 per cent of airframe by weight made of composites; two-spar wings; removable leading-edge on outer panels; circular-section aluminium alloy semi-monocoque fuselage built as five subassemblies; metal tail unit (CFRP tailplane and fin boxes planned for later aircraft).

LANDING GEAR: Retractable tricycle type, with twin wheels on each unit. All retract forward hydraulically; emergency extension by gravity. Oleo-pneumatic shock-absorbers. Tyres size 620×80 on nosewheels, 880×305 on mainwheels. Nosewheels steerable ±55°. Disc brakes on mainwheels. All wheel doors remain closed except during retraction or extension of landing gear.

POWER PLANT: Two 1,839 kW (2,466 shp) Klimov TV7-117S turboprops (with potential to increase, as TV7-117SM, to 2,088 kW; 2,800 shp), each driving a low-noise six-blade Stupino SV-34 CFRP propeller. Integral fuel tanks in wings, capacity 8,780 litres (2,319 US gallons; 1,931 Imp gallons).

ACCOMMODATION: Flight crew of two, plus stewardess. Emergency exit window each side of flight deck. Four-abreast seats for 64 passengers in main cabin, at 76 cm (30 in) seat pitch, with central aisle 45 cm (17¾ in) wide. Provision for rearrangement of interior for increased seating, removal of seats for cargo-carrying, and lengthening of fuselage for 70 to 75 passengers. Two passenger doors on port side: airstair door at front of cabin, further door at rear, both opening outward. Galley, cloakroom and lavatory at rear; emergency escape slide by service door on starboard side. Type III emergency exit over each wing. Service doors at front and rear of cabin on starboard side. Baggage compartments forward of cabin on starboard side and to rear of cabin, plus overhead baggage racks. Optional carry-on baggage shelves in lobby by main door at front.

SYSTEMS: TsNPKO-114 autopilot began trials on Il-114-100 in 2001. Dual-redundant pressurisation and air conditioning system using bleed air from both engines; maximum differential 0.44 bar (6.4 lb/sq in). Two independent hydraulic systems, pressure 207 bar (3,000 lb/sq in), for landing gear actuation, wheel brakes, nosewheel steering, airbrakes and flaps. Three-phase 115/220 V 400 Hz AC electrical system powered by 40 kW alternator on each engine. Secondary 24 V DC system. Wing and tail unit leading-edges de-iced electrically by patented pulse wave system. Electrothermal anti-icing system for propeller blades and windscreen. Engine air intakes de-iced by hot air. APU in tailcone.

AVIONICS: Digital avionics for automatic or manual control by day or night, including automatic approach and landing in limiting weather conditions (ICAO Cat. I and II).

Instrumentation: Two colour CRTs for each pilot for flight and navigation information. Centrally mounted CRT for engine and systems data.

Flight: Barco computer for FMS.

DIMENSIONS, EXTERNAL:

Wing span	30.00 m (98 ft 5¼ in)
Wing aspect ratio	11.0
Length overall	26.875 m (88 ft 2 in)
Fuselage: Length	26.20 m (85 ft 11½ in)
Max diameter	2.86 m (9 ft 4½ in)
Height overall	9.185 m (30 ft 1½ in)
Tailplane span	11.10 m (36 ft 5 in)
Wheel track	8.40 m (27 ft 6½ in)
Wheelbase	9.13 m (29 ft 11½ in)
Propeller diameter	3.60 m (11 ft 9¾ in)
Propeller ground clearance	0.50 m (1 ft 7¾ in)
Propeller fuselage clearance	0.97 m (3 ft 2¼ in)
Passenger doors (each): Height	1.70 m (5 ft 7 in)
Width	0.90 m (2 ft 11¼ in)
Service door (front): Height	1.30 m (4 ft 3¼ in)
Width	0.96 m (3 ft 1¾ in)
Service door (rear): Height	1.38 m (4 ft 6¼ in)
Width	0.72 m (2 ft 4¼ in)
Emergency exit (each): Height	0.91 m (3 ft 0 in)
Width	0.51 m (1 ft 8 in)

DIMENSIONS, INTERNAL:

Length between pressure bulkheads	22.24 m (72 ft 11½ in)
Cabin: Length	18.93 m (62 ft 1¼ in)
Width: max	2.64 m (8 ft 8 in)
at floor	2.28 m (7 ft 5¾ in)
Max height	1.92 m (6 ft 3½ in)
Cargo cabin volume (Il-114T)	76.0 m³ (2,684 cu ft)

AREAS:

Wings, gross	81.90 m² (881.6 sq ft)

WEIGHTS AND LOADINGS:

Operating weight empty	15,000 kg (33,070 lb)
Max payload	6,500 kg (14,330 lb)
Max fuel	6,500 kg (14,330 lb)
Max T-O weight	23,500 kg (51,808 lb)
Max ramp weight	23,600 kg (52,029 lb)
Max wing loading	286.9 kg/m² (58.77 lb/sq ft)
Max power loading	6.39 kg/kW (10.50 lb/shp)

PERFORMANCE:

Max level speed	270 kt (500 km/h; 310 mph)
Cruising speed	254 kt (470 km/h; 292 mph)
Approach speed	100 kt (185 km/h; 115 mph)
Landing speed	87 kt (160 km/h; 100 mph)
Optimum cruising height: Il-114	7,600 m (24,940 ft)
Il-114T	6,000 m (19,680 ft)
T-O run: paved	1,360 m (4,465 ft)
Landing run: paved or unpaved	1,260 m (4,135 ft)
Range, with reserves:	
with 64 passengers	540 n miles (1,000 km; 621 miles)
with 1,500 kg (3,300 lb) payload	2,590 n miles (4,800 km; 2,980 miles)

INTERAVIA

INTERAVIA RADONEZH AO (INTERAVIA RADONEZH JSC)

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GENERAL DIRECTOR: Sergey Esayan

Interavia has marketed the I-1L high-wing lightplane and I-3 aerobatic sportplane and designed what is now the Smolensk (Technoavia) Finist. The 3,000 m² (32,300 sq ft) Radonezh plant at Repikhovo, near Zagorsk, a former medium-range ballistic missile factory, built 23 I-3s before production was moved to RSK 'MiG' at Lukhovitsy in 2004; first examples from here appear to have been delayed. Majority shareholding in Interavia is held by Eagle Aerospace of Switzerland.

Single-seat Interavia I-3M 1121675

INTERAVIA I-3

TYPE: Aerobatic two-seat sportplane.

PROGRAMME: Designed by former Sukhoi personnel, also responsible for Su-26, Su-29 and Su-31 aerobatic types. Batch of 50 I-3s begun by Tushinsky Mashinostroitelnyi Zavod AO (Tushino Machine-Building Plant Ltd), Moscow, in early 1990s to order of Chechnya, but embargoed by Russian government. Five were completed as Technoavia SP-91s, but definitive SP-95 version failed to materialise; however, four SP-91s exported to USA, where one incorrectly registered as an SP-95. Fifth (RA-44496) retained as demonstrator, but subsequently to Skydance Aero Team in Germany. Sixth, designated SP-91L, built in 2000 and also based in Germany with Yak Team (as RA-44522).

Prototype I-3 exhibited at Moscow Air Show in 1993. Exports to USA began in 1996, some being registered as E-3s. Production transferred from Tushino to Repikhovo, with final assembly at Myachkovo; now at Lukhovitsy.

CURRENT VERSIONS: **SP-91/95:** Built by TMZ for Technoavia as two-seaters.

I-3: Built by Radonezh for Interavia.

I-3M: Built by RSK 'MiG' for Interavia. Increased fuel capacity; 50 kg (110 lb) decrease in empty weight; flush rivets; revised instrument panel with improved (Western) navaids; lightened canopy (including green tinted transparency); lightweight electrical system; wing/fuselage fairings; Western (Cleveland) wheels and (Parker) brakes; MT propeller; option of smoke system, strobe lights and 294 kW (394 hp) M-14PF engine.

As described.

Manufacture of I-3M began at Lukhovitsy in 2004, deliveries being due from March 2005, although subsequently delayed. In July 2006, announced that first I-3M due for delivery by end of 2006.

CUSTOMERS: Total of 23 built at Radonezh plant; last in 2004 for South African customer. I-3M had "15 or 16" orders by mid-2006.

COSTS: USD150,000 to 180,000 (2006).

DESIGN FEATURES: Conventional low-wing monoplane, capable of unlimited aerobatics: roll rate 345 °/s; tapered multispar wings of symmetrical section, without dihedral or anhedral; unswept tail surfaces with pointed rudder tip; clear-view blister canopy over one or two seats. At least two modified by removal of rudder tip. Convertible from two-seater to single-seater in 1 hour by removal of front cabin bay with control panel, installation of top fuselage panel and changing of canopy.

Wing incidence 0°; dihedral 0° at chord line.

FLYING CONTROLS: Manually actuated conventional horn-balanced elevators and horn-balanced rudder; 80 per cent span flaperons. Ground-adjustable tab on rudder; two suspended balance tabs on each flaperon. Control surface deflections: ailerons ±25°; elevators ±25°; rudder ±25°.

STRUCTURE: All-metal; semi-monocoque fuselage; fluted skin on fin, tailplane and all control surfaces.

LANDING GEAR: Tailwheel type, fixed; cantilever mainwheel legs. Mainwheel tyres size 400×150; tailwheel tyre size 200×80. Cleveland wheels and Parker brakes.

POWER PLANT: One 265 kW (355 hp) VOKBM M-14P nine-cylinder air-cooled radial engine driving an MT-Propeller MTV-9 three-blade, variable-pitch propeller. Fuel tank in each wingroot, combined capacity 120 litres (31.7 US gallons; 26.4 Imp gallons), of which 110 litres (29.0 US gallons; 24.2 Imp gallons) usable. Oil capacity 20 litres (5.3 US gallons; 4.4 Imp gallons).

ACCOMMODATION: One or two seats in tandem. Seats adapted for Western style flat parachutes and with Hooker harness.

SYSTEMS: Pneumatic system pressure 49 bar (711 lb/sq in).

DIMENSIONS, EXTERNAL:

Wing span	8.10 m (26 ft 7 in)
Wing aspect ratio	5.7
Length overall	6.72 m (22 ft 0½ in)
Tailplane span	2.72 m (9 ft 2¼ in)
Propeller diameter	2.40 m (7 ft 10½ in)

AREAS:

Wings, gross	11.54 m² (124.2 sq ft)
Ailerons (total)	1.76 m² (18.94 sq ft)
Fin	0.425 m² (4.57 sq ft)
Rudder, incl tab	0.915 m² (9.84 sq ft)
Tailplane	1.05 m² (11.30 sq ft)
Elevators (total, incl tab)	1.25 m² (13.45 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: single-seat	748 kg (1,648 lb)
two-seat	767 kg (1,692 lb)
Max T-O weight: ferry	1,200 kg (2,645 lb)
solo aerobatic	1,057 kg (2,330 lb)
Max wing loading, aerobatic	92.1 kg/m² (18.86 lb/sq ft)
Max power loading, aerobatic	4.02 kg/kW (6.60 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	250 kt (463 km/h; 288 mph)
Max level speed	175 kt (324 km/h; 201 mph)
Manoeuvring speed	215 kt (398 km/h; 247 mph)
Stalling speed, flaps up, power on	33 kt (60 km/h; 38 mph)
Service ceiling	5,000 m (16,400 ft)
T-O run: paved runway	200 m (660 ft)
unpaved runway	262 m (860 ft)
Landing run: paved runway	452 m (1,485 ft)
unpaved runway	514 m (1,685 ft)
g limits: single seat	+12/−10
two seats	+10/−8

IRKUT

NAUCHNO-PROIZVODSTVENNAYA KORPORATSIYA IRKUT OAO (IRKUT SCIENTIFIC-PRODUCTION CORPORATION JSC)

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Founded on 28 March 1932 and commissioned on 24 August 1934, as GAZ 125 (becoming GAZ 39 in 1941), Irkut has built some 6,500 aircraft of 16 types from Antonov, Ilyushin, MiG, Petlyakov, Sukhoi, Tupolev and Yakovlev bureaux and supplied them to 21 countries. In recent years, it has manufactured MiG-23UB trainers (1970–85); 165 kits for Indian-assembled MiG-27MLs; Su-27UB trainers (from 1986); and is currently responsible for producing the Su-30 fighter (since 1991) and Beriev Be-200 amphibian. Su-30 customers include China and India; offers Su-27UBM and Su-30KN upgrades to older aircraft. Series manufacture of the Yak-112 lightplane has been abandoned, although company has been allocated prospective manufacture of the Ilyushin/HAL Il-214 twin-jet transport. Also offers upgrades of Su-30, Mi-8, Mi-24, Aero L-39, Il-76 and Il-103.

Irkut shareholders are Brunswick UBS Warburg Nominees (25.72 per cent), Forpost Commercial Bank (20.60 per cent), FTK Company (20.35 per cent), APVK Sukhoi (14.70 per cent), Aerocom (10.18 per cent), other companies (4.9 per cent) and individuals (3.55 per cent). Subsidiary companies are Irkut Aviation Industrial Association (aircraft manufacturing plant), Beriev (39.57 per cent holding), Beta-Air (66.15 per cent), Russian Avionics (51 per cent), Irkut Aviastep (wholly owned), Itela (51 per cent), Techserviceavia (51 per cent), Gidroaviasalon (30 per cent) and Irkut private pension fund (wholly owned).

Is member of AVPK Sukhoi. Known from April 1989 until 2002 as IAPO (Irkutsk Aviation Industrial Association), having become a joint stock company in October 1992, but on 19 December 2002, shareholders approved a company change of name to Irkut NPK OAO, IAPO becoming a subsidiary. In 1997 was first Russian aviation enterprise to gain ISO 9002 status and in April 2001 became first Russian military production enterprise to issue short-term debt notes on financial market.

In 2000, IAPO branched out into design and manufacture of its own products in the form of the prototype A-002 autogyro, having acquired its own design bureau, AviaSTEP, in 1996. Expansion of civil programmes is strategic objective. The Irkut 111 design is for an ultra-wide-bodied regional airliner with twin fins and three-aisle configuration for only 106 passengers. This remains a long-term project, while Irkut continues to work on more immediate programmes, including contributing to the Ilyushin/Yakovlev MS-21 regional airliner.

Under government plans announced in May 2001, IAPO is to join the aerospace group also including Sukhoi, Ilyushin, Mil, Yakovlev and their associated factories. In August 2003, Irkut and Yakovlev announced plans for a joint venture company to manage their eventual merger, agreed in October 2003 by means of a 75.5 per cent share of Yakovlev stock, valued at US$45 million. Employees in 2003 totalled 22,000 including 15,000 at IAPO factory; further 1,500 firms supply plant with materials. Irkut planned 20 per cent public stock flotation in 2004.

In September 2004, former Irkut President Alexey I Fedorov was appointed head of RSK 'MiG', fuelling speculation of possible merger of the two firms.

IRKUT A-002

TYPE: Three-seat autogyro.

PROGRAMME: Project announced October 2000; first product of Irkutsk Light Aircraft Design Bureau (OKB Legkoi Aviatsy OAO), although an experimental version was tested in 1998. Designer: Andrey Tatarnikov. Almost complete prototype shown at Moscow, August 2001. Maiden flight 21 April 2002. Production launched August 2002. However, in October 2003, Irkut delayed deliveries to 2004 and curtailed production to five, pending further development. Nothing further heard until April 2005, when trials were reportedly nearing conclusion, with deliveries to begin in mid-2005. This also appears not to have taken place, but by early 2006 revised specification had been published, showing increases in rotor diameter (0.50 m; 1 ft 7¾ in), fuselage length (0.93 m; 3 ft 0½ in), empty (120 kg; 265 lb) and max T-O (50 kg; 110 lb) weights.

General arrangement of the Irkut A-002 autogyro 0121087

Irkut A-002 three-seat autogyro prototype 0593357

CUSTOMERS: First two deliveries were due in late 2003 to Susuman Susumanzoloto OAO mining company. Sales contracts then held for 20 aircraft; second buyer (also two) being Irkutskenergo OAO for powerline inspection.

COSTS: USD150,000 (2005).

DESIGN FEATURES: Conforms to FAR Pt 27 and Russian AP-27. Streamlined, cabin autogyro which can be stored and serviced in a motorcar garage. Choice of engines, including those using motorcar fuel. Classic configuration, with pusher propeller; single, sweptback fin with large rudder; broad track landing gear. Engine-driven pre rotation of rotor.

FLYING CONTROLS: Manual. All-moving tailplane mounted at one-third of fin height; horn- and mass-balanced rudder.

STRUCTURE: Generally of metal. Rudder and elevator of composites.

LANDING GEAR: Tricycle type; fixed. Cantilever-spring mainwheels; rubber in-compression shock-absorber on nosewheel. Mainwheel tyres 400×150; nose 300×125. Hydraulic disc brakes on mainwheels. Safety tail skid on prototype; auxiliary tailwheel on production version.

POWER PLANT: Prototype has one 157 kW (210 hp) Teledyne Continental IO-320 flat-six driving a fixed-pitch, two-blade propeller. Alternative engines of 134 to 157 kW (180 to 210 hp) and three-blade propeller can be installed. Subaru EJ 40 motorcar engine being preferred option.

ACCOMMODATION: Two front seats, side by side, with dual controls; single rear seat. Upward hinged door each side. Heating and ventilation provided.

DIMENSIONS, EXTERNAL:

Rotor diameter	10.30 m (33 ft 9½ in)
Length of fuselage	5.91 m (19 ft 4¾ in)
Height, rotor removed	3.30 m (10 ft 10 in)
Wheel track	2.40 m (7 ft 10½ in)
Wheelbase	2.015 m (6 ft 7¾ in)
Propeller diameter	1.90 m (6 ft 2¾ in)

AREAS:

Rotor disc	83.32 m² (896.9 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	620 kg (1,367 lb)
Max T-O weight	900 kg (1,984 lb)
Max rotor loading	10.80 kg/m² (2.21 lb/sq ft)
Max power loading	5.75 kg/kW (9.45 lb/hp)

PERFORMANCE (157 kW; 210 hp) engine:

Max level speed	113 kt (210 km/h; 130 mph)
Min flying speed	33 kt (60 km/h; 38 mph)
Max rate of climb at S/L	210 m (689 ft)/min
Service ceiling	2,400 m (7,880 ft)
T-O run: jump start	zero
normal	40 m (135 ft)
Landing run	up to 10 m (35 ft)
Range	324 n miles (600 km; 372 miles)

ISTRA

ISTRINSKIY EKSPERIMENTALNYI MEKHANICHESKIY ZAVOD (ISTRA EXPERIMENTAL MECHANICS DEPOT)

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DIRECTOR: Yury D Bazhanov
CHIEF ENGINEER: Eduard Bebeko

Istra EMZ formed 1997 as light aviation division of buildings materials company Vitek, and was previously known by that name. Promotion continues of the previous Ovod lightplane, of which only two appear to have been built. In March 2002, the company announced that it had completed design of the Ezhik agricultural aircraft, while a light helicopter project was unveiled in 2006. A three-seat lightplane and four-seat amphibian are also reported to be under development.

Company's 3,500 m² (37,675 sq ft) plant is capable of producing 30 light aircraft per year.

ISTRA EZHIK

English name: Hedgehog

TYPE: Agricultural sprayer.

PROGRAMME: Design begun in 1999 and completed by March 2002; construction of prototype then begun; public debut was then planned for August 2003 Moscow Salon but was rescheduled for the first half of 2004 and later revised to "Summer" 2004.

DESIGN FEATURES: Economic sprayer, with same payload as Sukhoi Su-38L, but at half purchase price. Raised cockpit with good forward/downward view. Constant-chord, low-mounted, cantilever wings; initially with sweptback tail surfaces with mutual wire bracing, but by mid 2005 had gained twin rectangular fins; narrow, deep fuselage. Fuel tanks designed to collapse in event of impact.

FLYING CONTROLS: Conventional and manual. No horn balances.

LANDING GEAR: Tailwheel type; fixed. Two side Vs hinged to lower longerons, plus half-axles attached to compression frame.

IEMZ Ezhik modified with twin fins *(Yefim Gordon)* 1158659

POWER PLANT: Initially intended to utilise one 154 kW (207 hp) LOM M337A six-cylinder piston engine operating on A-76 motorcar fuel; later revised to 157 kW (210 hp) Walter Minor M-337A. Fuel capacity 60 litres (15,9 US gallons; 13,2 Imp gallons).

ACCOMMODATION: Pilot only, in enclosed cockpit behind 'unbreakable' glass.

EQUIPMENT: Chemical hopper; eight rotary atomisers beneath wings. Motorised pump and sprayer being sourced from UK; distribution atomisers from USA; emergency purge takes 3 seconds; spray width 20 m (65 ft). Wire cutting system fitted in front of cockpit.

DIMENSIONS, EXTERNAL:

Wing span	12.00 m (39 ft 4½ in)[1]
Wing chord, constant	2.20 m (7 ft 2½ in)
Length overall	9.20 m (30 ft 2¼ in)
Height overall	3.05 m (10 ft 0 in)
Tailplane span	4.30 m (14 ft 1¼ in)

[1] *Company literature also gives 11.00 m (36 ft 1 in)*

AREAS:

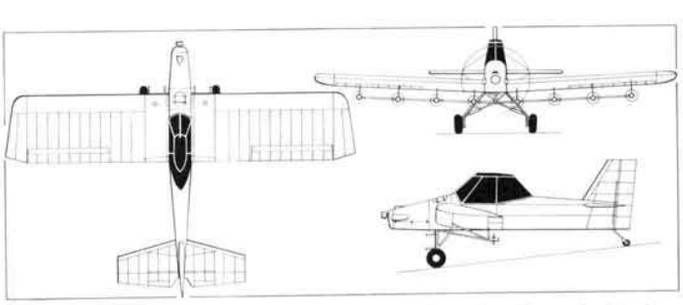
Wings, gross	24.25 m² (261.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	650 kg (1,433 lb)
Payload: normal	300 kg (661 lb)
max	360 kg (794 lb)
Max T-O weight	1,150 kg (2,535 lb)
Max wing loading	47.4 kg/m² (9.71 lb/sq ft)
Max power loading	7.32 kg/kW (12.03 lb/hp)

PERFORMANCE:

Max level speed	97 kt (180 km/h; 112 mph)
Spraying speed	59–81 kt (110-150 km/h; 68–93 mph)
Max rate of climb at S/L	270 m (885 ft)/min
T-O run	120 m (394 ft)
T-O to 15 m	260 m (853 ft)
Range	540 n miles (1,000 km; 621 miles)



Vitek Ezhik agricultural sprayer in its original configuration *(James Goulding)* 0525933

ISTRA ISTRA

TYPE: Two-seat helicopter.

PROGRAMME: Announced 2006.

DESIGN FEATURES: Intended to fulfil a variety of roles including flight training, patrol, aerial photography and mail flights.

FLYING CONTROLS: Conventional and manual. Automatic pitch-control mechanism with rigid drawbars. Cable-operated collective pitch for tail rotor.

STRUCTURE: Fuselage of welded steel tube cage and aluminium alloy skin; tailboom of aluminium alloy semi-monocoque. Rocker-style rotor hub with gyrostabilisation. Composites rotor blades have negative twist and thickness ratio of 12 per cent.

LANDING GEAR: Aluminium alloy skid.

POWER PLANT: One 123 kW (165 hp) LOM M137 six-cylinder inline piston engine mounted vertically with single-level gearbox, belt-driven transmission and axial-flow blower cooling.

All data provisional.

DIMENSIONS, EXTERNAL:

Main rotor diameter	8.00 m (26 ft 3 in)
Fuselage length	9.64 m (31 ft 7½ in)
Height to top of rotor head	2.99 m (9 ft 9¾ in)

AREAS:

Main rotor disc	50.27 m² (541.05 sq ft)

Istra Istra light helicopter *(Paul Jackson)* 1158577

WEIGHTS AND LOADINGS:

Weight empty	380 kg (838 lb)
Max payload	180 kg (397 lb)
Max T-O weight	680 kg (1,499 lb)
Max disc loading	13.5 kg/m² (2.77 lb/sq ft)
Max power loading	5.52 kg/kW (9.08 lb/hp)

PERFORMANCE (two occupants):

Max operating speed	86 kt (160 km/h; 99 mph)
Range	162 n miles (300 km; 186 miles)

KAMOV

KAMOV OAO (KAMOV JSC)

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DEPUTY GENERAL DESIGNER: Beniamin A Kasyanikov

CHIEF DESIGNERS:

Boris Gubarev (Ka-115)
Vyacheslav Krygin
Evgeny Pak
Aleksandr Piorzhnikov
Grigory Yakemenko (Ka-50)
Evgeny Sudarev

Formed in 1948 by Prof Dr Ing Nikolai Ilyich Kamov, this OKB originated in an experimental autogyro production plant operating in Moscow from 1940 to 1943. Kamov's initial brief was to design helicopters for naval use. Since the Ka-10 of 1949, Kamov helicopters have had coaxial contrarotating rotors; only the Ka-60/62, under development, have single main rotor, with anti-torque Fenestron. It was reported in September 2000 that a new transport helicopter, to compete against Western NH90 and S-92, is under development, but no further reports had been received by early 2005.

Since 1996, Kamov has been a member of the RSK 'MiG' consortium. Under plans announced in May 2001 by the Russian government, Kamov and MiG will be in the major aerospace grouping which also includes Tupolev, Aviastar, Aviacor and those factories producing Kamov helicopters, namely the Arsenyev factory (Ka-50) and the Kumertau factory (Ka-32 family). In 2002–03, Kamov was in the process of moving its flight test activities from the factory site at Lyubertsy to Chkalovsky, in the Shchelkovo area of Moscow Region, to escape the restrictions of urban development.

In September 2003, the Geralsy Group of Saudi Arabia announced plans for local manufacture of undisclosed Kamov helicopters. During the following month, Kamov agreed with Chinese industrial representatives on joint development of a fifth-generation combat helicopter, using Ka-50 and Ka-52 as a basis.

The affiliated Aero-Kamov Air Transportation Company (Tel/Fax: (+7 095) 700 31 60) operates a fleet of Ka-32s for diverse tasks, including firefighting, and has helicopters based in Russia, Canada and South Africa. Kamov Holding management company established in 2003 for financial and marketing functions.

KAMOV Ka-29, Ka-31 and Ka-35

NATO reporting name: Helix-B

TYPE: Medium transport helicopter; AEW helicopter.

PROGRAMME: Developed for AV-MF, following cancellation of proposed joint-service, tandem-rotor, multirole V-50 and its replacement by what became Ka-50, meeting Army requirement only. Ka-252TB prototype (also known as Izdelie D2B or Izdelie 502) first flew 28 July 1976, possibly with Ka-25 nose or original narrow Ka-27/Ka-32 nose. Production at Kumertau (KAPP) from 1984.

Entered service with Northern and Pacific Fleets 1985; photographed on board assault ship *Ivan Rogov* in Mediterranean 1987, thought to be Ka-27B and given NATO reporting name 'Helix-B'; identified as Ka-29 combat transport at Frunze (Khodinka) Air Show, Moscow, August 1989; Ka-31 radar picket version completed initial shipboard trials on aircraft carrier *Admiral of the Fleet Kuznetsov* (then *Tbilisi*) 1990.

CURRENT VERSIONS: **Ka-29TB: ('Helix-B')** Armed derivative for day/night, VFR and IFR, transport and close support of seaborne assault troops; in-the-field conversion from one role to the other. Non-retractable landing gear and 50 cm (20 in) wider armoured flight deck. Reportedly used by Experimental Combat Group in Chechen War in 1996. No recent production known.

Detailed description generally as for Ka-32 except as under.

Ka-31: (formerly **Ka-29RLD**; *radiolokatsyonnogo dozora:* radar picket helicopter) Development began 1980; company designation 03D2; first flown October 1987; two examples (031 and 032) tested on *Admiral of the Fleet Kuznetsov*; state testing completed in 1996; limited production launched (for Indian Navy) at Kumertau Aircraft Plant, Bashkirskaya, 1999.

Basic airframe of Ka-27 (which see in 2001–02 and earlier *Jane's*) with broader flight deck; E-801M or E-801E (export) Oko (eye) early warning radar system (E-801 in prototypes) by Radio Engineering Institute, Nizhny Novgorod, includes large (6.00 m; 19 ft 8¾ in) rotating radar antenna (area 6.0 m²; 64.5 sq ft) that stows flat against underfuselage and deploys downward, turning through 90° into vertical plane before starting to rotate at 6 rpm; landing gear retracts upward to prevent interference, nosewheels into long fairings. Once system has been switched on, antenna extended and operation mode selected, data on air targets flying below helicopter's altitude, and on water surface situation, are acquired, evaluated and transmitted automatically to command centre, requiring only two crew (pilot and navigator, latter monitoring — but not operating — the system) in helicopter. Modes are air-surface, air-air or combined; in last-mentioned case, each sixth sweep is in surface mode. Kronshtadt Kabris 31 GPS navigation and display system. Loiter speed 54 to 65 kt (100 to 120 km/h; 62 to 75 mph) at up to 3,500 m (11,480 ft); loiter duration 2 h 30 min. Maximum surveillance radius 62 n miles (115 km; 71 miles) for fighter-size targets (1.8 m²; 19 sq ft), horizon-limited for surface vessels (300 m²; 3,230 sq ft); up to 40 targets tracked simultaneously. Antenna can be retracted manually or explosively jettisoned in the event of a forced landing.

Two large panniers starboard side of cabin, fore and aft of main landing gear on helicopter numbered 032 (forward panniers only on 031); starboard airstair-type cabin door, aft of flight deck, divided horizontally into upward- and downward-opening sections, with box fairing in place of window; hatch window deleted above starboard rear pannier; new TA-8Ka APU positioned above rear of engine bay fairing, with slot-type air intake at front of housing, displacing usual ESM and IR jamming pods, gives radar and antenna an independent power supply. Tyre size 620×180 on mainwheels, 480×200 on nosewheels. Tailcone extended by fairing for flight recorder; no armour, gun door, stores pylons or outriggers.

Ka-33: Utility transport. Civilianised version of Ka-29TB shipborne assault transport. Designation revealed at Moscow Air Show in August 1997; no further details released and no known conversions.

Ka-35: Ground surveillance version of Ka-31, believed to have company designation 23D2; prototype '231' first flown November 2004 and believed to be a conversion of Ka-31 prototype '031', although company literature includes an illustration of '231' with other Ka-31s and fails to recognise the Ka-35 designation (which was first used for a heavy-lift twin-rotor helicopter project).

Radar based on E-801, although with slightly smaller scanner, measuring 5.50 m x 0.8 m (18 ft 0½ in x 2 ft 7½ in), rotating mechanically but with electronic elevation control. Crew of pilot and systems operator. Development status not revealed.

CUSTOMERS: Total of 59 Ka-29s built for Russian Federation Naval Aviation (about 45) and Ukrainian Navy (about 12). Following 1996 evaluation, four Ka-31s ordered in August 1999 by Indian Navy for delivery in 2001 and basing aboard aircraft carriers and 'Krivak' class destroyers; further five ordered February 2001. Additional 12 may be required. First flight of Indian Ka-31 (IN561) 16 May 2001; by October 2001, first two Indian airframes delivered from KAPP to Kamov at Moscow for avionics installation; flight trials completed of first two Indian aircraft by September 2002, with hand-over following soon after; second pair delivered in April 2003; last of nine delivered in 2004. In October 2002, Kamov reported a second export customer for Ka-31s in addition to Indian Navy; nothing further had emerged by mid-2005, although China, Brazil, Colombia and Venezuela all reportedly interested.

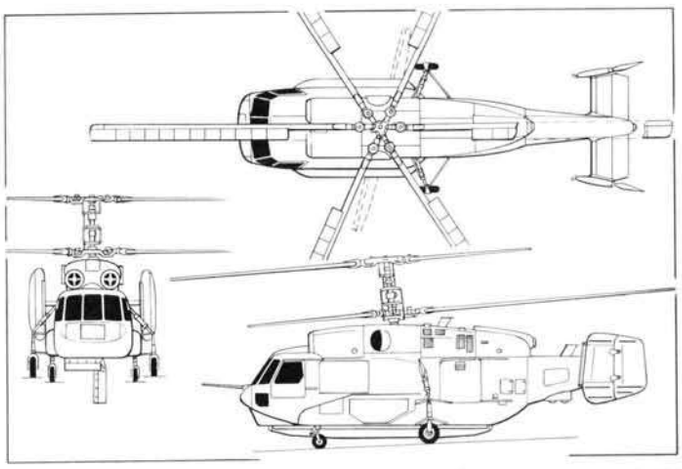
COSTS: Indian Navy batch of four priced at Rs4 billion (US$92 million) (2000); second five cost US$108 million (2001).

POWER PLANT: Two Klimov TV3-117VMA turboshafts, each 1,633 kW (2,190 shp). Indian Ka-31s have TV3-117MARs, with max continuous rating increased from 1,251 kW (1,677 shp) to 1,397 kW (1,874 shp). Engines started by APU. Fuel tanks filled with reticulated polyurethane foam for fire suppression. Total capacity (Ka-31) 3,060 litres (808 US gallons; 673 Imp gallons).

ACCOMMODATION: Wider flight deck than Ka-27 for two crew; three flat-plate windscreen glazings instead of two-piece curved transparency; 350 kg (772 lb) of armour around cockpit and engines; main cabin port-side door, aft of landing gear, divided horizontally into upward- and downward-opening sections, lower section forming step when open, to facilitate rapid exit of up to 16 assault troops; four stretcher patients, seven seated casualties and medical attendant in ambulance role; internal or slung cargo provisions.

AVIONICS: *Comms:* Two UHF and HF radios.

Prototype Kamov Ka-35 ground surveillance helicopter 1159318



Kamov Ka-31, showing radar deployed in nose view *(James Goulding)* 0130861

Radar: Primary radar in port side of nose.

Flight: INS; Doppler box under tailboom; IFF ('Slap Shot'). Ka-31 has Ramenskoye PNK-37DME flight and navigation system, providing extra stabilisation and vibration-clamping; INS-2000; A737 satellite navigation receiver; A-723/011 long-range navigation; SBKV-2V air data system; and SAU-37D autopilot.

Instrumentation: Ka-31 has two colour 152×203 mm (6×8 in) MFI-10-51 MFDs for pilot (left), plus analogue back-up flight instruments. Two PS3-1 MFDs in centre console. One MFI-10-5I for navigator/operator (right) displaying radar imagery and navigation data from GPS/Glonass.

Mission: Undernose Shturm-V missile guidance and LLTV pods; ESM 'flower pot' above rear of engine bay fairing.

Self-defence: L-166V IR jammer ('Hot Brick'); chaff/flare dispensers.

EQUIPMENT: Station-keeping light between ESM and jammer.

ARMAMENT: Four-barrel Gatling-type GShG-7.62 7.62 mm machine gun, with 1,800 rounds, flexibly mounted behind downward-articulated door on starboard side of nose; four pylons on outriggers, for two four-round packs of 9M114 Shturm (AT-6 'Spiral') ASMs and two UV-32–57 57 or B-8V20 80 mm rocket pods. Alternative loads include four rocket packs, two pods each containing a 23 mm gun and 250 rounds, or two ZAB-500 incendiary bombs. Internal weapons bay for torpedo or bombs. Provision for 30 mm Type 2A42 gun above port outrigger, with 250-round ammunition feed from cabin.

DIMENSIONS, EXTERNAL (A: Ka-29, B: Ka-31):

Rotor diameter (each)	15.90 m (52 ft 2 in)
Blade length, aerofoil section (each)	5.45 m (17 ft 10½ in)
Blade chord	0.48 m (1 ft 7 in)
Vertical separation of rotors	1.40 m (4 ft 7 in)
Length overall: excl noseprobe and rotors:	
A	11.30 m (37 ft 1 in)
B	11.25 m (36 ft 11 in)
rotors turning: B	12.25 m (40 ft 2¼ in)
Height overall: A	5.40 m (17 ft 8½ in)
B	5.60 m (18 ft 4½ in)
Width: between centrelines of outboard pylons	5.65 m (18 ft 6½ in)
over tailfins and centred rudders	3.65 m (12 ft 0 in)
of flight deck	2.20 m (7 ft 2 in)
Mainwheel track	3.50 m (11 ft 6 in)
Nosewheel track: A	1.41 m (4 ft 7½ in)
B	2.41 m (7 ft 11 in)
Wheelbase: A	3.00 m (9 ft 10 in)
B	3.05 m (10 ft 0 in)

AREAS:

Rotor disc (each)	198.50 m² (2,136.6 sq ft)

WEIGHTS AND LOADINGS (A, B as above):

Weight empty: A	5,520 kg (12,170 lb)
Max load: A, internal	2,000 kg (4,409 lb)
A, external	4,000 kg (8,818 lb)
Max combat load: A	1,800 kg (3,968 lb)
Normal T-O weight: A	11,000 kg (24,250 lb)
B	12,200 kg (26,896 lb)
Max T-O weight, internal load: A	11,500 kg (25,353 lb)
Max airborne weight:	
A, external slung load	12,600 kg (27,775 lb)

PERFORMANCE (A, B as above):

Max level speed at S/L: A	151 kt (280 km/h; 174 mph)
B	135 kt (250 km/h; 155 mph)
Nominal cruising speed: A	130 kt (240 km/h; 149 mph)
B	119 kt (220 km/h; 137 mph)
Loitering speed: B	54 kt (100 km/h; 62 mph)
Max rate of climb at S/L: A	888 m (2,910 ft)/min
Service ceiling: A	4,300 m (14,100 ft)
B	3,500 m (11,480 ft)
Loitering altitude: B	3,500 m (11,480 ft)
Hovering ceiling OGE: A	3,000 m (9,840 ft)
Combat radius: A, with six to eight attack runs over target	54 n miles (100 km; 62 miles)
B (datalink limited)	81 n miles (150 km; 93 miles)
Range:	
A, max standard fuel	248 n miles (460 km; 285 miles)
B	324 n miles (600 km; 372 miles)
A, ferry	400 n miles (740 km; 460 miles)
Loitering endurance at 3,200 m (10,500 ft): B	2 h 30 min

KAMOV Ka-32

NATO reporting name: Helix-C

TYPE: Multirole medium helicopter.

Kamov Ka-32A11BC operated by Spain's Helicopteros de Sureste 1128946

PROGRAMME: Development of Ka-27/32 began 1969; first flight of common prototype 1973; first Ka-32 (SSSR-04173) flew 8 October 1980; prototype of utility version shown at Paris Air Show June 1985; new military versions first exhibited at Moscow Air Show '95; Ka-32S and Ka-32T versions in production by KAPP; other conversions by Kamov at Lyubertsy through outfitting of KAPP airframes. Klimov VK-3000 turboshaft was to be certified in 2001 as alternative power plant, but no installations have been reported.

CURRENT VERSIONS: Most recent production has been of Ka-21A1 version; earlier types included Ka-32T, Ka-32S, Ka-32K and 'A2, 'A3 and 'A7 derivatives of Ka-32A.

Ka-32A: Assemblies and systems of basic Ka-32 modified in 1990–93 to meet all requirements of Russian NLG-32-29 and NLG-32-33 and US FAR Pt 29/FAR Pt 33 airworthiness standards in categories A and B. First flight September 1990; Russian type certificates obtained for Ka-32A and its TV3-117VMA engines in June 1993. Production began 1996. Larger tyres. Optional pressure fuelling with reduced fuel capacity. Maximum accommodation for 13 passengers. Advanced avionics available, including Canadian Marconi dual CMA-900 flight management system, with EFIS, AFCS, CMA-2012 Doppler velocity sensor and CMA-3012 GPS sensor. Modification of helicopters to Ka-32A standard started by Kamov 1994, customers purchasing Ka-32T airframe from KAPP plant and then engaging Kamov under separate contract for outfitting to Ka-32A standard.

Ka-32A1: Firefighting version of Ka-32A, first flown 12 January 1994. Equipped with Canadian or Russian variants of 'Bambi Bucket', capacity 5,000 litres (1,320 US gallons; 1,100 Imp gallons). Two operated by Moscow fire service, with doorway-mounted steerable water cannon and three types of rescue cage, able to lift two, 10 or 20 people from roofs of tall buildings. Other equipment includes searchlights and loudspeakers. Fire service aircraft and others flown by anti-riot police controlled by Aviatika Concern ISC, set up by Moscow city authorities and private investors to develop urban air transport system. Several on lease to South Korean forestry department have Simplex 10900-050 system, including 2,955 litre (780 US gallon; 650 Imp gallon) carbon fibre belly tank which can be refilled in 1½ minutes, plus 152 litre (40.2 US gallon; 33.4 Imp gallon) retardant tank. Ka-32 can also be fitted with 10900-055 system with two panniers totalling 5,000 litres (1,320 US gallons; 1,100 Imp gallons) of water and 250 litres (66.0 US gallons; 55.0 Imp gallons) of retardant.

One Moscow fire service helicopter (RA-31073) retrofitted with large, forward-facing nose boom for fire suppression in tall buildings; trials completed April 2001; shown statically at Moscow Salon, August 2001. System developed by Soyuz Federal Centre of Double Technologies at Dzerginsk; water supply of 2,800 litres (740 US gallons; 616 Imp gallons) carried in two underslung tanks or helicopter can be connected to fire vehicle on ground for unlimited supply; hose boom movable in vertical plane only.

Ka-32-10: Announced 25 May 2001; projected 24-seat civil version with enlarged cabin; internal payload 4,000 kg (8,818 lb). Target certification date was 2004; nothing further reported.

Ka-32A11BC: Built in accordance with requirements of Transport Canada, FAR Pt 29 certification gained 11 May 1998, but full clearance achieved 26 February 1999, after installation of dual actuators in flight control system; first Russian helicopter to gain Western certification. Two development aircraft delivered to VIH Logging in May 1997; flew 4,000 hours up to February 1999; also used for firefighting; further 10 produced by 2004, when further two ordered for Spanish operator, Helicopteros de Sureste (making four in that country from 2005) and one (making two) to Heliswiss of Switzerland. Further five ordered by undisclosed customer in November 2004. Designation sometimes mistakenly rendered as Ka-32A11VS, but BC indicates British Columbia — Canadian province where first used.

Ka-32A12: Version approved by Aviation Register of Switzerland.

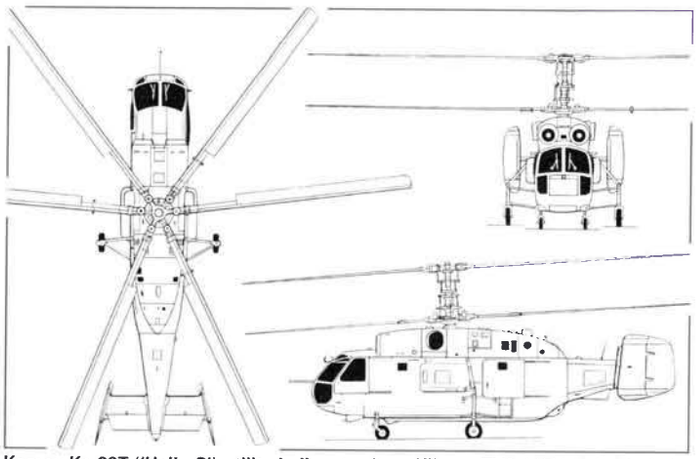
Ka-32M: Under development by Kamov, to increase lifting capability to 7,000 kg (15,432 lb); retrofit with 1,839 kW (2,466 hp) TV3-117VMA-SB3 engines. Probably replaced in planning by Ka-32-10.

CUSTOMERS: Aeroflot and its successors; operators in Bulgaria (32S), Canada (32A), Laos (air force; six Ka-32T), Papua New Guinea (32A), South Africa (32A), Spain (two 32A11BC delivered mid-2005 augmenting lease of two), Switzerland (32A), Yemen (32S/T). Estimated 160-170 Ka-32s built up to 2004. Between December 1993 and November 2000, 36 imported by LGI of South Korea for operation by Forestry Service (23 Ka-32Ts), National Maritime Police Agency (eight Ka-32Ss), Kyonggi Provincial Fire & Disaster HQ (two Ka-32Ts) and Kyongsang Buk-do Fire Defence Aviation Corps, National Parks and Ulsan Fire Defence HQ (one Ka-32T each); further 10 ordered in March 2001 and three delivered by end of 2001. Further seven (for a total of 46) equipped for RoK Air Force SAR operations by Lahav Division of Israel Aircraft Industries, including Israeli navigation systems, weather- and ground surveillance radar and digital moving map; first delivery in July 2004. Korean deliveries reached 50 in December 2005.

Following lease of two (later three) Ka-32s, Cyprus government announced intention, August 2001, to purchase three. Algerian Air Force acquiring unknown number, three of which (two Ka-32T and one Ka-32S) noted at Sankt Peterburg in August 2002. Ka-32A11BC production totalled 10 by early 2005, with five to follow that year, including four more for Helisureste, ordered in November, 2005.

Russian security services expecting delivery in 2006 of between five and seven Ka-32s.

DESIGN FEATURES: Conceived as completely autonomous 'compact truck', to stow in much the same space as Ka-25 with rotors folded, despite greater power and capability, and to operate independently of ground support equipment; special attention paid to ease of handling with single pilot; overall dimensions minimised by use of coaxial rotors, requiring no tail rotor, and twin fins on short tailboom; upper rotor turns clockwise, lower rotor anti-clockwise; rotor mast tilted forward 3°; twin turbines and APU above cabin, leaving interior uncluttered; lower fuselage sealed for flotation.



Kamov Ka-32T ('Helix-C') utility helicopter (two Klimov TV3-117V turboshafts) *(Dennis Punnett)* 0507189

FLYING CONTROLS: Dual hydraulically powered flight control systems, without manual reversion; spring stick trim; yaw control by differential collective pitch applied through rudder pedals; mix in collective system maintains constant total rotor thrust during turns, to reduce pilot workload when landing on pitching deck, and to simplify transition to hover and landing; twin rudders intended mainly to improve control in autorotation, but also effective in co-ordinating turns; flight can be maintained on one engine at maximum T-O weight.

STRUCTURE: Titanium and composites used extensively, with particular emphasis on corrosion resistance; fully articulated three-blade coaxial contrarotating rotors have all-composites blades with carbon fibre and glass fibre main spars, pockets (13 per blade) of Kevlar-type material, and filler similar to Nomex; blades have non-symmetrical aerofoil section; each has ground-adjustable tab; each lower blade carries adjustable vibration damper, comprising two dependent weights, on root section, with further vibration dampers in fuselage; tip light on each upper blade; blades fold manually outboard of all control mechanisms, to folded width within track of main landing gear; rotor hub is 50 per cent titanium/50 per cent steel; rotor brake standard; all-metal fuselage; composites tailcone; fixed incidence tailplane, elevators, fins and rudders have aluminium alloy structure, composites skins; fins toe inward approximately 25°; fixed leading-edge slat on each fin prevents airflow over fin stalling in crosswinds or at high yaw angles.

LANDING GEAR: Four-wheel type. Oleo-pneumatic shock-absorbers. Castoring nosewheels. Mainwheel tyres size 600×180 (Ka-32); 620×180, pressure 10,80 bar (156 lb/sq in) (Ka-32A). Nosewheel tyres size 400×150 (Ka-32); 480×200, pressure 5,90 bar (85 lb/sq in) (Ka-32A). Skis optional. Floats available for rescue versions.

POWER PLANT: Two 1,633 kW (2,190 shp) Klimov TV3-117V (Ka-32) or TV3-117VMA (Ka-32A) turboshafts, with automatic synchronisation system, side by side above cabin, forward of rotor driveshaft. Main gearbox brake standard. Oil cooler fan aft of gearbox. Cowlings hinge downward as maintenance platforms. Fuel in tanks under cabin floor and inside container each side of centre-fuselage; capacity of main tanks 2,180 litres (576 US gallons; 480 Imp gallons); maximum capacity with two underfloor auxiliary tanks 3,450 litres (911 US gallons; 759 Imp gallons). Single-point pressure refuelling behind small forward-hinged door on port side, where bottom of tailboom meets rear of cabin.

ACCOMMODATION: Pilot and navigator side by side on air conditioned flight deck, in adjustable seats. Rearward-sliding jettisonable door with blister window each side. Seat behind navigator, on starboard side, for observer, loadmaster or rescue hoist operator. Alcohol windscreen anti-icing. Direct access to cabin from flight deck. Heated and ventilated main cabin of Ka-32 can accommodate freight or 16 passengers, on three folding seats at rear, six along port sidewall and seven along starboard sidewall (13 passengers in Ka-32A). Lifejackets under seats. Fittings to carry four stretchers. No provisions for lavatory or galley. Pyramid structure can be fitted on floor beneath rotor driveshaft to prevent swinging of external cargo sling loads. Rearward-sliding door aft of main landing gear on port side, with steps below. Emergency exit door opposite. Hatch to avionics compartment on port side of tailboom.

SYSTEMS: Three hydraulic systems: main system supplies servos, mainwheel brakes and hydraulic winch when fitted; standby system supplies only servos after main system failure; auxiliary system supplies brakes after main system failure and adjusts height of helicopter fuselage above ground; it can also be connected to main system for checking all functions on ground. Electrical system includes two independently operating AC generators and two batteries which cut in automatically or manually via inverters after AC generating system failure. After failure of either generator, the other is switched automatically to supply both circuits. Two rectifiers supply DC power. Electrothermal de-icing of entire profiled portion of each blade switches on automatically when helicopter enters icing conditions. Hot air engine intake anti-icing. APU in rear of engine bay fairing on starboard side, for engine starting and to power all essential hydraulic and electrical services on ground, eliminating need for GPU.

AVIONICS: *Comms:* Ka-32A11BC equipment includes SRT-651 U/VHF, SRT-170/L HF, M-424 transponder. SAR version optionally also R-851 emergency radio with four fixed frequencies.

Flight: Ka-32A11BC equipment includes INS-2000 INS, strapdown AHRS, DISS-32-28 Doppler, VIM-95 VOR/ILS, A-737 GPS, ARC-25 ADF, AN/ARN-153 TACAN, SVS-V-28-1-2 air data system, A-052 radar altimeter.

Instrumentation: Ka-32A11BC equipment includes MFI-10-6M MFD, control display unit, video recording system.

Mission: Ka-32A11BC equipment includes BAGER-53 mission processor. Optional GEO-ONV1 NVGs and GOES 337 VKA FLIR.

EQUIPMENT: Doors at rear of fuel tank bay provide access to small compartment for auxiliary fuel, and liferaft which ejects during descent in emergency, by command from flight deck. Container each side of fuselage, under external fuel containers, for emergency flotation bags, deployed by water contact. Optional LPG-300 rescue hoist, capacity 300 kg (661 lb), between top of door opening and landing gear. Optional external load sling, with automatic release and integral load weighing and stabilisation systems; cable lengths 10 m (33 ft), 20 m (66 ft) and 40 m (131 ft). Optional PSN-6AK liferafts (three) for SAR versions.

DIMENSIONS, EXTERNAL:

Rotor diameter (each)	15,90 m (52 ft 2 in)
Length overall: excl rotors	11,27 m (36 ft 11¾ in)
rotors folded	12,25 m (40 ft 2¼ in)
Width, rotors folded	4,00 m (13 ft 1½ in)
Height to top of rotor head	5,45 m (17 ft 10½ in)
Wheel track: mainwheels	3,515 m (11 ft 6½ in)
nosewheels	1,41 m (4 ft 7½ in)
Wheelbase	3,03 m (9 ft 11¼ in)
Cabin door: Height	approx 1,20 m (3 ft 11¼ in)
Width	approx 1,20 m (3 ft 11¼ in)

DIMENSIONS, INTERNAL:

Cabin: Length	4,52 m (14 ft 10 in)
Max width	1,30 m (4 ft 3 in)
Max height	1,24 m (4 ft 0¾ in)

AREAS:

Rotor disc (each)	198,50 m² (2,136.6 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	6,610 kg (14,573 lb)
Max payload: internal	3,700 kg (8,157 lb)
external	5,000 kg (11,023 lb)
Normal T-O weight	11,000 kg (24,250 lb)
Max flight weight with slung load	12,700 kg (27,998 lb)

PERFORMANCE (Ka-32):

Max level speed	140 kt (260 km/h; 162 mph)
Max cruising speed	130 kt (240 km/h; 149 mph)
Service ceiling	6,000 m (19,680 ft)
Hovering ceiling OGE	3,500 m (11,480 ft)
Hovering ceiling OGE, OEI	1,705 m (5,600 ft)
Range with max standard fuel	432 n miles (800 km; 497 miles)
Max range with auxiliary fuel	612 n miles (1,135 km; 705 miles)
Endurance with max standard fuel	4 h 30 min
Max endurance with auxiliary fuel	6 h 25 min

KAMOV Ka-50 CHERNAYA AKULA

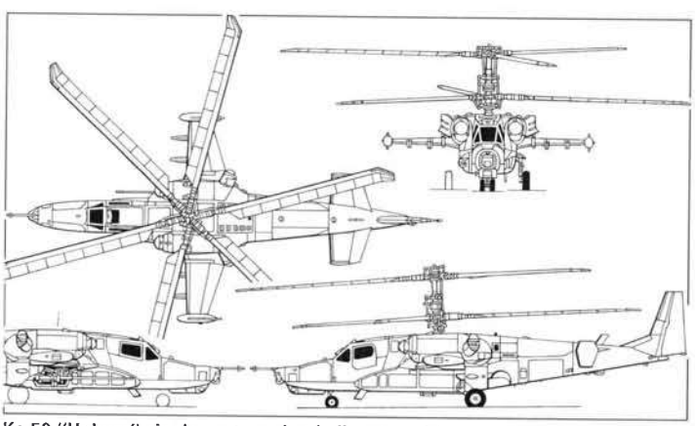
English name: Black Shark
NATO reporting name: Hokum

TYPE: Attack helicopter.

PROGRAMME: Project launched in December 1977 as **V-80** (*Vertolyet* 80: Helicopter 80); first prototype (010) built by Kamov bureau and hovered at Lyubertsy 17 June 1982 and flew on 23 July, powered by TV3-117V engines; second prototype (011) flew 16 August 1983 with TV3-117VMA engines and mockup of Shkval tracking system, Merkury LLLTV, cannon and K-041 sighting system; both prototypes wore painted 'windows' to simulate fictitious rear cockpits. Initially reported in West in mid-1984, but first photograph did not appear (US Department of Defense's *Soviet Military Power*) until 1989.

First prototype lost in fatal accident on 3 April 1985; replaced by third prototype (012) with Mercury LLTV system for state comparative test programme against Mil Mi-28, which completed in August 1986. Two preproduction **V-80Sh-1** s (014 and 015) were first to be built at Arsenyev and introduced UV-26 chaff/flare dispensers; second had K-37-800 ejection system and mockup of LLLTV in articulated turret. Ordered into production in December 1987. Further three for continued development work comprised 018 (first flown at Arsenyev 22 May 1991), 020 'Werewolf' and 021 'Black Shark'. (Export marketing name was originally Werewolf, but changed to Black Shark by 1996.) State tests of Ka-50 began in mid-1991 and type was commissioned into Russian Army Aviation in August 1993

Kamov Ka-50 '18', believed the former '018', displayed in 2005, described as Ka-50Sh *(Yefim Gordon)* 1129453



Ka-50 ('Hokum') single-seat combat helicopter with scrap view of gun installation on starboard side *(Mike Keep)* 0507190

1128947

Kamov Ka-50 single-seat attack helicopter *(Yefim Gordan)*

for trials at 4th Army Aviation Training Centre, Torzhok. In August 1994, the Ka-50 was included in the Russian Army inventory by Presidential decree, judged winner of the fly-off against Mi-28. The Mi-28 was nominally terminated on 5 October 1994 but the competition continued.

Further army evaluation followed when first two of four production Ka-50s were funded in 1994 and officially accepted on 28 August 1995; third and fourth received in 1996; these four numbered 20 to 23 (prompting pre-series 021 to be renumbered 024 to avoid confusion). Arsenyev production was to have increased to one per month during 1997, but this did not occur. The original Ka-50 (and rival Mi-28A) were overtaken by the issue of a revised requirement which emphasised night capability— favouring the two-seat Mi-28. The initial order for 15 Ka-50s was reportedly cancelled in September 1998, with procurement postponed until 2003. Three deployed to Mozdok during 1999 for use in Chechnya, but not used operationally. Two returned to theatre in December 2000; first firing of weapons against guerrilla forces was on 6 January 2001 (operating in conjunction with Mil Mi-24s); helicopters returned to Torzhok in March 2001. Unspecified modifications, found necessary as a consequence of operational deployment, had been incorporated by November 2002, according to a Kamov announcement.

Klimov VK-3000 turboshaft offered as alternative power plant.

By late 2004, it was being presumed that no further production of Ka-50s would take place, the Russian Air Forces having, instead, chosen Mil Mi-28 as main attack helicopter, backed by smaller number of Kamov Ka-52s. One year late, Russian Air Forces C-in-C was anticipating Ka-50 production to restart in 2005, to which end Arsenyev plant began restoring production line, where three Ka-50s partly complete; these still present in January 2006, with delivery due that year; fourth and fifth to follow.

CURRENT VERSIONS: **Ka-50: ('Hokum')** *As described.*

Ka-50N: (*Nochnoy:* Nocturnal) Also reported as Ka-50Sh. Night-capable attack version; essentially a single-seat Ka-52. Programme began 1993; originally based on TpSPO-V and Merkury LLLTV systems, which tested on Ka-50 development aircraft. Ka-50N first reported April 1997 as conversion of prototype 018 with Thomson-CSF Victor FLIR turret above the nose and Arbalet (crossbow) mast-mounted radar, plus second TV screen in cockpit; FLIR integrated with Uralskyi Optiko-Mekhanicheskyi Zavod (UOMZ) Shamshit-50 (Laurel-50) electro-optic sighting system, incorporating French IR set. First flight variously reported as 4 March or 5 May 1997; programmed improvements included replacement of PA-4-3 paper moving map with digital equivalent; by August 1997, FLIR turret was repositioned below nose and Arbalet was removed; by mid-1998, had IT-23 CRT display replaced by TV-109, and HUD removed and replaced by Marconi helmet display. Proposed new cockpit shown in September 1998, having two Russkaya Avionika 203 × 152 mm (8 × 6 in) LCDs and central CRT for sensor imagery. Indigenous avionics intended for any local production orders; French systems as interim solution and standard for export. Republic of Korea Army evaluated both the Ka-50N and the baseline Ka-50. In 1999, preproduction aircraft 014 was exhibited with a UOMZ GOES sensor turret in place of Shkval.

Ka-50-2: Designation applies to three quite different aircraft. Basic Ka-50-2 is a variant of the Ka-50 single-seater, though the designation is also applied to two twin-seat aircraft; first of these was a version of the Ka-52 Alligator and, as such, was described in 2001–02 and earlier *Jane's*. All Ka-50-2s differ from the baseline Ka-52 in retaining attack and anti-tank role using 12 laser beam-riding AT-8 Vikhr ATGMs or 16 Rafael NT-D ATGMs; avionics to be supplied by Israel Aircraft Industries, Lahav Division; 024 used as demonstrator. The basic Ka-50-2 was proposed to China, Finland, India, South Korea, Malaysia, Myanmar, Poland, South Africa, Syria and Turkey.

Second variant of Ka-50-2 is another two-seater, intended to have conventional stepped tandem cockpits; is offered to armed forces which do not accept the single-seat or side-by-side two-seat layouts. A further subvariant of the tandem-seat Ka-50-2, the **Erdoğan** (Turkish for Born Fighter), was proposed to Turkey jointly by Kamov and Israel Aircraft Industries. This would have been fitted with longer-span wings and feature a NATO-compatible Giat 621 turret containing a single 20 mm cannon which would fold down below the belly of the helicopter in flight, for a 360° arc of fire; it would fold to starboard for landing, and could be fired directly forward, even when folded. TV3-117VMA-02 engines. Ten Turkish pilots flew Alligator'061' at Antalya, Turkey, in early 1999 as part of evaluation process; requirement was for 145. Named as second choice when Bell AH-1Z selected, and negotiations briefly reopened in mid-2002, following impasse in agreement with USA.

Ka-52: Two-seat version; *described separately.*

CUSTOMERS: Four for Russian Army service trials, plus eight flying prototype and pre-series helicopters; all delivered. First eight had been built by 1996; next four deliveries began in 2000. Other sources report 15 Ka-50s completed, but this may include static test airframes. By January 2006, some 17 partly complete airframes at Arsenyev plant, of which first three due for completion in that year. One army helicopter lost in accident, 17 June 1998; attributed to rotor clash.

COSTS: Unit price of Ka-50N quoted as between USD12 million and USD15 million in mid-1999.

DESIGN FEATURES: World's first single-seat close support helicopter. Coaxial, contrarotating and widely separated semi-rigid three-blade rotors, with swept blade tip, attached to hub by steel plates; small fuselage cross-section, with nose sensors; flat-screen cockpit, heavily armour protected by combined steel/aluminium armour and spaced aluminium plates, with rearview mirror above windscreen; small sweptback tailfin, with inset rudder and large tab; high-set tailplane on rear fuselage, with endplate auxiliary fins; retractable landing gear; mid-set unswept wings, carrying ECM pods at tips; four underwing weapon pylons; engines above wingroots; high agility for fast, low-flying, close-range attack role; partially dismantled can be air-ferried in Il-76 freighter. Much of fuselage skin formed by large hinged door panels, providing access to interior equipment from ground level.

FLYING CONTROLS: Kamov coaxial design; generally as Ka-32.

STRUCTURE: Fuselage built around steel torsion box beam, of 1.0 m (3 ft 3¼ in) square section. Wing centre-section passes through beam. Cockpit mounted at front of beam, gearbox above and engines to sides. Carbon-based composites materials constitute 35 per cent by weight of structure, including rotors. Approximately 350 kg (770 lb) of armour protects pilot, engines, fuel system and ammunition bay; canopy and windscreen panels are 55 mm (2¼ in) thick bulletproof glass.

LANDING GEAR: Hydraulically retractable tricycle type; twin-wheel steerable nose unit and single mainwheels all semi-exposed when up; all wheels retract rearward; low-pressure tyres.

POWER PLANT: Two 1,633 kW (2,190 shp) Klimov TV3-117VMA turboshafts with VR-80 main reduction gearbox and two PVR-800 intermediate gearboxes, with air intake dust filters and exhaust heat suppressors. Later use of 1,838 kW (2,465 shp) TV3-117VMA-SB3 turboshafts intended. Two primary fuel tanks, filled with reticulated foam, inside fuselage box beam. Total internal capacity approximately 1,800 litres (485 US gallons; 404 Imp gallons). Front tank feeds port engine; rear feeds starboard and APU. Each tank protected by layers of natural rubber. Provision for four 500 litre (132 US gallon; 110 Imp gallon) underwing auxiliary fuel tanks. Transmission remains operable for 30 minutes after oil system failure.

ACCOMMODATION: Double-wall steel armoured cockpit, able to protect pilot from hits by 20 and 23 mm gunfire over ranges as close as 100 m (330 ft). Interior black-painted for use with NVGs. Specially designed Zvezda K-37-800 ejection system, ostensibly for safe ejection at any altitude (actually from 100 m; 330 ft); following explosive separation of rotor blades and opening of cockpit roof, pilot is extracted from cockpit by large rocket; alternatively, he can jettison doors and stores before rolling out of cockpit sideways. Associated equipment includes automatic radio beacon, activated during ejection, inflatable liferaft and NAZ-7M survival kit.

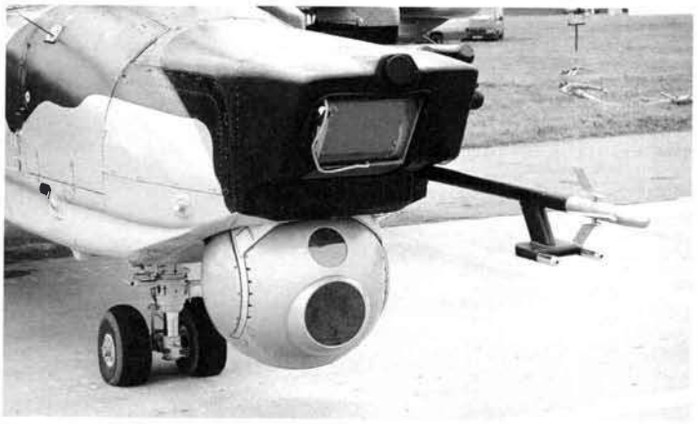
SYSTEMS: All systems configured for operational deployment away from base for up to 12 days without need for maintenance ground equipment; refuelling, avionics and weapon servicing performed from ground level. AI-9V APU for engine starting, and ground supply of hydraulic and electrical power, in top of centre-fuselage. Anti-icing system for engine air intakes, rotors, AoA and yaw sensors; de-icing of windscreen and canopy by liquid spray.

PrPNK Rubikon (L-041) piloting, navigation and sighting system based on five computers: four Orbita BLVM-20-751s for combat and navigation displays and target designation, plus one BCVM-80-30201 for WCS. Incorporates PNK-800 Radian navigation system, with C-061K pitch and heading data, IK-VSP-VI-2 speed and altitude and PA-4-3 automatic position plotting subsystems. Series 3 Tester U3 flight data recorder. Ekran BITE and warning system. KKO-VK-LP oxygen system with 2 litre (0.07 cu ft) supply for 90 minutes. Electrical supply from two 400 kW generators at 115 V 400 Hz three-phase AC; 500 W converter; rectifiers for 27 V DC supply.

AVIONICS: Integrated by NPO Elektro Avtomatika.

Comms: Two R800L1 and one R-868 UHF transceivers, SPU-9 intercom, P-503B headset recorder, Almaz-UP-48 voice warning system and HF com/nav; IFF ('Slap Shot').

Flight: INS; autopilot; Doppler box under tailboom; ARK-22 radio compass; A-036A radio altimeter.



Nose detail of Ka-50Sh *(Yefim Gordon)* 1128948

Instrumentation: Conventional instruments; ILS-31 HUD; moving map display (Kronshtadt Abris on some aircraft); small IT-23MV CRT beneath HUD, with rubber hood, to display only FLIR and monochrome LLLTV imagery. Pilot has Obzor-800 helmet sight effective within ±60° azimuth and from −20 to +45° elevation; when pilot has target centred on HUD, he pushes button to lock sighting and four-channel digital autopilot into one unit. Displays compatible with OVN-1 Skosok NVGs.

Mission: To reduce pilot workload and introduce a degree of low observability, target location and designation are assigned to other aircraft; equipment behind windows in nose includes I-251V Shkval-V daylight electro-optical search and auto-tracking system, laser marked target seeker and range-finder; FOV ±35° in azimuth +15 to −80° in elevation. FLIR turret to be added in nose for use with NVGs.

Self-defence: L150 Pastel RWR in tailcone, at rear of each wingtip EW pod and under nose; total of 512 chaff/flare cartridges (in four UV-26 dispensers) in each wingtip pod. L-140 Otklik laser detection system; L-136 Mak IR warning.

ARMAMENT: Four BD3-UV pylons on wings. Up to 80 S-8 80 mm air-to-surface rockets in four underwing B8V20A packs or 20 S-13 122 mm rockets in four B-13L pods; or up to 12 9A4172 Vikhr-M (AT-12) tube-launched laser-guided ASMs with range of 8 to 10 km (5 to 6.2 miles) capable of penetrating 900 mm of reactive armour; or mix of both; Vikhr launched from trainable UPP-800 mounts, which can be depressed to −12°; single-barrel 30 mm 2A42 gun on starboard side of fuselage, with up to 470 armour-piercing or high-explosive fragmentation rounds, can be depressed from +3° 30′ to −37° in elevation and traversed from −2° 30′ to +9° in azimuth hydraulically and is kept on target in azimuth by tracker which turns helicopter on its axis; two ammunition boxes in centre-fuselage. Front box contains 240 AP rounds, rear box 230 HE rounds. Selectable rapid (550 to 600 rds/min) or slow (350 rds/min) fire, with bursts of 10 or 20 rounds. Provision for alternative weapons, including UPK-23-250 23 mm gun pods, Igla or R-73 (AA-11 'Archer') AAMs, Kh-25MP (AS-12 'Kegler') ARMs, FAB-500 bombs or dispenser weapons.

DIMENSIONS, EXTERNAL:

Rotor diameter (each)	14.50 m (47 ft 7 in)
Length overall, rotors turning	16.00 m (52 ft 6 in)
Fuselage length, excl noseprobe	14.20 m (46 ft 7 in)
Wing span	7.34 m (24 ft 1 in)
Height overall	4.93 m (16 ft 2 in)
Tailplane span	3.16 m (10 ft 4½ in)
Wheel track: main	2.67 m (8 ft 9 in)
nose	0.34 m (1 ft 1½ in)
Wheelbase	4.19 m (13 ft 9 in)

AREAS:

Rotor disc (each)	165.13 m² (1,777.4 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	7,800 kg (17,196 lb)
Max external stores	3,000 kg (6,610 lb)
Normal T-O weight: Ka-50	9,800 kg (21,605 lb)
Erdoğan	9,800 kg (21,605 lb)
Max T-O weight: Ka-50	10,800 kg (23,810 lb)
Erdoğan	11,300 kg (24,912 lb)

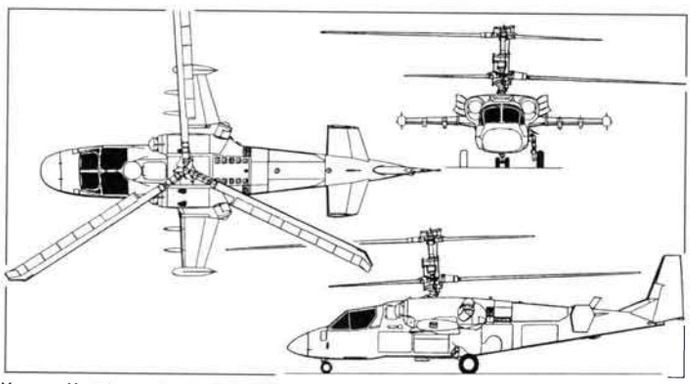
PERFORMANCE:

Max speed:	
in shallow dive	210 kt (390 km/h; 242 mph)
in level flight	162 kt (300 km/h; 186 mph)
in sideways flight	43 kt (80 km/h; 49 mph)
in backward flight	48 kt (90 km/h; 55 mph)
Cruising speed	146 kt (270 km/h; 168 mph)
Vertical rate of climb at 2,500 m (8,200 ft)	600 m (1,970 ft)/min
Service ceiling	5,500 m (18,040 ft)
Hovering ceiling OGE	4,000 m (13,120 ft)
Range: combat	243 n miles (450 km; 279 miles)
with max internal fuel	280 n miles (520 km; 323 miles)
with 4 auxiliary tanks:	
Ka-50	594 n miles (1,100 km; 683 miles)
Erdoğan	626 n miles (1,160 km; 720 miles)
Endurance: standard fuel, 10 min reserves	1 h 40 min
with 2 auxiliary tanks	2 h 50 min
g limit	+3.5

KAMOV Ka-52 ALLIGATOR

PROGRAMME: Only one prototype of this two-seat combat helicopter has been built. Attempts to secure a customer continued in 2001–02 with the offer of a Ka-52K variant to South Korea. Flight performance tests completed late 2002; second stage of State Tests was due to have begun in early 2003, up to which time, it was confirmed, the Arbalet radar had not been installed (except for display purposes). Radar trials were said to have begun by November 2003 but a January 2005 report stated that these shortly to begin, following 17 test flights in first stage of radar trials. Further round of cannon, rocket and missile firing trials at 344th CCTC, Torzhok, completed in early 2006. Irregular financing expected to cause trials to be extended over an indefinite period, but in a surprise announcement of December 2003, C-in-C of Russian Air Forces revealed plans for delivery of 12 Ka-52s (and some Mil Mi-28s) to begin in early 2004. One year later, the target had been changed to three delivered in 2005 and two in 2006, all from 'Progress' plant at Arsenyev. None noted by early 2006; however, commitment maintained to small number of Ka-52s to be obtained for "special units". During 2004, Yemen was mentioned as a possible customer for 12 Ka-52s, while Turkish interest maintained into 2006.

Unique Kamov Ka-52 displayed at Moscow in 2005 with mast-mounted radar 1128949



Kamov Ka-52 combat helicopter *(Paul Jackson)* 1042479

KAMOV Ka-60 KASATKA

English name: Killer Whale

TYPE: Medium transport helicopter.

PROGRAMME: Original coaxial rotor, twin tail, single-engined V-60 won Soviet Army lightweight helicopter and Mi-8 replacement competition against heavier, twin-engined Mil Mi-36 in 1982; subsequently, design considerably modified to achieve greater speed through adoption of single main rotor and Fenestron-type of tail rotor with eleven blades. First flight originally due 1993, but programme slowed by funding shortages, and priority changed to promotion of civil variant (see following entry for Ka-62). Ka-60 officially revealed at Lyubertsy on 29 July 1997, when prototype close to completion; first flew (601) 10 December 1998; second sortie 21 December; first official flight 24 December; all were hovering flights; international debut at MAKS '99, Moscow, August 1999; first 'forward flight' 24 December 1999. Further testing was intermittent, due to irregular Ministry of Defence funding; production versions of RD-600V turboshaft installed mid-2002. At this time, it was stated only that the prototype had completed "several" flights, although State Trials were not due to begin until early 2003, which subsequently postponed to 2004. No. 601 had flown some 50 hours by October 2003.

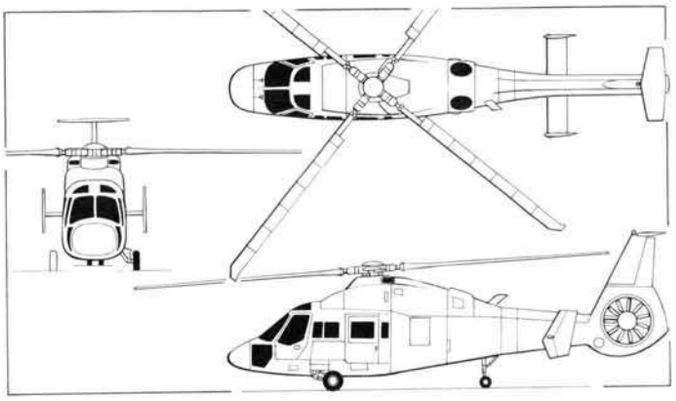
Conflicting reports quote both Arsenyev and Ulan Ude as prospective production lines. However, LMZ (now LAPIK, part of RSK 'MiG') was reported in April 2000 to be preparing for production and in mid-2001 was building second prototype, which to be completed as a trainer in **Ka-60U** configuration. This entered final assembly in July 2002, although RD-600 engines were not due to have been received until late 2002. Displayed, apparently unflown, (marked as 602) at MAKS '03, Moscow, August 2003. Revised configuration, with vertical stabilising fins repositioned from tailboom to top of fin, No. 602 shown at Moscow in 2005 with engines installed, apparently still unflown.

Series production by LAPIK was due to begin in 2003, later delayed to 2005. Meanwhile, third prototype was to have been completed in 2004 in assault transport configuration, all three to participate in almost 400 sorties of State Tests, lasting two years. By early 2004, Kamov was engaged in a redesign of the Ka-60 to address CG and controllability problems caused by overweight tail structure and insufficient torque control. Measures include enlargement of tail rotor and a reproportioned fin. No further progress reported by early 2006, when prototype remained sole Ka-60 confirmed to have flown. Change to VK-1500 engine in production version requires new main gearbox.

In August 2002, it was announced that power plant will be changed to Klimov VK-1500 to increase participation by RSK 'MiG' group.

A smaller variant of Ka-60 was reported in mid-2001 to have been offered to Russian Navy.

Second Kamov Ka-60 after installation of engines *(Yefim Gordon)* 1128960



Original configuration of Kamov Ka-60 military multipurpose helicopter *(James Goulding)* 0062678

CURRENT VERSIONS: Pilot and aircrew training (Ka-60U), utility, shipborne over-the-horizon targeting (Ka-60K) reconnaissance (Ka-60R) anti-tank and anti-helicopter versions proposed; role of Ka-60R, with Shamshit target acquisition system, transferred to Kamov Ka-52.

CUSTOMERS: None. Long-term interest maintained by Russian Army; reportedly evaluated by Iran. Russian requirements estimated as over 100 Ka-60U's between 2001 and 2010.

COSTS: USD11.7 million, Ka-60U (2000).

DESIGN FEATURES: Generally as for Ka-62 (which see), but with IR- and radar-absorbent coatings, reduced rotor speed, low-IR exhausts.

POWER PLANT: Prototype has RKBM Rybinsk RD-600V turboshafts, as Ka-62. Production engine will be 1,103 kW (1,479 shp) Klimov VK-1500, RRTM RTM322 or GE CT7 available in export versions.

ACCOMMODATION: Up to 16 infantry troops; or six stretchers and three attendants. Pilot (starboard) and co-pilot/gunner (port) side by side. Provision for dual controls; control stick top common with Ka-50/52.

SYSTEMS: All Russian; Western equivalents optional for export.

AVIONICS: As above, including Pastel RWR and Otklik laser warning system.

Radar: Arbalet MMW antenna in nose.

Instrumentation: Three-screen EFIS.

EQUIPMENT: Cargo hook.

ARMAMENT: One-piece transverse boom through cabin, to rear of doors, optional to provide suspension for total of two B-8V-7 seven-round 80 mm rocket pods, two 7.62 mm or 12.7 mm gun pods, or similar armament.

DIMENSIONS, EXTERNAL: As Ka-62 except:

Fuselage length ..... 13.465 m (44 ft 2 in)

WEIGHTS AND LOADINGS: Generally as Ka-62 except:

Max payload: external ..... 2,750 kg (6,062 lb)

KAMOV Ka-62

TYPE: Multirole medium helicopter.

PROGRAMME: This civil version of Kamov Ka-60 appears to have made little progress in recent years. No prototype had been built by 2006, priority of Ka-62 indicated by official announcement in October 2006 that building of a prototype (which would be fourth Ka-60/62) only could "not be ruled out".

Funded under Russian programme for development of civil aviation for 2000. Construction of prototype Ka-62 (then known as V-62) began early 1990, but apparently abandoned; one Ka-60 military version (which see) and two Ka-62s intended to undertake flight trials, although second of basic type completed as Ka-60U, delaying debut of civil version; will be certified under Russian AP and FAR Pt 29A/B standards. Republic of Buryatia officially requested Moscow for production rights for UUAP in February 2000. In April 2001, Turkish Ministry of Public Health was discussing contract for six Ka-62s, with total value of US$31.5 million.

Russian government's 2002-10 aviation plan includes Rb62 million to develop Ka-62 and Rb51 million to launch production at UUAP and, possibly, RSK 'MiG' (LAPIK). UUAP confirmed Ka-62 production plans in January 2006, at which time USD60 million had been invested out of USD150 million required to launch manufacture; initial production helicopter due to fly in 2008-09 and annual rate of 30 to 40 per year to be achieved by 2010.

Initial deployment will be in Khabarovsk Federal District of Russian Far East, following June 2002 agreement between Kamov and Far East Investment Company for manufacture of Ka-62 at unspecified plant(s) and marketing in Asia/Pacific region.

CURRENT VERSIONS: **Ka-62:** Basic model for domestic market.

Detailed description applies to the above.

Ka-62M: To be certified to Western standards, for sale outside Russian Federation and Associated States (CIS); two 1,212 kW (1,625 shp) General Electric T700/CT7-2D1 turboshafts; five-blade main rotor; avionics to be developed by Aviapribor. Production version is expected to be manufactured by KnAAPO at Komsomolsk.

Ka-64 Sky Horse: This development of the Ka-60/62 series is reported to be a joint venture with Agusta of Italy intended for export. Features include a conventional tail rotor, modified passenger cabin, Western avionics and option of General Electric CT7-2DL, LHTEC T800 or RRTI RTM 322 turboshaft engines. Production would be by UUAP at Ulan-Ude.

DESIGN FEATURES: Originated as military transport; all main systems and components duplicated, with main and secondaries routed on opposite sides of airframe; transmission resistant to 12.7 mm bullets; main blades to 23 mm shells; run-dry gearboxes. Advanced technology main rotors with sweptback tips. Production versions will have slower-turning five-blade rotor. Yaw control by 11-blade fan-in-fin. Reverse tricycle landing gear.

STRUCTURE: Composites account for 60 per cent, by weight, of structure, including blades of main rotor; fuselage sides, doors, floor and roof, tailboom, fin, vertical stabilisers, and fan blades of carbon-reinforced Kevlar.

LANDING GEAR: Retractable reverse tricycle type; single KT-217 mainwheels retract inward and upward into bottom of fuselage; twin rear wheels retract forward into tailboom; shock-absorber in each unit. Optional inflatable pontoons for emergency use on water.

POWER PLANT: Basic Ka-62 has two RKBM Rybinsk RD-600V turboshafts, each 956 kW (1,282 shp) max continuous; 1,140 kW (1,529 shp) emergency rating. However 1,103 kW (1,479 shp) Klimov VK-1500 may be offered in parallel with adoption of this engine for Ka-60. Fuel tanks under floor, capacity 1,450 litres (383 US gallons; 319 Imp gallons). General Electric T700/CT7-2D1 offered as alternative to RD-600V.

Model of Kamov Ka-62 civil multirole helicopter, confusingly wearing military camouflage *(Yefim Gordon)* 0528671

ACCOMMODATION: Crew of one or two, side by side; optional bulkhead divider between flight deck and cabin; up to 14 passengers in four rows; forward-hinged door each side of flight deck; large forward-sliding door and small rearward-hinged door each side of cabin; baggage hold to rear of cabin. VIP configuration to be available, with five to nine seats and refreshment bar.

SYSTEMS: Interior heated and air conditioned. Thermoelectric de-icing system optional. Ivchenko AI-9V APU originally proposed, but replacement Aerosila TA-14 under development.

AVIONICS: Optional Russian or Western.

EQUIPMENT: Stretchers, hoist above port cabin door, cargo tiedowns, and other items as necessary for variety of roles, including transport of slung freight; air ambulance/operating theatre; search and rescue; patrol of highways, forests, electric power lines, gas and oil pipelines; survey of ice areas; surveillance of territorial waters, economic areas and fisheries; mineral prospecting; and servicing of offshore gas and oil rigs.

DIMENSIONS, EXTERNAL:

Main rotor diameter	13.50 m (44 ft 3½ in)
Tail rotor diameter	1.40 m (4 ft 7 in)
Length overall, rotors turning	15.60 m (51 ft 2¼ in)
Fuselage length	13.465 m (44 ft 2 in)
Height: overall	4.60 m (15 ft 1 in)
to top of rotor head	3.80 m (12 ft 5½ in)
Width over endplate fins	3.00 m (9 ft 10 in)
Wheel track	2.50 m (8 ft 2½ in)
Wheelbase	5.445 m (17 ft 10¼ in)
Cabin doors (each) Height	1.30 m (4 ft 3¼ in)
Width	1.25 m (4 ft 1¼ in)

DIMENSIONS, INTERNAL:

Cabin, excl flight deck: Length	3.40 m (11 ft 2 in)
Width	1.78 m (5 ft 10 in)
Height	1.30 m (4 ft 3¼ in)

AREAS:

Main rotor disc	143.10 m² (1,540.3 sq ft)
Tail rotor disc	1.54 m² (16.57 sq ft)

WEIGHTS AND LOADINGS:

Max payload: internal: 62, 62M	2,000 kg (4,409 lb)
external: 62, 62M	2,500 kg (5,510 lb)
T-O weight: 62, normal	6,000 kg (13,228 lb)
62, internal load, max	6,250 kg (13,779 lb)
62 external load and 62M, internal load, max	6,500 kg (14,330 lb)
62M, external load, max	6,750 kg (14,880 lb)
Max disc loading: 62	41.9 kg/m² (8.58 lb/sq ft)
62M	47.1 kg/m² (9.66 lb/sq ft)

PERFORMANCE (estimated, at max T-O weight with internal load):

Max level speed:	
62, 62M	162 kt (300 km/h; 186 mph)
Cruising speed: 62, 62M	148 kt (275 km/h; 171 mph)
Max rate of climb at S/L: 62	625 m (2,050 ft)/min
62M	690 m (2,263 ft)/min
Rate of climb at S/L, OEI: 62, 62M	123 m (403 ft)/min
Service ceiling: 62	5,150 m (16,900 ft)
62M	5,500 m (18,040 ft)
Hovering ceiling: IGE: 62	2,900 m (9,520 ft)
OGE: 62	2,100 m (6,880 ft)
62M	2,500 m (8,200 ft)
Range with max standard fuel at 2,000 m (6,560 ft), no reserves: 62	332 n miles (615 km; 382 miles)
62M	353 n miles (655 km; 407 miles)
Range with auxiliary fuel at 2,000 m (6,560 ft), no reserves: 62	566 n miles (1,050 km; 652 miles)
62M	553 n miles (1,025 km; 637 miles)

KAMOV Ka-226A SERGEI

TYPE: Light utility helicopter.

PROGRAMME: Turbine version of Ka-26, of which 816 built between 1968 and 1977. Announced at 1990 Helicopter Association International convention, Dallas, USA. Developed originally for Russian TsENTROSPAS disaster relief ministry, which is providing significant funding. First flight (RA-00199), at Lyubertsy, 3 September 1997; 'official' first flight on following day. Flew total of four sorties by 31 December 1997. Began AP-29 certification testing on 28 March 2001. State ground testing of Ka-226 second prototype completed at Strela's Orenburg plant on 6 March 2000. KAPP built two prototypes, of which first was rolled out at Kumertau on 29 May 1998; first production aircraft from KAPP was due to have flown in first quarter of 2002 but remained under construction in mid-2002, although a 'pre-production' helicopter was shown (red colour scheme) in April 2002. Planned certification in third quarter of 2002 was not achieved.

Prototype Kamov Ka-226T utility/lift version *(Yefim Gordon)* 1128961

Kamov Ka-226 from Strela production line *(Yefim Gordon)* 1128962

being reportedly "seriously delayed". Provisional certification awarded by Interstate Aviation Committee (MAK) on 18 August 2003. First deliveries to Gazprom in June 2004, at which time IFR certification had not been achieved, although full VFR granted 19 August 2004. Prototype destroyed in ground resonance incident, November 2002, but apparently replaced by demonstrator '199', displayed at Moscow, August 2003.

Named Sergei in 1999, honouring politician Sergei Shoigu, but programme also guided by Sukhoi General Designer, Sergei Mikheev. By mid-2000, Moscow regional government had provided Rb12 million in development funding and was beginning disbursements under second programme valued at Rb4 million. Initial deliveries due in first half of 2000, but not effected.

Prototypes built jointly by Kamov, Strela, KAPP and Ufa Motors, with final assembly by KAPP and Strela for production aircraft. Strela scheduled to have delivered five preproduction helicopters to Kamov at Lyubertsy by mid-2000; these for MChS Rossii, but not completed until 2003, when one exhibited at MAKS '03, prior to suspension of the order. Ka-32 obtained in interim, but reinstated order for three Ka-226As under negotiation in 2004. KAPP designated second production plant; first batch of five under construction by 2001. Motor-Sich of Zaporozhye, Ukraine, negotiated with Kamov in June 2000 to build Ka-226s powered by indigenous ZMKB AI-450 engine; agreement on AI-450 installation signed 15 August 2001. On 19 October 2001, however, Motor Sich announced it would source all Ka-226 components with Ukrainian industry, if decision to proceed were taken. In March 2006, Russo-Jordanian joint venture company, Oboronprom Middle East, formed to assemble Ka-226s in Jordan.

Batch of Rolls-Royce 250 engines ordered by Kamov in July 2000. Later contracts in December 2004 (24 engines) and August 2005 (50 engines for delivery by November 2006).

CURRENT VERSIONS: **Ka-226A:** *As described.*

Ka-226AG: Gazprom specific configuration, including cargo winch and medical equipment.

Ka-226-50: Designation first revealed in September as 'improved' version, but appears to apply to all production aircraft (at least from KAPP).

Ka-226T: Two Turbomeca Arrius 2G2 turboshafts, each 500 kW (670 shp); service ceiling increased to 7,000 m (22,960 ft).

MoU on use of Turbomeca Arrius 2G2 signed in August 2001 with NPO Saturn and French manufacturer; collaboration agreement followed on 16 April 2002, and engines delivered in December 2003. First stage of Arrius testing completed April 2005. Prototype (221) first flew December 2004; camouflage paint applied January 2005; public debut at Moscow Salon, August 2005.

Ka-226U: Dual control trainer. First order placed early 2003 for one helicopter to fly in 2004, following manufacture at Kamov's own plant. Progress AI-450 turboshafts.

CUSTOMERS: Orders by January 2002 totalled 66: Gazprom 50 (of which 22 firm), Moscow City 10, TsENTROSPAS five and Bashkiriyan one. This had increased to 80 by August 2003.

Firm order for 25 reportedly received from TsENTROSPAS by 1997, but quantity had reduced to 10 by 1999; by mid-2000 this quoted as five firm (to be first five production aircraft) and further 15 to be ordered by 2002; manufacture by Strela which had completed first two (including one in medevac configuration) by early 2002, but in October 2003 it was reported that all five had been "frozen". Bashkiriyan local government ordered one Ka-226-50 from KAPP in September 2001; this accepted 28 December 2001 (when still not cleared for flight) and due for trials at Zhukovsky before service entry. Funds for 22 of initial Gazprom order for 50 had been transferred by 2001, this initial batch, built by Strela, to have been received by 2005 (although formal signing of order for 50 was undertaken at Moscow Salon in August 2001). First for Gazprom handed over at Ostafyevo, Moscow Region, on 10 June 2004 in baseline configuration; 18 of remainder modified to specific customer requirements, designated Ka-226AG, and all 22 due in service by 2007.

Moscow city government signed USD1.5 million order for 10 in December 2001, delivery over two years, but later announcement indicated that funds had not been earmarked; Moscow's helicopters built by KAPP. City allocated initial Rb33 million in 2002 and intended to receive three helicopters in 2003, four in 2004 and final three in 2005. Subsequently amended to first two receipts in 2004, although their arrival not confirmed. These may now have been received, in light of December 2005 delivery to "Security Services" of " a further two" Ka-226s, with another six or eight to be ordered in 2006. Ka-226 was beaten by Kazan Ansat in competition to supply new training helicopter to Russian armed forces, announced September 2001; however, small number of Ka-226s required by Russian Navy.

COSTS: USD1.5 million (2003). Batch of five for MChS worth RUR187 million (2003). Development cost RUR108 million (1999).

DESIGN FEATURES: Classic Kamov utility helicopter, featuring interchangeable mission pods. Refined development of Ka-26/126; new rotor system with hingeless hubs and glass fibre/carbon fibre blades; changes to shape of nose, twin tailfins and rudders, and passenger pod; passenger cabin has much larger windows and remains interchangeable with variety of payload modules including agricultural systems with hopper capacity of 1,000 litres (264 US gallons; 220 Imp gallons); Kamov BP-226 transmission; new rotor system, interchangeable with standard coaxial system, will become available later.

FLYING CONTROLS: Assisted by irreversible hydraulic actuators. Automatic rotor constant-speed control; conventional four-channel control (longitudinal, lateral, cyclic and differential pitch). Two endplate fins and rudders, toed inward 15°; fixed horizontal stabiliser.

STRUCTURE: Primarily of aluminium alloys, steel alloys and composites sandwich panels of GFRP with honeycomb filler. Rotor blade overhaul interval 2,000 hours; total life 6,000 hours, but to be extended by increments to 18,000 hours.

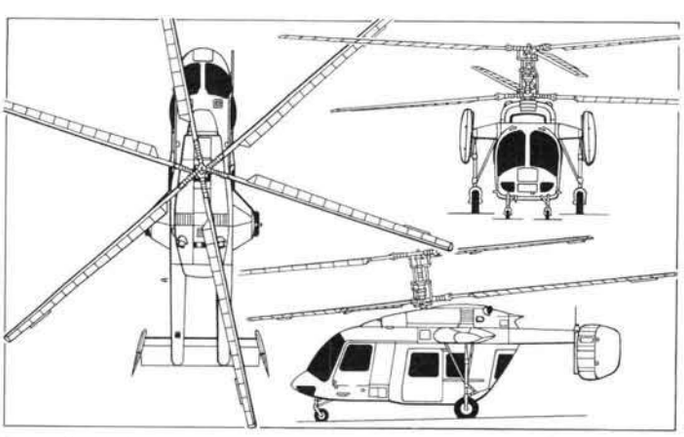
LANDING GEAR: Non-retractable four-wheel type. Main units at rear, carried by stub-wings. All units embody oleo-pneumatic shock-absorber. Mainwheel tyres size 595×185, pressure 2.50 bar + 0.50 (36.25 lb/sq in + 7.25); forward tyres size 300×125, pressure 3.50 bar + 0.50 (50.75 lb/sq in + 7.25). Forward units of castoring type, without brakes. Rear wheels have pneumatic brakes. Optional skis.

POWER PLANT: Two 335 kW (450 shp) Rolls-Royce 250-C20R/2 turboshafts, side by side aft of rotor mast, with individual driveshafts to rotor gearbox. Two 335 kW (450 shp) Rolls-Royce 250-C20B engines in prototypes. Transmission rating 626 kW (840 shp). Alternatively, two Progress (ZMKB) AI-450 turboshafts, each 331 kN (444 shp) or two Turbomeca Arrius 2G2 (500 kW; 670 shp) or Klimov VK-800 turboshafts (588 kW; 789 shp).

Standard fuel capacity 770 litres (203 US gallons; 169 Imp gallons), in tanks above and forward of payload module area. Provision for two external tanks, on sides of fuselage, total capacity 320 litres (84.5 US gallons; 70.4 Imp gallons).

ACCOMMODATION: Fully enclosed and lightly pressurised flight deck, with rearward-sliding door each side; normal operation by single pilot; second seat and dual controls optional. Cabin ventilated, and warmed and demisted by air from combustion heater, which also heats passenger cabin when fitted. Space aft of cabin, between main landing gear legs and under transmission, can accommodate variety of interchangeable payloads. Standard cargo/passenger pod has two bench seats, each accommodating three persons; one bench faces forward, the other, rear; baggage compartment behind rear wall. Seventh passenger beside pilot on flight deck. 'Service' eight-seat and 'VIP' five-seat pods also available. Two versions of medical pod comprise 'Ambulance' with oxygen, respirator, defibrillator and resuscitation kit; and 'Medevac' with two stretcher patients, two seated casualties and medical attendant plus Cardex MAR-01 monitor, DKI-N-04 defibrillator, EK10-0412 electrocardiograph, EKSM-041 cardio-stimulator, Nonin 8500 pulse-meter, oxygen apparatus and Thermos flask. 'Emergency' pod has two stretchers and simplified medical kit, plus hydraulic rescue tools. 'Law Enforcement' pod includes four abseiling ropes, eight seats and provision on and in main airframe for cockpit side blister windows, SGS-23 loudspeaker, GOES-630 gyro-stabilised turret with thermal imaging camera and TSL-224H video recorder. For agricultural work, chemical hopper (capacity 1,000 litres; 264 US gallons; 220 Imp gallons) and dust spreader or spraybar are fitted in this position, on

Kamov Ka-226 demonstrator '201' exhibited in Jordan, March 2006, to promote local assembly plans 1158059



Kamov Ka-226A utility helicopter with production passenger cabin design *(Mike Keep)* 1158064

aircraft's CG. (Flight deck pressurisation protects crew against chemical ingress.) Aircraft can also be operated with either an open platform for hauling freight or hook for slinging loads at end of a cable or in a cargo net.

SYSTEMS: Single hydraulic system, with manual override, for control actuators. Main electrical system 27 V 3 kW DC, with back-up 40 Ah battery; secondary system 36/115 V AC with two static inverters; 115/200 V AC system with 16 kVA generator (6 kVA to power agricultural equipment and rotor anti-icing). Electrothermal rotor blade de-icing; hot air engine air intake anti-icing; alcohol windscreen anti-icing; electrically heated pitot. Pneumatic system for mainwheel brakes, tyre inflation, agricultural equipment control, pressure 39 to 49 bar (570 to 710 lb/sq in). Oxygen system optional.

AVIONICS: Cockpit instrumentation and avionics to customer's choice, including Bendix/King equipment for IFR flight.

Comms: Twin Yurok radios; SPGU-35 intercom. Optional 4205-02 or UVD SO-94R transponder and ARB PK-10 ELT.

Flight: SVS-226 air data computer, A-053 radar altimeters, ADF-25 ADF, MKS-1V compass. Optional SAU-226 flight control system and VIM-95 navigation and landing sensor for IFR operation. Optional SNS -3 satellite navigation, BUR-LKV flight data recorder.

Instrumentation: SEI-226 display systems, INP-R HSI.

EQUIPMENT: Optional SLG-300 hoist, SX-5 or SX-16 Nitesun spotlight, SGS-23 loudspeaker, GOES-630 surveillance system, TSK-3 10-person rescue cage.

ARMAMENT: Optional provision for light weapons.

DIMENSIONS, EXTERNAL:

Rotor diameter (each)	13.00 m (42 ft 7¾ in)
Length of fuselage	8.10 m (26 ft 7 in)
Width over stub-wings	3.22 m (10 ft 6¾ in)
Height to top of rotor head	4.15 m (13 ft 7½ in)
Wheel track: nosewheels	0.90 m (2 ft 11½ in)
mainwheels	2.56 m (8 ft 4¾ in)
Wheelbase	3.48 m (11 ft 5 in)
Passenger pod: Length	2.35 m (7 ft 8½ in)
Width	1.40 m (4 ft 7 in)
Height	1.54 m (5 ft 0¾ in)

DIMENSIONS, INTERNAL:

Passenger pod: Length	2.04 m (6 ft 8¼ in)
Width	1.28 m (4 ft 2¼ in)
Height	1.40 m (4 ft 7 in)

AREAS:

Rotor disc (each)	132.70 m² (1,428.4 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	1,952 kg (4,304 lb)
Max underslung payload	1,300 kg (2,865 lb)
Max internal fuel	600 kg (1,322 lb)
Auxiliary fuel	256 kg (564 lb)
T-O weight: normal	3,100 kg (6,835 lb)
max	3,400 kg (7,495 lb)
Transmission loading at max T-O weight and power: normal	4.95 kg/kW (8.14 lb/shp)
max	5.43 kg/kW (8.92 lb/shp)

PERFORMANCE (estimated):

Never-exceed speed (VNE)	115 kt (214 km/h; 133 mph)
Max level speed	111 kt (205 km/h; 127 mph)
Max cruising speed	105 kt (194 km/h; 120 mph)
Max rate of climb at S/L	610 m (2,000 ft)/min
Rate of climb, OEI	96 m (315 ft)/min
Vertical rate of climb at S/L	168 m (550 ft)/min
Service ceiling	6,200 m (20,340 ft)
Hovering ceiling OGE	2,500 m (8,200 ft)
Range: with max payload	16 n miles (30 km; 18 miles)
with max internal fuel	324 n miles (600 km; 372 miles)
with auxiliary fuel, no reserves	480 n miles (890 km; 552 miles)
Max endurance with internal fuel, no reserves	4 h 42 min

KAPO

KAZANSKOYE AVIATSIONNOYE PROIZVODSTVENNOYE OBEDINENIE IMENI S P GORBUNOVA (KAZAN AIRCRAFT PRODUCTION ASSOCIATION NAMED FOR S P GORBUNOV)

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KAPO (formerly GAZ 22) established in Moscow on 14 May 1927 and moved to Kazan in November 1941; has built more than 18,000 aircraft of 34 types, including the Tu-4, Tu-16, Tu-22, Tu-104 and Il-62. It currently produces the Tupolev Tu-214 and will manufacture the Tu-334 regional airliner; Tu-330 freighter, if it is ordered; and is assigned the Tu-324 regional airliner. In 2000, KAPO belatedly delivered one Tu-160 strategic bomber, completion of which had been delayed by collapse of the former USSR; a second was to follow in 2002, but has been delayed and a further two are planned. In April 2002, Kazan received the first of 15 in-service Tu-160s to undergo upgrading; two Tu-22Ms also in stock.

Tu-334 production in parallel with Aviant of Ukraine (which will build 20) to begin in 2007 with completion of 12 aircraft, followed by 20 per year until initial batch of 100 (agreed 2004) is delivered. Announcement on 22 February 2005 by Tatarstan president promised first Tu-334 in 2006, changed five months later to 2007, under April 2005 decree by Russian prime minister allocating manufacture. MoU funding production of Tu-334 at Kazan signed 8 March 2006, although devoted to preliminary activities of formulating business plan and gathering "pool of investors".

Under aerospace industry restructuring plans announced in 2001, KAPO is to be joined with RSK 'MiG', Kamov, Tupolev and their associated plants (Sokol, Aviakor, Aviastar and KAPP). The plant also produces customer goods, including leather processing machinery and small boats. Nothing further has been heard of 2002 discussions on the possibility of aerostructures subcontracting for Airbus.

KAZAN

KAZANSKY VERTOLETNYI ZAVOD OAO (KAZAN HELICOPTER PLANT JSC)

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ANSAT PROGRAMME DIRECTOR: Valery B Kartashev

GAZ 387 founded in Leningrad in 1940 and re-established at Kazan on 15 August 1941 following evacuation. Built 11,344 Polikarpov Po-2 biplanes up to 1947, when production turned to combined harvesters. Since 1951, however, Kazan (KVZ) has marketed and built Mil helicopters comprising 30 Mi-1s, 3,257 Mi-4s, 4,066 Mi-8s, 2,620 Mi-8M/Mi-17s, 273 Mi-14s and (up to 2001) 1,150 Mi-8MTV/Mi-17-1Vs. Exports began in 1956 and now encompass over 80 countries and some 4,000 aircraft; the Mi-17 accounts for 1,200 exports to 30 countries.

Kazan became a joint stock company in 1994, then owned 38 per cent by Tatarstan Republic, 62 per cent by its employees. State holding reduced to 29.92 per cent, but this then transferred to OPK Oboronprom holding company in return for 15.07 per cent stake in latter. Other Oboronprom holders are Rostvertol (2.79 per cent), Rosiboronexport (31.13 per cent) and Tatarstan Republic (51 per cent).

At the 1995 Paris Air Show, Kazan exhibited a mockup of the first product of its own newly formed (1993) design office, the Ansat light multipurpose helicopter. Modifications and upgrades to Mi-17 have generated new business for Kazan. Russian certification for helicopter design awarded February 1997. A second light helicopter, the Aktai, was revealed at Moscow in August 1997 and was due to fly in 2004. In February 2003, Kazan offered to establish a production line for the Mi-52 if Mil is unable to secure funding. Kazan was also a co-founder of Euromil, with Mil Moscow Helicopter Plant, Eurocopter and Klimov, and is responsible for manufacturing parts for, and assembling, the Mi-38 prototypes the first of which flew in December 2003. However, in July 2003, Eurocopter withdrew from Euromil because of Russian laws constricting foreign businesses, allowing Kazan to acquire half its shareholding. Re-integration of Eurocopter would be likely if mooted law change can be effected.

KAZAN/Mil Mi-17

TYPE: Medium transport helicopter.

Following entry refers specifically to Kazan production; refer to Mil entry for other Mi-8M/Mi-17 versions.

PROGRAMME: Kazan's Mi-17 development intended to compete with latest Western helicopters (such as Sikorsky S-92, NHI NH 90 EHI EH 101 and Eurocopter AS 332) combining advanced avionics and systems with well-proven airframe and dynamic system. Prototype (RA-70937, converted from Mi-8MTV) displayed at 1995 Paris Air Show with features including widened forward, port, door; additional starboard door; and rear loading via short ramp and two clamshell doors. Further modified, with large, single-piece rear-loading ramp and other changes, for display at ILA '96, Germany, in search and rescue form, designated Mi-17MD Night. By 1997, '70937 had gained a spine-mounted IR jammer and flight deck armour and was stated by Kazan to have the dual designation Mi-17MD/Mi-8MTV-5. At the 1999 Moscow Air Show it had lost its registration and become an 'Mi-8MTV5-1' with the alternative designations (for export) Mi-17V-5. First flight in this guise was in January 1998; first production Mi-17V-5 flew August 1999.

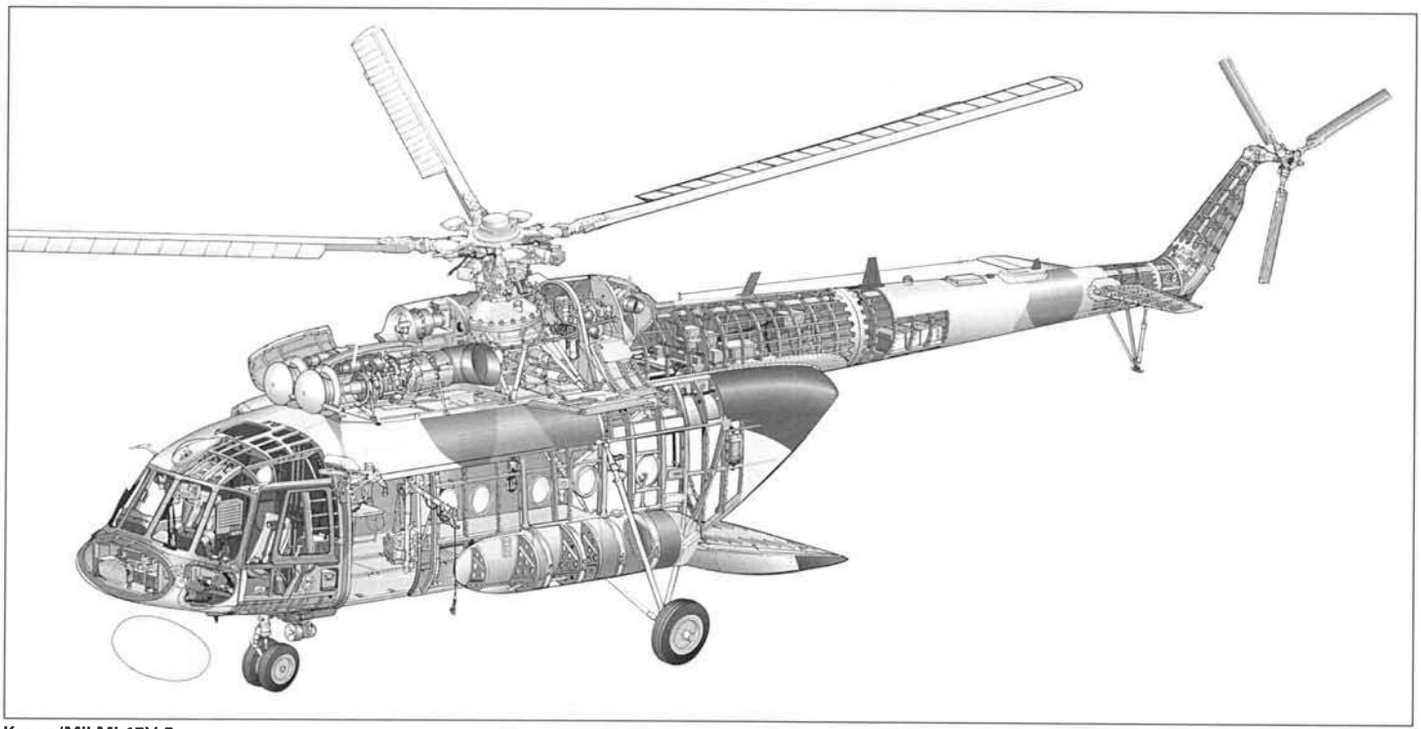
Second example (RA-70877) shown at LIMA, Malaysia, November 1999, marked as Mi-17-1V, although with full Mi-17MD airframe modifications, was conversion of prototype Mi-17KF (Honeywell 'glass cockpit' avionics), destined for South Korean police force (eventually handed over, January 2000). Mi-17KF redesignated Mi-172.

Kazan demonstrator RA-70898, rebuilt in Mi-172 guise in 2000 (following accident) with partial 'glass cockpit' supplied by Elbit, GOES FLIR chin turret and additional external fuel tank (900 litres; 238 US gallons; 198 Imp gallons) each side, increasing range to 600 n miles (1,111 km; 690 miles); optimised for offshore oil support and maritime patrol; displayed at Farnborough, July 2000.

In 2002, Kazan began production of Mi-17V-5 with Klimov VK-2500 engines (replacing 1,471 kW; 1,973 shp TV3-117VMs) for increased high-altitude performance, including increase of 620 m (2,040 ft) in OGE hover and 200 m (660 ft) in service ceiling; can also take off with one engine inoperative; features Saphir APU to permit engine starting at 6,000 m (19,680 ft). Optional equipment includes NVGs, FLIR and searchlight, plus firefighting, SAR and medevac interiors. VK-2500 version certified, and deliveries began, mid-2003.

CURRENT VERSIONS: **Mi-17V-5 (Mi-8MTV5-1)**: Rear ramp and either round or square cabin windows. *As described.*

Mi-17V-7: Upgraded version with VK-2500 engines; uprated transmission; Saphir APU; new, swept-tip, composites main blades, with elastomeric bearings; X-type tail rotor; 'glass



Kazan/Mil Mi-17V-5

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cockpit' by Honeywell; increased service ceiling; and extra 500 kg (1,102 lb) payload. Available from 2005.

Mi-17-1V: Multirole version suitable for duties including flying hospital. Clamshell rear doors and round windows.

Mi-172: Passenger version for up to 26 in regular seating or up to 11 VIPs. Clamshell rear doors and square windows. Roles include offshore oil/gas rig support, optionally with weather radar and two additional, external 915 litre (242 US gallon; 201 Imp gallon) fuel tanks.

CUSTOMERS Refer to table:

KAZAN MI-17 DELIVERIES

Customer	Version	Qty	Year	Remarks
China	Mi-17V-5	60+		Army
Colombia	Mi-17-1V	16	2002	
Cyprus	Mi-172	2		Forestry
India	Mi-17-1V	40	2000	
Iran	Mi-17	3	2004	Health Ministry
Korea, South	Mi-172	2	1999	
Myanmar	Mi-17V-5	7	2004	
Nepal	Mi-17	9	2004	
Rwanda	Mi-17-1V	4	1999	Armed
	Mi-172	1	1999	VIP
Sri Lanka	Mi-17	3		
Venezuela	Mi-17V-5	6	2005	
Vietnam	Mi-17	4	2003	

COSTS: Colombian order for six valued at USD36.1 million (2002).

DESIGN FEATURES: Generally similar to latest versions of Mi-17. Main differences include rear loading ramp and pointed 'Dolphin' nose with increased volume to allow space for radar. Ramp allows disembarkation of 36 equipped troops in less than 15 seconds; helicopter can fly with ramp open for supply dropping. Conventional pod and boom configuration; five-blade main rotor, inclined forward 4° 30' from vertical; interchangeable blades of basic NACA 230 section, twist 5°, thickness/chord ratio 13 per cent at root, 11.38 per cent at tip; spar failure warning system; drag and flapping hinges a few inches apart; flapping compensator and centrifugal blade droop stop; rotor brake standard; non-folding blades carried on machined spider; pendulum vibration damper; three-blade port tail rotor. Transmission comprises VR-14 two-stage planetary main reduction gearbox (engine input 15,000 rpm; oil capacity 49 litres; 12.9 US gallons; 10.8 Imp gallons), intermediate (8A-1515-000) and tail rotor (2Y6-1517-000) gearboxes, and drives off main gearbox for tail rotor, fan, AC generator, hydraulic pumps, compressor and tachometer generators; correct rotor speed maintained automatically by system that also synchronises output of the two engines; tail rotor pylon forms small vertical stabiliser; horizontal stabiliser near end of tailboom.

FLYING CONTROLS: Mechanical system, with irreversible hydraulic boosters; main rotor collective pitch control linked to throttles.

STRUCTURE: All-metal; semi-monocoque fuselage of riveted construction. Main rotor blades of aluminium alloy, each with extruded spar carrying root fitting, 21 honeycomb-filled trailing-edge pockets and blade tip, with titanium abrasion shielding on some of leading-edge; balance tab on each blade; each tail rotor blade made of spar and honeycomb-filled trailing-edge. Composites blades and elastomeric hub components under development.

LANDING GEAR: Non-retractable tricycle type; self-centring twin-wheel nose unit, locked in flight; single wheel on each main unit; oleo-pneumatic (gas) shock-absorbers. Mainwheel tyres 865×280 type K2-110, pressure 5.4 bar (78 lb/sq in); nosewheel tyres 595×185 type KT-97/3, pressure 4.4 bar (64 lb/sq in). Pneumatic shoe-type brakes on mainwheels. Optional mainwheel fairings or skis. Optional Aerazur four-bag inflatable emergency floats.

POWER PLANT: Two Klimov VK-2500 turboshafts; installed ratings of 1,986 kW (2,663 shp) in emergency; 1,765 kW (2,367 shp) for T-O. Engine cowling side panels form maintenance platforms when open, with access via hatch on flight deck.

Standard fuel capacity of 2,725 litres (720 US gallons, 599 Imp gallons) in two main external tanks and internal feed tank. Up to four ferry tanks in cabin, each 895 litres (236 US gallons; 197 Imp gallons). Other versions may carry two supplementary tanks externally. Engine oil capacity 15 litres (4.0 US gallons; 3.3 Imp gallons).

ACCOMMODATION: Two pilots side by side on flight deck, with provision for flight engineer's station. Windscreen de-icing standard. Up to 36 troops or 12 casualties on stretchers in cabin. Hydraulically actuated rear ramp.

Two sliding, jettisonable passenger doors at front of cabin, port door widened in comparison with original Mi-17; electrically operated rescue hoist can be installed at this doorway.

SYSTEMS: AP-34B autopilot. ZMKB Progress AI-9 APU at rear of rotor head fairing. AC electrical supply from two 40 kW three-phase 115/220 V 400 Hz GT40P488 generators; two 25 V 20 Ah batteries. Optional KO-50 kerosene heater or air conditioning unit ahead of external fuel tank or over starboard passenger door. Main and auxiliary hydraulic systems, operating pressure between 44 and 64 bar (640 to 924 lb/sq in). Pneumatic system for braking; pressure 4 to 5 bar (58 to 73 lb/sq in); reservoir volume 10 litres (2.6 US gallons; 2.2 Imp gallons). Engine air intake de-icing standard. KKO oxygen system.

AVIONICS: *Comms:* Yadro-1A1 and KHF 950 VHF; P-863 VHF/UHF; ACR-500 VHF/UHF; Orlan-85ST UHF; UVD CO-70 or CO-96 transponder.

Radar: Type 8A-813, RDR 1400 or RDR 2000 weather radar optional.

Flight: Radio altimeter; radio compass; VOR/ILS; VIM-95; CD-75 VND-94 or Bendix/King KN 62 DME.

Instrumentation: Optionally compatible with night vision goggles.

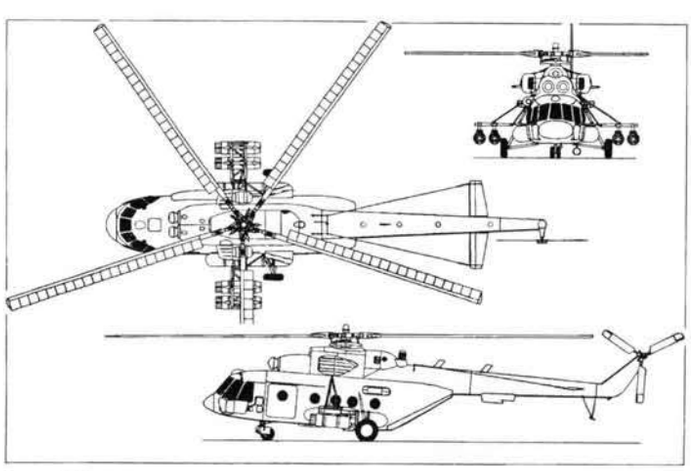
Self-defence : (optional) ASO-2V chaff/flare dispensers under tailboom and L166V1AE IR jammer (NATO 'Hot Brick') at forward end of tailboom.

EQUIPMENT: Optional external hook for underslung loads of up to 4.5 tonnes and 65 m (215 ft) in length at speeds up to 81 kt (150 km/h; 92 mph). Optional medical evacuation and SAR fitments. LPG-150M winch for cargo loading; optional SLG-300 300 kg (661 lb) external SAR winch above port, forward door. Various search lights, loudspeakers and EO sensor turrets may be installed. Optional Bristol Aerospace cable-cutters.

ARMAMENT: Optional armament on two external pylons. Typical loads include UPK-23-250 23 mm cannon pods, 500 kg bombs and rocket pods.

DIMENSIONS, EXTERNAL:

Main rotor diameter	21.295 m (69 ft 10½ in)
Main rotor blade chord	0.52 m (1 ft 8½ in)
Tail rotor diameter	3.91 m (12 ft 9 ⅞ in)
Length: overall, rotors turning	25.31 m (83 ft 1¼ in)
fuselage	18.99 m (62 ft 3½ in)
Width over weapon pylons	7.20 m (23 ft 7½ in)
Tailplane span	3.705 m (12 ft 1¾ in)
Height: overall, rotors turning	5.545 m (18 ft 2¼ in)
to top of rotor head	4.865 m (15 ft 11½ in)



Kazan/Mil Mi-17V-5

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Kazan-built Mil Mi-17V-5 in Chinese Army service 1159018

Wheel track: main	4.51 m (14 ft 9½ in)
nose	0.30 m (11¾ in)
Wheelbase	4.28 m (14 ft 0½ in)
Fwd passenger door (stbd): Height	1.405 m (4 ft 7¼ in)
Width	0.825 m (2 ft 8½ in)
Fwd passenger door (port): Height	1.405 m (4 ft 7¼ in)
Width	1.215 m (3 ft 11¾ in)
Rear cargo ramp: Height	1.56 m (5 ft 1½ in)
Width	2.30 m (7 ft 6½ in)
DIMENSIONS, INTERNAL:	
Cabin: Length at floor	5.34 m (17 ft 6¼ in)
Width: at ramp	2.34 m (7 ft 8¼ in)
max	2.60 m (8 ft 6¼ in)
Height	1.80 m (5 ft 10¾ in)
Volume	23.0 m³ (812 cu ft)
AREAS:	
Main rotor disc	356.16 m² (3,833.7 sq ft)
Tail rotor disc	12.01 m² (129.28 sq ft)
WEIGHTS AND LOADINGS:	
Weight empty, equipped	7,468 kg (16,464 lb)
Max payload:	
internal	4,000 kg (8,820 lb)
external, on sling	4,500 kg (9,920 lb)
Max T-O weight: TV3 engines	13,000 kg (28,660 lb)
VK-2500 engines	13,500 kg (29,762 lb)
Max disc loading	36.5 kg/m² (7.48 lb/sq ft)
PERFORMANCE (TV3-117VM engines):	
Never-exceed speed (VNE)	162 kt (300 km/h; 186 mph)
Max level speed	135 kt (250 km/h; 155 mph)
Max cruising speed	124 kt (230 km/h; 143 mph)
Econ cruising speed	70 kt (130 km/h; 81 mph)
Max forward rate of climb at S/L	624 m (2,047 ft)/min
Service ceiling: TV3	6,000 m (19,680 ft)
VK-2500	6,500 m (21,320 ft)
Hovering ceiling, OGE: TV3	3,980 m (13,055 ft)
VK-2500	4,500 m (14,760 ft)
Range with 5% reserves:	
with 4,000 kg (8,820 lb) payload	189 n miles (350 km; 217 miles)
ferry: normal fuel	386 n miles (715 km; 444 miles)
with max cabin fuel	890 n miles (1,650 km; 1,025 miles)

KAZAN ANSAT

English name: Light

TYPE: Light utility helicopter.

PROGRAMME: Design begun at Kazan in 1993; design subcontracts to Kazan State Technical University for structural strength and aerodynamic calculations; Aviacon Scientific and Production Centre for rotor; and Aeromekhanica for transmission. Name in Tatar language variously translated as *easy, simple, ethereal* and *light*.

Fuselage mockup exhibited at 1995 Paris Air Show; considerably revised engineering mockup (001) at Paris '97; by August 1998, now marked '01', this had accumulated 10 hours of ground running with engines and rotors; total 800 hours by February 2003.

First flight scheduled for late 1997, but initial designated flight trials aircraft (02) exhibited at Farnborough in September 1998, still unflown. First flight (02) was 12 minute hover on 17 August 1999; initial forward flight on 6 October 1999. Trials halted in November 1999, after 4 hours, due to gearbox problems; resumed in second quarter of 2000 with strengthened and redesigned main transmission, scarfed engine exhausts and new identity '902'. Total 120 hours up to February 2003.

Third (second flying) prototype (03) was to have joined the programme in late 1999, but not completed until August 2001. First flown 27 December 2001, this is to pre-production standard with small, detachable, pannier tanks, increased fin area, PW207 engines, additional side window and flatter windscreen combined with revised nose shape; intended to add 400 hours to trials programme. Certification flight testing, to total 600 sorties, began 31 October 2002; by early 2003 had been renumbered '904' and received modifications including relocation of fuel tanks under cabin floor; rear landing gear bow partly housed within fuselage and front bow protected by cowling. Total 300+ sorties and 200+ hours by termination of trials in June 2004.

Prototype Kazan Ansat-UT military trainer 1159020

Russian AP-29 type certificate awarded 29 December 2004, amended 24 February 2005 to include two-crew operation and fitment of emergency flotation system.

On 14 September 2001, Ansat declared winner of competition to supply 100 training helicopters to Russian armed forces by 2015 (beating Mi-34 and Ka-226). Launch of production announced 27 September 2004; first for military use rolled out some days later, but apparently had not flown by mid-2005.

CURRENT VERSIONS: Can be optimised for transport (including underslung load), ambulance, SAR, training, patrol and other duties. Provision for attachment of sponsons or tanks to sides of cabin.

Ansat: *As described.*

Ansat-UT: Optimised for training (*uchebni*). Aircraft No. 5 (fourth prototype) completed as UT and delivered to flight test unit on 1 April 2004. Skid landing gear appeared in early photographs; not stated if flown thus; by late 2005 was flying with intended tricycle gear.

Ansat-AG: Version for Gazprom pipeline inspection.

Ansat-LL: Flying laboratory. (RA-)20440 shown at Moscow Salon in August 2005 outfitted for avionics trials by Radar-MMS company.

Ansat 2RTs: Previously known as **Ansat Nablyudatel** (Ansat Observation). Mockup of proposed scout helicopter based on Ansat was shown at Moscow Salon in August 2001. GOES 521 turret in nose with Svisheh sensors integrated by Optooil ZAO. Max useful load 1,500 kg (3,307 lb); max T-O weight 3,500 kg (7,716 lb); max level speed 162 kt (300 km/h; 186 mph); range 350 n miles (650 km; 403 miles) on internal fuel, 691 n miles (1,280 km; 795 miles) with external tanks; service ceiling 5,700 m (18,700 ft); hovering ceiling 3,800 m (12,460 ft). Powered by two PW207K turboshafts, each rated at 522 kW (700 shp).

Prototype of a considerably revised design constructed from dynamic systems (including P&WC engines) of Ansat '902', retaining that aircraft's identity. First flew July 2005 and exhibited in flying display at Moscow Salon during following month, having changed designation (as applied to side of fuselage) from -2R to -2RTs during that short period.

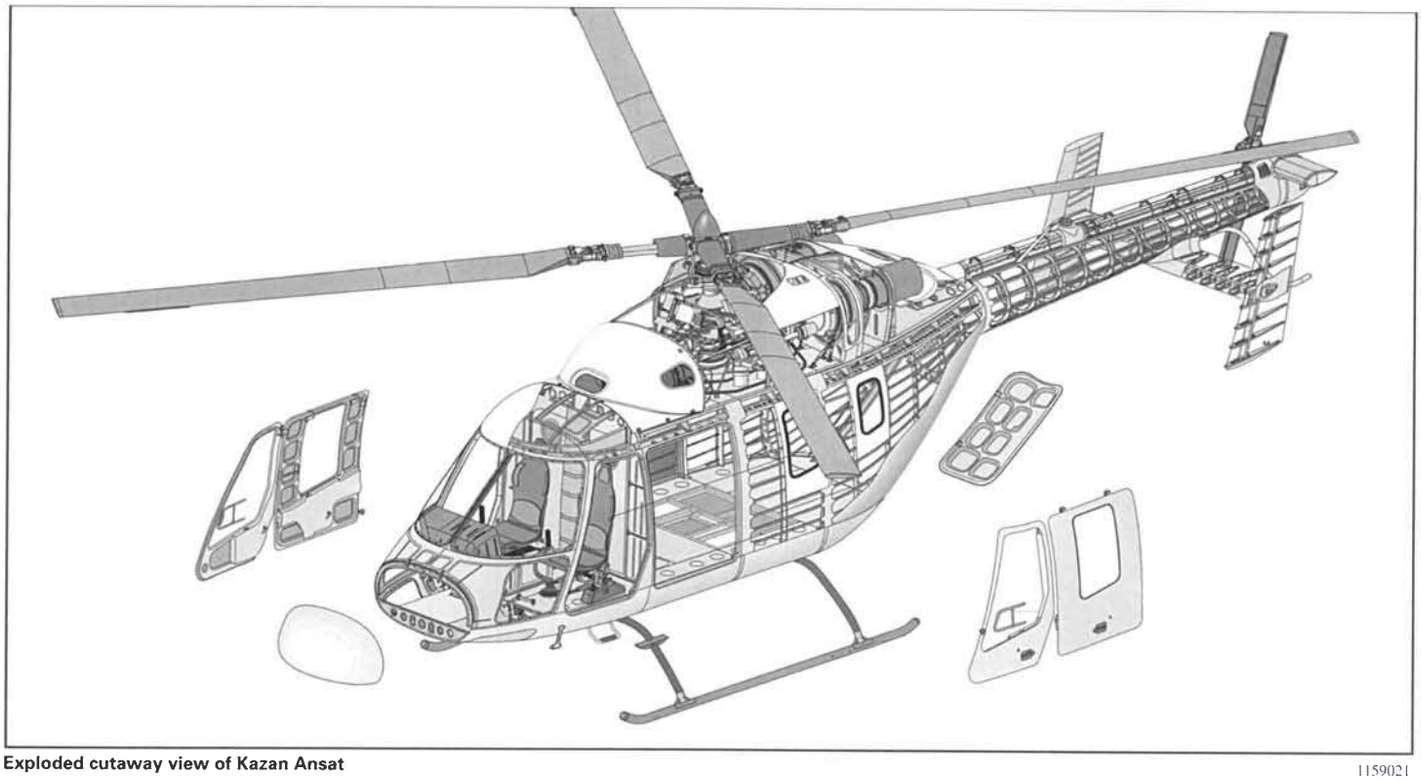
Intended for export, with South Korea as target launch customer. Twin stabilising fins are sole obvious external connection with original Ansat. Weapons on four pylons attached to stub wings; GOES 521 chin turret; Kord 12.7 mm machine gun scabbed to starboard side of fuselage; UV-26 chaff/flare dispensers mounted internally, each side of mid-fuselage. Pilot in rear of tandem seats; acrylic (unarmoured, curved) transparencies.

CUSTOMERS: Initial export customer, South Korean forestry service, first three received in December 2004 and total of five by late 2005, with sixth due in 2006. One on order for Tatarstan Airline in 2005.

COSTS: USD2.0 million for utility version (2003). Kazan's development expenditure had reached RUR500 million by mid-2004, with expected RUR100 million required for completion of certification.

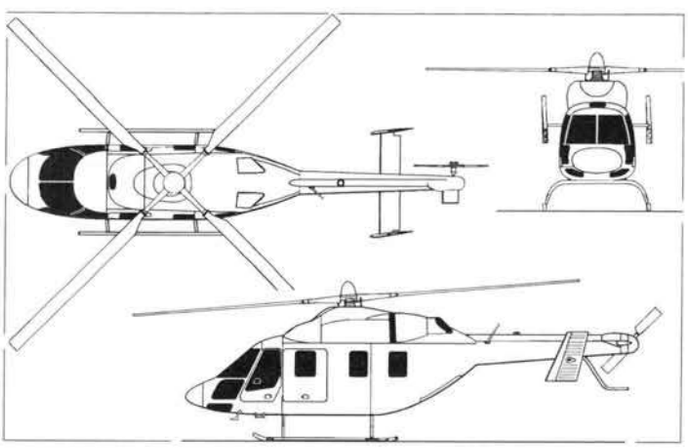
DESIGN FEATURES: Optimised for aerodynamic efficiency, survivability in emergency landing (1 m; 3 ft/s power-off touchdown speed) and off-base routine maintenance. Traditional metal structure for simplicity and reliability. Meets FAR Pt 29 Category A and Russian AP-29 requirements. First Russian helicopter with shock-absorbing seats for passengers. Conventional configuration, with high-mounted tailboom carrying fixed horizontal stabiliser and twin fins; power plant above cabin. Hingeless main rotor hub with glass fibre torsion bar; forward inclination 4° 30'; four main blades; two-blade tail rotor. Two-stage, VR-23 main rotor reduction gear in magnesium case ahead of engines; ratio 16.4; rotation speed 365.4 rpm; blade tip speed 220 m (722 ft)/s. Transmission rating 769 kW (1,031 shp).

Kazan Ansat of South Korean forestry service 1159022



Exploded cutaway view of Kazan Ansat 1159021

Attack-optimised Kazan Ansat-2RTs *(Yefim Gordon)* 1159023



Kazan Ansat light utility helicopter *(Paul Jackson)* 1128982

Tail rotor speed 2,000 rpm via single stage conical geabox. Rotor brake. Manual blade folding.

Main rotor aerofoil section NACA 23012.

STRUCTURE: Duralumin fuselage; sparing use of composites for cowlings, doors and hatches; layered glass fibre main rotor blades, window frames and nosecone.

LANDING GEAR: Twin skids with Kazan transverse shock-absorbers; tail bumper to protect anti-torque rotor. Wheels optional; tricycle configuration, with Yaroslav tyres and Gidroagregat (Balashikha) brakes. Optional emergency flotation system.

POWER PLANT: Two P&W Rus XRK206S turboshafts, each rated at 477 kW (640 shp) for T-O, 418 kW (560 shp) max continuous, in prototypes. Production version with PW207Ks, rated at 470 kW (630 shp) for T-O, 410 kW (550 shp) max continuous, 529 kW (710 shp) for 30 s, 470 kW (630 shp) continuous OEI and 491 kW (659 shp) 2 minutes OEI. FADEC standard. Fuel capacity 707 litres (187 US gallons; 156 Imp gallons) in either external panniers or underfloor. Optional internal ferry fuel.

Alternatively, two Salyut TV-500A turboshafts, each 478 kW (641 shp).

ACCOMMODATION: Up to 11 persons, including one or two pilots, on energy-absorbing seats; or two stretcher patients and three attendants; or internal or externally slung freight. Two forward-hinged doors each side of flight deck; two forward-hinged doors each side of cabin, forward; baggage bay behind cabin, with rear-facing door. Baggage door also used for loading stretchers of medical variant. Accommodation ventilated and heated; optional air conditioning.

SYSTEMS: Avionika FBW controls comprise quadruplex electronic system and duplex hydraulic system. Automatic flight control is standard on all piloting functions and optional on navigation functions. Current FBW system to be replaced by Moscow Research & Production Complex Avionika KSU-A four-channel digital-analogue control system. Main transmission drives two alternators (each 200 V, 400 Hz), two generators (each 27 V), two fans and two hydraulic fuel pumps for separate systems. Electrical system 27 V, with battery; optional AC system, with second battery. Electric de-icing optional.

AVIONICS: Standard Russian avionics and instruments (apart from prototypes' BAE Systems North America engine parameters display, which to be replaced by Ulyanovsk BISK-A system); full Western avionics fit available as an option.

Radar: Provision in nosecone.

EQUIPMENT: Cabin tie-down points. Optional rescue hoist and sling.

ARMAMENT: Optional external rocket and machine gun pods.

DIMENSIONS, EXTERNAL:

Main rotor diameter	11.50 m (37 ft 8¾ in)
Main rotor blade chord	0.32 m (1 ft 0½ in)
Tail rotor diameter	2.10 m (6 ft 10½ in)
Length: overall, rotors turning	13.64 m (44 ft 9 in)
fuselage	11.18 m (36 ft 8¼ in)
Height to top of rotor head	3.56 m (11 ft 8¼ in)
Width: fuselage	1.80 m (5 ft 10¾ in)
over optional sponsons	3.61 m (11 ft 10¼ in)
Skid length	3.10 m (10 ft 2 in)
Skid track	2.50 m (8 ft 2½ in)

DIMENSIONS, INTERNAL:

Cabin: Length	3.17 m (10 ft 4¾ in)
Max width	1.66 m (5 ft 5¼ in)
Max height	1.30 m (4 ft 3¼ in)
Volume	6.7 m^3 (237 cu ft)

AREAS:

Main rotor disc	103.87 m^2 (1,118.0 sq ft)
Tail rotor disc	3.46 m^2 (37.28 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, equipped	1,900 kg (4,189 lb)
Max fuel weight	540 kg (1,190 lb)
Max payload: internal	1,000 kg (2,204 lb)
external	1,300 kg (2,866 lb)
T-O weight, internal or external load:	
normal	3,000 kg (6,613 lb)
max	3,300 kg (7,275 lb)
Max disc loading	31.8 kg/m^2 (6.51 lb/sq ft)
Transmission loading at max T-O weight and power	4.29 kg/kW (7.06 lb/shp)

PERFORMANCE:

Never-exceed speed (VNE)	148 kt (275 km/h; 170 mph)
Max level speed	148 kt (275 km/h; 171 mph)
Max cruising speed	135 kt (250 km/h; 155 mph)
Max rate of climb at S/L	780 m (2,559 ft)/min
Max rate of climb at S/L, OEI	240 m (787 ft)/min
Service ceiling	5,700 m (18,700 ft)
Service ceiling, OEI	2,600 m (8,540 ft)
Hovering ceiling, OGE	3,300 m (10,820 ft)
Range: with 5% reserves	286 n miles (530 km; 329 miles)
Endurance	3 h 20 min

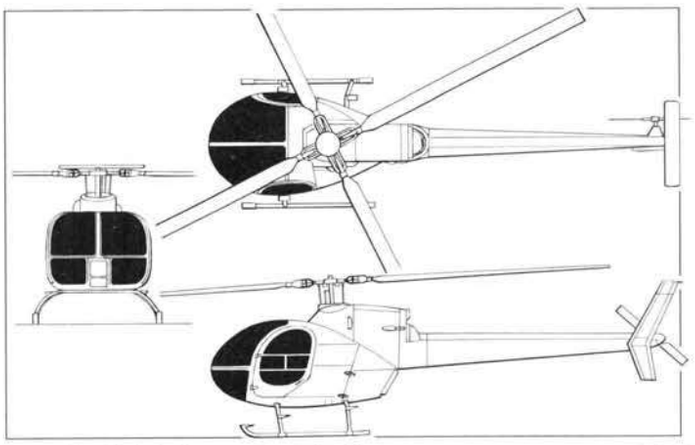
KAZAN AKTAI

English name: White Colt

TYPE: Three-seat helicopter.

PROGRAMME: Work began 1996. Project revealed at Moscow Air Show, 19 August 1997, with display of mockup. Second, engineering mockup built 1998. Kazan decided in mid-2001 to begin building a prototype to fly in 2003, but the programme suffered delay and no further progress was evident by mid-2006.

Mockup of Kazan Aktai *(Yefim Gordon)* 1129423



Kazan Aktai light helicopter *(James Goulding)* 0131345

CURRENT VERSIONS: Passenger, medical, evacuation and military configurations planned.

COSTS: "Less than USD950,000" (2003). Estimated (2000) market for over 1,000. Development cost (2000) USD10 million.

DESIGN FEATURES: Intended for light transport, patrol, medical evacuation and training. Certification will be to FAR Pt 27. Conventional pod and boom configuration with T tail. Semi-articulated three-blade main rotor; tapered blades on production version; max (emergency) rotation speed 2,586 rpm; rotor brake; no provision for folding; Krasnyy Oktyabr VR-10 main gearbox, transmission rating 216 kW (290 hp); engine input 6,000 rpm; XP-10 gearbox for two-blade tail rotor.

STRUCTURE: Extensive use of composites throughout, including main rotor blades.

LANDING GEAR: Conventional, non-retractable skids on arched support tubes; spring shock absorbtion.

POWER PLANT: One 201 kW (270 hp) VAZ-4265 rotary motorcar engine mounted above the cabin and behind the gearbox and operating on 92/93 grade petrol. Manual rpm control. Fuel capacity 300 litres (79.2 US gallons; 66.0 Imp gallons). Refuelling point port side. Oil capacity 20 litres (5.3 US gallons; 4.4 Imp gallons).

ACCOMMODATION: Pilot and two passengers, all side by side, in individual seats; forward-hinged door each side. Twin clamshell doors at rear of pod, below tailboom, provide access to flat freight floor; one casualty stretcher can be loaded through rear doors when passenger seat is removed. Alternative access via door (including circular window) on starboard side. Optional, rear-facing seat in luggage bay. Optional heating and air conditioning.

SYSTEMS: Electrical system with accumulator and M-16 generator, max rating 16 kW. Anti-icing of main rotor blades.

AVIONICS: *Comms:* Yurok radio.
Flight: KG-1B navigation system; GPS.

EQUIPMENT: Inset toe-steps for maintenance access.

DIMENSIONS, EXTERNAL:

Main rotor diameter	10.00 m (32 ft 9¾ in)
Main rotor blade mean chord	0.24 m (9½ in)
Tail rotor diameter	1.60 m (5 ft 3 in)
Length overall, rotors turning	11.64 m (38 ft 2¼ in)
Fuselage: Length	8.35 m (27 ft 4¾ in)
Max width	1.70 m (5 ft 7 in)
Max height	1.48 m (4 ft 10¾ in)
Height overall	2.69 m (8 ft 10 in)
Tailplane span	1.44 m (4 ft 8¾ in)
Skid track	2.10 m (6 ft 10¾ in)
Passenger doors, both:	
Max height	1.00 m (3 ft 3¼ in)
Max width	0.80 m (2 ft 7½ in)
Baggage door, starboard:	
Max height	0.60 m (1 ft 11½ in)
Max width	0.70 m (2 ft 3½ in)

DIMENSIONS, INTERNAL:

Cabin: Length	1.20 m (3 ft 11¼ in)
Max width	1.70 m (5 ft 7 in)
Floor area	2.80 m² (30.1 sq ft)
Volume	4.0 m³ (141 cu ft)
Freight compartment: Length	1.20 m (3 ft 11¼ in)
Max width	1.00 m (3 ft 3¼ in)
Max height	1.48 m (4 ft 4 in)
Volume	2.8 m³ (99 cu ft)

AREAS:

Main rotor blades, each	0.99 m² (10.66 sq ft)
Tail rotor blades, each	0.11 m² (1.18 sq ft)
Main rotor disc	78.54 m² (845.4 sq ft)
Tail rotor disc	2.01 m² (21.64 sq ft)
Fins, each	0.40 m² (4.31 sq ft)
Tailplane	0.35 m² (3.77 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	605 kg (1,334 lb)
Max payload	300 kg (661 lb)
Max T-O weight: normal	1,050 kg (2,314 lb)
max	1,150 kg (2,535 lb)
Max disc loading	14.64 kg/m² (3.00 lb/sq ft)
Max power loading	5.71 kg/kW (9.39 lb/hp)

PERFORMANCE (estimated):

Never-exceed speed (VNE)	102 kt (190 km/h; 118 mph)
Max level speed at S/L	97 kt (180 km/h; 112 mph)
Econ cruising speed	84 kt (155 km/h; 96 mph)
Max rate of climb at S/L	336 m (1,102 ft)/min
Service ceiling	4,700 m (15,420 ft)
Hovering ceiling: OGE	1,300 m (4,260 ft)
Range with 5% reserves	216 n miles (400 km; 248 miles)
Endurance	3 h

KAZAN ANSAT 3 MAKSIMUM

English name: Maximum

TYPE: Medium transport helicopter.

PROGRAMME: Initial details released, and cabin mockup shown, at Moscow Salon in August 2003. To be certified to AP-29 civil standards.

DESIGN FEATURES: Development of Ansat into medium helicopter category with stretched cabin and tailfin. Variously shown with four- and five-blade main rotor; and two-, three- and X-blade tail rotor.

POWER PLANT: Two turboshaft engines mounted above cabin. Option of 956 kW (1,282 shp) RD-600, 1,103 kW (1,479 shp) VK-1500 or 736 kW (987 shp) VK-800.

ACCOMMODATION: Two flight crew and up to 17 passengers on troop seats in cabin.

DIMENSIONS, EXTERNAL:

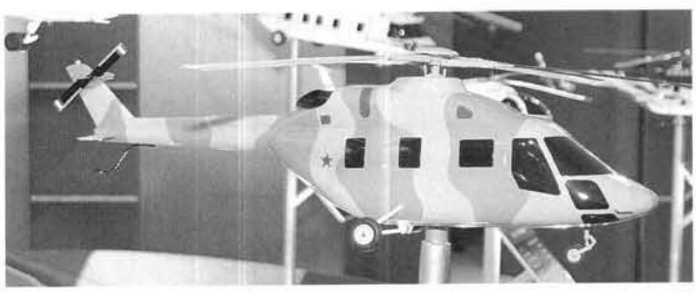
Main rotor diameter	14.50 m (47 ft 6¾ in)
Tail rotor diameter	2.70 m (8 ft 10¾ in)
Fuselage max width	1.80 m (5 ft 10¾ in)
Height to top of fin	3.73 m (12 ft 2¾ in)
Tailplane span	2.85 m (9 ft 4¾ in)
Wheel track	2.83 m (9 ft 3½ in)
Wheelbase	3.55 m (11 ft 7¾ in)

DIMENSIONS, INTERNAL:

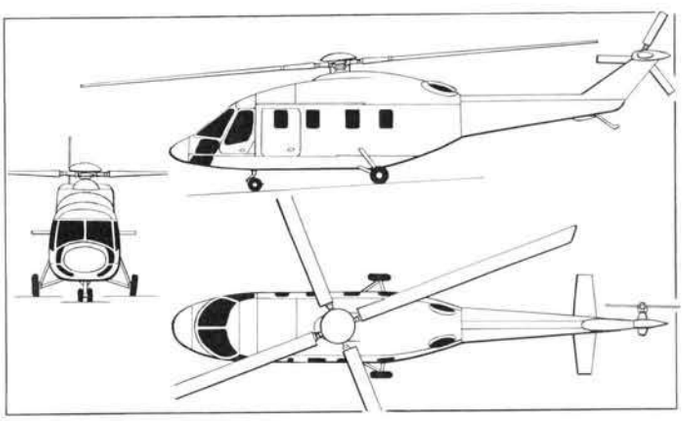
Cabin floor area	8.95 m² (96.3 sq ft)

AREAS:

Main rotor disc	165.10 m² (1,777.1 sq ft)
Tail rotor disc	5.72 m² (61.57 sq ft)



Model of Kazan Ansat 3 Maksimum *(Paul Jackson)* 1159068



Ansat 3 Maksimum medium helicopter *(James Goulding)* 0576723

For details of the latest updates to ***Jane's All the World's Aircraft*** online and to discover the additional information available exclusively to online subscribers please visit
jawa.janes.com

WEIGHTS AND LOADINGS:
Max payload ..... 1,700 kg (3,748 lb)
Max T-O weight ..... 5,678 kg (12,517 lb)
Max disc loading ..... 34.4 kg/m² (7.04 lb/sq ft)
PERFORMANCE:
Max level speed ..... 151 kt (280 km/h; 174 mph)
Normal cruising speed ..... 135 kt (250 km/h; 155 mph)
Hovering ceiling: IGE ..... 5,000 m (16,400 ft)
OGE ..... 3,500 m (11,480 ft)
Service ceiling ..... more than 6,000 m (19,680 ft)
Range with 30 min reserves ..... more than 459 n miles (850 km; 528 miles)

KHRUNICHEV

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DESIGN DIVISION MANAGER: Mikhail M Vasyuk

The Aviation Department of this prominent rocket and space vehicle design and manufacturing centre was formed in August 1994 to develop and manufacture general purpose aircraft. It comprises a design bureau, experimental facilities and operational and maintenance services. The main task of the Aviation Department is to develop to the series production stage aircraft designed on the basis of foreign and domestic components, and then to market them worldwide.

The T-411 Aist (in production, notably for the export market) and the T-501 are priority programmes, according to an announcement of April 2004. This also confirmed suspension of the T-440 Mercury turboprop twin and the relegation of various agricultural aircraft to the longer term, though these remain available, subject to customer interest. Several other designs have failed to progress beyond the mockup or prototype stage, including the T-21, T-415 and T-507. In 2005, details of the T-207 were released.

During 2001, the company launched a joint venture with Sherpa Aircraft of the USA to market the T-411 in North America. It also builds Sherpa 200 and 300 airframes for distribution in the US, manufacture of the first '200 having begun in June 2003.

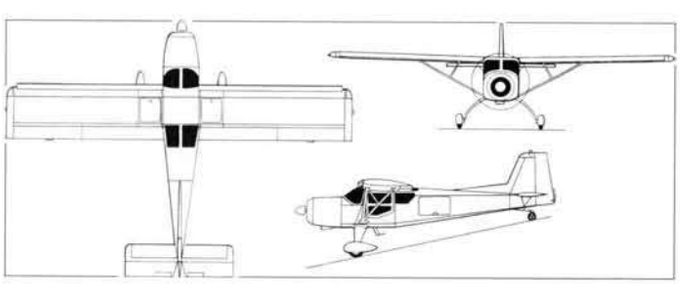
KHRUNICHEV T-205 and T-207

TYPE: Light utility turboprop.
PROGRAMME: Announced 2005.
CURRENT VERSIONS: **T-205:** Tailwheel version, intended for use on unprepared landing strips.
T-207: Basic version, *as described*.
DESIGN FEATURES: Conventional strut-braced, high-wing monoplane with STOL performance and fixed landing gear; intended for multiple missions, including search and rescue, parachuting, firefighting and pilot training. Superficially similar to company's T-507 Skvorets. Interior allows carriage of LD3 containers; underfuselage cargo pod can be fitted.
Wing aerofoil P-II-14 with 14 per cent thickness-chord ratio.
FLYING CONTROLS: Conventional and manual. Trim tab in elevator. Slotted flaps and ailerons. Dorsal fin.
STRUCTURE: All-metal. Fuselage has fixed bulkhead with door between cockpit and passenger cabin.
LANDING GEAR: T-205 has tailwheel; T-207 is of tricycle type; both fixed. Steerable nosewheel on T-207. Floats and skis optional.
POWER PLANT: One 969 kW (1,300 shp) P&WC PT6A-65 turboprop, driving a Hartzell five-blade, variable-pitch propeller.
ACCOMMODATION: Pilot and up to nine passengers for flights under FAR Pt 23 rules; maximum capacity two pilots and 12 passengers. Large cargo door on port side.
SYSTEMS: Engine-driven alternator with back-up battery. Electric starter.
All data are provisional.
DIMENSIONS, EXTERNAL:
Wing span ..... 20.00 m (65 ft 7½ in)
Length overall ..... 15.00 m (49 ft 2½ in)
Propeller diameter ..... 2.82 m (9 ft 3 in)
Cargo door: Height ..... 1.53 m (5 ft ¼ in)
Width ..... 1.46 m (4 ft 9½ in)
DIMENSIONS, INTERNAL:
Underfuselage pod volume ..... 3.00 m³ (106 cu ft)
WEIGHTS AND LOADINGS:
Max fuel weight ..... 1,280 kg (2,822 lb)
Max T-O weight ..... 5,700 kg (12,566 lb)
Max power loading ..... 5.88 kg/kW (9.67 lb/shp)
PERFORMANCE:
Normal cruising speed ..... 175 kt (325 km/h; 202 mph)
T-O run ..... 230 m (755 ft)
T-O to 15 m (50 ft) ..... 430 m (1,411 ft)
Landing from 15 m (50 ft) ..... 500 m (1,640 ft)
Landing run ..... 160 m (525 ft)
Range ..... 890 n miles (1,650 km; 1,025 miles)

KHRUNICHEV T-411 AIST

English name: Stork
TYPE: Utility kitbuilt.
PROGRAMME: Programme started in 1994 when licence acquired from Aeroprogress/ROKS-Aero to produce the T-411 Aist-2 (see 1997–98 and previous editions); Aist-2 design started September 1992; construction of prototype began April 1993; first flight (marked only 'T-411') 10 November 1993 in standard form; 15 March 1994 with ski landing gear. Khrunichev prototype (RA-01585), with several detail changes, first exhibited at Moscow Air Show 1997. Second prototype reported nearing first flight in January 2002. Initially designated T-411 Wolverine, which name later transferred to T-421. North American promotion (in kit form) taken over by Sherpa Aircraft in 2001 and first two (unassembled) kits for US market were displayed at AirVenture, Oshkosh, in July 2003.
Manufacture intended by RSK 'MiG', whose Voronin plant contracted in March 2000 to build 15 for delivery in 2001, but delivery target slipped to first quarter 2002, with all 15 to be handed over during following six months. However, by June 2002, talks between Khrunichev and RSK 'MiG' still had not reached a satisfactory conclusion, although first aircraft then nearing completion. Nothing further known.
In November 2003, Khrunichev reached agreement with Infrakos of Kazakhstan to produce T-411s at Baikonur, where the RSK-assembled aircraft will be completed. Certification was then expected by end 2004. At the same time an improved version with 2,500 kg (5,511 lb) max T-O weight and undisclosed increased fuel capacity was under consideration. By March 2003, deliveries were stated to be due for completion by end 2003, but this slipped and only two were delivered (in kit form) that year with the remaining 13 scheduled for delivery during 2004.
CURRENT VERSIONS: **T-411:** *As described.*
T-411A: Agricultural version.
T-411P: Floatplane version with twin floats, for operations in seas with wave height up to 0.35 m (1 ft 1½ in); length overall 10.00 m (32 ft 9¾ in); maximum take-off weight 1,650 kg (3,637 lb); payload 440 kg (970 lb); cruising speed 113 kt (210 km/h; 130 mph); T-O run 315 m (1,033 ft); T-O to 15 m (50 ft) 475 m (1,558 ft); landing from 15 m (50 ft) 305 m (1,000 ft); landing run 195 m (640 ft); maximum range 607 n miles (1,125 km; 699 miles).
T-411F: As T-411P, but with amphibious floats.
T-411L: Ski-equipped version.
T-411LY: Textron Lycoming TIO-540 powered version, see Power Plant below.
T-411 Turbo: Walter M 601B turboprop. Incomplete prototype shown in Moscow, August 2001. An upgraded M 601E-powered example has also been mooted.
T-421: Described in 2001–02 *Jane's All the World's Aircraft*.
CUSTOMERS: Orders received from Russian forestry, fisheries and national emergency ministries, Australia, Malaysia and US, but only three US aircraft identified: c/n 63101 registered to Wesley Gordon, of Scappoose, Oregon, December 2003 as N411RK and shown at Airventure, Oshkosh, July 2006; and kits c/n 63102 and one other, marked '002', neither of which had been completed by mid-2006.
COSTS: Kit USD90,000 (2006) not including engine.
DESIGN FEATURES: Conventional strut-braced high-wing monoplane. Constant-chord unswept wings with fixed leading-edge slat, slotted ailerons and single-slotted, three-position (0, 20, 40°) trailing-edge flaps; V bracing struts. Rectangular-section fuselage. Unswept tail unit with dorsal fin; constant-chord horizontal tail surfaces. Compared with the Aeroprogress Aist-2, the Khrunichev version has slightly stretched airframe and more roomy cabin; different landing gear and power plant.
Wing section NACA 23011; dihedral 2° from root; incidence 3° 30'.
FLYING CONTROLS: Conventional and manual. Actuation by pushrods and cables; electrically controlled trim tab in each elevator; fixed full-span leading-edge slats; slotted flaps.

First Khrunichev T-411 Aist in US *(Paul Jackson)* 1158591


Khrunichev T-411 Aist four/five-seat light aircraft *(James Goulding)*

STRUCTURE: Fuselage structure of 4130 steel tube covered with Dacron synthetic fabric and (cabin and engine cowling) aluminium alloys. Two-spar, constant-chord wings: metal skin on leading-edge and over fuel tanks at root, Dacron covered between spars. Metal tail surfaces, Dacron covered.

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted spring steel cantilever mainwheel legs with wheel fairings. Self-centring castoring tailwheel. Mainwheel tyres 600×180; tailwheel 310×135. Brakes on mainwheels.

POWER PLANT: One 268 kW (360 hp) VOKBM M-14X or M-14Kh nine-cylinder radial with Mühlbauer MTV-9 three-blade variable-pitch propeller, or 261 kW (350 hp) Textron Lycoming TIO-540 flat-six with Hartzell three-blade variable-pitch propeller. Two main and two auxiliary fuel tanks in wingroots, total capacity 340 litres (89.8 US gallons; 74.8 Imp gallons); gravity fuelling. Oil capacity 22.0 litres (5.8 US gallons; 4.8 Imp gallons).

ACCOMMODATION: Pilot and three or four passengers, on side-by-side front seats and rear bench seat; starboard front seat and rear bench removable, or bench seat foldable, for carrying equivalent freight; convertible into ambulance for one stretcher patient, one seated casualty and medical attendant in addition to pilot. Dual controls standard. Baggage/cargo compartment aft of rear seats, with large upward-opening door on port side, used also for loading freight or stretcher. Forward-hinged jettisonable door each side of cabin. Ventilation and heating standard.

SYSTEMS: Pneumatic system for starting engine and operating mainwheel brakes; pressure 50 bar (725 lb/sq in). Electrical system includes GSR-3000M engine-driven 27 V DC generator and 28 Ah 12CAM-28 battery.

AVIONICS: Russian or Western (Honeywell) avionics available, including GPS. Optional autopilot.

DIMENSIONS, EXTERNAL:

Wing span	13.02 m (42 ft 8½ in)
Wing aspect ratio	7.0
Length overall	9.45 m (31 ft 0 in)
Height overall	2.60 m (8 ft 6¼ in)
Wheel track	2.59 m (8 ft 6 in)
Wheelbase	6.50 m (21 ft 4 in)
Propeller diameter	2.03 m (6 ft 8 in)
Baggage door: Max height	0.65 m (2 ft 1½ in)
Width	1.22 m (4 ft 0 in)

DIMENSIONS, INTERNAL:

Cabin: Length	2.94 m (9 ft 7½ in)
Max width	1.27 m (4 ft 2 in)
Max height	1.30 m (4 ft 3 in)

AREAS:

Wings, gross	24.30 m² (261.6 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	544 kg (1,200 lb)
Max payload	361 kg (795 lb)
Max fuel weight	255 kg (562 lb)
Max T-O weight	1,680 kg (3,703 lb)
Max wing loading	69.1 kg/m² (14.16 lb/sq ft)
Max power loading	6.27 kg/kW (10.30 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	151 kt (280 km/h; 174 mph)
Cruising speed	110 kt (204 km/h; 127 mph)
Stalling speed: flaps up	61 kt (112 km/h; 70 mph)
flaps down	51 kt (93 km/h; 58 mph)
Max rate of climb at S/L	444 m (1,457 ft)/min
Service ceiling	3,000 m (9,840 ft)
T-O run	85 m (279 ft)
Landing run	136 m (446 ft)
T-O to 15 m (50 ft)	210 m (690 ft)
Landing from 15 m (50 ft)	331 m (1,090 ft)
Range with max fuel	648 n miles (1,200 km; 745 miles)

KHRUNICHEV T-419 STREKOZA

English name: Dragonfly

TYPE: Agricultural sprayer.

PROGRAMME: Mockup shown at Moscow Salon, August 2001. (Designation **T-411SKh** has also been used). Reported in May 2002 that prototype to fly within a few months, but no further progress apparent by mid-2004; by May 2006, company was intending to fly prototype in 'Summer' 2006.

COSTS: USD100,000 (2002).

DESIGN FEATURES: Similar to company's earlier T-517 Farmer, using strut-braced high wing and underslung crew and payload pod. Intended for wide variety of uses, including passenger and cargo transportation, agricultural spraying, pipeline inspection and police and border guard patrols.

FLYING CONTROLS: Conventional and manual. Horn-balanced elevators and rudder. Flaps.

STRUCTURE: Principally of metal with external bracing.

LANDING GEAR: Tailwheel type; fixed.

POWER PLANT: One 268 kW (360 hp) VOKBM M-14X nine-cylinder radial engine. Fuel in two wing tanks.

ACCOMMODATION: Pilot and three passengers in cabin.

DIMENSIONS, EXTERNAL:

Wing span	13.20 m (43 ft 3¾ in)
Length overall	8.55 m (28 ft 0½ in)

WEIGHTS AND LOADINGS:

Max payload	420 kg (926 lb)
Max fuel weight	280 kg (617 lb)
Max T-O weight	1,700 kg (3,747 lb)
Max power loading	6.33 kg/kW (10.41 lb/hp)

PERFORMANCE:

Normal cruising speed	97 kt (180 km/h; 112 mph)
T-O run	90 m (295 ft)
T-O to 15 m (50 ft)	250 m (820 ft)
Landing from 15 m (50 ft)	280 m (919 ft)
Landing run	136 m (446 ft)
Range	594 n miles (1,100 km; 683 miles)

0552718

Khrunichev T-419 mockup *(Paul Jackson)*

KHRUNICHEV T-501

English name: Dragonfly

TYPE: Light utility turboprop.

PROGRAMME: In April 2004, Khrunichev announced that it had assigned priority to development of an extensively modified version of the Aeroprogress/ROKS-Aero T-101 Grach, which is now envisaged with two turboprop engines each of some 969 kW (1,300 hp); accommodation for up to 12 passengers; 2,700 n mile (5,000 km; 3,106 mile) range; and a price of USD1.2 million. Nothing further heard by mid-2006.

KNAAPO

GOSUDARSTVENNOYE UNITARNOYE PREDPRIYATIE KOMSOMOLSKOE-NA-AMURE AVIATSIONNOYE PROIZVODSTVENNOYE OBEDINENIE IMENI YU A GAGARINA (STATE UNITARY ENTERPRISE KOMSOMOLSK-ON-AMUR AIRCRAFT PRODUCTION ASSOCIATION NAMED FOR Y A GAGARIN)

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e-mail(1): knaapo@kmscom.ru
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Web: www.knaapo.ru
GENERAL DIRECTOR: Viktor I Merkulov
TECHNICAL DIRECTOR: Aleksandr I Pekarsh
FIRST DEPUTY DIRECTOR-GENERAL AND MANAGER OF CIVIL AIRCRAFT PRODUCTION: Vladislav B Kotovsky
DEPUTY DIRECTOR-GENERAL AND BUSINESS MANAGER: Alexandr Ovchinnicov

KNAAPO is the major manufacturer of the Su-family aircraft and leading production centre of Aviation Holding Company "Sukhoi". Manufactures Su-27SK, Su-27SKM, Su-30MK, Su-30MK2 and Su-33 fighters and is responsible for the RRJ, Su-80GP, Be-103, and SA-20P civil programs. Modernising Sukhoi Su-27 for Russian Air Forces; delivered initial aircraft on 23 December 2004. In September 2001 announced own SA-20P programme, being modified version of Be-103, with single engine; by late 2005 had 40 Be-103/SA-20Ps in various stages of assembly. In anticipation of market trends, will reduce reliance on military aircraft sales to 50 per cent by 2010.

Known as GAZ 126 when established in 1934, it has built more than 11,000 aircraft of Ilyushin, Mikoyan-Gurevich and Tupolev types, including 3,000 exported to 20 countries, beginning in May 1936. Test airfield is Dzemgi. Other products include small aluminium boats, audio-video equipment, televisions, polygraphy equipment and wooden furniture, and refurbishment of tramcars. Operates own transport airline with four An-12s, one An-26, two An-32s, two (leased to Atlant-Soyuz) Il-76s, two Tu-134s and three Mi-8s.

KnAAPO-built Sukhoi Su-30MK during missile trials 1159024

KumAPP

KUMERTSKOYE AVIATSIONNOYE PROIZVODSTVENNOYE PREDPRIYATIE (KUMERTAU AVIATION PRODUCTION ENTERPRISE)

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Tel: (+7 34761) 422 53 and 423 00
Fax: (+7 34761) 439 13
Web: www.kumape.ru
GENERAL DIRECTOR: Boris S Malyshev
EXPORT DEPARTMENT: R M Rafikov

KumAPP has manufactured helicopters, aeroplanes and related equipment at Kumertau since 1962. Major programmes have involved the Kamov Ka-26 (800 built 1968-79) and Ka-27/28/29/32 helicopter series, Myasishchev M-17/M-55, wings for the Tupolev Tu-154M transport, and unmanned air vehicles including the Tu-243 Reis-D reconnaissance system. KAPP is the only manufacturer of carbon fibre/glass fibre rotor blades in the Russian Federation and Associated States (CIS).

Current production includes main rotor blades and associated bushes for the Ka-226. KumAPP built second and third prototype Ka-226s and contracted to build 10 for Moscow city government, although deliveries repeatedly postponed; and one for Bashkiriyan local government. Ka-32 remains in low-volume production at some five to 10 per year; Ka-31 previously manufactured for India. KumAPP has also been chosen to manufacture the Ilyushin Il-112 transport for the Russian Air Forces. Helicopter overhaul activities have included Indian Ka-28s.

The plant is to become part of the consortium led by RSK 'MiG' under aerospace restructuring plans announced by the Russian government in May 2001 and is due for privatisation. Employment in 2003 was 5,600. In 2004, KumAPP reported to be financially solvent, but still owing back pay to workforce.

LAPLAN

LAPLAN OAO (LAPLAN LTD)

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Tel: (+7 495) 739 37 80
Fax: (+7 495) 739 37 81
PRESIDENT: Alexey Lamanov

Established 2004 as division of Novye Transportnye Tekhnologyi (New Transport Technology) financial and industrial group, itself formed in 1994, initially to supply the rail travel industry. Workforce of 100 in 2006, including specialists previously employed by Ilyushin, MiG and Sukhoi.

Initial designs, L-451 and L-471, exhibited at Moscow in August 2005. By 2006, L-551 and L-572 also under development.

LAPLAN L-451

TYPE: Light utility transport.

PROGRAMME: Prototype, (RA-)3367K, exhibited at Moscow in August 2005. To be certified to AP-23/FAR Pt 23.

DESIGN FEATURES: Rugged multipurpose design, carrying 400 kg (882 lb) payload, suitable for undeveloped areas. STOL performance; unsophisticated design; low purchase and operating costs, with options of kit assembly and Diesel power plant.

High-mounted, constant-chord wing braced to lower fuselage by streamlined V struts. Sweptback fin; mid-mounted tailplane braced below by V struts.

FLYING CONTROLS: Conventional and manual. Mass-balanced ailerons; horn-balanced rudder and elevators. Actuation by pushrods and cables. Tab on rudder; flight-adjustable tab in starboard elevator. Slotted flaps.

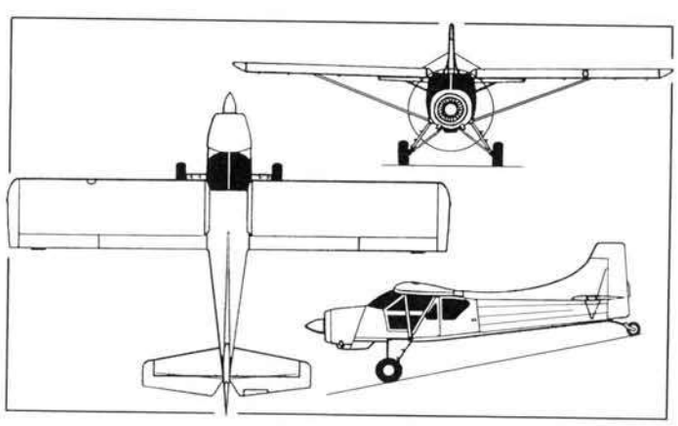
STRUCTURE: Welded tubular steel fuselage and two-spar metal wing; Stits fabric covering, except D16T metal forward fuselage and composites wingtips.

LANDING GEAR: Tricycle type; fixed. Faired-in side Vs hinged to lower longerons, with half-axles sprung on centreline. Mainwheels 800×260; steerable tailwheel.

POWER PLANT: One 265 kW (355 hp) VOKBM M-14X nine cylinder radial driving an MT-Propeller MTV-9 three-blade propeller. Optionally 231 kW (310 hp) Centurion Diesel engine. Twin fuel tanks in each wing, inboard; combined capacity 460 litres (121.5 US gallons; 101 Imp gallons).

ACCOMMODATION: Pilot, plus three passengers or equivalent freight. Upward-hinged door each side, forward; cabin door, port. Cockpit heated and ventilated.

SYSTEMS: Electrical system 28 V DC.



Laplan L-451 light utility transport *(Paul Jackson)* 1159398

AVIONICS: *Comms:* Garmin GNS 430 COM/GPS/VOR with GA 106 indicator and GMA 340 audio unit. ELS-110NM ELT.

Flight: S-Tec autopilot. Bendix/King KCS 55A navigation system with KI 525A indicator.

DIMENSIONS, EXTERNAL:

Wing span	13.50 m (44 ft 3½ in)
Wing aspect ratio	6.9
Length overall	9.60 m (31 ft 6 in)
Height overall	2.95 m (9 ft 8¼ in)
Tailplane span	5.20 m (17 ft 0¾ in)
Wheel track	2.80 m (9 ft 2¼ in)
Wheelbase	7.20 m (23 ft 7½ in)

DIMENSIONS, INTERNAL:

Cabin: Max width	1.24 m (4 ft 0¾ in)
Max height	1.20 m (3 ft 11¼ in)
Volume	4.2 m³ (148 cu ft)
Baggage area volume	0.65 m³ (23.0 cu ft)

1159319

Laplan L-451 on display at Moscow's MAKS air show, 2005 *(Yefim Gordon)*

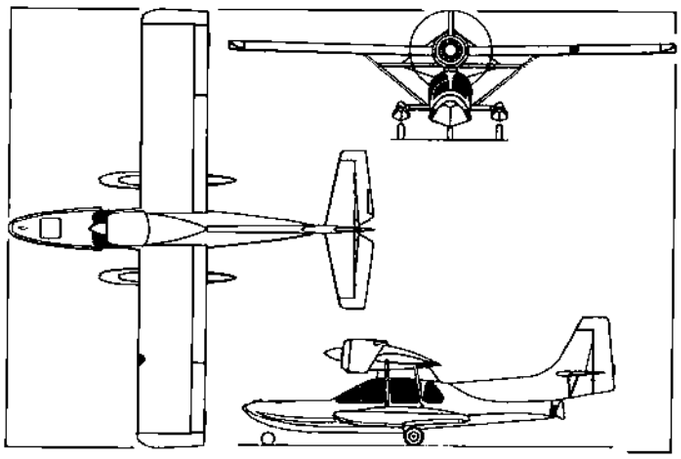
AREAS:
Wings, gross ..... 26.50 m² (285.2 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 1,250 kg (2,756 lb)
Max payload ..... 400 kg (882 lb)
Max fuel weight ..... 330 kg (728 lb)
Max T-O weight ..... 1,850 kg (4,078 lb)
Max landing weight ..... 1,800 kg (3,968 lb)
Max wing loading ..... 69.8 kg/m² (14.30 lb/sq ft)
Max power loading ..... 6.98 kg/kW (11.49 lb/hp)
PERFORMANCE:
Max level speed ..... 127 kt (235 km/h; 146 mph)
Stalling speed ..... 48 kt (88 km/h; 55 mph)
Max rate of climb at S/L ..... 390 m (1,280 ft)/min
T-O to 15 m (50 ft) ..... 375 m (1,230 ft)
Landing from 15 m (50 ft) ..... 420 m (1,380 ft)
Range with 45 min reserves:
with max payload ..... 297 n miles (550 km; 341 miles)
ferry ..... 1,052 n miles (1,950 km; 1,211 miles)
Endurance ..... 10 h 20 min
g limits ..... +3.8/ 1.5

LAPLAN L-471

TYPE: Four-seat amphibian.
PROGRAMME: (RA-)3368K shown at Moscow in August 2005.
DESIGN FEATURES: Inexpensive utility transport for undeveloped areas, offering rough airfield and water operation. Two-step hull; constant chord wing mounted on cabane, braced by parallel, streamlined struts each side. Sweptback fin; mid-mounted tailplane with V-strut bracing below. Single engine mounted on wing leading edge above cabin. Outrigger sponsons on cantilever booms each side of lower fuselage. Operable in wave heights up to 0.5 m (1½ ft).
FLYING CONTROLS: Conventional and manual. Actuation by pushrods and cables. Horn-balanced rudder and elevators. Trim tab on fin; flight adjustable tab in starboard elevator. Electrically actuated slotted flaps.
STRUCTURE: Generally of anodised aluminium, with some composites components. Hull divided into watertight compartments.
LANDING GEAR: Tricycle type; retractable. Mainwheels retract into sponsons; nosewheel into hull.
POWER PLANT: One 265 kW (355 hp) VOKBM M14P-XDK nine cylinder radial driving a two blade AB-81 propeller. Two fuel tanks in each wing, inboard, combined capacity 460 litres (121.5 US gallons; 101 Imp gallons).
ACCOMMODATION: Pilot and three or four passengers, or equivalent freight. Upward-hinged door each side, forward and port, rear. Accommodation heated and ventilated.
SYSTEMS: Engine powered electrical generator.
AVIONICS: *Flight:* Garmin GNS 530 GPS.
Comms: ELT 110-406 ELT.
DIMENSIONS, EXTERNAL:
Wing span ..... 13.50 m (44 ft 3½ in)
Wing aspect ratio 6.9
Length overall ..... 11.80 m (38 ft 8½ in)
Height overall ..... 4.10 m (13 ft 5½ in)
Tailplane span ..... 5.00 m (16 ft 4¾ in)
Wheel track ..... 3.00 m (9 ft 10 in)
Wheelbase ..... 4.80 m (15 ft 9 in)

1159320

Laplan L-471 amphibian *(Yefim Gordon)*



General arrangement of Lapan L-471 *(Paul Jackson)* 1159399

DIMENSIONS, INTERNAL:
- Cabin, Max width: 1.20 m (3 ft 11¼ in)
- Max height: 1.00 m (3 ft 3¾ in)
- Volume: 2.0 m³ (70 cu ft)
- Cargo bay volume: 1.3 m³ (46 cu ft)

AREAS:
- Wings, gross: 26.30 m² (283.1 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty: 1,350 kg (2,976 lb)
- Max payload: 400 kg (882 lb)
- Max fuel weight: 330 kg (728 lb)
- Max T-O weight: 1,950 kg (4,299 lb)
- Max landing weight: 1,900 kg (4,188 lb)
- Max wing loading: 74.1 kg/m² (15.19 lb/sq ft)
- Max power loading: 7.37 kg/kW (12.11 lb/hp)

PERFORMANCE:
- Max level speed: 116 kt (215 km/h; 133 mph)
- Stalling speed: 49 kt (90 km/h; 56 mph)
- Max rate of climb at S/L: 390 m (1,280 ft)/min
- T-O to 15 m (50 ft): land: 395 m (1,295 ft)
  - water: 470 m (1,545 ft)
- Landing from 15 m (50 ft): land: 485 m (1,595 ft)
  - water: 225 m (740 ft)
- Range with 45 min reserves:
  - with max payload: 237 n miles (440 km; 273 miles)
  - ferry: 688 n miles (1,275 km; 792 miles)
- Endurance: 8 h 0 min
- g limits: +3.8/–1.5

LAPLAN L-551

TYPE: Light utility turboprop.

PROGRAMME: Details published 2006. None yet built.

DESIGN FEATURES: Turboprop version of L-451.
Principal differences as below.

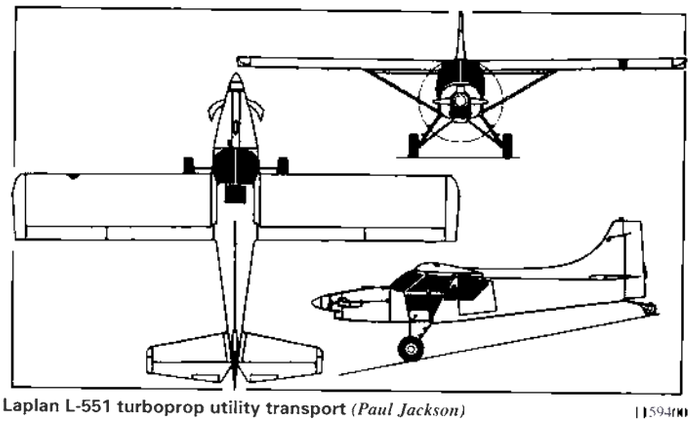
POWER PLANT: One 560 kW (751 shp) M 601 E turboprop driving an Avia V-510 five-blade variable pitch propeller. Five tanks in each wing centre section, combined capacity 1,040 litres (275 US gallons; 229 Imp gallons).

ACCOMMODATION: Pilot and up to seven passengers.

DIMENSIONS, EXTERNAL:
- Cabin: Length: 2.45 m (8 ft 0½ in)
  - Max width: 1.50 m (4 ft 11 in)
  - Max height: 1.20 m (3 ft 11¼ in)

WEIGHTS AND LOADINGS:
- Max payload: 750 kg (1,653 lb)
- Max fuel weight: 830 kg (1,830 lb)
- Max T-O weight: 2,700 kg (5,952 lb)
- Max wing loading: 101.9 kg/m² (20.87 lb/sq ft)
- Max power loading: 4.82 kg/kW (7.93 lb/shp)

PERFORMANCE:
- Max level speed: 178 kt (330 km/h; 205 mph)



Laplan L-551 turboprop utility transport *(Paul Jackson)* 1159400

- T-O to 15 m (50 ft): 400 m (1,315 ft)
- Landing from 15 m (50 ft): 290 m (955 ft)
- Range: 1,052 n miles (1,950 km; 1,211 miles)

LAPLAN L-572

TYPE: Twin-turboprop amphibian.

PROGRAMME: Under development by 2006.

DESIGN FEATURES: Twin-turboprop derivative of L-471, with engines similarly mounted on wing leading-edge; broader beam; outrigger floats removed to wingtips.

POWER PLANT: Two AI-450TP turboprop versions of Progress (ZMKB) AI-450 turboshaft, each 331 kW (443 shp). Fuel capacity 1,000 litres (264 US gallons; 220 Imp gallons).

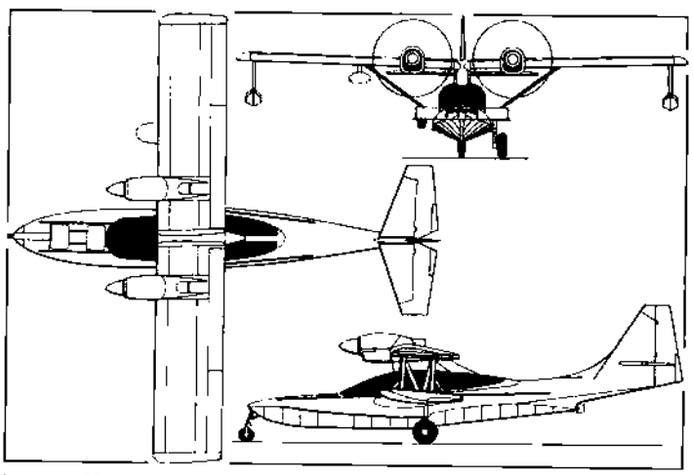
ACCOMMODATION: Pilot and seven passengers.

AVIONICS: *Radar:* Optional podded radar under starboard wing.

DIMENSIONS, EXTERNAL:
- Cabin: Length: 2.45 m (8 ft 0½ in)
  - Max width: 1.50 m (4 ft 11 in)
  - Max height: 1.32 m (4 ft 4 in)

WEIGHTS AND LOADINGS:
- Max payload: 780 kg (1,720 lb)
- Max fuel weight: 800 kg (1,763 lb)
- Max T-O weight: 3,000 kg (6,613 lb)
- Max power loading: 4.54 kg/kW (7.46 lb/shp)

PERFORMANCE:
- Max level speed: 194 kt (360 km/h; 224 mph)
- T-O to 15 m (50 ft): on land: 420 m (1,380 ft)
  - on water: 570 m (1,870 m)
- Landing from 15 m (50 ft): on land: 370 m (1,215 ft)
  - on water: 520 m (1,710 ft)
- Range with max fuel: 853 n miles (1,580 km; 981 miles)



Laplan L-572 twin-turboprop amphibian *(Paul Jackson)* 1159401

MIG

INZHENIRNYI TSENTR "OKB IMENI A I MIKOYANA" ("A I MIKOYAN EXPERIMENTAL DESIGN BUREAU" ENGINEERING CENTRE)

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CHIEF, PUBLIC RELATIONS AND ADVERTISING DEPARTMENT: Svyatoslav Yu Ribas

This bureau originated in GAZ 1 (factory No. 1) founded in 1893. The experimental design bureau, founded by Artem I Mikoyan, dissociated from the factory in 1939 and later became officially the Mikoyan Aviation Scientific-Industrial Complex 'MiG' (the final letter indicating Mikhail I Gurevich). It developed 250 projects and built 120 prototypes. More than 60,000 aircraft of MiG design have been manufactured, including 11,000 for export and MiG aircraft have at one time or another held 72 world records.

In 1995, the Moscow Aircraft Production Organisation and ANPK MiG were merged into the single state company MAPO 'MiG'. The original 'MiG' acronym continued to be used, though MiG lost its separate legal identity and was prevented from selling its own aircraft. On 4 July 1997 the legal status of MAPO 'MiG' was restored. Following a change of title, the bureau is now subordinate to RSK 'MiG', described separately.

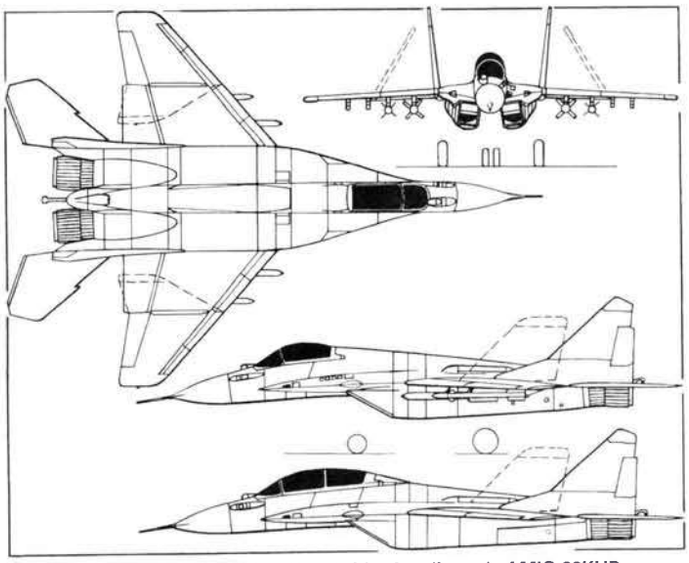
Seeking to further its aerodynamic research, MiG proposed in late 2002 to return to airworthy condition the twice-flown 1.44 technology demonstrator, subject to interest and financial contribution by engine manufacturer, Saturn/Lyulka. A decision to proceed with further 1.44 testing was made in May 2004, although the announcement did not specify flight trials and none appeared to have taken place by mid-2006.

MiG-29 and MiG-35

NATO reporting name: Fulcrum
Indian Air Force name: Baaz (Eagle)

TYPE: Multirole fighter.

PROGRAMME: Production of land-based MiG-29s ended in mid-1990s after some 1,600 aircraft, leaving substantial stock of semi-complete airframes available to meet export orders. Most recently, Yemen received MiG-29SMTs and MiG-29UBT trainers in late 2004, this being



Navalised 'Fulcrums', the MiG-29K and side view (lower) of MiG-29KUB *(James Goulding)* 1159402

MiG-29 OVT (MiG-35 proof-of-concept) displaying its agility *(Paul Jackson)* 1159372

the first delivery of these variants. Activity currently centres on upgrades for existing aircraft.

Prospects for new production were long dependent upon Indian order for carrier-based MiG-29K. By 2001 — in advance of formal order — MiG was constructing two pre-series MiG-29Ks, one MiG-29KUB and static test airframe in single-seat configuration. Sokol plant (described separately) contracted in 2001 to build folding wing and nose section for production aircraft.

Eventually, on 20 January 2004, contract signed with India for 12 MiG-29Ks and four MiG-29KUB two-seat trainers, worth in excess of US$700 million, for delivery by 2007–08. Option exists for further 30 to be supplied by 2015. Production by LAPIK at Lukhovitsy. At time of contract signature, detailed technical specification still to be finalised.

Following data generally for MiG-29K. Earlier versions described in Jane's Aircraft Upgrades. However, Algeria reported in January 2006 to have purchased 36 MiG-29 SMTs and taken option on further 20; if new-build, these would require resumption of MiG-29 in its land-based form.

CURRENT VERSIONS: **MiG-29K: (Factory index 9.31; K for** *korabelnyy:* ship-based) Maritime version, used for ski-jump take-off and deck landing trials on carrier *Admiral of the Fleet Kuznetsov* (formerly *Tbilisi*), beginning 1 November 1989; two new-build prototypes, using second-generation MiG-29M structure; completely redesigned, mainly steel, wing using modified aerofoil section and of increased area (increased span, reduced leading-edge sweep) with double slotted flaps, drooping flaperons and more powerful leading-edge flaps; new spar in front of original wing box; new strengthened centre-section without overwing louvres; upward-folding outer wing panels; RD-33K turbofans with 92.2 kN (20,723 lb st) contingency rating for ski-jump take-offs. Fuel capacity reduced to 5,670 litres (1,498 US gallons; 1,247 Imp gallons). First flown (16188 '311') 23 June 1988; second prototype was 27579 '312'.

State Acceptance Trials suspended due to funding difficulties, early 1992. Further development ended initially when not selected for deployment on *Admiral of the Fleet Kuznetsov*, but resumed at Zhukovsky in September 1996, in expectation of order from India. First prototype currently grounded; second returned to flight status in support of MiG-29M programme. Proposed naval **MiG-29KU** (9.62) trainer derivative with two separate stepped cockpits remained unbuilt.

'MiG-29K-2002': (Factory index 9.41) The original MiG-29SMTK (factory index 9.17K; effectively a MiG-29SMT with the 9.31's folding wing and landing gear), previously offered to India along with the former helicopter carrier *Admiral Gorshkov*, is understood to have been replaced by a new, multirole, carrierborne variant based more closely on the MiG-29K/M, albeit without the expensive Al-Li alloys. Development of new MiG-29M variants (single- and two-seat) continued in 2003 with MiG-29OVT (thrust-vectoring ground testbed) and MiG-29M2 (29MRCA) which first flew on 26 September 2001 after conversion to tandem configuration.

With a MIL-STD-1553B-type bus and open systems avionics architecture, the MiG-29K-2002 is compatible with a wide range of Russian and Western weapons, and may feature the colour displays and GPS-based navigation system of the MiG-29SMT. This variant, possibly designated MiG-29 MTK, is claimed to be able to perform 90 per cent of its missions with a 10 kt (18 km/h; 11 mph) wind-over-deck, even in tropical conditions using new autothrottle. Notable features of the new aircraft are its improved wing with enlarged trailing-edge flaps, digital FBW system, emergency fuel draining and much-reduced folded span of 5.80 m (19 ft 0¼ in), achieved by positioning the fold line much closer in to the wingroot, and by adding upward-folding tailplanes. The aircraft can also fold its radome (up and back), reducing overall length to 14.13 m (46 ft 4¼ in). Accordingly, 44,570-tonne *Admiral Gorshkov*, which India has also purchased (as INS *Vikramaditya*), can carry a full air wing of 24 MiG-29Ks (plus six helicopters), or (according to some sources) as many as 30.

A projected **MiG-29K-2008** upgrade configuration could add Zhuk-MF phased-array radar, RD-133 turbofans, a computer upgrade and additional electro-optic, radar, IIR and reconnaissance pods, together with take-off performance improvements. In December 1999, it was reported that India had selected the MiG-29K for use aboard *Admiral Gorshkov*, with a quantity of Kh-35 anti-ship missiles and Kh-31P ARMs. Proposed local manufacture by HAL appears no longer to be viable.

MiG-29KUB: (Factory index 9.47) Revised carrier-borne two-seat trainer design offered to India, based on MiG-29K-2002 with reduced-span, inboard wing fold and folding tailplanes. Assumed to feature original stepped tandem cockpits of MiG-29KU. Some reports suggest enlarged tailfins with integral fuel tanks.

MiG-35: Most recent use of this designation adopted in 2005 when MiG-29OVT upgrade was redesignated for possible new manufacture in India to meet local requirement for 126 aircraft. Offers high commonality with Indian Navy aircraft; RD-33MK thrust vectoring engines; and electronically scanned radar.

DESIGN FEATURES: Emphasis from start on high manoeuvrability, to counter US F-15, F-16 and F-18, with target destruction at distances from 200 m (660 ft) to 32 n miles (60 km; 37 miles), and with effective air-to-surface capability. All-swept mid-wing configuration, with wide ogival wing leading-edge root extensions (LERX), 40 per cent of lift provided by lift-generating centre-fuselage, twin tailfins carried on booms outboard of widely spaced engines with wedge intakes. Gap between roof of each intake and skin of wingroot extension for boundary layer bleed.

Fire-control and mission computers link radar with laser range-finder and infra-red search/track sensor, in conjunction with helmet-mounted target designator. Difficult to get into stable flat spin, reluctant to enter normal spin, recovers as soon as controls released; wing leading-edge sweepback 73° 30' on LERX, 42° on outer panels; anhedral approximately 3°. Tailfins canted outward 6°; leading-edge sweep 47° 50' on fins, 50° on horizontal surfaces; anhedral 3° 30'. Fins canted outwards 6°. Engine replacement time 2 hours; preflight preparation 20 minutes. Design flying life 2,500 hours.

FLYING CONTROLS: Digital fly-by-wire.

STRUCTURE: Approximately 7 per cent of airframe, by weight, of composites; remainder metal; three-spar wings with three 'false spars' two ahead of, one behind, torsion box; 16 stringers and skins reinforced by stringers; trailing-edge wing flaps, ailerons and vertical tail surfaces of carbon fibre honeycomb; approximately 65 per cent of horizontal tail surfaces aluminium alloy, remainder carbon fibre; semi-monocoque all-metal fuselage built around 10 mainframes in three subassemblies, with forward (frames 1 to 3), centre (frames 4 to 7) and rear sections, the latter including the engine bays; fuselage sharply tapered and downswept aft of flat-sided cockpit area, with ogival dielectric nosecone mounting PVD-18 main pitot boom (PVD-7 auxiliary pitot mounted on side of nose); small vortex generator each side of nose helps to overcome early tendency to aileron reversal at angles of attack above 25°; tail surfaces carried on slim booms alongside engine nacelles.

LANDING GEAR: Hydromash retractable tricycle type, with oleo-pneumatic shock-absorbers. Mainwheels retract forward into wingroots, turning through 90° to lie flat above leg; nosewheels, on trailing-link oleo, retract rearward between engine air intakes. Hydraulic retraction and extension, with mechanical emergency release.

POWER PLANT: Two Klimov/Sarkisov RD-33MK Morskaya Osa (Sea Wasp) 'marinised' turbofans, each 85.3 kN (19,180 lb st) with afterburning. Engines mounted 4° nose-up, and nacelles toe-in by 1° 30'. Engine ducts canted at approximately 9°, with wedge intakes, sweptback at approximately 35°, under wingroot leading-edge extensions. Refuelling probe and increased internal capacity.

ACCOMMODATION: Pressurised cockpit enclosed by frames 1 and 2. Pilot only, on 16° rearward-inclined K-36DM Series 2 zero/zero ejection seat, giving −14° view forward over the nose, and under hydraulically actuated, rearward-hinged transparent blister canopy in high-set cockpit. Sharply inclined one-piece curved windscreen of electrically de-iced triple glass. Three internal mirrors provide rearward view.

SYSTEMS: Two independent hydraulic systems powered by NP-103A variable-displacement pumps, driven by the engine accessory gearboxes, pressurised to 207 bar (3,000 lb/sq in), with 80 litres (21 US gallons; 17.5 Imp gallons) fluid. Main system powers one chamber of each control surface actuator, leading-edge and trailing-edge flaps, stick-pusher, artificial feel unit, landing gear extension/retraction, nosewheel steering and APU exhaust door; back-up system powers second chamber of each control surface actuator and stick-pusher, and can be powered by an emergency NS-58 pump.

Three separate pneumatic systems, with main system powering the wheel-brakes, canopy, fuel shut-offs and brake parachute actuator and jettison; and emergency system operating mainwheel brakes, and allowing emergency gear extension; final system pressurises hydraulic tanks and avionics bays.

Air conditioning uses bleed air cooled by heat exhangers and turbocooler. System also pressurises pilot's suit, demists screen and cools the gun bay.

Ozh-65 glycol-based liquid cooling system for radar.

AVIONICS: Expected to incorporate French, Russian and Indian components integrated by Elektroavtomatika or RPKB.

Radar: Phazotron-NIIR Zhuk-M (Zhuk-MEh in export form for MiG-29K and -29SMT). N011M Bars offered as basis for alternative.

Mission: Helmet-mounted sight.

ARMAMENT: R-73 (AA-11 'Archer'), R-27 (AA-10A 'Alamo'), and/or R-77 (AA-12 'Adder') AAMs; Kh-35 (AS-20 'Kayak'), Kh-31 (AS-17 'Krypton') and Kh-29 (AS-14 'Kedge') ASMs; KAB-250KR TV-guided bombs; FAB-500 and FAB-250 free-fall bombs; and rocket pods. One 30 mm Gryazev/Shipunov GSh-301 (TKB-687/9A4071K) single barrel gun in port wingroot leading-edge extension, with 150 AO-18 rounds.

DIMENSIONS, EXTERNAL:

Wing span	11.99 m (39 ft 4 in)
Wing aspect ratio	3.4
Length overall: incl noseprobe	17.37 m (56 ft 11¾ in)
folded	14.13 m (46 ft 4¼ in)
Height overall	5.18 m (17 ft 0 in)

AREAS:

Wings, gross	42.00 m² (452.1 sq ft)

WEIGHTS AND LOADINGS:

Max weapon load	4,500 kg (9,921 lb)
Max fuel load	5,240 kg (11,552 lb)
T-O weight: normal	18,550 kg (40,895 lb)
max	22,400 kg (49,383 lb)
Max wing loading	533.3 kg/m² (109.24 lb/sq ft)
Max power loading	131 kg/kN (1.29 lb/lb st)

PERFORMANCE:

Max level speed:	
at height	1,296 kt (2,400 km/h; 1,491 mph)
at S/L	670 kt (1,240 km/h; 771 mph)
Max rate of climb at S/L	17,760 m (58,260 ft)/min
Service ceiling	17,500 m (57,420 ft)
Range:	
combat: with max internal fuel	459 n miles (850 km; 528 miles)
with external tanks	702 n miles (1,300 km; 807 miles)
ferry	1,889 n miles (3,500 km; 2,174 miles)
g limits	+8

MiG-AT

TYPE: Advanced jet trainer/light attack jet.

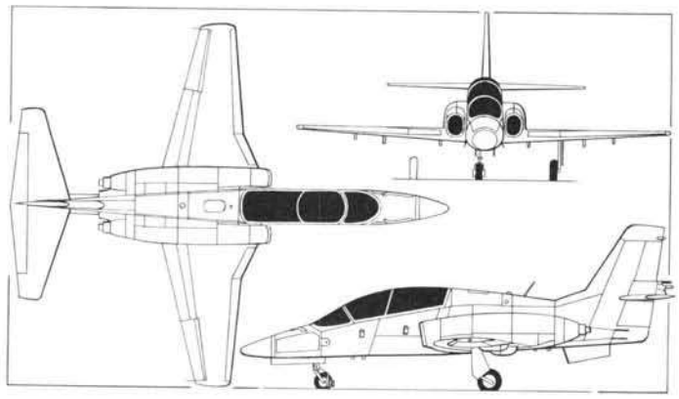
PROGRAMME:

DEVELOPMENT MILESTONES

Design began	late '80s
Programme launched	25 Jun 90
Official go-ahead	May 92
Rolled out	18 May 95
First flight	16 Mar 96
Official first flight	21 Mar 96

Design started late 1980s; start of work formally authorised on 25 June 1990 by State Commission for Military-Industrial Affairs, in parallel with contracts to competing design bureaux; selected in May 1992 as one of two finalists (with Yak-130, following rejection of single-engined Sukhoi S-54 and Myasishchev M-200 contenders) as replacements for Aero L-29 Delfin and L-39 Albatros; originally planned (as MiG-ATTA, a designation also applied to abortive joint venture with Promavia) with T tail and R-35 (DV-2) engines, with wing by Daewoo, landing gear by Messier-Bugatti, avionics by Sextant, Thomson-CSF (now Thales) and SFENA. Under October 1992 and subsequent agreements, prototypes and pre-series aircraft are powered by Larzac 04R20 engines supplied by SNECMA of France; production aircraft for domestic market could have Larzacs licence-built by Chernyshev of Moscow, though there is a new Russian engine - the 16.7 kN (3,748 lb st) Aviadvigatel (Soyuz/CIAM) RD-1700 - which is stated to be 2.5 times cheaper than the Larzac and which may remedy early shortfalls in performance, ceiling and range. Suggested that MiG-AT has bureau Type number 08, perhaps with original T-tail configuration being 8.1 and later version as 8.2, prototype configuration being 8.21.

Prototype rolled out 18 May 1995; high-speed taxi trials at Zhukovsky August 1995; first 5 minute hop 16 March 1996; first flight 21 March 1996, piloted by Roman Taskaev; three aircraft to be used for flight test programme; two static test airframes; by 27 March 2001, first prototype had flown 496 sorties and second, 47. This increased by April 2002 to combined total of 770. Russian Air Forces began acceptance trials in December 2002 at 929th Test Centre, Akhtubinsk. Production of first series of 16 at RSK 'MiG' (Voronin) plant well advanced with seven in final assembly by December 1998. Subsequent progress delayed by funding difficulties; total of six airframes (including static test) completed by late 2001, although only two then flown. Fourth flying aircraft handed over to MiG (for completion) by mid-2001. However, by end of 2003 only two aircraft flown, but third then expected to fly in early 2004, with fourth following six months later. Neither third nor fourth aircraft appeared during 2004, however.



MiG-AT advanced trainer *(James Goulding)* 1129404

Following initial series of static trials on second (non-flying) airframe, operation at 5,600 kg (12,346 lb) cleared in 2001; subsequent increases planned to 6,500 kg (14,330 lb), then 7,800 kg (17,196 lb). By 2003, second prototype had received full-standard digital FBW system and cockpit displays, including 152 × 203 mm (6 × 8 in) LCD MFD.

Russian requirement for 200 to 250 trainers in this category. Request for funds for first 10 aircraft made by Russian Air Forces, late 1996, at which time 10 engines ordered from Turbomeca-SNECMA (following initial five supplied for two prototypes). Further 20 engines ordered late 1997 for FFr230 million (US$39 million), while Sextant contracted to supply 30 nav/attack systems. Competition against Yak-130 continued throughout 1990s; Russian Defence Ministry committee responsible for deciding between two contenders held first meeting on 17 February 2002, having been constituted six days earlier; Yak announced (formally, on 10 April 2002) as winner, but MiG encouraged to continue development of AT for possible export. However, in February 2003, Russian Air Forces C-in-C declared MiG-AT still in contention for production contract.

Actively promoted in India (evaluated in Russia by IAF pilots, December 2001) and South Africa; eliminated from Indian and South African competitions by BAE Hawk. Greek requirement for 40 trainers was targeted in 2001. Also assessed by Algeria and UAE. MiG-AT aircraft now being marketed as one element in AT System, incorporating simulators, computerised class rooms, part-task simulators, and video training packages, all using unified software. In August 2003, RSK 'MiG' and PZL signed enabling agreement for MiG-AT licensed production in Poland to replace TS-11 Iskra.

CURRENT VERSIONS (general): **MiG-AT:** Basic trainer; suitable for combat use of unguided weapons against ground and sea targets, and air-to-air missiles in conjunction with helmet-mounted target designation system. Pylons for three weapons/stores in trainer role, seven for combat training. Version for domestic use (ATR) has Russian-built engines and avionics; export version (ATF) has Sextant Topflight avionics (French).

Production version has longer nose than prototypes, but with pitots repositioned to slightly ahead of windscreen.

MiG-UTS: (MiG-ATR) Planned Russian Air Forces' version, with Russian avionics and RD-1700 engines.

MiG-ATS: Combat trainer, with increased capabilities and underwing hardpoints able to launch guided missiles, using guidance equipment pod. Second flying prototype (823 '83') to this standard and has Russian avionics.

MiG-AS: Single-seat light tactical fighter version with built-in gun and radar for all-weather use of AAMs and ASMs; intended to compete in international market with BAE Hawk 200. Single-seater, aerodynamically similar to original MiG-AT, with rear cockpit covered by metal fairing of similar outline to original canopy.

MiG-AP: Patrol coastguard fishery protection law enforcement and SAR co-ordination aircraft; based on MiG-AS; nose-mounted search radar.

MiG-AT advanced trainer prototype *(Yefim Gordon)* 1159321

All versions can be modified for deck operation on aircraft carriers at customer's request as **MiG-ATK** (French avionics), **MiG-ATSK** (armed trainer), or **MiG-ASK** (single seater). Span with optional wing folding 6.50 m (21 ft 4 in). Provision for deck arrester hook and catapult launching.

MiG-AT can undertake the following training missions, all with take-off at 50 per cent fuel (plus 150 kg; 331 lb reserves):

Basic flying training: Between 30 and 35 flight manoeuvres, three roller landings and straight-in final landing at up to 27 n miles (50 km; 31 miles) from base, altitude up to 6,000 m (19,680 ft).

Ground attack: Four diving attacks, three advanced manoeuvre attacks and circuit/landing against visual target up to 43 n miles (80 km; 50 miles) from base, transiting at up to 2,500 m (8,200 ft).

Interception/combat manoeuvring: Loiter, directed interception, attack and close combat, day VMC/IMC at up to 140 n miles (260 km; 161 miles) from base, altitudes up to 8,000 m (26,240 ft).

CURRENT VERSIONS (specific): **AT-1/821 '81':** Prototype; first flight 16 March 1996; first 'official' flight 21 March 1996. Has been modified since its initial flights, briefly gaining an overwing fence level with the leading-edge discontinuity. This since removed, but intakes have been redesigned and now project forward of the wing leading-edge; now have oval cross-section and blunter lips, rather than appearing to be sharp, inverted Us from the front. New intake configuration is understood to have first flown during May 1999, shown at MAKS '99, Moscow, August 1999. Generally French instruments in front cockpit; rear cockpit now filled with test instrumentation. Tested with external fuel tanks. Conventional (non-FBW) controls. By 2001 had replaced pitot booms with shorter units not protruding beyond nosecone. Modified in 2004 with twin ventral fins.

AT-3/823 '83': Second flying prototype shown (then still unflown) at MAKS '97, Moscow, August 1997; nominally representative of intended UTS in some respects, and of ATS armed trainer configuration in others. Fitted with centreline and underwing hardpoints; weapon carriage trials; Russian avionics and displays. Fitted with three-channel, digital FBW system in early 2000 (first Russian aircraft thus equipped); original 70 kg (154 lb) nose counterweight then removed, giving neutral stability. Original intake configuration with overwing fences was replaced by current design and aircraft resumed flying (with desert camouflage scheme) in June 2001, appearing at Paris later that month and first displaying wingtip missile rails.

AT-4/824 '84': Third flying prototype; under construction by 1999, but not flown up to mid-2006. Was to have featured new Sextant avionics suite (full Topflight system, including compatibility with helmet-mounted displays); completion deferred pending availability of RD-1700 engines. By 2006 was envisaged as representative of Russian Air Forces version, with RD-1700 engines and avionics by Elektroavtomatika.

COSTS: USD10 million to USD12 million (2002); development cost USD200 million.

DESIGN FEATURES: Intended to have manoeuvrability comparable with front line combat aircraft, and service life of 15,000 flying hours or 30 years, with not fewer than 25,000 landings, maximum angle of attack of 25°, and sustained 5.4 g turn in 4 km (2.5 mile) radius at M0.7. Able to fly OEI at any stage, including take-off. Reconfigurable FBW FCS to simulate both the handling and limits of other front-line combat types. Onboard simulation of manoeuvring target, meteorological conditions and system failures via HUD, as well as specialised training for all operational modes of individual types of modern combat aircraft of Russian or foreign manufacture.

Conventional low-wing monoplane; wing-root leading-edges swept forward, with engine air intakes ionally overwing to minimise risk of FOD; sweptback vertical tail surfaces; unswept tailplane; tailcone comprises two front-hinged door-type airbrakes.

FLYING CONTROLS: Avionika KSU-821 integrated hybrid (digital/analogue) multichannel fly-by-wire flight control system with multiple redundant air data computer. System incorporates autopilot, autothrottle and automatic stall-protection systems. Three-axis controls; three leading-edge slat sections and single-section slotted trailing-edge flaps on each wing. (Second prototype also flown with leading-edge flaps, which may be adopted.) Split two-section rudder above and below tailplane.

STRUCTURE: One-piece, three-panel tapered wing of aluminium alloy, with some honeycomb skin. Three-section fuselage of aluminium alloy, but reportedly with 40 per cent of skin in CFRP/GFRP, including access panels on spine, three-piece engine covers, nose avionics bay cover and parts of wing/nacelle and nacelle/fuselage fairings. CFRP intake ducts and CFRP honeycomb wing trailing-edge control surfaces (elevators and flaps) and fin box, rudders, tailplane and elevators. Fin leading-edge of aluminium alloy and integral with rear fuselage. Titanium alloy rear fuselage forming 'open-box' with sidewalls acting as engine bay fire protection. Split airbrakes and ejection seat mounting tracks also of titanium with intake lips in stainless steel.

LANDING GEAR: Retractable tricycle type; nosewheel offset to starboard; single wheel on each trailing-link unit; wide-track main units retract inward, nosewheel forward; mainwheel tyre size 660x200, pressure 8.80 bar (128 lb/sq in); nosewheel tyre size 500x150, pressure 4.90 bar (71 lb/sq in); high-efficiency brakes; operation practicable from unpaved surfaces of bearing ratio 6 kg/cm² (85.3 lb/sq in).

POWER PLANT: Two Turbomeca-SNECMA Larzac 04-R20 turbofans, each 14.12 kN (3,175 lb st), mounted above wingroots. MRT-93 FADEC controls. Ratings can be reduced by 30 to 40 per cent for primary training. Export version offered with Larzac 04-Y3, having thrust increased to 16.7 kN (3,748 lb st) in joint development venture between Turbomeca and Klimov. Change to 16.7 kN (3,748 lb st) Chernyshev-built Soyuz RD-1700 originally planned by 2002, but had not flown by mid-2006. One main fuselage fuel tank and one (three-section) tank in each inner wing. Total capacity 2,390 litres (632 US gallons, 527 Imp gallons). Single-point pressure refuelling point in lower rear fuselage adjacent to wing trailing-edge, with five gravity refuelling points (one above the fuselage tank and two above each wing). Tanks pressurised with engine bleed air to ensure high-altitude supply.

ACCOMMODATION: Two crew in tandem, on Zvezda K-93-UT zero/zero, 60 m (200 ft) inverted flight ejection seats operable at up to 485 kt (900 km/h; 559 mph) and M1.5 at altitudes up to 15,000 m (49,215 ft); minimum inverted flight ejection height 50 m (165 ft). Rear seat raised by 400 mm (15.75 in) to improve occupant's forward view. View over the nose −17° from cockpit, −7° from the rear. One-piece birdproof canopy, hinged on starboard side, with 'lock the canopy' warning. Provision for blinds for IFR flight training. Some sources suggest provision of 'built-in ladders', but no evidence for any more than retractable steps.

SYSTEMS: Dual hydraulic systems, driven by independent Messier-Bugatti PR70660-20 engine-driven pumps, actuate control surfaces, landing gear and wheel doors. General system supplied by starboard engine actuates one chamber of each electrohydraulic control actuator and hydraulic actuators of other systems; booster system supplied by port engine actuates other chamber of control actuators. Auxiliary booster system operated by NS-65 emergency hand pump. Electrical system supplies primary 27 V DC and 200/115 V 400 Hz three-phase secondary AC. Two 9 kW Auxilec 8044-31 DC starter/generators with Auxilec WDH-014 control and protection unit; two AC static inverters; 15CTSS-45B lead-zinc batteries.

AVIONICS: Integrated by Russian GosNIIAS avionics research institute and Sextant Avionique, France. Multifunctional central computer, with all data integrated through MIL-STD-1553B equivalent databus.

Comms: ERA 2000 VHF/UHF transceiver, SG100 IFF, SPU-821 intercom, ALMAZ-UBS voice recorder.

Radar: Osa installation under development for optional fitment.

Flight: Automatic control system; UMT 33 air data unit; Totem 3000 laser-gyro INS; NSS 100S-1 GPS; NR 510A 101 VOR/ILS receiver/marker; NC-12R Tacan; EVS 915 video recorder; Tester 133A flight data recorder.

Instrumentation: Two MFD 55 multifunctional liquid-crystal colour CRT displays with buttons in each cockpit; helmet-mounted displays; front-cockpit wide-field HUD with input from colour video and TV camera; HSI/ADI.

ARMAMENT (MiG-AS): Nine (including wingtips) hardpoints for up to 2,000 kg (4,410 lb) of guided and unguided missiles, guns and bombs, including R-73E (AA-11 'Archer'), R-77 (AA-12 'Adder'), AIM-9L Sidewinder or Magic AAMs; Kh-29TD (AS-14 'Kedge') or Kh-31AP/PE (AS-17 'Krypton') ASMs; UB-16 (16 × 57 mm) or UB-8M (20 × 80 mm) rocket pods; cluster weapons; 100 to 500 kg bombs; UPK-23 twin-barrel 23 mm gun pods; eight Vikhr anti-tank missiles.

DIMENSIONS, EXTERNAL:

Wing span	10.16 m (33 ft 4 in)
Wing aspect ratio	5.7
Length overall	12.01 m (39 ft 4¾ in)
Height overall	4.42 m (14 ft 6 in)
Wheel track	3.80 m (12 ft 5¾ in)
Wheelbase	4.43 m (14 ft 6½ in)

AREAS:

Wings, gross	17.67 m² (190.2 sq ft)

WEIGHTS AND LOADINGS:

Fuel: normal	850 kg (1,874 lb)
intermediate	1,280 kg (2,822 lb)
max	1,680 kg (3,704 lb)
Normal T-O weight: training	4,610 kg (10,163 lb)
Max T-O weight: training	5,210 kg (11,486 lb)
combat	7,800 kg (17,196 lb)
combat (alternate)	8,150 kg (17,967 lb)
Max wing loading:	
Normal T-O	260.9 kg/m² (53.43 lb/sq ft)
Max T-O	396.2 kg/m² (81.14 lb/sq ft)
Max power loading:	
Normal T-O	163 kg/kN (1.60 lb/lb st)
Max T-O	248 kg/kN (2.43 lb/lb st)

PERFORMANCE (estimated, A: basic training, B: advanced training):

Max Mach No.: A, B	0.85
Max level speed:	
A, B:	
at 2,500 m (8,200 ft)	540 kt (1,000 km/h; 621 mph)
at S/L	460 kt (850 km/h; 528 mph)
T-O speed: A	97 kt (180 km/h; 112 mph)
B	97–119 kt (180–220 km/h; 112–137 mph)
Landing speed:	
A, B	94–125 kt (175–232 km/h; 109–144 mph)
Max rate of climb	
at S/L: A	1,680 m (5,510 ft/min
B	4,140 m (13,580 ft/min
at 5,000 m (16,400 ft): A	1,320 m (4,330 ft/min
B	2,400 m (7,875 ft/min
Service ceiling: A, B	14,000 m (45,940 ft)
T-O run: A	540 m (1,772 ft)
B	310 m (1,020 ft)
Landing run:	
on concrete: B	570 m (1,870 ft)
on unpaved runway: B	540 m (1,775 ft)
Range at M0.5 at 6,000 m (19,680 ft):	
A, B	647 n miles (1,200 km; 745 miles)
Ferry range: A, B	1,400 n miles (2,600 km; 1,615 miles)
A, B (alternate)	1,079 n miles (2,000 km; 1,242 miles)
g limits: A, B	+8.0/−2.0
Sustained g limit at M0.7 in turn:	
at S/L: A	+4.5
B	+8
at 5,000 m (16,400 ft): A	+3.4
B	+5
Max side wind for T-O/landing	29 kt (54 km/h; 33 mph)

MiG-201

TYPE: Light utility twin-prop transport.

PROGRAMME: First details announced in mid-2003. Construction of prototype then scheduled to begin in late 2004 or early 2005, but revealed in November 2005 that mockup commission would not be convened until 2006.

CURRENT VERSIONS: **MiG-201:** *As described.*

MiG-201M: Alternative power plant of two 324 kW (435 hp) Teledyne Continental GTSIO-520F flat-six piston engines.

MiG-201MT1: Turboprop version with two 560 kW (751 shp) Walter M 601Es.

MiG-201MT2: Alternative turboprop version with two Pratt & Whitney Canada PT6A-42s, each rated at up to 634 kW (850 shp). Range 755 n miles (1,400 km; 869 miles) with max payload.

COSTS: USD650,000 with M-9 engines, USD1,400,000 with PT6A-42 engines. Development cost estimated USD60 million to 70 million (2005).

DESIGN FEATURES: Replacement for Antonov An-2 utility biplane, but with twin engines. Rugged construction and short-field performance with maximum of 10 occupants or equivalent freight.

High, constant-chord wing, moderately sweptback fin with ventral fillet; low-mounted, constant-chord tailplane. Service life 40,000 hours.

STRUCTURE: Generally of metal.

LANDING GEAR: Tricycle type; retractable.

POWER PLANT: Two 327 kW (434 hp) VOKBM M-9FS nine-cylinder radial engines, each driving an MT-Propeller MTV-9 three-blade, variable-pitch propeller. Version powered by liquid natural gas may be offered.

ACCOMMODATION: Provision for nine passengers.

DIMENSIONS, EXTERNAL:

Freight door (port): Height	1.22 m (3 ft 11¾ in)
Width	1.30 m (4 ft 3¼ in)

DIMENSIONS, INTERNAL:
Cabin: Length 4.50 m (14 ft 9 in)
Max width 1.52 m (4 ft 11¾ in)
Max height 1.35 m (4 ft 5¼ in)
WEIGHTS AND LOADINGS:
Weight empty, equipped 2,850 kg (6,283 lb)
Max payload 840 kg (1,852 lb)
Max fuel weight 650 kg (1,433 lb)
Max T-O weight 3,900 kg (8,598 lb)

PERFORMANCE:
Max level speed 205 kt (380 km/h 236 mph)
Econ cruising speed 162 kt (300 km/h; 186 mph)
Service ceiling 6,000 m (19,680 ft)
T-O run 390 m (1,280 ft)
Range: with 840 kg (1,852 lb) payload 297 n miles (550 km; 341 miles)
with 550 kg (1,213 lb) payload 1,025 n miles (1,900 km; 1,180 miles)

MIL

MOSKOVSKY VERTOLETNY ZAVOD IMIENI M L MILYA OAO (MOSCOW HELICOPTER PLANT NAMED FOR M L MIL JSC)

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DESIGNER GENERAL (ACTING): Aleksei Samusenko

OKB founded 1947 by Mikhail Leontyevich Mil, who was involved with Soviet gyroplane and helicopter development from 1929 until his death on 31 January 1970, aged 60. His original Mi-1, first flown September 1948 and introduced into service 1951, was first series production helicopter built in former USSR. Twelve basic types of Mil helicopter have been built in 100 subvariants, representing total production of some 30,000, of which over 4,500 exported to 80 countries; 95 per cent of all helicopters in Russian Federation and Associated States (CIS) are Mil designs. Mil helicopters have set 96 world records. The Mil design bureau (previously OKB 4, then OKB 329 from 1951) has its own experimental workshops in Moscow and flight test facilities at Chkalovsky airfield. The company established a joint venture, Euromil, with Eurocopter and others, for development and production of the Mil Mi-38, but Eurocopter withdrew in 2003. The Mi-38 flew at Kazan in December 2003; promotion and marketing is largely the responsibility of the Kazan company.

In 2001, Mil designers reported to be working on seven projects, comprising Mi-30, Mi-32, Mi-54 and Mi-58 transports; and Mi-40, Mi-42 and Mi-44 combat helicopters. Of these, only details of the Mi-40, Mi-54 and Mi-58 have been released and only the Mi-54 is currently listed as an active programme, along with Mi-28 and Mi-38. Continues to provide support and offer upgrades for Mi-2, Mi-8/Mi-17, Mi-24/Mi-35 and Mi-26, including Mi-24 turbine conversion launched in 2003.

Mil forced into receivership in 1999; new management, imposed by Federal Financial Recovery Service, returned company to solvency and paid staff wage arrears; bankruptcy cancelled 23 February 2001 after effective return to State control when debts bought-out by Gosincor (Ministry of Property) and Inter-Regional Bank.

Mil design and production facilities eventually to be integrated into group managed by Oboronprom, and including Kamov, Kazan Helicopters, Rostvertol and Ulan-Ude. Oboronprom assumed government's shareholding in Mil in May 2005 and later bought privately owned shares. The lighter types of Mil helicopter were marketed by the separate entity, LVM, but this appears no to have been active recently.

MIL Mi-17 (Mi-8M), Mi-19, Mi-171 and Mi-172

NATO reporting name: Hip

TYPE: Multirole medium helicopter.

PROGRAMME:

DEVELOPMENT MILESTONES

Mi-8	
First flight	24 Jun 61
Subsequent versions	
Mi-17	
First flight	17 Aug 75
Public debut	Jun 81
First delivery	1977

Development of original Mi-8 began May 1960, to replace piston-engined Mi-4; first of two prototypes (V-8), with single AI-24V turboshaft and four-blade main rotor, flew 24 June 1961, given NATO reporting name 'Hip-A'; further prototype (V-8A: 'Hip-B'), with two production standard TV2-117 engines and four-blade main rotor, flew 2 August 1962; change to five-blade rotor for production. Total 7,300 Mi-8s and subsequent improved Mi-17s and Mi-171/172s marketed and delivered from Kazan since 1967, with more than 11,000 (about 3,700 Mi-8T and 7,300 Mi-17) from Ulan-Ude since 1970 for civil and military use, including 3,500 exported to 70 countries.

Prototype Mi-17, known initially as Mi-18, completed 1975 with basic Mi-8 airframe, and power plant and dynamic components of Mi-14. First flew 17 August 1975. Entered service with former Soviet forces in 1977 as Mi-8MT. First displayed at 1981 Paris Air Show as Mi-17 for civil use and export; exports began (to Cuba) 1983; Mi-8MTV followed in 1987; production of improved versions continues at Kazan and Ulan-Ude plants. Kazan has undertaken further development of the Mi-17 and these variants are described separately.

CURRENT VERSIONS: **Mi-17: ('Hip-H')** Basic designation of series, with suffix M for military versions. Mi-17P is basic civil version with 28 seats and rectangular cabin windows.

Detailed description applies to basic versions, except where indicated. Note that all helicopters of Mi-8/Mi-17 series in Russian military service are known as Mi-8s of various subtypes, regardless of engines fitted.

Mi-8MT: ('Hip-H') Designation of standard Mi-17s in RFAS military service. Twin or triple stores racks, but normal armament is 40 × 80 mm S-8 rockets in two BV-8-20A packs. Afghan experience led to adoption of nose armour, IR jammer, IR suppressors and provision for door-mounted PKT machine gun (rear starboard) and AGS-17 Plamya grenade launcher or NSV 12.7 mm Utyos heavy machine gun (forward port cabin door).

Mi-8MT EW variants: More than 30 EW versions of the Mi-8MT serve, or have served, with RFAS armed forces.

Mi-8MTPB: (or Mi-17TPB, Mi-17P, Mi-17PP) ('Hip-H EW') ECM (radar and communications jammer) and comint helicopter, with three jamming systems in D/F band range over 30° sector and other frequencies over 120°.

Mi-8MTV: ('Hip-H') (V = *vysotnyi*: high-altitude); 1,633 kW (2,190 shp) TV3-117VM turboshafts for improved 'hot-and-high' operation. Built at Ulan-Ude (as **Mi-8AMT**) from 1991; 100 built by 1999. Civil version built at Kazan is **Mi-8MTV-1**: missile-armed, radar-equipped military version with six-hardpoint stub-wing is **Mi-8MTV-2**; export equivalent is **Mi-17-1V**, with optional armament, nose radar, flotation gear and firefighting equipment. Indian Mi-17-1V has enlarged side doors and a rear ramp to facilitate airdrops, as developed at Kazan (which see). Firefighting conversion by Airod in Malaysia adds detachable aluminium boom to starboard side, stowed facing forwards, but trainable through 90°, with hose nozzle at tip. Internal tanks, fillable via own trailing hose and onboard pump in 1½ minutes, carry 2,300 litres (608 US gallons; 506 Imp gallons) of water, which may also be dumped from belly port in 8 seconds. Addition of suffix **-GA** indicates civil version, often with rectangular 'Salon'-type cabin windows. **Mi-8MTV-1S** is VVIP variant for Rossiya state transport company; two believed ordered in 2001. An Mi-8MTV upgrade project was under way in mid-2002 that may result in adoption of more powerful VK-2500 engines, composites main rotor blades and updated avionics as well as new armament to be developed by 2010; this is expected to be offered in new-build form towards the end of the present decade.

Mi-8MTKO: (or Mi-8N); ('Hip-H') (O = *ochki nochnogo videniya*: night vision goggles). Dedicated night attack conversion of Mi-8MT/MTV to meet urgent operational requirement; tested in Chechnya ('Caucasian campaign') with aircraft equipping BEG (Boyevaya Eksperimentalnaya Gruppa: Combat Experimental Group) based at Mozdok; at least five aircraft thus upgraded by mid-2000. (Unit additionally equipped with four or six upgraded Mi-24s, and also parented trial deployment of Ka-50. Originally intended to be equipped with modified Ka-29TB and Ka-50). Upgrade produced by Mil Moscow plant, with collaboration of Russkaya Avionika, NPO Geofizika and Uralsky Optik Mechanichesky Zavod team, and tested at Russian Air Forces flight test centre at Chkalovskaya from April 1999, thereafter undergoing evaluation at Torzhok with the 696th HVP, equipping BEG from September 1999. By 2003, first deliveries had been made to unit in North Caucasus district, with further deliveries planned (in conjunction with Mi-24PN 'Hinds') to equip one night-capable regiment by year's end. Original requirement was for total of 40, with deliveries suspended on termination of Chechen campaign, only to resume in early 2004.

Aircraft has NVG-compatible cockpit and external lights and may also feature NVG-covert, formation-keeping external lights. Crew equipped with Geofizika ONV-1 NVGs, and also use gyrostabilised GOES-321M undernose turret containing AGEMA 1000 or SAGEM-321 FLIR, laser range-finder and LLTV. Incorporates cockpit and navigation system upgrade, with KNI-8 navigation and display system, MFI-68 (or, possibly, US-supplied) colour LCD MFDs, A737-00 GPS, full-standard MTO will gain new air data system and Saratov Industrial Automatics OKB PKV-M digital autopilot. Real-time targeting/tactical information datalink also installed. Similar export version offered to India (which has already used its existing Mi-17s in the gunship role in Kashmir, and hopes to upgrade these with an Mi-35-type weapon aiming system, improved avionics and a 'night cockpit') and others as **Mi-17N.**

Mi-17-1VA: Version of Mi-8MTV-1 produced for Ministry of Health of former USSR as flying hospital.

Mi-8MTV-3/Mi-172A: As Mi-8MTV-2, also from Kazan, but with four-hardpoint stub-wing and other equipment changes and planned for certification to FAR Pt 29 standards; TV3-117VM Srs 2 engines, giving maximum cruising speed of 118 kt (218 km/h; 135 mph) and service ceiling of 6,000 m (19,680 ft); air conditioning and heating systems, main and tail rotor blade de-icing, canopy demisting and heating of engine air intakes standard; options include flotation gear, Doppler, weather radar, DME, GPS, VOR, ILS, transponder and VIP interiors for seven, nine and 11 passengers. Standard seating for up to 26 passengers.

Mi-172A export version first exhibited at 1994 Singapore Air Show; based on 'salon' (rectangular window) cabin. Seven ordered by Mesco, India, 1995; others to Vietnam.

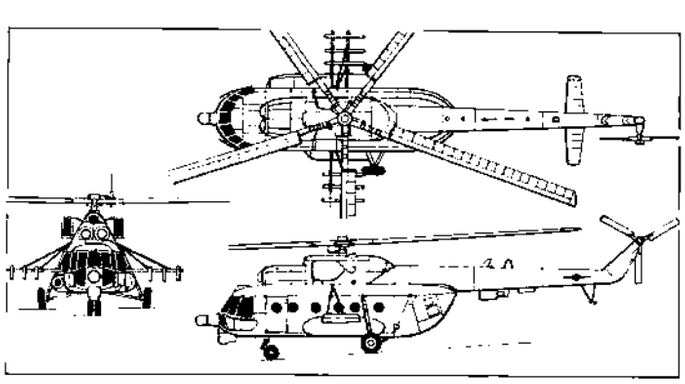
Mi-8MTV-7: Upgraded development by Kazan; announced 2002.

Mi-172AG: Announced mid-2000; proposed version with TV3-117SB3 engines, improved composites main rotor blades and upgraded navigation avionics.

Mi-17PI: As Mi-17P but single D-band jamming system able to jam up to eight sources simultaneously over 30° sector.

Mi-17PG: As Mi-17P but with H/I-band system for jamming pulse/CW and CW interrupted equipment.

Mi-17AMT: Provisional designation for proposed Ulan-Ude-built variant offered to Malaysia to meet eventual 40-aircraft requirement, with initial order for six CSAR-configured aircraft reportedly already placed. May have rear loading ramp of Mi-8MTV-5.



Mil Mi-8AMT(Sh) combat helicopter — the latest Mi-17 variant *(James Goulding)*

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Ulan-Ude-built Mil Mi-171Sh *(Yefim Gordon)*

Mi-17 will replace 31 S-61 Nuri helicopters, and two already in use with Malaysian Fire Department. SME Aerospace appointed as partner responsible for assembly, flight test and local certification.

Mi-8AMT(Sh) 'Terminator': Current counterpart of Mi-8MTV series, built at Ulan-Ude. Crew positions protected by armour plating. Armament can include up to eight Igla-V AAMs or 9M114/9M114M Shturm-V ('Spiral') ASMs, with thimble radome on nose and chin-mounted electro-optics pod; alternative armament configurations include up to four pods of B8V20A type, each containing 20 S-8 unguided rockets; or a mix of guided and unguided weapons. Prototype (RA-25755) exhibited at Farnborough in September 1996. First production helicopter almost complete by late 1998, but delayed by funding shortage. State testing began 10 April 2000, and had been completed by January 2001; funding assistance provided by Interprofavia. Offered for export as **Mi-171Sh**. Night-capable variant under development by mid-2001. Delivery of 16 Mi-171Sh to Czech Republic began 9 June 2005, when first three airlifted to Pardubice on An-124; following assembly and test flight, first example (9781) accepted by Air Force at Prerov on 26 June. Incorporates hydraulically actuated rear ramp and has large sliding door to starboard, plus rescue winch, integrated NVG compatibility and can be fitted with removable wings on upper mid-fuselage for carriage of up to four auxiliary fuel tanks, offering three times the endurance of basic Mi-17.

Mi-171: Export version of Mi-8AMT; first displayed 1989 Paris Air Show. Mostly Western avionics, including Honeywell and Rockwell Collins radios. Built at Ulan-Ude since 1991.

In August 2001, Ulan-Ude showed upgraded Mi-171A at Moscow Salon, featuring rear cargo ramp (straight-sided, compared with Kazan version) and enlarged starboard passenger door. Klimov VK-2500 turboshaft also installed on latest examples of Mi-171.

Mi-17V-5 (Mi-8MTV-5) and Mi-17V-7: Developed and built at Kazan. Described separately.

Mi-17KF Kittiwake: Flight deck upgrade offered by Kazan and Kelowna of Canada.

Mi-18: Original designation of prototype Mi-17.

Mi-19: Command relay platform; similar to earlier Mi-9.

Mi-17Z-2: Converted from 'Hip-H' in former Czechoslovakia for electronic warfare ECM role; local designation (Z-1 is similarly tasked Antonov An-26).

Long-range modification: AEFT (Auxiliary External Fuel Tanks) system by Aeroton adds a further 1,900 litres (502 US gallons; 418 Imp gallons) in two internal tanks, plus 2,850 litres (753 US gallons; 626 Imp gallons) in six tanks on the stores pylons of Mi-8MT, AMT, MTV-1, civil MTV and Mi-17 variants.

Upgrades: Kazan offers three stages of upgrade for existing Mi-17 variants. The first can include new composites main rotor blades with a 6,000-hour service life, NVG-compatible cockpit and improved avionics; second could include more powerful 1,864 kW (2,500 shp) engines, uprated transmission and Delta-H 'X-type' tail rotor, latter refinements presaging increase in MTOW to 14,000 kg (30,864 lb). Kazan has also teamed with BAE Systems and Kelowna Flightcraft Ltd to offer aircraft with new mission system, including automated flight control system and 'glass cockpit', plus FLIR, LLTV and other sensors; this upgrade package (or elements of it) can be installed in the Mi-172.

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Mil Mi-8MTKO night attack version of 'Hip' *(Yefim Gordon)*

Mil Mi-8AMTSh, built at Ulan-Ude *(Yefim Gordon)*

1153786

Kronshtadt is offering an avionics and cockpit upgrade, with LCD screens, digital moving map and embedded GPS.

Israel Aircraft Industries announced **Peak-17** in February 2001, combining features from Kamov Ka-50-2 Erdogan and Mi-35 export 'Hind' with 'glass cockpit', improved self-defence Rafael NT-D Dandy and NT-S Spike anti-armour missiles.

Elbit Systems of Israel in 2001 was promoting **'Andor'** Mi-8/17 upgrade for civil and military applications. Modular modernisation concept entails addition of various items of equipment, including electro-optical sensor turret, MFDs, HOCAS, NVGs, HUD, EW systems and choice of Eastern or Western weaponry.

CUSTOMERS: Many operational alongside Mi-8s in RFAS armed forces; also operated in Algeria, Angola, Armenia, Bangladesh, Bulgaria, Burkina Faso, Cambodia, China, Colombia, Costa Rica, Croatia, Cuba, Czech Republic, Ecuador, Egypt, Ethiopia, Hungary, India, Indonesia, Iran, Kenya, North Korea, Laos, Macedonia, Malaysia, Mexico, Myanmar, Nicaragua, Pakistan, Papua New Guinea, Peru, Poland, Romania, Sierra Leone, Slovak Republic, Sri Lanka, Syria, Turkey, Uganda, Ukraine, Venezuela, Vietnam, Yugoslavia. More than 810 exported by Aviaexport. Recent announced sales include 16 Mi-171s for Czech Republic (delivered in 2005) as part of Russian debt reduction effort and three Mi-171s for Bangladesh, these all from Ulan-Ude factory. Kazan factory delivered two Mi-17s to Vietnam and four Mi-17s to Indonesia in 2004, as well as first four of 20 Mi-17s to Kazakhstan, with balance to follow in 2005-06. Other recent orders include 13 Mi-17s for delivery to Venezuelan Army in first half of 2005 and one VIP-configured Mi-171 for Yemen that was due to be handed over in December 2004. Malaysia placed order for 10 Mi-171Shs from Ulan-Ude production in 2003 and could eventually obtain as many as 40 for the air force; initial deliveries planned for 2004 but deferred to 2005. Two additional Mi-171s handed over to Malaysian Ministry of Internal Affairs (for operation by police) in 2004. Croatia expected to receive up to 15 Mi-17s as debt reparations according to announcement in second quarter of 2005. Chinese orders began in 1990 with 24 Mi-17s, followed in 1995-97 by 60 Mi-171s; additional orders, including Mi-17V-5s, increased total to 190 by 2003, while further 24 Mi-17V-7s followed in 2003-2004.

COSTS: Kazan quoted USD3.7 million, flyaway, basically equipped, in March 2001. In mid-2002, Ulan-Ude quoting price as USD3.5 million to USD4 million, depending on configuration and equipment. Sale of 42 Mi-171s to Algeria in 2003 said to be worth USD180 million.

DESIGN FEATURES: Conventional pod and boom configuration; clamshell rear-loading freight doors on most versions, but both Kazan and Ulan-Ude plants offer rear-loading ramp version; five-blade main rotor, inclined forward 4° 30' from vertical; interchangeable blades of basic NACA 230 section, solidity 0.0777; spar failure warning system; drag and flapping hinges a few inches apart; blades carried on machined spider; pendulum vibration damper; three-blade port tail rotor; transmission comprises VR-14 two-stage planetary main reduction gearbox, intermediate and tail rotor gearboxes, main rotor brake, and drives off main gearbox for tail rotor, fan, AC generator, hydraulic pumps and tachometer generators; correct rotor speed maintained automatically by system that also synchronises output of the two engines; tail rotor pylon forms small vertical stabiliser; horizontal stabiliser near end of tailboom. Civil versions have rectangular cabin windows.

FLYING CONTROLS: Mechanical system, with irreversible hydraulic boosters; main rotor collective pitch control linked to throttles.

STRUCTURE: All-metal; main rotor blades, mainly VD-76 aluminium alloy, each has extruded spar carrying root fitting, 21 honeycomb-filled trailing-edge pockets and blade tip, with titanium abrasion shielding on some of leading-edge; balance tab on each blade; each tail rotor blade made of spar and honeycomb-filled trailing-edge; semi-monocoque fuselage. Composites blades and elastomeric hub components under development.

LANDING GEAR: Non-retractable tricycle type; steerable twin-wheel nose unit, locked in flight; single wheel on each main unit; oleo-pneumatic (gas) shock-absorbers. Mainwheel tyres 865×280; nosewheel tyres 595×185. Pneumatic brakes on mainwheels; pneumatic system can also recharge tyres in the field, using air stored in main landing gear struts. Optional mainwheel fairings.

POWER PLANT: Two 1,397 kW (1,874 shp) Klimov TV3-117MT turboshafts in basic Mi-17; should one engine stop, output of the other increases automatically to contingency rating of 1,637 kW (2,195 shp), enabling flight to continue. Alternative high-altitude TV3-117VM engine has installed ratings of 1,545 kW (2,071 shp) in emergency; 1,397 kW (1,874 shp) for T-O; 1,250 kW (1,677 shp) normal; and 1,103 kW (1,479 shp) for cruising. Newest version of engine is TV3-117VMA-SB3, which believed to be available for new-build and upgraded aircraft. Deflectors on engine air intakes prevent ingestion of sand, dust and foreign objects; engine cowling side panels form maintenance platforms when open, with access via hatch on flight deck. VK-2500 engine installed on latest versions of Mi-171.

Standard fuel capacity of 2,615 litres (691 US gallons, 575 Imp gallons), comprising 2,170 litres (573 US gallons; 477 Imp gallons) in main external tanks and 445 litres (118 US gallons; 98.0 Imp gallons) in feed tank. Additional 1,830 litres (483 US gallons; 402 Imp gallons) optional auxiliary fuel in two tanks.

ACCOMMODATION: Two pilots side by side on flight deck, with provision for flight engineer's station. Military versions can be fitted with external flight deck armour. Windscreen de-icing standard.

Seats and bulkheads of basic version quickly removable for cargo carrying. Standard military versions have cargo tiedown rings in floor, winch of 150 kg (330 lb) capacity and pulley block system to facilitate loading of heavy freight, an external cargo sling system (capacity 3,000 kg; 6,614 lb), and 24 tip-up seats along sidewalls of cabin; six additional centreline seats optional. Military Mi-17-1V carries up to 30 troops, up to 20 wounded or 12 stretchers in ambulance role, or weapons on six outrigger pylons; civilian Mi-17 promoted as essentially a cargo-carrying helicopter, with secondary passenger transport role; Mi-171/172 both able to carry up to 26 passengers. Large windows on each side of flight deck slide rearward. Sliding, jettisonable main passenger door at front of cabin on port side; electrically operated rescue hoist (capacity 150 kg; 330 lb) can be installed at this doorway. Rear of cabin made up of clamshell freight-loading doors, which are smaller on commercial versions, with downward-hinged passenger airstair door centrally at rear. Hook-on ramps used for vehicle loading.

SYSTEMS: (Mi-17-1V/171): AI-9V APU for pneumatic engine starting; AC electrical supply from two 40 kW three-phase 115/220 V 400 Hz GT40/P-48 V generators. Engine air intake de-icing standard. Provision for oxygen system for crew and, in ambulance version, for patients. Freon fire extinguishing system in power plant bays and service fuel tank compartments, actuated automatically or manually. Two portable fire extinguishers in cabin.

AVIONICS: (Mi-17-1V/171): *Comms:* Baklan-20 and Yadro-1G1 com radio.

Radar: Type 8A-813 weather radar optional.

Flight: Type A-723 long-range nav.

Instrumentation: ARK-15M radio compass, ARK-UD radio compass, DISS-32-90 Doppler; AGK-77 and AGR-74V automatic horizons; BKK-18 attitude monitor; ZPU-24 course selector; A-037 radio altimeter.

Self-defence: (optional) ASO-2V chaff/flare dispensers under tailboom and L-166V IR jammer (NATO 'Hot Brick') at forward end of tailboom.

EQUIPMENT: Options on military versions include external cockpit armour, triple-lobe engine nozzle IR suppressors and a VMR-2 fit for airdropping such stores as mines.

ARMAMENT: Various combinations of weaponry available, including 64 × 57 mm S-5 rockets in four UV-16-57 packs or 192 × 57 mm S-5 rockets in six UV-32-57 packs or four 9M17P Skorpion (AT-2 'Swatter') anti-armour missiles or six 9M14M Malyutka (AT-3 'Sagger') anti-armour missiles; can also operate with bombs and mines and able to use 23 mm GSh-23 gun packs, each with 250 rounds of ammunition. (AAMs and newer ASMs on Mi-8AMT(Sh).)

DIMENSIONS, EXTERNAL:

Main rotor diameter	21.29 m (69 ft 10½ in)
Tail rotor diameter	3.91 m (12 ft 9 ⅞ in)
Distance between rotor centres	12.66 m (41 ft 6 in)
Length: overall, rotors turning:	
Mi-17	25.35 m (83 ft 2 in)

Mil Mi-171 in Chinese military service

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Fuselage: Mi-17 ..... 18.465 m (60 ft 7 in)
Nose to tail rotor c/l: Mi-17 ..... 18.425 m (60 ft 5½ in)
Mi-172 ..... 18.855 m (61 ft 10¼ in)
Mi-17MD ..... 18.99 m (62 ft 3¾ in)
Fuselage, excl tail rotor ..... 18.17 m (59 ft 7¼ in)
Width of fuselage, excl fuel tanks ..... 2.50 m (8 ft 2½ in)
Tailplane span ..... 3.705 m (12 ft 1¾ in)
Height: overall, rotors turning ..... 5.545 m (18 ft 2¼ in)
to top of rotor head: Mi-8 ..... 4.73 m (15 ft 6¼ in)
Mi-17 ..... 4.745 m (15 ft 6¾ in)
Mi-17MD, Mi-171 ..... 4.755 m (15 ft 7¼ in)
Mi-172 ..... 4.865 m (15 ft 11½ in)
Wheel track: main ..... 4.51 m (14 ft 9½ in)
Nose ..... 0.30 m (11¾ in)
Wheelbase ..... 4.28 m (14 ft 0½ in)
Fwd passenger door: Height ..... 1.41 m (4 ft 7½ in)
Width ..... 0.82 m (2 ft 8¼ in)
Rear passenger door: Height ..... 1.70 m (5 ft 7 in)
Width ..... 0.84 m (2 ft 9 in)
Rear cargo door: Height ..... 1.82 m (5 ft 11½ in)
Width ..... 2.34 m (7 ft 8¼ in)

DIMENSIONS, INTERNAL:
Passenger cabin: Length ..... 6.36 m (20 ft 10¼ in)
Width ..... 2.34 m (7 ft 8¼ in)
Height ..... 1.80 m (5 ft 10¾ in)
Cargo hold (freighter, excl doors):
Length at floor ..... 5.34 m (17 ft 6¼ in)
Width ..... 2.29 m (7 ft 6¼ in)
Height ..... 1.80 m (5 ft 10¾ in)
Volume ..... 22.5 m³ (795 cu ft)

AREAS:
Main rotor disc ..... 356.16 m² (3,833.7 sq ft)
Tail rotor disc ..... 12.01 m² (129.28 sq ft)

WEIGHTS AND LOADINGS:
Weight empty, equipped: Mi-17 ..... 7,200 kg (15,873 lb)
Mi-171 ..... 6,913 kg (15,241 lb)
Mi-17-1V ..... 7,489 kg (16,510 lb)
Mi-17-1VA/171 ..... 7,586 kg (16,724 lb)
Mi-8AMT(Sh) ..... 8,493 kg (18,724 lb)
Fuel weight, Mi-17-1V/171:
Normal ..... 2,027 kg (4,469 lb)
Plus one auxiliary tank ..... 2,737 kg (6,034 lb)
Plus two auxiliary tanks ..... 3,447 kg (7,600 lb)
Max payload:
Internal: Mi-17, Mi-17-1V/171, Mi-8AMT(Sh) ..... 4,000 kg (8,820 lb)
External, on sling:
Mi-17, Mi-17-1V ..... 3,000 kg (6,614 lb)
Mi-171, Mi-8AMT(Sh) ..... 4,000 kg (8,820 lb)
Mi-17-1V ..... 5,000 kg (11,023 lb)
Normal T-O weight:
Mi-17, Mi-17-1V/171, Mi-8AMT(Sh) ..... 11,100 kg (24,470 lb)
Max T-O weight:
Mi-17, Mi-8AMT(Sh) ..... 13,000 kg (28,660 lb)
Mi-171 ..... 12,000 kg (26,455 lb)
Mi-172 ..... 11,878 kg (26,186 lb)
Max disc loading:
Mi-17, Mi-17-1V/171 ..... 36.5 kg/m² (7.48 lb/sq ft)

PERFORMANCE:
Max level speed:
Mi-17/172, max AUW ..... 135 kt (250 km/h; 155 mph)
Mi-17-1V/171, normal AUW ..... 135 kt (250 km/h; 155 mph)
Mi-17-1V/171, max AUW ..... 124 kt (230 km/h; 143 mph)
Max cruising speed:
Mi-17/172, max AUW ..... 129 kt (240 km/h; 149 mph)
Mi-17-1V, normal AUW ..... 135 kt (250 km/h; 155 mph)
Mi-171, normal AUW ..... 124 kt (230 km/h; 143 mph)
Mi-171, max AUW ..... 113 kt (210 km/h; 130 mph)
Service ceiling:
Mi-17M, normal AUW ..... 5,600 m (18,380 ft)
Mi-17M, max AUW ..... 4,400 m (14,440 ft)
Mi-17-1V, normal AUW ..... 6,000 m (19,680 ft)
Mi-17-1V, max AUW ..... 4,800 m (15,740 ft)
Mi-171, normal AUW ..... 5,700 m (18,700 ft)
Mi-171, max AUW ..... 4,500 m (14,760 ft)
Mi-172, max AUW ..... 5,650 m (18,535 ft)
Hovering ceiling OGE:
Mi-17, max AUW ..... 1,780 m (5,840 ft)
Mi-17M, normal AUW ..... 3,900 m (12,795 ft)
Mi-17M, max AUW ..... 1,500 m (4,920 ft)
Mi-17-1V/171, normal AUW ..... 3,980 m (13,055 ft)
Mi-17-1V/171, max AUW ..... 1,700 m (5,575 ft)
Mi-172, max AUW ..... 3,300 m (10,825 ft)
Range with max standard fuel, 5% reserves:
Mi-17, normal AUW ..... 270 n miles (500 km; 310 miles)
Mi-17, max AUW ..... 251 n miles (465 km; 289 miles)
Mi-172, max AUW ..... 267 n miles (495 km; 307 miles)
Range at 500 m (1,640 ft), max AUW, 30 min reserves:
Mi-17M/-1V, standard fuel ..... 251 n miles (465 km; 289 miles)
Mi-171, standard fuel ..... 334 n miles (620 km; 385 miles)
Mi-171, standard fuel plus one auxiliary tank ..... 440 n miles (815 km; 506 miles)
Mi-17M, standard fuel plus two auxiliary tanks ..... 545 n miles (1,010 km; 627 miles)
Mi-171, standard fuel plus two auxiliary tanks ..... 575 n miles (1,065 km; 661 miles)
Mi-17M, standard fuel plus four auxiliary tanks ..... 809 n miles (1,500 km; 932 miles)

MIL Mi-26

NATO reporting name: Halo

TYPE: Heavy lift helicopter.

PROGRAMME: Development started early 1970s (initially as Mi-6M); aim was payload capability 1½ to 2 times greater than that of any previous production helicopter; first prototype flew 14 December 1977; first production aircraft rolled out October 1980; one of several prototype or preproduction Mi-26s (SSSR-06141) displayed at 1981 Paris Air Show; in-field evaluation, probably with military development squadron, began early 1982; fully operational 1983; export deliveries started (to India) June 1986; production continues at low rate, with manufacture and marketing by Rostvertol.

CURRENT VERSIONS: **Mi-26:** (*Izdelie:* 90) Basic military transport.

Detailed description applies to basic Mi-26, except where indicated.

Mi-26A: Modified military Mi-26, tested in 1985, with PNK-90 integrated flight/nav systems for automatic approach and descent to critical decision point, and other tasks. Not proceeded with.

Mi-26T: Basic civil transport (*Izdelie* 209), generally as military Mi-26. Production begun in 1985. Variants include **Geological Survey Mi-26** towing seismic gear, with tractive force of 10,000 kg (22,045 lb) or more, at 97 to 108 kt (180 to 200 km/h; 112 to 124 mph) at 55 to 100 m (180 to 330 ft) for up to 3 hours. The mockup of an Mi-26 two-crew flight deck was shown at the 1997 Moscow Air Show and again at Farnborough 2002, when Rostvertol said decision to install new avionics on helicopter dependent upon outcome of discussions undertaken at Farnborough; if go-ahead was given, new designation **Mi-26T2** would apply. New avionics suite planned to include PNK-26M flight-navigation system, incorporating five colour MFDs, two data input panels and a digital computer, plus GPS receiver and digital map and weather radar; increased automation would eliminate need for navigator/communications operator and flight engineer, although loadmaster retained. Military equivalent adapted for night operations, using OVN-1 Skosok NVGs and GOES-321 gyrostabilised observation turret, containing a FLIR sensor and a laser range-finder. No designation announced for military versions. Mi-26T2 to be offered to Brazil, which has requirement for four heavy lift helicopters and is expected to invite bids in near future.

Mi-26TS: (*sertifitsyrovannyi:* certified) Mi-26T (*Izdelie 219*), but prepared for certification and marketed (in West as **Mi-26TC**) from 1996. One delivered to Samsung Aerospace Industries of South Korea in September 1997; supplied with Twin Bambi Bucket fire-suppressant system and fulfils dual transport/firefighting roles. This version is also subject of upgrade proposal involving installation of new avionics suite and other improvements that will reduce crew numbers from five to three and offer benefits in area of operational effectiveness; if implemented, is expected to result in improved helicopter becoming available in about 2006.

Mi-26MS: Medical evacuation version of Mi-26T, typically with intensive care section for four casualties and two medics, surgical section for one casualty and three medics, pre-operating section for two casualties and two medics, ambulance section for five stretcher patients, three seated casualties and two attendants; laboratory; and amenities section with lavatory, washing facilities, food storage and recreation unit. Civil version in use by MChS Rossii (Ministry of Emergency Situations). Alternative medical versions available, with modular box-laboratories or fully equipped medical centres that can be inserted into the hold for anything from ambulance to field hospital use. As field ambulance can accommodate up to 60 stretcher patients; or seven patients in intensive care, 32 patients on stretchers and seven attendants; or 47 patients and eight attendants in other

Indian Air Force Mil Mi-26 'Halo' *(IAF)* 1153785

configurations, which can include 12 bunks in four tiers forward, or patent Rostvertol box laboratory behind the first row of bunks, with 16 bunks behind.

The box includes an operating table, diagnostic equipment, anaesthetic and breathing equipment and other systems. Another configuration includes a larger theatre box by Heinkel Medizin Systeme and 12 stretchers behind, and the helicopter can be fitted with an X-ray laboratory or form the central element of a deployable air-portable field hospital.

Mi-26NEF-M: ASW version with search radar in undernose faired radome, extra cabin heat exchangers and towed MAD housing mounted on ramp.

Mi-26P: Transport for 63 passengers, basically four abreast in airline-type seating, with centre aisle; lavatory, galley and cloakroom aft of flight deck.

Mi-26PK: Flying crane (*kran*) derivative of Mi-26P with operator's gondola on fuselage side, next to cabin door on port side. First produced in 1997.

Mi-26PP: Reported ECM version. First noted 1986; current status unknown.

Mi-26S: Hastily developed version for disaster relief tasks following explosion at Chernobyl nuclear facility; equipped with deactivating liquid tank and underbelly spraying apparatus.

Mi-26TM: Flying crane, with gondola for pilot/sling supervisor under fuselage aft of nosewheels or under rear-loading ramp. First produced in 1992.

Mi-26TP: Firefighting (*pozharnyi*) version that appeared in 1994, with internal tanks able to dispense up to 15,000 litres (3,962 US gallons; 3,300 Imp gallons) fire retardant from one or two vents, or 17,260 litres (4,560 US gallons; 3,796 Imp gallons) of water from an underslung VSU-15 bucket, or from two linked EP-8000 containers. Can fill tanks on the ground using pumps with 3,000 litres (793 US gallons; 660 Imp gallons)/min throughput. One delivered to Moscow Fire Brigade on 19 August 1999.

Mi-26TZ: Tanker version that emerged in 1998, with 14,040 litres (3,710 US gallons; 3,088 Imp gallons) of T2, TS1 or R2 aviation fuel or DL, DZ or DA diesel oil fuel and 1,040 litres (275 US gallons; 228 Imp gallons) lubricants (in 52 jerry cans), dispensed through four 60 m (197 ft) hoses for aircraft, or 10 20 m (66 ft) hoses for ground vehicles. Conversion to/from Mi-26T takes 1 hour 25 minutes for each operation.

Mi-26M: Upgrade under development; all-GFRP main rotor blades of new aerodynamic configuration, new ZMKB Progress D-127 turboshafts (each 10,700 kW; 14,350 shp), and modified integrated flight/nav system with EFIS. Transmission rating unchanged, but full payload capability maintained under 'hot-and-high' conditions, OEI safety improved, hovering and service ceilings increased, and greater maximum payload (22,000 kg; 48,500 lb) for crane operations.

Two prototypes of a command support version of the Mi-26 are reported to have been built in 1988, with designation **Mi-27**. These featured new antennas along lower 'corner' of fuselage, blade and box-type and with long folded masts which are horizontal in flight, vertical when deployed on ground. Orders for production helicopters do not appear to have been placed.

CUSTOMERS: Nearly 300 said to have been built by 2001. Reportedly sold to about 20 countries; operators include Belarus (15), Cambodia (two), Congo Democratic Republic (one; second example delivered in late 2005, following long period of storage at Bierset, Belgium), India (10), Kazakhstan, North Korea (two), South Korea (one), Mexico (two second-hand) in 2000, Peru (three), Russian Army (35), Russian Ministry of Emergencies, Mil-Avia and Ukraine (20). Russian Army deliveries included four in 1994 (but none subsequently). One attrition replacement ordered in 2003 for Siberian division of MChS Rossii emergency relief service. In April 2004, it was reported that Pakistan armed forces negotiating supply of unspecified number of Mi-26s; no further news has emerged of this possible sale. One Mi-26T included in bulk purchase of 10 Mil helicopters by Venezuelan Defence Ministry, according to announcement of May 2005.

COSTS: USD8 million to USD10 million (Mi-26T) (2000).

DESIGN FEATURES: Largest ever production helicopter; empty weight comparable to that of Mi-6 and, as specified, is approximately 50 per cent of maximum T-O weight; weight saved by in-house design of main gearbox providing multiple torque paths, GFRP tail rotor blades, titanium main and tail rotor heads, main rotor blades of mixed metal and GFRP, use of aluminium-lithium alloys in airframe; conventional pod and boom configuration, but first successful use of eight-blade main rotor, of smaller diameter than Mi-6 rotor; payload and cargo hold size similar to those of Lockheed C-130 Hercules; auxiliary wings not required; rear-loading ramp/doors; main rotor rpm 132; main rotor spindle inclined forwards 4°.

FLYING CONTROLS: Hydraulically powered cyclic and collective pitch controls actuated by small parallel jacks, with redundant autopilot and stability augmentation system inputs. Fly-by-wire system flight tested 1994.

STRUCTURE: Eight-blade constant-chord main rotor; flapping and drag hinges, droop stops and hydraulic drag dampers; no elastomeric bearings or hinges; each blade has one-piece tubular steel spar and 26 GFRP aerofoil shape full-chord pockets, honeycomb filled, with ribs and stiffeners and non-removable titanium leading-edge abrasion strip; blades have moderate twist, taper in thickness toward tip, and are attached to small forged titanium head of unconventional design; each has ground-adjustable trailing-edge tab; five-blade constant-chord tail rotor, starboard side, has GFRP blades, forged titanium head; conventional transmission, with tail rotor shaft inside cabin roof; all-metal riveted semi-monocoque fuselage with clamshell rear doors; flattened tailboom undersurface; engine bay of titanium for fire protection; all-metal tail surfaces; swept vertical stabiliser/tail rotor support profiled to produce sideways lift; ground-adjustable variable incidence horizontal stabiliser.

LANDING GEAR: Non-retractable tricycle type; twin wheels on each unit; steerable nosewheels, tyre size 900×300; mainwheel tyres size 1,120×450. Retractable tailskid at end of tailboom to permit unrestricted approach to rear cargo doors. Length of main legs adjusted hydraulically to facilitate loading through rear doors and to permit landing on varying surfaces. Device on main gear indicates take-off weight to flight engineer at lift-off, on panel on shelf to rear of his seat.

POWER PLANT: Two 8,500 kW (11,399 shp) ZMKB Progress D-136 free-turbine turboshafts, side by side above cabin, forward of main rotor driveshaft. Air intakes fitted with particle separators to prevent foreign object ingestion, and have both electrical and bleed air anti-icing systems. Above and behind is central oil cooler intake. VR-26 fan-cooled main transmission, rated at 14,914 kW (20,000 shp), with air intake above rear of engine cowlings. System for synchronising output of engines and maintaining constant rotor rpm; if one engine fails, output of other is increased to maximum power automatically. Independent fuel system for each engine; fuel in eight underfloor rubber tanks, feeding into two header tanks above engines, which permit gravity feed for a period in emergencies; maximum standard internal fuel capacity 12,000 litres (3,170 US gallons; 2,640 Imp gallons); provision for four auxiliary tanks. Mi-26TS normal capacity is 13,020 litres (3,440 US gallons; 2,864 Imp gallons). Two large panels on each side of main rotor mast fairing, aft of engine exhaust outlet, hinge downward as work platforms.

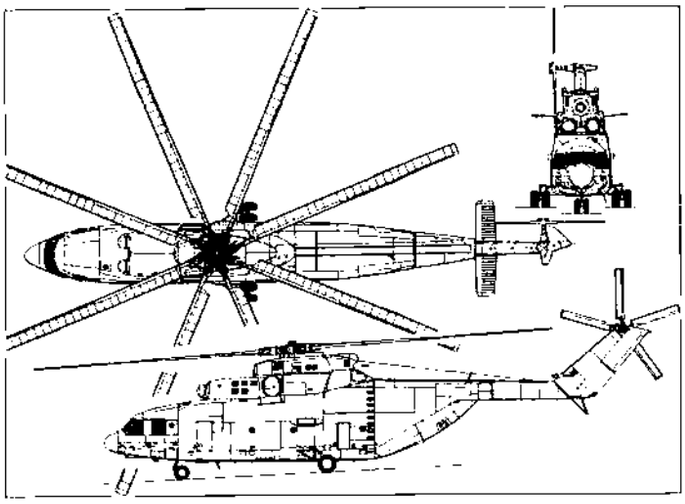
ACCOMMODATION: Crew of five on flight deck: pilot (on port side) and co-pilot side by side, tip-up seat between pilots for flight technician, and seats for flight engineer (port) and navigator (starboard) to rear; upgrade proposal revealed in early 2001 involves installation of new avionics and will result in reduction of flight deck crew to three. Four-seat passenger compartment aft of flight deck. Loads in hold include two airborne infantry combat vehicles and a standard 20,000 kg (44,090 lb) ISO container; about 20 tip-up seats along each sidewall of hold; maximum military seating for 90 combat-equipped troops; alternative provisions for 60 stretcher patients and four/five attendants; or up to maximum of 82 passengers. Heated windscreen, with wipers; four large blistered side windows on flight deck; forward pair swing open slightly outward and rearward. Downward-hinged doors, with integral airstairs, at front of hold on port side, and each side of hold aft of main landing gear units. Hold loaded via downward-hinged lower door, with integral folding ramp, and two clamshell upper doors forming rear wall of hold when closed; doors opened and closed hydraulically, with back-up hand pump for emergency use. Two LG-1500 electric hoists on overhead rails, each with capacity of 2,500 kg (5,511 lb), enable loads to be transported along cabin; winch for hauling loads, capacity 500 kg (1,100 lb); roller conveyor in floor and load lashing points throughout hold. Flight deck fully air conditioned.

SYSTEMS: Two main and one emergency hydraulic systems, operating pressure 157 and 206 bar (2,276 and 2,987 lb/sq in). Electrical system three-phase 200/115 V 400 Hz; single-phase 115 V 400 Hz; three-phase, 36 V 400 Hz; single-phase 36 V 400 Hz; DC 27 V. TA-8V 119 kW (160 hp). APU under flight deck, with intake louvres (forming fuselage skin when closed) and exhaust on starboard side, for engine starting and to supply hydraulic, electrical and air conditioning systems on ground. Electrically heated leading-edge of main and tail rotor blades for anti-icing. Only flight deck pressurised.

AVIONICS: All items necessary for day and night operations in all weathers are standard.

Radar: Groza 7A813 weather radar in hinged (to starboard) nosecone.

Flight: Integrated PKV-26-1 flight/nav system and automatic flight control system, Doppler, map display, HSI, and automatic hover system. Optional GPS.



Mil Mi-26 multipurpose heavy-lift helicopter *(Paul Jackson)* 1151996

Self-defence: Military versions can have IR jammers and suppressors, IR decoy dispensers and colour-coded identification flare system

EQUIPMENT: Hatch for load sling in bottom of fuselage, in line with main rotor shaft; sling cable attached to internal winching gear. Closed-circuit TV cameras to observe slung payloads. Specialised versions can utilise firefighting equipment.

ARMAMENT: None.

DIMENSIONS, EXTERNAL:

Main rotor diameter	32.00 m (105 ft 0 in)
Tail rotor diameter	7.61 m (24 ft 11½ in)
Length: overall, rotors turning	40.025 m (131 ft 3¾ in)
nose to turning tail rotor	35.91 m (117 ft 9¾ in)
fuselage, excl tail rotor	33.745 m (110 ft 8½ in)
Height: to top of rotor head	8.145 m (26 ft 8¾ in)
to top of fin	7.45 m (24 ft 5¼ in)
tail rotor turning	11.60 m (38 ft 0¾ in)
Width overall (outsides of mainwheels)	6.15 m (20 ft 2¼ in)
Tailplane span	6.02 m (19 ft 9 in)
Wheel track: c/l shock-absorbers	5.00 m (16 ft 4¾ in)
outer wheels	5.75 m (18 ft 10½ in)
Wheelbase	8.95 m (29 ft 4½ in)

DIMENSIONS, INTERNAL:

Freight hold:	
Length: excl ramp	12.08 m (39 ft 7½ in)
ramp trailed	15.00 m (49 ft 2½ in)
Max width	**3.25 m (10 ft 8 in)**
Height	**2.91–3.17 m (9 ft 6¼ in–10 ft 4¾ in)**
Floor area: excl ramp	**39.3 m² (423 sq ft)**
ramp trailed	**49.2 m² (530 sq ft)**
Volume: excl ramp	121.0 m³ (4,273 cu ft)
ramp trailed	135.9 m³ (4,799 cu ft)

AREAS:

Main rotor disc	804.25 m² (8,656.8 sq ft)
Tail rotor disc	45.48 m² (489.54 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	29,000 kg (63,934 lb)
Max payload, internal or external	20,000 kg (44,090 lb)
Normal T-O weight:	
except Mi-26TS	49,600 kg (109,350 lb)
Mi-26TS	49,650 kg (109,455 lb)
Max T-O weight	56,000 kg (123,450 lb)
Max disc loading: Mi-26TS	69.6 kg/m² (14.26 lb/sq ft)
Transmission loading at max T-O weight and power:	
Mi-26TS	3.76 kg/kW (6.17 lb/shp)

PERFORMANCE (A: Mi-26, B: Mi-26M, C: Mi-26TS at normal T-O weight):

Max level speed: A	159 kt (295 km/h; 183 mph)
C	146 kt (270 km/h; 168 mph)
Normal cruising speed: A, C	137 kt (255 km/h; 158 mph)
Service ceiling: A	4,600 m (15,100 ft)
B	5,900 m (19,360 ft)
C	4,300 m (14,100 ft)
Hovering ceiling IGE:	
A, ISA, with 5,100 kg (11,240 lb) payload	1,000 m (3,280 ft)
B, ISA + 15°C, with 12,300 kg (27,115 lb) payload	1,000 m (3,280 ft)
Hovering ceiling OGE, ISA: A	1,800 m (5,900 ft)
B	2,800 m (9,180 ft)
C	1,520 m (4,980 ft)
Range: A at 2,500 m (8,200 ft) ISA + 15°C, with 7,700 kg (16,975 lb) payload	270 n miles (500 km; 310 miles)
B at 2,500 m (8,200 ft) ISA + 15°C, with 13,700 kg (30,200 lb) payload	270 n miles (500 km; 310 miles)
A, S/L ISA, with max internal fuel at max T-O weight, 5% reserves	318 n miles (590 km; 366 miles)
A, S/L ISA, with four auxiliary tanks	1,028 n miles (1,905 km; 1,183 miles)

MIL Mi-28

NATO reporting name: Havoc

TYPE: Attack helicopter

PROGRAMME:

DEVELOPMENT MILESTONES

Design began	1980
First flight	10 Nov 1982

Design started 1980 under Marat N Tishchenko; first of two flying Mi-28 prototypes (012) flew 10 November 1982; each prototype different: first and second (022) had upward-pointing exhaust diffusers and fixed undernose fairing for electro-optic equipment; first also had conventional three-blade tail rotor; second replaced this with the definitive 'Delta-H' configuration. The first Mi-28A (032) introduced the downward-pointing exhaust suppressors and flew in January 1988; second Mi-28A prototype (042) demonstrated at Moscow in 1992 and represented the intended production configuration. It had the definitive moving E-O sensor turret undernose, downward-pointing exhaust diffusers and wingtip electronics/chaff dispenser pods.

Following official assessment, Kamov Ka-50 was announced on 5 October 1994 as Russian Army's future light combat helicopter, in preference to Mi-28, and received order for small batch for State Tests. (Army Aviation was absorbed by Russian Air Forces on 1 January 2003.) However, Mi-28N programme kept active by Rostvertol at Rostov-on-Don, which maintained readiness to launch production. By late 2003, Mi-28N's fortunes had revived and this confirmed in January 2004 by Air Forces C-in-C in announcement that it was "being considered" as next generation attack helicopter, partnered by small number of Ka-52 (two-seat Ka-50s) in intelligence-gathering role. Defence minister Sergey Ivanov declared in August 2004 that Mi-28 would be included in equipment of two mountain brigades to be formed in North Caucasus Military District. By mid-2004, official sources were referring to delivery of 50 Mi-28Ns by 2010 and long-term plans to acquire 500; Rostvertol announced in February 2005 that it had begun series production of Mi-28N with fourth and fifth examples on assembly line at Rostov-on-Don by the beginning of July. Entry into Russian Air Force service now expected towards end of 2006.

CURRENT VERSIONS: **Mi-28:** First two prototypes with 1,434 kW (1,923 shp) TV3-117BM engines and VR-28 gearbox. **Mi-28A** (Type 280): Basic version, *as described in detail*. Third and fourth aircraft built.

Mi-28N: (*Nochnoy*: Night): Export marketing name: Night Hunter. Added night/all-weather operating capability. Russian Army funding announced January 1994; first prototype (OP1/014) modified from original Mi-28 prototype (012); first hover 14 November 1995; formal roll-out 16 August 1996; first flight 30 April 1997. Problems reportedly experienced with original VR-28 main gearbox caused long stand-down, which ended 24 April 2002, following installation of advanced VR-29 replacement main gearbox; by August 2003, prototype said to have accumulated only 20 flight hours. Mi-28N OP1 grounded by early 2006, when employed to test advanced avionics systems.

Mast-mounted 360° scan millimetre wave radar (pod soon enlarged in vertical plane); FLIR ball beneath missile-guidance nose radome and above new shuttered turret for optical/laser sensors, including Zenit low-light-level TV. EFIS cockpit. Armament of production version to include 9M114 Shturm (AT-6'Spiral') or 9M120 Vikhr/Ataka (AT-12 'Swinger') ASMs and Igla (SA-16 'Gimlet') AAMs and R-73 AAMs. New composites rotor with sweptback blade tips added subsequently. Mi-28N introduced uprated VR-29 transmission and IKBO integrated flight/weapon aiming system, with automatic terrain-following and automatic target search, detection, identification and (in formations of Mi-28Ns) allocation; Ramenskoye Breo-28N mission control system.

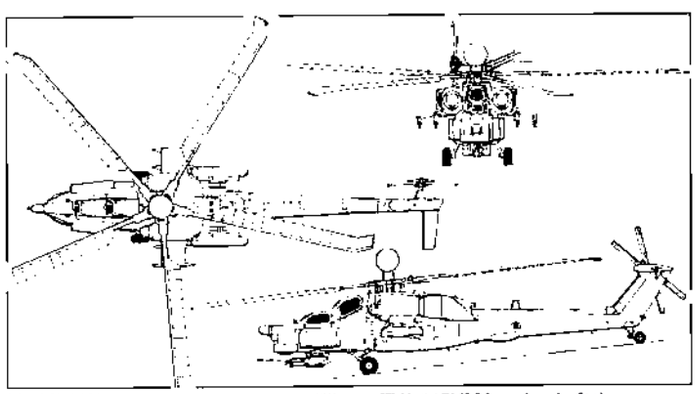
Second Mi-28N prototype (OP2) produced by Rostvertol with joint funding by Yugo-Zapadnyy Bank; rolled out at Rostov 9 March 2004; first flight (as '02'; later renumbered '024') 25 March 2004; press and VIP demonstration 31 March 2004; following factory tests, departed Rostov for State Tests in Moscow Region, 18 January 2005, with Stage A of official trials beginning late June 2005. First production helicopter rolled out (c/n 0101) August 2004; due for completion of outfitting in first half of 2005 but official contract for three production examples was not signed until second quarter of 2005; first flight eventually achieved 27 December 2005; handed over to Russian Defence Ministry (as '32') 29 May 2006. Second production example assigned to State Tests by joint Mil and Russian Air Force team. Official programme reported to have begun by mid-2005 and will require 600 sorties. Initial production batch reportedly numbers seven, although 2006 acquisition plan said to involve total of eight, comprising initial three under 2005 contract with five more to be ordered in 2006. Air Forces' C-in-C stated June 2006 that seven due by end of year; 12 for purchase in 2007; 40 in service by 2010; and Mi-24 'Hind' entirely replaced by 2015.

Almaz-280 mast-mounted radar originally planned for use by Mi-28N, but subsequently rejected, with alternatives under consideration; these include N025 radar from GRPZ plant in Ryazan, which undergoing bench-testing in latter half of 2005.

Mi-28NE: (*Nochnoy, Ehksport:* Night, Export): Version offered to, and rejected by, South Korea in 2000. Evaluated by Swedish Army in 2001 against Boeing AH-64 Apache and Eurocopter Tiger. Also offered to India and Malaysia, as well as Turkey, which still has requirement for 50 attack helicopters, following collapse of attempt to purchase Bell AH-1Z King Cobra from USA. Is a candidate to fulfil China's requirement for an attack helicopter. In June 2006, Rostvertol notified willingness to install Western avionics if required by potential customers including Brazil and Saudi Arabia.

COSTS: Mi-28N development cost USD150 million (2000); unit cost approximately USD12 million (Rostvertol, 2004).

DESIGN FEATURES: Conventional gunship configuration, with two crew in stepped cockpits; original three-blade tail rotor superseded by low noise 'scissors' or 'Delta-H' type comprising two independent two-blade rotors set as narrow X (35°/145°) on same shaft with self-lubricating bearings; resulting flapping freedom relieves flight loads; agility enhanced by doubling hinge offset of main rotor blades compared with Mi-24; survivability emphasised; crew compartments protected by titanium and ceramic armour and armoured glass transparencies; single hit will not knock out both engines; new composites main rotor can withstand hit from round of up to 30 mm calibre; vital units and parts are redundant, widely separated and shielded by the less vital; multiple self-sealing fuel tanks in



Mil Mi-28N combat helicopter (two Klimov TV3-117VMA turboshafts) *(James Goulding)* 0507528

Mil Mi-28N '024' displaying at Moscow Salon in August 2005 *(Yefim Gordon)* 1153784

centre-fuselage enclosed in composites second skin, outside metal fuselage skin; no explosion, fire or fuel leakage results if tanks hit by bullet or shell fragment; energy absorbing seats and landing gear protect crew in crash landing at descent rate of 12 m (40 ft)/s; crew doors are rearward-hinged, to open quickly and remain open in emergency; parachutes are mandatory for Russian Federation and Associated States (CIS) military helicopter aircrew; if Mi-28 crew had to parachute, emergency system would jettison doors, blast away stub-wings, and inflate bladder beneath each door sill; as crew jumped, they would bounce off bladders and clear main landing gear; no provision for rotor separation; port-side door, aft of wing, provides access to avionics compartment large enough to permit combat rescue of two or three persons on ground, although it lacks windows, heating and ventilation.

Hand crank, inserted into end of each stub-wing, enables stores of up to 500 kg (1,100 lb) to be winched on to pylons without hoists or ground equipment; current 30 mm gun is identical with that of RFAS army ground vehicles and uses same ammunition; jamming averted by attaching twin ammunition boxes to sides of gun mounting, so that they turn, elevate and depress with gun; main rotor shaft has 5° forward tilt, providing tail rotor clearance; transmission capable of running without oil for 20 to 30 minutes; main rotor rpm 242; with main rotor blades and wings removed, helicopter is air-transportable in Il-76 freighter.

FLYING CONTROLS: Hydraulically powered mechanical type; horizontal stabiliser linked to collective; controls for pilot only.

STRUCTURE: Five-blade main rotor; blades have very cambered high-lift section and sweptback tip leading-edge; full-span upswept tab on trailing-edge of each blade; structure comprises numerically controlled, spirally wound glass fibre D-spar, blade pockets of Kevlar-like material with Nomex-like honeycomb core, and titanium erosion strip on leading-edge; each blade has single elastomeric root bearing, mechanical droop stop and hydraulic drag damper; four-blade GFRP tail rotor with elastomeric bearings for flapping; rotor brake lever on starboard side of cockpit; strong and simple machined titanium main rotor head with elastomeric bearings, requiring no lubrication; power output shafts from engines drive main gearbox from each side; tail rotor gearbox, at base of tail pylon, driven by aluminium alloy shaft inside composites duct on top of tailboom; sweptback mid-mounted wings have light alloy primary box structure, leading— and trailing-edges of composites; no wing movable surfaces; provision for countermeasures pod on each wingtip, housing chaff/flare dispensers and sensors, probably RWR; light alloy semi-monocoque fuselage, with titanium armour around cockpits and vulnerable areas; composites access door aft of wing on port side; swept fin has light alloy primary box structure, composites leading— and trailing-edges; cooling air intake at base of fin leading-edge, exhaust at top of trailing-edge; two-position composites horizontal stabiliser.

LANDING GEAR: Non-retractable, tailwheel type; single wheel on each unit; mainwheel tyres size 720×320, pressure 5.40 bar (78 lb/sq in); castoring tailwheel with tyre size 480×200.

POWER PLANT: Two Klimov TV3-117VMA turboshafts, each 1,636 kW (2,194 shp), in pod above each wingroot; three jetpipes inside downward-deflected composites nozzle fairing on each side of third prototype shown in Paris 1989; upward deflecting type also tested. Deflectors for dust and foreign objects forward of air intakes, which are de-iced by engine bleed air. Internal fuel capacity 1,720 litres (454 US gallons; 378 Imp gallons). Provision for four external fuel tanks on underwing pylons.

ACCOMMODATION: Navigator/gunner in front cockpit; pilot behind, on elevated seat; transverse armoured bulkhead between; flat non-glint tinted transparencies of armoured glass; navigator/gunner's door on port side, pilot's door on starboard side.

SYSTEMS: Cockpits air conditioned and pressurised by engine bleed air. Duplicated hydraulic systems, pressure 152 bar (2,200 lb/sq in). 208 V AC electrical system supplied by two generators on accessory section of main gearbox, ensuring continued supply during autorotation. Low-airspeed system standard, giving speed and drift via main rotor blade-tip pitot tubes at −27 to +38 kt (−50 to +70 km/h; −31 to +43 mph) in forward flight, and ±38 kt (±70 km/h; ±43 mph) in sideways flight. Main and tail rotor blades electrically de-iced. Ivchenko AI-9V APU in rear of main pylon structure supplies compressed air for engine starting and to drive small turbine for preflight ground checks.

AVIONICS: *Radar:* N025 X/Ka-band mast-mounted radar expected to be installed in production helicopters following completion of trials programme.

Comms: UHF/VHF nav/com; small IFF fairing each side of nose and tail.

Instrumentation: Conventional IFR instrumentation, with autostabilisation, autohover, and hover/heading hold lock in attack mode; pilot has HUD and centrally mounted CRT for basic TV; aircraft designed for use with night vision goggles.

Mission: Radio for missile guidance in nose radome. Daylight optical weapons sight and laser range-finder in gyrostabilised and double-glazed nose turret above gun, with which it rotates through ±110°; wiper on outer glass protects inner optically flat panel.

Self-defence: Two fixed IR sensors on initial basic production Mi-28; IR suppressors, radar and laser warning receivers standard; optional countermeasures pod on each wingtip, housing chaff/flare dispensers and sensors, probably RWR. Mi-28N has integrated Vitebsk DASS with Pastel RWR, Mak IR warning system, Platan jammer and UV-26 flare dispensers.

EQUIPMENT: Two slots, one above the other on port side of tailboom, for colour-coded identification flares. Three pairs of rectangular formation-keeping lights in top of tailboom; further pair in top of main rotor pylon fairing.

ARMAMENT: One 2A42 30 mm turret-mounted gun (with 250 rounds in side-mounted boxes) in NPPU-28 mount at nose, able to rotate ±110°, elevate 13° and depress 40°; maximum rate of fire 900 rds/min air-to-air and air-to-ground. Two pylons under each stub-wing, each with capacity of 480 kg (1,058 lb), typically for total of sixteen 9M114 Shturm C (AT-6 'Spiral') radio-guided tube-launched anti-tank missiles and two UB-20 pods of eighty 80 mm S-8 or twenty 122 mm S-13 rockets or two UPK-23-250 gun pods. Alternative ATMs include Shipunov 9M120/9M121F Vikhr/Ataka-V and 9A-2200; up to eight 9M39 Igla-V AAMs in place of ATMs; in minelaying role can carry two KGMU-2 dispensers. Main 2A42 gun fired and guided weapons launched normally only from front cockpit; unguided rockets fired from both cockpits. (When fixed, gun can also be fired from rear cockpit.)

DIMENSIONS, EXTERNAL:

Main rotor diameter	17.20 m (56 ft 5 in)
Main rotor blade chord	0.67 m (2 ft 2½ in)
Tail rotor diameter	3.84 m (12 ft 7¼ in)
Tail rotor blade chord	0.24 m (9½ in)
Length overall, excl rotors, incl gun	17.01 m (55 ft 9¾ in)
Fuselage max width	1.85 m (6 ft 1 in)
Width over stub-wings	4.88 m (16 ft 0¼ in)
Height: overall	4.70 m (15 ft 5 in)
to top of rotor head	3.82 m (12 ft 6½ in)
Wheel track	2.29 m (7 ft 6¼ in)
Wheelbase	11.00 m (36 ft 1 in)

AREAS:

Main rotor disc	232.35 m² (2,501.0 sq ft)
Tail rotor disc	11.58 m² (124.65 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, equipped: 28	7,900 kg (17,416 lb)
28A	8,095 kg (17,846 lb)
28N	8,600 kg (18,960 lb)
Fuel weight: standard internal	1,337 kg (2,947 lb)
with added tanks	1,782 kg (3,928 lb)
Normal T-O weight: 28	10,200 kg (22,487 lb)
28A	10,400 kg (22,928 lb)
28N	10,700 kg (23,589 lb)
28NE	11,000 kg (24,250 lb)
Max T-O weight: 28	11,200 kg (24,691 lb)
28A, 28N	11,500 kg (25,353 lb)
Max disc loading: 28	48.2 kg/m² (9.87 lb/sq ft)
28A, 28N	49.5 kg/m² (10.14 lb/sq ft)

PERFORMANCE:

Max level speed: 28A	162 kt (300 km/h; 186 mph)
28N	172 kt (320 km/h; 199 mph)
28NE	164 kt (305 km/h; 189 mph)
Max cruising speed: 28A	143 kt (265 km/h; 164 mph)
28N, 28NE	145 kt (270 km/h; 168 mph)
Max rate of climb at S/L	816 m (2,677 ft)/min
Service ceiling: 28A	5,800 m (19,020 ft)
28N (-SB3)	5,700 m (10,700 ft)
Hovering ceiling OGE: 28	3,470 m (11,380 ft)
28A, 28N, 28NE	3,600 m (11,820 ft)
28N (-SB3)	4,500 m (14,760 ft)
Radius of action, standard fuel, 10 min loiter at target, 5% reserves	108 n miles (200 km; 124 miles)
Range, max standard fuel, 10% reserves: all	234 n miles (435 km; 270 miles)
Ferry range, 5% reserves	593 n miles (1,100 km; 683 miles)
Endurance with max fuel	2 h
g limits	+3/−0.5

MIL Mi-34

NATO reporting name: Hermit

TYPE: Four-seat helicopter.

PROGRAMME: Design began 1980 at personal request of head of DOSAAF paramilitary training organisation, which had found Mi-2 uneconomical as replacement for Mi-1. Mil designation *Izdelie* 300 (Article 300); chief designer M N Tishchenko; low priority due to military demands for Mi-8, -17 and -24 modifications for operations in Afghanistan. Instruction to proceed issued by USSR Council of Ministers on 10 February 1984.

First hover 17 November 1986; first forward flight 26 December 1986; two prototypes and structure test airframe completed by mid-1987, when exhibited for first time at Paris Air Show; first helicopter built in former USSR to perform normal loop and barrel roll; Stage A tests completed in 123 hours and 280 sorties; Stage B State Tests delayed by loss of one prototype on 27 February 1989, resulting in static test airframe being converted for flight. Following dissolution of DOSAAF (and USSR), State Tests resumed late 1992 and extended to 1996.

Series production began at Arsenyev plant and first aircraft flew 4 November 1993; airframe manufactured by Carpathian Helicopter Production Association; marketed by Mi-Light Helicopters (LVM); Mi-34S/-34C completion was at Moscow plant of LVM, but subsequently reverted to Arsenyev; planned completion of 30 in 1994–95 hampered by lack of funding; five delivered in 1995, one in first half of 1996. State order for resumed manufacture 1996. Marketing initiative, early 1999, planned worldwide establishment of service centres in countries where more than 10 Mi-34s ordered. In mid-2003, production was stated to have temporarily ceased to allow transfer of manufacture to a fully constituted production line, the previous 22 helicopters having been manufactured as 'pre-production' aircraft. Production will resume with 276 kW (370 hp) power plant, development delays with which were due to have been overcome by early 2004, although no announcement of resumed production had been received by the end of the following year.

Trials in 1999 by civil pilot training school at Omsk showed Mi-34 to be 2.8 times cheaper and more effective to operate than current fleet; school to acquire three Mi-34Cs and obtain up to 10 more in long term. Other schools expected to replace ageing Mi-2 with Mi-34.

In 2001, an upgraded variant was proposed with M-14 engine rated at 272 kW (365 hp), IFR instrumentation and auxiliary fuel tank. An agricultural variant was planned for debut in 2003.

CURRENT VERSIONS: **Mi-34S:** Basic version; marketed in Russia as Mi-34; certified by Interstate Aviation Committee Aviation Register (initially at 1,350 kg; 2,976 lb max T-O weight), with helicopter, engine and noise type certificates; meets FAR Pt 27 requirements.

(Note that until 1999, all marketing literature for this version used the hybrid Roman/Cyrillic **'Mi-34C'** to indicate certified status.)

Description applies to Mi-34S (Mi-34C), except where indicated.

Mi-34L: Projected version with 261 kW (350 hp) Textron Lycoming TIO-540J piston engine.

Mi-34P: (*patrulnyi:* patrol) Version of Mi-34S, equipped for police duties; Elbit thermal imaging equipment. Renewed interest in 2001 from Gazprom for pipeline patrol.

Mi-34A: Originally with 335 kW (450 shp) Rolls-Royce 250-C20R turboshaft; mockup, with luxury interior, exhibited at Moscow Air Show'95. Promotion recommended in 1999, employing 376 kW (504 shp) Turbomeca TM 319 Arrius 2F turboshaft; MTOW 1,450 kg (3,196 lb); usable fuel increased to 340 litres (89.7 US gallons; 74.8 Imp gallons); accommodation for four passengers, plus pilot; 1.0 m³ (35 cu ft) baggage compartment. None yet built.

Mi-34M1/M2: Projected twin-turbine, six-passenger versions originating in 1981 study; MTOW 2,500 kg (5,511 lb).

Mi-34UT: Announced 2001. Dual control trainer. Unsuccessfully competed against Kazan Ansat in competition, in which decision announced September 2001, to provide 100 training helicopters for Russian armed forces.

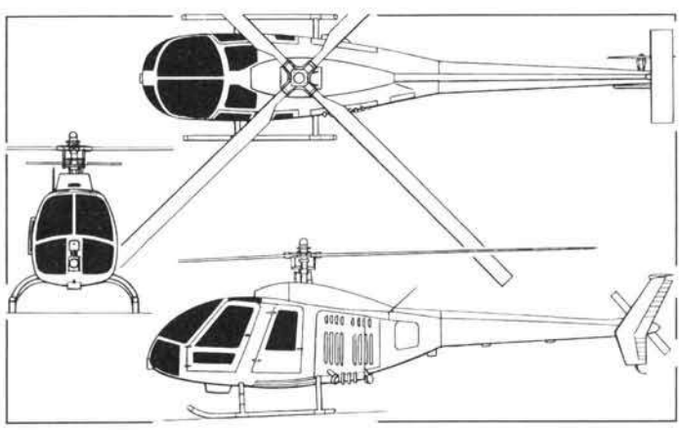
Mi-234: VAZ rotary engine. Not built.

CUSTOMERS: Total of 22 delivered from Arsenyev by mid-2003, compared with estimated 425 called for in Russia's 1992–2000 civil aviation development plan. No further production reported, but Arsenyev announced plans for resumed manufacture in February 2006, citing successful outcome to recent sales negotiations. This conditional upon resolution of several "legal and technical" issues, including international certification of Russian-built helicopters. First three for Mayor's office, Moscow. Others used by Bashkir Airlines for oilfield support and Mi-Avia for patrol and training. One operated by Bosniac and Croat Federation Air Force. Three delivered to Nigerian Air Force in 2001, along with six Mi-35s; these were from first batch of six Mi-34s built at Arsenyev, after pause of several years; further five delivered to Nigeria by end of 2002. LVM (Mil's light helicopter marketing subsidiary) reportedly ordered 20 Mi-34s for construction at Arsenyev in 2001, but only delivery in that year apart from Nigerians was one to Sibneft. In June 2002, Russian sources reported foreign (assumed Nigerian) negotiations for "several dozen" Mi-34s although only known 2003 production commitment was follow-on batch of four for Nigeria and five for Omsk Civil Aviation Flying and Technical College by end of 2005.

COSTS: US$400,000, fully equipped (2003).

DESIGN FEATURES: Aerobatic helicopter; intended initially for training and international competition flying; conventional pod and boom configuration; piston engine of same basic type as that in widely used Sukhoi and Yakovlev fixed-wing training aircraft of DOSAAF and Kamov Ka-26 helicopters; suitable also for light utility, mail delivery, observation and liaison duties, and border patrol; later developments concentrate on light transport role.

Aerobatic capabilities include looping; backwards flight at 70 kt (130 km/h; 81 mph); and rotation about main rotor axis at 60°/s.



Mil Mi-34 two/four-seat training, competition and light transport helicopter *(Dennis Punnett)* 1159403

Mil Mi-34P light utility helicopter *(Paul Jackson)* 1159373

FLYING CONTROLS: Manual, with no hydraulic boost.

STRUCTURE: Semi-articulated four-blade main rotor with flapping and cyclic pitch hinges, but natural flexing in lead/lag plane; blades of GFRP built around spiral coil spar of unidirectional glass fibre and with honeycomb filler aft of spar, attached by flexible steel straps to head like that of MDH MD 500; two-blade tail rotor of similar composites construction, on starboard side; riveted light alloy fuselage; sweptback tailfin with small unswept T tailplane. Limited use of titanium alloys.

LANDING GEAR: Conventional fixed skids on arched support tubes; small tailskid to protect tail rotor.

POWER PLANT: One 239 kW (320 hp) VOKBM M-14V-26V nine-cylinder radial air-cooled (fan-assisted) engine mounted sideways in centre-fuselage. Upgrade to 276 kW (370 hp) from 2004. Fuel capacity 176 litres (46.5 US gallons; 38.7 Imp gallons); system for inverted flight.

ACCOMMODATION: Normally one or two pilots, side by side, in enclosed cabin, with optional rapidly removable dual controls. Rear of cabin contains detachable, low bench seat, available for two passengers and offering flat floor for cargo carrying. Forward-hinged door on each side of flight deck and on each side of rear cabin; all doors jettisonable in emergency. Accommodation heated and ventilated; hot air demisting.

SYSTEMS: Primary electric power provided by 27 V 3 kW engine-driven generator; secondary power supplies of 115 V AC, 400 Hz, single-phase and 36 V AC, 400 Hz, three-phase; 27 V 17 Ah battery. Pneumatic system for engine starting.

AVIONICS: *Comms:* Briz VHF radio.

Flight: A-037 radio altimeter; ARK-22 radio compass.

Instrumentation: Magnetically slaved compass system incorporating radio magnetic indicator.

EQUIPMENT: Gyro horizon. Version used by Moscow Police has dual controls, two rear seats and loudspeaker under rear of pod.

DIMENSIONS, EXTERNAL:

Main rotor diameter	10.00 m (32 ft 9¾ in)
Main rotor blade chord	0.22 m (8¾ in)
Tail rotor diameter	1.48 m (4 ft 10¼ in)
Tail rotor blade chord	0.16 m (6¼ in)
Length overall, rotors turning	11.415 m (37 ft 5½ in)
Fuselage: Length	8.71 m (28 ft 7 in)
Max width	1.42 m (4 ft 8 in)
Height: overall	2.75 m (9 ft 0¼ in)
to fintip	2.45 m (8 ft 0½ in)
Skid track	2.175 m (7 ft 1½ in)
Fuselage ground clearance	0.36 m (1 ft 2¼ in)
Cockpit doors: Height	1.15 m (3 ft 9¼ in)
Max width	0.70 m (2 ft 3½ in)

AREAS:

Main rotor disc	78.70 m² (847.1 sq ft)
Tail rotor disc	1.72 m² (18.52 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	950 kg (2,094 lb)
Fuel weight	128 kg (282 lb)
T-O weight: Aerobatic	1,100 kg (2,425 lb)
Normal	1,280 kg (2,822 lb)
Max	1,450 kg (3,196 lb)
Max disc loading	18.4 kg/m² (3.77 lb/sq ft)
Max power loading	6.08 kg/kW (9.99 lb/hp)

PERFORMANCE (Mi-34S/C at Normal TOW; Mi-34A at MTOW):

Max level speed: Mi-34S/C	113 kt (210 km/h; 130 mph)
Mi-34A	121 kt (225 km/h; 140 mph)
Max cruising speed:	
Mi-34S/C	92 kt (170 km/h; 106 mph)
Mi-34A	113 kt (210 km/h; 130 mph)
Best climbing speed: Mi-34S/C	49 kt (90 km/h; 56 mph)
Service ceiling: Mi-34S/C	4,000 m (13,120 ft)
Mi-34A	5,000 m (16,400 ft)
Hovering ceiling, OGE: Mi-34S/C	900 m (2,960 ft)
Mi-34A	2,750 m (9,020 ft)
Range with max fuel at 500 m (1,640 ft), 5% reserves:	
Mi-34S/C	192 n miles (356 km; 221 miles)
Mi-34A	297 n miles (550 km; 341 miles)
g limit	+3

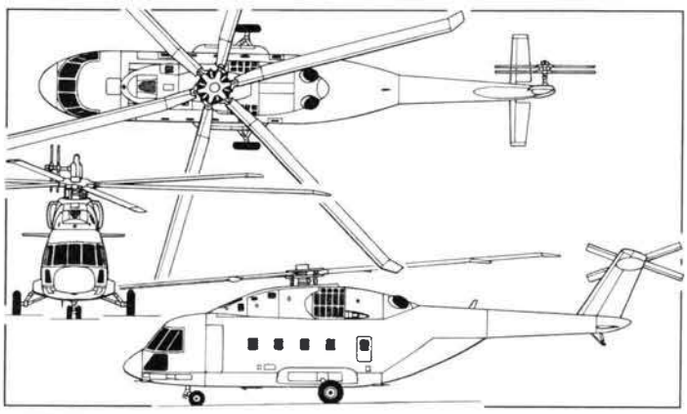
MIL Mi-38

TYPE: Medium transport helicopter.

PROGRAMME: USSR Council of Ministers approved proposal for an 'improved Mil Mi-8' on 30 July 1981, this using (for third time) designation Mi-8M. Optimised for civil operation, and thus sought economical engine and composites rotor blades. Following further refinements, including elastomeric hub, retractable landing gear and X-type tail rotor, was redesignated Mi-38 in 1983. Early work at Kazan branch of Mil design office; transferred to Moscow in January 1988 under A N Ivanov and, from 1995, N I Chalov. Agreement of August 1990 provided for Kazan to build prototypes as cost-saving measure.

Model shown at 1989 Paris Air Show, when aircraft at mockup stage. Modifications in

Mil Mi-38 prototype *(Yefim Gordon)* 1159323



Mil Mi-38 medium transport helicopter *(Michael Badrocke)* 1159404

evidence by 1993 included fixed landing gear with wider track and reduced base. Under December 1992 agreement, Eurocopter was to integrate flight deck, avionics and passenger systems, and adapt Mi-38 for international market; Euromil joint stock company established September 1994 to advance collaboration, adding Kazan production plant (as main manufacturing and final assembly centre); funding for Euromil granted in October 1994 by European Bank for Reconstruction and Development. Sextant and Pratt & Whitney Canada added as risk-sharing parties for avionics and engine, later replacing Klimov. Funding by Russian Ministry for Defence Industries 1996. In July 2003, however, Eurocopter withdrew from Euromil, which continues as an all-Russian company, but with Eurocopter continuing to supply avionics as a contractor. Mi-38 rotor blades began test flying on an Mi-17 in early 2001.

By 1997, Euromil was anticipating first flight in 1999 and start of production two years later, following FAR Pt 29 certification, but contracts for completion of demonstrator not signed until 18 August 1999, following unilateral decision of Euromil board in December 1998 to launch programme and fly demonstrator at Kazan in 2001. This subsequently slipped to 2002 and then to mid-2003, finally taking place on 22 December 2003, following roll-out on 20 November. Demonstrator (PT-1/RA-38011) is third airframe, following test articles at Mil Moscow and Kazan. First formal presentation held at Kazan on 1 October 2004. Prototype wears 'Euromil' name and European Union flag. Four further prototypes to follow, including two for static testing. Certification planned in 2009.

CURRENT VERSIONS: **Mi-38**: Pratt & Whitney engines.

Mi-38M: Proposed development version with 16,500 kg (36,376 lb) MTOW only when carrying underslung load.

Mi-382: Klimov engines.

Mi-382M: Proposed development version with 18,000 kg (39,683 lb) MTOW only when carrying underslung load of up to 8,000 kg (17,637 lb).

CUSTOMERS: Predicted sales of 200 in CIS, plus 100 exports.

COSTS: Estimated development cost (2001) USD500 million; unit cost USD12 million to USD16 million for export; USD11 million in Russian Federation (2002).

DESIGN FEATURES: Planned as replacement for Mi-8/17 series. Western engines optional. Conventional pod and boom configuration; power plant above cabin; six-blade main rotor with considerable non-linear twist and swept tips; main rotor has hydraulic drag dampers; single lubrication point, at driveshaft; rotor brake standard; Krasny Oktyabr VR-E8 transmission, comprising main, intermediate and tail gearboxes and tail rotor drive shaft; engine input 19,017 rpm; two independent two-blade tail rotors, set as narrow X on same shaft; sweptback fin/tail rotor mounting; small horizontal stabiliser; for day/night operation over temperature range −60 to +50°C.

FLYING CONTROLS: Fly-by-wire, with manual back-up.

STRUCTURE: Composites main and tail rotors by Kazan; low-profile VNV-E8 titanium main rotor head, with elastomeric bearings, built by Stupino; fuselage, mainly composites, built by Kazan.

LANDING GEAR: Fixed tricycle type; single wheel on each main unit; oleo-pneumatic shock absorbers; twin, self-centring nosewheels; low-pressure tyres; optional pontoons for emergency use in overwater missions. Main tyres 950 mm diameter, pressure 5.88 bar (85 lb/sq in); nose tyres 600 mm diameter, pressure 4.90 bar (71 lb/sq in).

POWER PLANT: Those helicopters for CIS customers powered by two Klimov TVA-3000 (TV7-117 derivative) turboshafts, each rated at 1,838 kW (2,465 shp) for T-O; single-engine rating 2,610 kW (3,500 shp) and transmission rated for same power. Demonstrator to have two 2,461 kW (3,300 shp) P&WC PW127 turboshafts, which are also available, in PW127T/S form, as an option for Western customers. Power plant above cabin, to rear of main reduction gear; air intakes and filters in sides of cowling. Six fuel tanks beneath floor of main cabin are resistant to 15 m (50 ft) drop without rupturing; normal fuel capacity 3,942 litres (1,041 US gallons; 867 Imp gallons). Provision for external auxiliary fuel tanks. Liquid petroleum gas fuel planned as alternative to aviation kerosene.

ACCOMMODATION: Crew of two on flight deck, separated from main cabin by compartment for majority of avionics; single-pilot operation possible for cargo missions. Cabin includes first 2.07 m (6 ft 9½ in) of tailboom. Lightweight seats for 30 passengers as alternative to unobstructed hold for 5,000 kg (11,020 lb) freight. Ambulance (16 litters) and air survey versions planned. Passenger door, forward, port; freight door, forward, starboard; cargo ramp at rear; hatch in cabin floor, under main rotor driveshaft, for tactical/emergency cargo airdrop and for cargo sling attachment; optional windows for survey cameras in place of hatch. Provision for hoist over port-side door, remotely controlled, hydraulically actuated rear cargo ramp, powered hoist on overhead rails in cabin, and roller conveyor system in cabin floor and ramp.

SYSTEMS: Air conditioning by compressor bleed air, or APU on ground, maintains temperature of not more than 25°C on flight deck in outside temperature of 40°C, and not less than 15°C on flight deck and in main cabin in outside temperature of −50°C. Three independent hydraulic systems; any one able to maintain control of helicopter in emergency. Electrical system has three independent generators, two at 12 kW DC and one 60 kW AC; optional fourth generator 40 or 60 kW AC; two batteries; electric rotor blade de-icing, main and tail. Independent fuel system for each engine, with automatic crossfeed; forward part of cowling houses VD-100 APU, hydraulic, air conditioning, electrical and other system components.

AVIONICS: Sextant equipment in export aircraft.

Radar: Weather/nav radar (range 54 n miles; 100 km; 62 miles).

Flight: Preset flight control system allows full autopilot, autohover and automatic landing. Avionics controlled by large central computer, linked also to automatic nav system with Doppler, ILS, satellite nav system, main radar, autostabilisation system and automatic radio compass.

Instrumentation: Six colour CRTs for use in flight and by servicing personnel on ground. Equipment monitoring, failure warning and damage control system. Closed-circuit TV for monitoring cargo loading and slung loads. Options include low-cost electromechanical instrumentation based on that of Mi-8, sensors for weighing and CG positioning of cargo in cabin, and for checking weight of slung loads.

EQUIPMENT: Optional 300 kg (661 lb) capacity SAR hoist.

DIMENSIONS, EXTERNAL:

Main rotor diameter	21.10 m (69 ft 2¾ in)
Tail rotor diameter	3.84 m (12 ft 7¼ in)
Distance between rotor centres	12.755 m (41 ft 10¼ in)
Length: overall, rotors turning	25.20 m (82 ft 8¼ in)
fuselage	19.95 m (65 ft 5½ in)
Width, rotors folded	3.17 m (10 ft 4¾ in)
Height: to top of rotor head	5.20 m (17 ft 0¾ in)
to top of fin	5.56 m (18 ft 3 in)
Stabiliser span	4.20 m (13 ft 9½ in)
Wheel track	4.50 m (14 ft 9¼ in)
Wheelbase	5.17 m (16 ft 11½ in)
Forward freight door: Height	1.665 m (5 ft 5½ in)
Width	1.445 m (4 ft 9 in)
Forward passenger door: Height	1.66 m (5 ft 5¼ in)
Width	0.61 m (2 ft 0 in)
Floor hatch: Length	1.15 m (3 ft 9¼ in)
Width	0.75 m (2 ft 5½ in)

DIMENSIONS, INTERNAL:

Main cabin: Length: at floor	6.80 m (22 ft 3¾ in)
at top of ramp	8.63 m (28 ft 3¾ in)
including available tailboom	10.70 m (35 ft 1¼ in)
Max width	2.36 m (7 ft 9 in)
Width at floor	2.20 m (7 ft 2½ in)
Height: centre	1.84 m (6 ft 0½ in)
rear	1.85 m (6 ft 1 in)
Volume	29.5 m^3 (1,042 cu ft)

AREAS:

Main rotor disc	349.67 m^2 (3,763.8 sq ft)
Tail rotor disc	11.58 m^2 (124.65 sq ft)

WEIGHTS AND LOADINGS (provisional):

Max payload: internal	5,000 kg (11,020 lb)
external	7,000 kg (15,432 lb)
Max fuel weight	3,055 kg (6,735 lb)
Normal T-O weight	14,200 kg (31,305 lb)
Max T-O weight	15,600 kg (34,392 lb)
Max disc loading	44.6 kg/m^2 (9.14 lb/sq ft)
Transmission loading at max T-O weight and power	5.97 kg/kW (9.82 lb/shp)

PERFORMANCE (estimated, PW127 engines):

Max level speed	153 kt (285 km/h; 177 mph)
Max cruising speed	148 kt (275 km/h; 171 mph)
Service ceiling	5,100 m (16,740 ft)
Hovering ceiling OGE	2,800 m (9,180 ft)
Range: with 5,000 kg (11,020 lb) payload	256 n miles (475 km; 295 miles)
with max internal fuel	477 n miles (885 km; 549 miles)
ferry, with auxiliary fuel	701 n miles (1,300 km; 807 miles)

MIL Mi-54

TYPE: Multirole medium helicopter.

PROGRAMME: Project announced mid-1992; at preliminary design stage by 1993, to replace Mi-2 and Mi-8; model displayed at Moscow Air Show '92; envisaged initially with two Saturn/Lyulka AL-32 turboshafts; single-engined version for Asian market then being studied; IOC planned 1998, but not achieved. By 2005, had been included in 2002-10 Russian civil aviation plan, following minor revisions of design; mockup shown at Moscow Salon in August 2005, displaying numerous detail differences from previous designs. Further changes reflected in 2006 brochure.

DESIGN FEATURES: Intentions include low operating costs; high safety; spacious cabin; and operability in broad range of temperatures and altitudes. Configuration shown in accompanying illustrations; four-blade composites main and tail rotors.

LANDING GEAR: Tricycle type; fixed single wheel on each main unit, carried below sponsons; twin nosewheels; tailskid.

POWER PLANT: Two Klimov VK-800V turboshafts, each 588 kW (789 shp), mounted side by side above cabin.

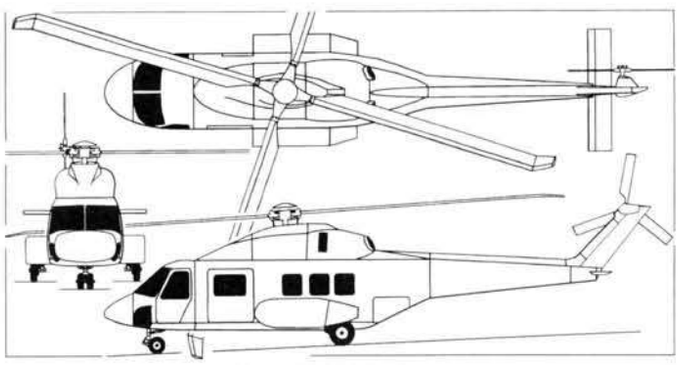
ACCOMMODATION: Normal seating for two pilots and up to 12 passengers. Separate baggage compartment.

DIMENSIONS, EXTERNAL:

Main rotor diameter	13.50 m (44 ft 3½ in)
Tail rotor diameter	2.70 m (8 ft 10¼ in)
Fuselage: Length	13.13 m (43 ft 1 in)
Width over sponsons	2.90 m (9 ft 6¼ in)
Height to top of rotor head	3.40 m (11 ft 1¾ in)
Wheel track	2.50 m (8 ft 2½ in)
Wheelbase	4.45 m (14 ft 7¼ in)

Model of Mil Mi-54 1159324

Mockup of Mil Mi-60 MAI exhibited by Rostvertol at Moscow Salon, August 2001 *(Paul Jackson)* 0121036



Current arrangement of Mil Mi-54 *(Paul Jackson)* 1159405

DIMENSIONS, INTERNAL:
- Cabin: Length at floor ..... 4.25 m (13 ft 11¼ in)
- Max width ..... 1.71 m (5 ft 7¼ in)
- Max height ..... 1.40 m (4 ft 7 in)
- Baggage compartment volume ..... 0.80 m³ (28.3 cu ft)

AREAS:
- Main rotor disc ..... 143.14 m² (1,540.7 sq ft)
- Tail rotor disc ..... 5.31 m² (57.16 sq ft)

WEIGHTS AND LOADINGS:
- Max payload: internal ..... 1,500 kg (3,307 lb)
- external ..... 1,800 kg (3,968 lb)
- Max T-O weight: internal load ..... 4,500 kg (9,920 lb)
- external load ..... 4,700 kg (10,362 lb)
- Max disc loading: internal load ..... 31.4 kg/m² (6.44 lb/sq ft)
- external load ..... 32.8 kg/m² (6.73 lb/sq ft)

PERFORMANCE (estimated):
- Max level speed ..... 154 kt (285 km/h; 177 mph)
- Nominal cruising speed ..... 139 kt (257 km/h; 160 mph)
- Service ceiling ..... 5,500 m (18,040 ft)
- Hovering ceiling: OGE ..... 2,500 m (8,200 ft)
- Range, 30 min reserves ..... 324 n miles (600 km; 372 miles)

MIL Mi-60

TYPE: Three-seat helicopter.

PROGRAMME: Development began 1993 under leadership of M N Tishchenko of Moscow Aviation Institute, thus designated Mi-60 MAI; financed by Ministry of Education. Technical proposal completed 1994; sponsored from 1997 by Army Aviation as twin-engine helicopter trainer; improved version with de-icing, autopilot and cabin heating proposed by Rostvertol in 1998. Announced July 2000, when mockup under construction at Kazan helicopter factory; this exhibited at Moscow Salon in August 2001, promoted by Rostvertol, which considering establishing production line. Building of prototype was to have begun in 2001; development cost USD30 million, including USD2.58 million for scientific research and USD15.77 million for prototypes and preparation for series production; estimated unit cost USD140,000 to USD150,000. Programme included in Russian federal aviation plan for 2002-10, but no further announcements made by 2006, when still awaiting investors to launch production.

DESIGN FEATURES: Maintenance-free rotor hub; airframe TBO of 2,000 hours.

LANDING GEAR: Skid type.

POWER PLANT: One or two piston engine driving main gearbox via a belt. Design power plant two LOM M332A four cylinder engines, each 103 kW (138 hp). Option of one 145 kW (195 hp) Textron Lycoming HIO-360-F1AD, one 177 kW (237 hp) VAZ-4261 or two 84.6 kW (113.4 hp) Rotax 914Fs.

DIMENSIONS, EXTERNAL:
- Main rotor diameter ..... 10.00 m (32 ft 9¾ in)
- Main rotor blade chord ..... 0.22 m (8¾ in)

WEIGHTS AND LOADINGS (estimated; L: Lycoming, R: Rotax, V: VAZ engines):
- Fuel weight: L ..... 79 kg (174 lb)
- R ..... 70 kg (154 lb)
- V ..... 71 kg (157 lb)
- Max underslung load ..... 90 kg (198 lb)
- T-O weight: Normal: all ..... 800 kg (1,764 lb)
- Max: L ..... 1,115 kg (2,458 lb)
- R ..... 1,260 kg (2,778 lb)
- V ..... 1,300 kg (2,866 lb)

PERFORMANCE (estimated; L, R, V as above):
- Max level speed: L ..... 108 kt (200 km/h; 124 mph)
- R ..... 113 kt (210 km/h; 130 mph)
- V ..... 121 kt (225 km/h; 140 mph)
- Max cruising speed: L ..... 94 kt (175 km/h; 109 mph)
- R ..... 103 kt (190 km/h; 118 mph)
- V ..... 100 kt (185 km/h; 115 mph)
- Econ cruising speed: L, V ..... 46 kt (85 km/h; 53 mph)
- R ..... 43 kt (80 km/h; 50 mph)
- Max rate of climb at S/L:
- vertical: L ..... 228 m (748 ft)/min
- R ..... 300 m (984 ft)/min
- V ..... 468 m (1,535 ft)/min
- inclined: L ..... 444 m (1,457 ft)/min
- R ..... 480 m (1,575 ft)/min
- V ..... 630 m (2,067 ft)/min
- Hovering ceiling, IGE: L ..... 1,800 m (5,900 ft)
- R ..... 2,000 m (6,560 ft)
- V ..... 3,200 m (10,500 ft)
- Service ceiling: L ..... 4,900 m (16,080 ft)
- R ..... 5,200 m (17,060 ft)
- V ..... 5,500 m (18,040 ft)
- Range, all ..... 216 n miles (400 km; 248 miles)
- Endurance: L ..... 3 h 40 min
- R,V ..... 4 h 20 min

MVEN

MVEN OOO (MVEN LTD)

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Web: www.mven.ru

Since establishment in 1990, MVEN has produced Cobra and Rada parachute ballistic recovery systems for various types of aircraft. It is a member of the 27-strong group of innovation centres founded by the Russian Fund of Assistance for Scientific and Technological Development of Small Enterprises (Bortnik's Fund). Core activities include manufacture of light aircraft and consumer goods both of polymer-composites material.

In 1995 it was incorporated within the Scientific Research Institute of Aeronautical Technologies and began the manufacture of light aircraft fuselages and components under subcontract to Chernov and others. The company's first aircraft, the MVEN-1 agricultural sprayer was shown at the Gelendzhik Hydroaviation Salon in September 2002, three months before its maiden flight. Production will be of MVEN-2 version. Longer-term projects include a four-seat business aircraft and six-seat STOL light transport. On 2 July 2003, MVEN received official certification as a designer and constructor of aircraft and parachute recovery systems.

MVEN is Russian dealer for Aeroprakt lightplanes built in Ukraine. Other activities include manufacture of commercial vehicle bodies and operation of a flying school at Kazan's domestic airport. The company has a workforce of 90 at its 9,000 m² (96,875 sq ft) plant.

MVEN FERMER

English name: Farmer

TYPE: Agricultural sprayer.

PROGRAMME: Prototype built 2002. Shown at Gelendzhik, 4 to 8 September 2002. First flight 9 November 2002; official evaluation flight of 11 December gave clearance for continued company testing.

CURRENT VERSIONS: **MVEN-1**: Initial version. Length 6.58 m (21 ft 7 in); one 118 kW (158 hp) LOM M332B four-cylinder piston engine driving a three-blade propeller.

MVEN-2: Announced 2003, with target first flight date of May 2004 (apparently not achieved and no further announcements by end of that year). Lycoming engine. Increased length and weights. Intended production version. By 2005, at least two Lycoming-powered aircraft had been noted: RA-3259K and RA-0180G. *As described.*

DESIGN FEATURES: Classic low-wing sprayplane with chemical hopper ahead of raised cockpit giving good view over nose. Forward C of P and C of G for improved handling obtained by ovelap of cockpit and chemical tank, plus forward wing sweep. Strut-braced, constant-chord wings and tailplane. Heavy-duty suspension and tyres.

Wing forward sweep 2°; dihedral 5°; incidence 3°.

FLYING CONTROLS: Conventional and manual. No aerodynamic balances. Ailerons and flaps occupy full extent of wing trailing-edge. Flap deflections 0°, 20° and 40°.

STRUCTURE: Principally of vacuum-formed glass fibre/epoxy with foam filler. Forward fuselage built around four longerons; X18H9T stainless steel firewall; glass fibre chemical tanke with cutouts at rear for pilot's legs.

LANDING GEAR: Tailwheel type: fixed. Centreline-hinged tube Vs attached to pneumatic compression struts, upper ends of which anchored to fuselage sides. Cantilever sprung tailwheel. Hydraulic brakes on mainwheels. Mainwheels 595×185; tailwheel 250×80.

MVEN-1 Fermer (Lycoming engine) at Moscow Salon in 2005 *(Yefim Gordan)*
1128964

POWER PLANT: One 134 kW (180 hp) Textron Lycoming O-360 flat-four. Fuel in two integral wing tanks, total capacity 140 litres (37.0 US gallons; 30.8 Imp gallons).
ACCOMMODATION: Two persons in tandem. Single, upward-hinged door, port side. Cockpit air filtered. Roll-bar over polit's seat. Baggage locker to rear.
EQUIPMENT: Chemical tank to rear of engine bay. Sprayer system with 13 atomisers on each of two underwing elements. Coverage 88 to 97 ha (217 to 240 acres) per hour. MVEN ballistic parachute behind cockpit.
DIMENSIONS, EXTERNAL:

Wing span	10.40 m (34 ft 1½ in)
Wing chord, constant	1.25 m (4 ft 1¼ in)
Wing aspect ratio	8.3
Length overall	7.15 m (23 ft 5½ in)
Height overall	2.15 m (7 ft 0¾ in)
Tailplane span	3.76 m (12 ft 4 in)
Propeller diameter	1.93 m (6 ft 4 in)
Crew door: Width	0.70 m (2 ft 3½ in)

DIMENSIONS, INTERNAL:

Cockpit: Max width	1.22 m (4 ft 0 in)
Max height	0.74 m (2 ft 5 in)
Baggage space: Length	0.58 m (1 ft 10¾ in)
Max height	0.67 m (2 ft 2½ in)
Max width	0.57 m (1 ft 10½ in)

AREAS:

Wings, gross	13.00 m² (139.9 sq ft)
Ailerons (total)	1.65 m² (17.76 sq ft)
Flaps	2.78 m² (29.92 sq ft)
Fin	1.20 m² (12.92 sq ft)
Rudder	0.80 m² (8.61 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	575 kg (1,268 lb)
Max chemical load	270 kg (595 lb)
Max baggage weight	10 kg (22 lb)
Max T-O weight	980 kg (2,160 lb)
Max wing loading	75.4 kg/m² (15.44 lb/sq ft)
Max power loading	8.31 kg/kW (13.65 lb/hp)

PERFORMANCE:

Max level speed	108 kt (200 km/h; 124 mph)
Normal operating speed	70–86 kt (130–160 km/h; 81–99 mph)
Max rate of climb at S/L	270 m (885 ft)/min
T-O run	180 m (590 ft)
Landing run	150 m (495 ft)
g limits	+6/–2

MYASISHCHEV

EKSPERIMENTALNYI MASHINOSTROITELNYI ZAVOD IMENI V M MYASISHCHEVA (EXPERIMENTAL ENGINEERING BUREAU NAMED FOR V M MYASISHCHEV)

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GENERAL DESIGNER: Valery K Novikov
CHIEF DEPUTY GENERAL DESIGNER: Valery A Shyrinyants
CHIEF DESIGNER, M-101: Evgeny S Charsky
CHIEF DESIGNER, M-55: Leonid A Sokolov
INFORMATION AND PUBLIC RELATIONS OFFICER: Stanislav G Smirnov

The Myasishchev OKB was founded on 24 March 1951 as OKB-23 , and led by Prof Vladimir Mikhailovich Myasishchev until his transfer in 1960 to head of the TsAGI research institute. Reconstituted in 1967, a new bureau was again led by Myasishchev up to his death in 1978. In the 1970s and 1980s, the bureau was engaged in development of multipurpose subsonic high-altitude aircraft, but has more recently diversified into civil aviation. In 1981, the bureau was named after Prof Myasishchev.

Attempts to forge overseas alliances proved unsuccessful, but in April 2001 it was announced that the KASKOL group of companies, the Nizhny Novgorod Sokol Aviation Plant and Myasishchev had formed Novi Regionalnyi Samoletnyi (NoRS, New Regional Aeroplanes), which is producing the M-101T Gzhel business aircraft at Nizhny Novgorod. Deliveries to customers began in 2005.

The bureau lists numerous other projects, although none appears to be close to the prototype stage. These are M-203 Barsuk (Badger), M-500 agricultural sprayer, M-201 Sokol, M-102 Duet (produced in Indian as Saras), M-202, M-112, M-302 19-passenger jet and Ecologiya, Kruiz and S-80 aerostats. Several have been described in previous editions of *Jane's All the World's Aircraft*.

MYASISHCHEV M-101T SOKOL

English name: Falcon
TYPE: Light utility turboprop.
PROGRAMME: Derived from Nelli and M-70 projects; first shown in model form at Moscow Air Show '90; developed full-scale mockup exhibited at Moscow Air Show '92 with piston engine and at Moscow Air Show '93 with turboprop. Two static test airframes and three flying prototypes built at Nizhny Novgorod by Sokol; first (RA-15001) first flew 31 March 1995; this and second flying aircraft (RA-15003), shown at Moscow Air Show '95, lack ventral fin. Third prototype (RA-15004) to what then regarded as preproduction standard; first preproduction aircraft (RA-15101) displayed at Paris and Moscow Air Shows 1997. Initial batch of 12 at Sokol plant; 11 reportedly completed by September 2001; No. 6 (RA-15106) is first in full production configuration, shown at Moscow, August 2001; No. 7 for reliability tests; No. 8 previously intended as first for customer delivery. Trials aircraft crashed near Zhukovsky test aerodrome on 12 September 2001, following loss of longitudinal stability, putting programme back by six months. Certification trials were due to restart in May 2002, with completion scheduled by December 2002; certification to AP-23 eventually awarded 14 January 2003. In April 2002 it was reported that 12 aircraft had been built — 10 for flying trials and two for static testing. Cold weather testing at temperatures as low as –50°C (–58°F) was undertaken in Yakutia, Sakh Republic, in February 2004.

Russian certification to AP-23 in passenger category was expected late 1998 or early 1999, following delivery of two aircraft to State Civil Aviation Research Institute (Gos NII GA) on 23 January 1998 for short-range freight services from Moscow/Sheremetyevo by Fenix Air but delayed by lack of funding; meanwhile five aircraft used on freight services by Sokol plant, completing 200 sorties and 460 hours between 31 airports between December 1997 and September 1999; one demonstrated in Africa by Central African Airlines, based in Egypt, accumulating 14,000 n miles (26,000 km; 16,150 miles). In November 2001, US$3 million was being sought to complete certification and further US$5 million to complete production tooling and retrospectively modify airframes already built. In April 2004, an agreement was announced with Mooney International for assembly of M-101Ts at Greenville for the US market; this appears to have lapsed.

Shortcomings in directional stability addressed by retrospective installation of additional two ventral fins and dorsal fillet on third prototype (RA-15004) in 1999, this also having extended wingtips. These additional tail surfaces standardised from RA-15106 onwards.

The aircraft was originally named Gzhel for a type of fine porcelain made in the city of Gzhel. Some development funding was provided by Gzhel, other finance coming from Myasishchev, Sokol, Inkombank and a Czech bank. Marketing is by Gzhel-Avia. In 2004, name was changed to Expediteon, apparently because of additional, alcoholic connections of Gzhel. By 2005 this had been changed, yet again, to Sokol.

Deliveries of new-build aircraft eventually began in late 2005.

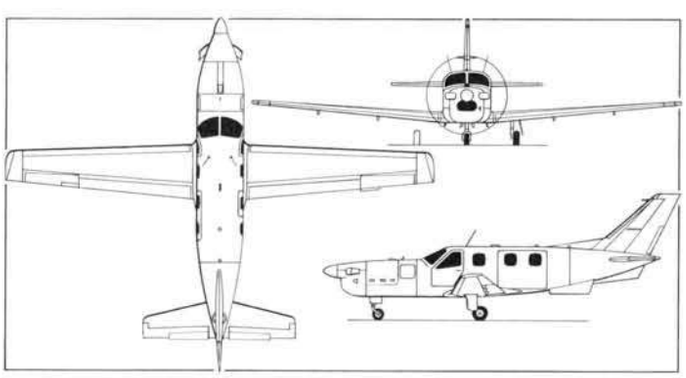
CUSTOMERS: Three flying prototypes and up to six preproduction aircraft completed by 2001; further two may have been finished by 2004. By April 2003, company reported 15 built, with 30 more under construction; delivery of first customer aircraft was due mid-2003, with eight scheduled to be handed over by end 2003 and a further 25 in 2004; by 2004, the company was stating that orders had been received from South Africa and Australia and production for the year would total seven (two for Russia and five abroad), followed by 18 in 2005. First confirmed receipt, in April 2004, by South African dealer, Rosavia Group of Johannesburg, although this was previously built (2001) aircraft RA-15106 which had returned to Russia a few months later. On 15 November 2005, Sokol production plant delivered two M-101T Sokols to civil aviation flying schools at Ulyanovsk and Buguruslan.

In December 2005, Avia Management Group ordered 45 Sokols, valued at USD67.5 million, with deliveries to be complete by mid-2007, for use by Dexter air taxi operation between 17 Russian cities. First (RA-15106) handed over 3 March 2006.

COSTS: USD1.6 million (2001). Hourly operating cost estimated at USD200 (2001). By mid-1999, Sokol plant had invested Rb102.4 million in M-101, and in 2000 was planning funding of USD2.5 million to complete certification.

DESIGN FEATURES: Intended for operation in remote areas; able to serve away from base aerodrome for up to 50 flying hours and fly from unpaved runways. Conventional all-metal low-wing monoplane with pressurised cabin; sweptback vertical tail surfaces and ventral

South African demonstrator Myasishchev M-101T RA-15106 'Ingwe', first and only aircraft to wear type name Expediteon 1042767



Myasishchev M-101T Sokol six-seat light aircraft *(Mike Keep)* 0121660

fin. Designed in accordance with Russian AP-23 and US FAR Pt 23 airworthiness requirements. Service life of 15 years or 20,000 hours.

FLYING CONTROLS: Conventional and manual. Electrically operated trim tabs in port aileron, rudder and each elevator; ground-adjustable tab on starboard aileron. Double-slotted flaps operated hydraulically.

STRUCTURE: All-metal. Wing constructed around torsion box.

LANDING GEAR: Hydraulically retractable tricycle type; single wheel on each unit; nosewheel retracts rearward, mainwheels inward into wingroots and fuselage; mainwheels uncovered by doors when retracted; tyre size 500×150-9 on mainwheels, 400×150-5 on nosewheel; levered suspension legs; castoring nosewheel with shimmy damper; designed to use paved and unpaved runways.

POWER PLANT: One 559 kW (751 shp) Walter M 601 F32 turboprop, driving Avia Hamilton Sundstrand V-510 five-blade propeller. Power plant is protected against particle ingestion. Fuel in two wing tanks and two feeder tanks, with electrical pumps.

ACCOMMODATION: One or two pilots and four passengers, in pairs in pressurised cabin; max capacity, one pilot and seven passengers. Rear-hinged door to flight deck on port side; large door for passengers and freight loading aft of wing on port side; emergency exit on starboard side above wing; provision for rapid change to cargo/passenger, freight or ambulance configuration.

SYSTEMS: Hydraulic system for landing gear and flaps. Pressurisation system maintains cabin altitude of 2,400 m (7,880 ft). Pneumatic de-icing of wing, tailplane and fin leading-edges; electric anti-icing of propeller, pitot tubes and windscreen clear-view panel. Electrical system, 27 V DC, supplied by 250SG125Q1 starter/generator and 115 A/400 Hz single-phase secondary supply with Varta 24 V emergency battery.

AVIONICS: Russian or Western equipment for single-pilot VFR or two-pilot IFR.

Comms: Bendix/King KX 165 nav/com.

Flight: Bendix/King KLN 89B GPS, WX-900 Stormscope and autopilot all optional.

DIMENSIONS, EXTERNAL:

Wing span	13.00 m (42 ft 8 in)
Length overall	9.975 m (32 ft 8¾ in)
Height overall	3.45 m (11 ft 3¾ in)
Tailplane span	4.32 m (14 ft 2 in)
Wheel track	3.00 m (9 ft 10 in)
Wheelbase	2.885 m (9 ft 5½ in)
Propeller diameter	2.30 m (7 ft 6½ in)
Passenger/freight door: Height	1.15 m (3 ft 9¼ in)
Width	1.23 m (4 ft 0½ in)
Flight deck door: Max width	0.90 m (2 ft 11½ in)
Max height	0.975 m (3 ft 2½ in)
Emergency exit: Max width	0.485 m (1 ft 7 in)
Max height	0.665 m (2 ft 2¼ in)

DIMENSIONS, INTERNAL:

Cabin: Length	4.56 m (14 ft 11½ in)
Max width	1.32 m (4 ft 4 in)
Max height	1.26 m (4 ft 1½ in)
Volume	7.5 m³ (265 cu ft)

AREAS:

Wings, gross	17.06 m² (183.6 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	2,190 kg (4,828 lb)
Max payload	540 kg (1,190 lb)
Max fuel weight	450 kg (992 lb)
T-O weight: normal	2,900 kg (6,393 lb)
max	3,270 kg (7,209 lb)
Max landing weight	3,160 kg (6,966 lb)
Max wing loading	191.7 kg/m² (39.26 lb/sq ft)
Max power loading	5.84 kg/kW (9.59 lb/shp)

PERFORMANCE:

Max cruising speed	210 kt (390 km/h; 242 mph)
Stalling speed, flaps down, MLW	71 kt (130 km/h; 81 mph)
Cruising altitude	7,600 m (24,940 ft)
T-O run	460 m (1,510 ft)
Landing run	390 m (1,280 ft)
Range:	
with max fuel, 45 min reserves	594 n miles (1,100 km; 683 miles)
ferry	701 n miles (1,300 km; 807 miles)

NAPO

GOSUDARSTVENNOYE UNITARNOYE PREDPRIYATIE NOVOSIBIRSKOYE AVIATSIONNOYE-PROIZVODST-VENNOYE OBEDINENIE IMENI V P CHKALOVA (STATE UNITARY ENTERPRISE NOVOSIBIRSK AIRCRAFT PRODUCTION ASSOCIATION NAMED FOR V P CHKALOV)

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GENERAL DIRECTOR: Aleksandr P Bobryshev
MARKETING DIRECTOR: Evgeniy A Elgaev

Founded in 1931 as GAZ 153, NAPO has built about 36,000 aircraft of many types, including I-16, LaGG-3, Yak-7, Yak-9, MiG-15, MiG-17, MiG-19, Yak-28, Su-9, Su-15 and, from 1972, Su-24 multirole combat aircraft. The plant is wholly state-owned, but 74.5 per cent of shares are to be transferred to Sukhoi Aviation Holding Company. NAPO's current products include the Antonov An-38 (available with local TVD-20 engines from 2002) and Sukhoi Su-34 (Su-27IB/Su-32) as well as motor boats. Built total of six An-38s. Also operates civil aerodrome at Eltsovka and NAPO Airlines; provides An-38 after-sales support. Is promoting Su-24 modernisation programmes for export customers. Was designated to build Su-49 abandoned piston trainer and was nominated in March 2003 to produce the Sukhoi Russian Regional Jet, beginning in 2006.

OSKBES MAI

OTRASLEVOYE SPETSIALNOYE KONSTRUKTORSKOYE BYURO EKSPERIMENTALNOGO SAMOLOTSTROENIYA, MOSKOVSKOGO AVIATSIONNOGO INSTITUTA (SPECIAL DESIGN SECTOR BUREAU OF EXPERIMENTAL AIRCRAFT CONSTRUCTION, MOSCOW AVIATION INSTITUTE)

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e-mail: oskbes@com2com.ru
Web: www.oskbes.ru
CHIEF DESIGNER: Nikolai P Goryunov

MAI founded 1930 and immediately began aircraft design and construction. Current design bureau formed by students in 1967 and was engaged in creation of piloted and unmanned light aircraft, which were developed according to requirements of various subsidiaries of the Ministries of Aviation Industry, Civil Aviation and Defence. By official decree of 11 August 1982, the Design Bureau was transformed into an experimental students' aircraft construction design bureau of MAI, although with a full-time engineering staff, to which students and lecturers were attached as required. By late 1980s, six experimental types had been built, comprising MAI-920 glider, Kvant aerobatic lightplane, Photon research jet, PS-01 Komar and Elf-D UAVs and Elf and Junior lightplanes. Additionally the company has built the gondola, controls and tail for the RosAeroSystems Au-12M airship.

During late 1980s turned to aircraft production, first with Photon design association and later the Aviatika joint-stock company. As part of the Aviatika joint stock company, the MAI Design Bureau (OB) received the name of a 'Low-Sized Aircraft Experimental Design Bureau' (OKB MA). MAI Development Plant and MAPO (Moscow Aircraft Production Organisation) were used as an industrial base. Application to Avia Register and Air Industry Department of the Ministry of Industry of Russian Federation on 27 July 1992 resulted in award on 17 February 1993 of certificate N2R9 for the rights to develop civil aircraft.

Basis for the Aviatika aircraft manufacture at MAPO (now RSK 'MiG') plant is licence agreement of 10 April 1995. Following name change to Aviatika, new light aircraft certificate (NQ P-9A) issued on 20 April 1994. During 1994–1995, OSKBES MAI (OKB MA) developed a technical offer for a light six-seat business aircraft designated Aviatika-950. In early 1996, Aviatika JSC changed its business plan and dispensed with services of OSKBES (to the OSKBES (OKB MA)), although latter continued work with MAPO.

Aviatika transferred all aircraft design, engineering and intellectual rights to the Moscow State Aviation Institute (MAI) under Contract N9 13/39 of 19 February 1998 and an additional agreement, N2 1-13/39 dated 3 April 1998. Subsequently, OSKBES MAI transferred manufacturing license for Aviatika series aircraft to MAPO. Has now designed aircraft or subvariants; more than 300 of MAI-890 built.

In 2006, the company announced that the MAI-217 project had been cancelled in favour of the MAI-208, no details of which have been released.

MAI-205

TYPE: Single-seat autogyro ultralight.

PROGRAMME: Prototype completed 1994; designated Aviatika-MAI-890A and powered by a 47.8 kW (64.1 hp) Rotax 582 UL. Developed MAI-205 (marked only as '205') first flew 26 January 2001. Flight testing was continuing in 2003 at Khodinka, Moscow, but by early 2006 the programme was suspended while the company concentrated on the MAI-208.

MAI-217

TYPE: Two-seat lightplane.

PROGRAMME: Development under way at OSKBES by 2000. Promotion continuing in 2003, using heavily modified MAI-910. However, the programme was cancelled without aircraft being built.

MAI-223 KITYONOK

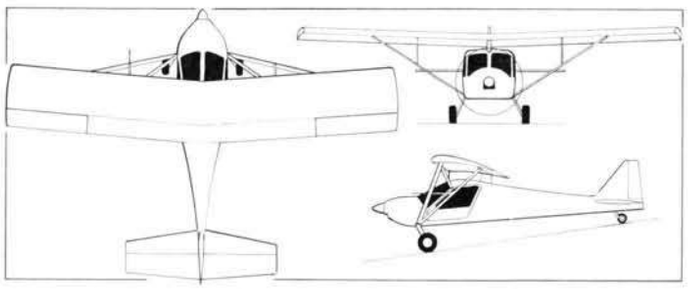
English name: Whale Calf

TYPE: Side-by-side ultralight/kitbuilt.

PROGRAMME: Contruction of prototype (serial 0101) began in 2002 and first flight achieved 20 October 2004. Flight testing on wheels, skis and floats was completed in summer 2005. Two further prototypes being built by MAI (0102) and Ural Civil Aviation Plant (PRAD) in Ekaterinburg (0103); these were nearly complete by mid-2006. In February 2006, prototype returned to factory for modification to MAI-223SKh cropspraying standard; flight testing in this guise then planned from May 2006.

For details of the latest updates to *Jane's All the World's Aircraft* online and to discover the additional information available exclusively to online subscribers please visit
jawa.janes.com

Aviatika-MAI-223 Kityonok exhibited at MAKS '05 *(Yefim Gordon)* 1129027



Aviatika-MAI-223 side-by-side ultralight as originally conceived with straight belly lines 0558326

CURRENT VERSIONS: **MAI-223:** Basic version, *as described*.

MAI-223SKh: Crop-spraying version, under development.

CUSTOMERS: First batch of 10 aircraft under construction by MAI and second batch of 10 being built by PRAD during 2006.

COSTS: Kit EUR16,200, excluding engine, EUR25,200 with Rotax 582, EUR32,200 with Rotax 912 ULS. Flyaway EUR34,220 with Rotax 582, EUR40,920 with Rotax 912 ULS. MAI-223SKh EUR47,860 (all 2006).

DESIGN FEATURES: Intended to conform to JAR-VLA regulations. Constant-chord, V-strut braced parasol wing is forward-swept at approximately 4°, and can be folded for storage and transportation.

DFS aerofoil, dihedral 3°, incidence 3°.

FLYING CONTROLS: Conventional and manual. Electrically operated trim tab and flaps; ground-adjustable rudder tab.

STRUCTURE: First prototype has aluminium fuselage frame with glass fibre cockpit fairing and fabric-covered tailboom. All other aircraft have glass fibre skin throughout. Two-spar wing has glass fibre skin and aluminium alloy ribs. Fabric-covered aluminium alloy control surfaces.

LANDING GEAR: Tailwheel type; fixed. Sweptback cantilever mainwheel leg attached to a torsion bar; castoring tailwheel. Hydraulic disc brakes. Mainwheel tyre size 15 × 6.00. Optionally, floats can be fitted.

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS2 flat-four driving a ground-adjustable three-blade propeller. Alternatively, a 37.0 kW (49.6 hp) Rotax 503 UL or 47.8 kW (64.1 hp) Rotax 582 UL can be fitted. Fuel capacity 60 litres (15.9 US gallons; 13.2 Imp gallons).

SYSTEMS: 26 Ah GP 12260 battery; electrical items with total power consumption of 250W, 12V can be fitted.

DIMENSIONS, EXTERNAL:

Wing span	8.19 m (26 ft 10½ in)
Width, wing folded	3.20 m (10 ft 6 in)
Length overall	6.00 m (19 ft 8¼ in)
Height overall	2.10 m (6 ft 10¾ in)

AREAS:

Wings, gross	11.40 m² (122.7 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	305 kg (672 lb)
Max fuel weight	40 kg (88 lb)
Max T-O weight: UL	495 kg (1,091 lb)
JAR VLA	600 kg (1,322 lb)

PERFORMANCE (estimated, Rotax 912 ULS):

Max operating speed	105 kt (195 km/h; 121 mph)
Normal cruising speed	97 kt (180 km/h; 112 mph)
Stalling speed, flaps down	36 kt (65 km/h; 41 mph)
Max rate of climb at S/L	360 m (1,181 ft)
T-O run	80 m (263 ft)
Landing run	65 m (214 ft)
Range, with max fuel	367 n miles (680 km; 422 miles)

AVIATIKA-MAI-890

TYPE: Single-seat ultralight biplane; side-by-side ultralight biplane.

PROGRAMME: Open cockpit Yunior (Junior) first flew July 1987 as single-seater with 5.68 m (18 ft 7½ in) span and 280 kg (617 lb) MTOW. Developed as MAI-89, 1989, span 8.11 m (26 ft 7½ in); MTOW 340 kg (750 lb). Production version, MAI-890, flew 1990 and entered series manufacture in 1991; although this halted temporarily in mid-1990s, it was announced in 2002 that production would continue. Russian certification awarded in December 1999. Manufactured by RSK 'MiG'.

CURRENT VERSIONS: **Aviatika-MAI-890:** Single-seater.

Aviatika-MAI-890U: Side-by-side two-seater (*uchebny*: training). First flown August 1991 (47.8 kW; 64.1 hp Rotax 582 UL). Normally with Rotax 912 UL engine (first flight 16 September 1992). Empty weight 298 kg (657 lb); MTOW 540 kg (1,190 lb); length 5.49 m (18 ft 0¼ in). Floatplane version completed trials on Lake Shartash, Ekaterinburg, September 2000. Certification agreement reported to be nearly complete in June 2004; with estimated final certification date of end 2005.

Aviatika-MAI-890SKh: Single-seat crop-sprayer version (*selskokhozyaistvenny*: agricultural); Rotax 912 ULS engine; marketing name **Farmer**. Chemical tank under engine and spraybar aft of lower wings; weight of agricultural equipment 28 kg (62 lb); chemicals 60 kg (132 lb) (105 litres; 27.7 US gallons; 23.1 Imp gallons) maximum with Rotax 582 engine.

Certified version received Avia Register approval on 26 April 2002. Changes include conformal chemical tank, enhanced spraying equipment, ventilated cockpit with filter, stall warner, reinforced landing gear, improved fuel system and FLYdat engine instrument system.

Aviatika-MAI-890USKh: Two-seat crop-sprayer version based on MAI-890U. Tank volume 100 litres (26.4 US gallons; 22.0 Imp gallons).

Aviatika-MAI-890S: Rotax 912 ULS 73.5 kW (98.6 hp) flat-four. Prototype (ZU-BZO) converted in South Africa, 1999, by Aeroserve Pty Ltd. Regarded by OSKBES as standard 890.

Aviatika-MAI-890U two-seat ultralight 0593277

CUSTOMERS: More than 300 delivered by March 2006, of which some 60 were agricultural variants; eight sold during last six months of 2001, including six equipped for crop spraying. Approximately 30 imported by a South African dealer in 1995; these known locally as **890CSH Mai** and **890U Mai**. Total market for agricultural variant estimated at 800 to 1,000.

COSTS: MAI-890 with Rotax 503 UL EUR17,410, Rotax 582 UL EUR19,470; MAI-890 SKh EUR32,450, with JAR-VLA certification EUR37,050; MAI-890U with Rotax 912ULS EUR32,150; MAI-890USKh with Rotax 912ULS EUR38,450 (2005).

DESIGN FEATURES: Strut- and wire-braced biplane; unspinnable; conventional tail surfaces carried on tubular boom; engine mounted under trailing-edge of upper wing; slight sweepback on all wings; dihedral on lower wings only. Semi-aerobatic and capable of flying in rough air conditions. Designed to JAR-VLA and FAR Pt 23 standards. Two cockpit doors, one jettisonable; provision for backpack parachute(s).

FLYING CONTROLS: Conventional and manual. Full-span ailerons on lower wings; large-area rudder and elevators, each with ground-adjustable tab.

STRUCTURE: Aircraft grade aluminium and titanium alloys, alloy steels; fabric covering unaffected by sun's radiation or atmospheric precipitation.

LANDING GEAR: Tricycle type; fixed. Twin cantilever mainwheel legs attached to main boom to rear of cabin; single wheel on each unit. Brakes on mainwheels. Optional skis or floats. All wheels 300×125.

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS four-cylinder piston engine; VV-98E-11 two-blade pusher propeller. A 37.0 kW (49.6 hp) Rotax 503 UL-2V may also be fitted. Standard fuel 50 litres (13.2 US gallons; 11.0 Imp gallons); provision for 55 litre (14.5 US gallon; 12.1 Imp gallon) auxiliary tank on single-seat version.

EQUIPMENT: Provision for up to 120 kg (265 lb) payload on four attachments, under engine mountings (60 kg; 132 lb), or underbelly (100 kg; 220 lb), or at lower wingtips (each 45 kg; 99 lb), including agricultural dusting and spraygear for Aviatika-MAI-890USKh Farmer. Optional BRS ballistic parachute system.

Following details apply to certified 890SKh with Rotax 912 ULS engine.

DIMENSIONS, EXTERNAL:

Wing span, upper	8.11 m (26 ft 7½ in)
Length overall, incl pitot	5.32 m (17 ft 5½ in)
Height to tip of fin	2.25 m (7 ft 4½ in)

AREAS:

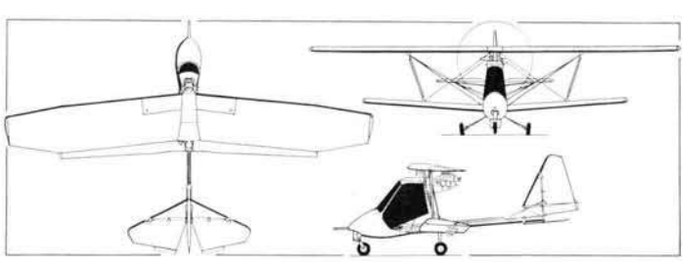
Wings, gross	14.29 m² (153.8 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	331 kg (730 lb)
Max T-O weight	540 kg (1,190 lb)

PERFORMANCE:

Max level speed	70 kt (130 km/h; 81 mph)
Cruising speed	49 kt (90 km/h; 60 mph)
Landing speed	41 kt (75 km/h; 47 mph)
Max rate of climb at S/L	159 m (522 ft)/min
T-O run	90 m (295 ft)
Landing run	130 m (430 ft)
Endurance	2 h 53 min
g limits	+5/−2.5



Aviatika-MAI-890 (Rotax piston engine) *(Paul Jackson)* 0051198

AVIATIKA-MAI-910 INTERFLY

TYPE: Two-seat lightplane.

PROGRAMME: Design started and construction of first prototype began 1993; first flight 22 June 1995 in MAI-910 configuration. Promotion began at MAKS '99, Moscow, August 1999; by early 2006, flight testing had been completed.

Original version had boom-mounted empennage. Boom subsequently covered with removable fairings, for more conventional appearance, and ventral strake added.

DESIGN FEATURES: Designed to JAR-VLA standards. Braced high-wing monoplane; single bracing strut and jury strut each side; fully enclosed cabin pod; strut- and wire-braced conventional tail unit carried on interchangeable rear fuselage of conventional thickness or on short boom. Wings fold.

Wing section CAHI (TsAGI) Sh-1-14; 1° leading-edge sweepback; thickness/chord ratio 14 per cent; constant chord except for tapered tips; no dihedral; incidence 5°.

FLYING CONTROLS: Conventional and manual. Actuation by cables; long-span flaperon on each wing; ground-adjustable tab on rudder and each elevator.

STRUCTURE: Metal structure with fabric-covered wings and tail surfaces, metal-skinned fuselage. Wings have single tubular spar, diameter 102 mm (4 in), and stamped sheet metal ribs. Materials primarily aluminium alloy, with stainless steel and titanium alloy where appropriate.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted, spring cantilever mainwheel legs; trailing-link nosewheel. Mainwheel tyres 400×150 or 300×120; nosewheel tyre 300×120; tyre pressure (all) 2.53 bar (37 lb/sq in). Mechanical brakes with 300×120 tyres; hydraulic brakes with 400×150 tyres. Nosewheel steerable through ±50°. Tailwheel gear optional.

POWER PLANT: One 59.6 kW (79.9 hp) Rotax 912 UL flat-four; Russian two-blade fixed-pitch propeller. Two fuel tanks, each 25 litres (6.6 US gallons; 5.5 Imp gallons); one in each wingroot. Oil capacity 6 litres (1.6 US gallons; 1.3 Imp gallons).

ACCOMMODATION: Two seats side by side in fully enclosed cabin with wide field of view for observation, patrol, search and aerial photography. Passenger seat folds for carriage of stretcher or lengthy freight. Large rearward-sliding window/door each side. Space for baggage or freight behind seats. Cabin heated and ventilated.

SYSTEMS: 12 V AC electrical system; Teledyne battery.

AVIONICS: *Comms:* UHF radio.

Flight: GPS.

DIMENSIONS, EXTERNAL:

Wing span	10.73 m (35 ft 2½ in)
Wing chord: at root	1.10 m (3 ft 7¼ in)
at tip	0.70 m (2 ft 3½ in)
Wing aspect ratio	10.3

Aviatika-MAI-910 with original rear fuselage *(James Goulding)* 0011968

Aviatika-MAI-910 light passenger/freight aircraft, showing new rear fuselage 0593291

Length overall	5.26 m (17 ft 3 in)
Height overall	2.50 m (8 ft 2½ in)
Wheel track	2.20 m (7 ft 2¾ in)
Wheelbase	1.60 m (5 ft 3 in)
Propeller diameter	1.90 m (6 ft 2¾ in)
Propeller ground clearance	0.30 m (11¾ in)
Doors (each): Height	0.87 m (2 ft 10¼ in)
Max width	1.10 m (3 ft 7¼ in)
Baggage door: Length	0.75 m (2 ft 5½ in)
Width	0.70 m (2 ft 3½ in)

DIMENSIONS, INTERNAL:

Cabin: Max width	1.20 m (3 ft 11¼ in)
Max height	1.08 m (3 ft 6½ in)
Floor area	1.20 m² (12.9 sq ft)
Baggage/freight volume	0.70 m³ (24.7 cu ft)

AREAS:

Wings, gross	11.20 m² (120.6 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	380 kg (838 lb)
Max fuel	40 kg (88 lb)
Max T-O weight	620 kg (1,366 lb)
Max wing loading	55.4 kg/m² (11.34 lb/sq ft)
Max power loading	10.40 kg/kW (17.09 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	121 kt (225 km/h; 139 mph)
Max level speed at S/L	84 kt (155 km/h; 96 mph)
Max and econ cruising speed	75 kt (140 km/h; 87 mph)
Stalling speed	41 kt (76 km/h; 48 mph)
Max rate of climb at S/L	210 m (690 ft)/min
Service ceiling	3,000 m (9,840 ft)
T-O run	150 m (495 ft)
T-O to 15 m (50 ft)	300 m (985 ft)
Landing from 15 m (50 ft)	150 m (495 ft)
Range	216 n miles (400 km; 248 miles)
g limits	+4/−2

POLYOT

PROIZVODSTVENNOYE OBEDINENIE POLET (POLYOT PRODUCTION ASSOCIATION)

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GENERAL DIRECTOR: Valentin Ziatsev

Antonov An-3 converted by Polyot 1128965

DESIGN BUREAU:
Tel: (+7 3812) 51 01 51
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CHIEF DESIGNER: Viktor V Markelov

Established in 1941, Polyot is one of the largest aerospace enterprises in Russia, with facilities extending over more than 15 km² (5.8 sq miles) and up to 20,000 employees. During the Second World War it manufactured 3,405 Tupolev Tu-2 bombers and Yakovlev Yak-7 and Yak-9 fighters in 2½ years; post-war products included 758 Ilyushin Il-28 jet bombers and 58 Tupolev Tu-104 jet transports. It remains state-owned. The Antonov An-74 series of STOL transports is in low-rate production.

Polyot manufactured SS-4, SS-7 and SS-11 strategic missiles, warheads, and first-stage engines for Zenith and Energiya rocket launch vehicles. Other products include Kosmos rocket, spacecraft and wind turbines and a variety of consumer goods under *konversiya* programmes.

In June 1997, Polyot and Baranov Engine Manufacturing Association relaunched the Antonov An-3 programme (An-2 with 1,140 kW; 1,529 shp OMKB TVD-20 turboprop). Certification of factory to build An-3 received by May 2000, but funding unavailable for production line and only conversions of An-2s being considered. By mid-2003, An-3s were serving in seven companies and Polet expected to sell its annual allocation of 10, increasing this to 15 in 2004. Cost is US$800,000 to US$900,000. An-3 work was interrupted during the first half of 2001 when Polyot repaired the prototype Antonov An-70 after it had crashed following take-off from Omsk. Revealed in September 2001 that Polyot selected to assemble An-70s ordered for Russian Air Forces; first An-70 originally intended to fly in 2003. Required investment to begin An-70 production (Polyot to build cargo hold) quoted in late 2001 as Rb3 billion, of which Russian government and Omsk regional government each donating Rb1,050 million.

In May 2002, Polyot revealed its recent work on the Yula 'strap-on' personal helicopter, although little further has been heard of the proposal.

RAA

RUSSIAN AMERICAN AVIATION DESIGN GROUP

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DIRECTORS:
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A diverse range of new and (mostly) established aircraft designs is offered for production by RAA, including the Aeroprogress T-101 Grach (deputy designer A V Andreyev); Khrunichev T-411 Aist and T-415; Thurston TA-16 (most recently offered in US as Aquastar Seafire); and Ivolga and VVA-14 wing-in-ground-effect craft. Research is continuing into a 2,000-tonne ekranoplan, 24-seat airliner and a training aircraft. The Voyager E-7 was first offered in the US in 2006.

RAA VOYAGER E-7 BUSHPLANE

TYPE: Light utility transport.

PROGRAMME: Incomplete fuselage exhibited at AirVenture, Oshkosh, July 2006; seeking partners to launch production.

CURRENT VERSIONS: **Model 300:** Baseline version; tailwheel; 224 kW (300 hp) Textron Lycoming IO-540 piston engine and short (11.73 m; 38 ft 5¾ in) wing span. MTOW 2,200 kg (4,850 lb); range 1,133 n miles (2,100 km; 1,304 miles) with 30 min reserves.

Model 400: *As described.*

Model 750 Turbo: With 559 kW (750 shp) Pratt & Whitney Canada PT6A turboprop. Otherwise generally as Model 400, except all-metal wing and eight fuel tanks, combined capacity 800 litres (211 US gallons; 176 Imp gallons); max level speed 170 kt (315 km/h; 196 mph); range 809 n miles (1,500 km; 932 miles); MTOW 2,700 kg (5,952 lb).

DESIGN FEATURES: Modelled on capabilities of DHC-2 Beaver. High, constant-chord, strut-braced wing; low, constant-chord tailplane; sweptback fin with small fillet. Landing gear, engine and wing area options.

FLYING CONTROLS: Conventional and manual.

STRUCTURE: Generally of metal, but fabric-covered wing (except metal for Model 750).

LANDING GEAR: Tricycle type; fixed. Telescopic mainwheel legs hinged to lower sides of fuselage and braced to centreline by V-type radius arms. Cantilever, trailing link nose unit. Model 300 has tailwheel and main leg attachments further forward. Optional floats and skis.

POWER PLANT: One 298 kW (400 hp) Textron Lycoming IO-720 piston engine. Fuel in six tanks, total capacity 432 litres (114 US gallons; 95.0 Imp gallons).

ACCOMMODATION: Seven persons, including one or two pilots. Two doors each side, separated by central window. Forward doors totally transparent.

Data follow for Model 400.

DIMENSIONS, EXTERNAL:

Wing span	13.575 m (44 ft 6½ in)
Wing aspect ratio	7.4
Length overall	11.075 m (36 ft 4 in)
Height overall	3.885 m (12 ft 9 in)

DIMENSIONS, INTERNAL:

Cabin: Length	3.56 m (11 ft 8¼ in)
Max width	1.38 m (4 ft 6¼ in)
Max height	1.55 m (5 ft 1 in)

AREAS:

Wings, gross	24.80 m² (266.9 sq ft)

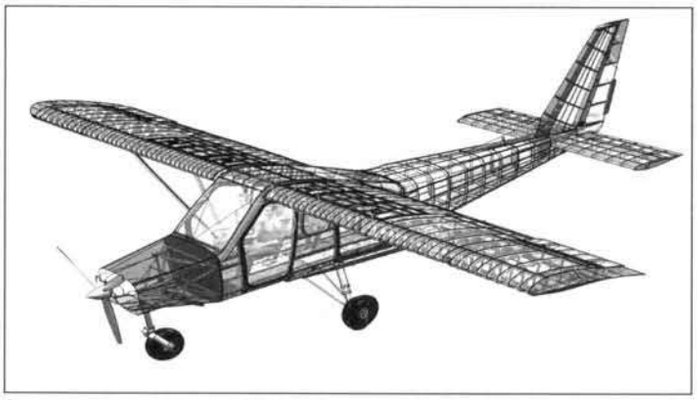
WEIGHTS AND LOADINGS:

Max T-O weight	2,300 kg (5,070 lb)
Max wing loading	92.7 kg/m² (18.99 lb/sq ft)
Max power loading	7.71 kg/kW (12.68 lb/hp)

PERFORMANCE:

Max level speed	135 kt (250 km/h; 155 mph)
Stalling speed, flaps down	38 kt (70 km/h; 44 mph)
T-O run	48 m (160 ft)
T-O to 15 m (50 ft)	135 m (445 ft)
Landing from 15 m (50 ft)	162 m (535 ft)
Landing run	42 m (140 ft)
Range with 30 min reserves	1,133 n miles (2,100 km; 1,304 miles)

Fuselage of prototype RAA Voyager E-7 Bushplane 1158661



Cutaway of RAA Voyager E-7 Bushplane 1158662

RIDA

PKB RIDA ANO

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Web: www.reda.ru
CHAIRMAN: Aleksey Ivanter

Rida design bureau established in 1989 and designed the P10 Ptenets lightplane; produced a prototype of the Pony two-seat amphibian; and planned a four-seat derivative, the Prize.

More recently, two new programmes have been announced: the Aleks-251 and a larger, Proect 256 (Project 256). Neither appears to have made progress in recent years.

RIDA ALEKS-251

TYPE: Six-seat amphibian.

PROGRAMME: Announced 2003, when first flight planned in second half of 2004; this, apparently, did not take place and the programme remained unfruitful, but still active, in early 2006. Reportedly developed for an undisclosed Russian Federation ministry, which has a requirement for up to 800.

DESIGN FEATURES: Parasol wing amphibian with single-step hull; cruciform empennage with sweptback fin. Constant-chord wing and tailplane; outrigger floats retract to form wingtips when not in use. Operable on water with wave height of 0.45 m (1 ft 6 in).

FLYING CONTROLS: Conventional and manual. Horn-balanced rudder. Flaps.

LANDING GEAR: Optional tricycle type.

POWER PLANT: Two LOM M332S four-cylinder engines, each 127 kW (170 hp), projecting forward from undersides of wing. Fuel tanks in wings; total capacity 800 litres (211 US gallons; 176 Imp gallons).

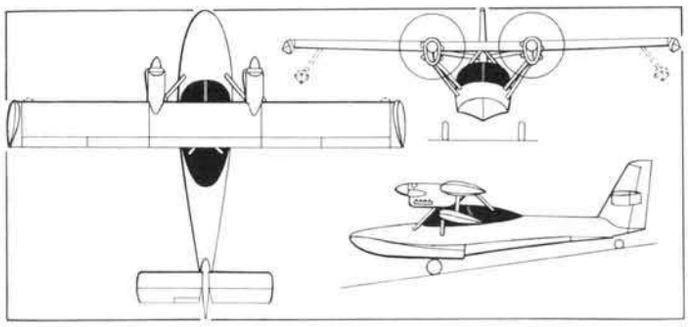
ACCOMMODATION: Pilot and five passengers; six passengers at maximum capacity. Port, centre transparency removable for access to cabin; windscreen split along centreline and hinged at base, both sides, to ease access for pilot(s).

EQUIPMENT: MVEN ballistic recovery parachute.

DIMENSIONS, EXTERNAL:

Wing span	13.20 m (43 ft 3¾ in)
Wing chord, constant	1.50 m (4 ft 11 in)
Wing aspect ratio	8.8
Length overall	10.54 m (34 ft 7 in)
Height, wheels retracted	3.10 m (10 ft 2 in)

Artists's impression of Rida Aleks-251 0583657



Rida Aleks-251 six-seat amphibian *(James Goulding)* 1151698

Tailplane span ..... 4.15 m (13 ft 7½ in)
Wheel track (optional) ..... 2.35 m (7 ft 8½ in)
Wheelbase (optional) ..... 6.25 m (20 ft 6 in)
Propeller diameter ..... 1.855 m (6 ft 1 in)
Distance between propeller centres ..... 3.00 m (9 ft 10 in)

DIMENSIONS, INTERNAL:

Cabin: Length ..... 3.10 m (10 ft 2 in)
Max width ..... 1.40 m (4 ft 7 in)
Max height ..... 1.30 m (4 ft 3¼ in)

AREAS:

Wings, gross ..... 19.80 m² (21.31 sq ft)

WEIGHTS AND LOADINGS:

Weight empty ..... 1,360 kg (2,998 lb)
Max payload ..... 600 kg (1,323 lb)
Max T-O weight ..... 2,100 kg (4,629 lb)
Max wing loading ..... 106.1 kg/m² (21.72 lb/sq ft)
Max power loading ..... 8.29 kg/kW (13.61 lb/hp)

PERFORMANCE:

Max level speed ..... 127 kt (235 km/h; 146 mph)
Normal cruising speed at FL98 ..... 113 kt (210 km/h; 130 mph)
Econ cruising speed at FL98 ..... 97 kt (180 km/h; 112 mph)
Unstick speed ..... 59 kt (110 km/h; 68 mph)
Stalling speed: clean ..... 62 kt (114 km/h; 71 mph)
flaps and gear down ..... 52 kt (96 km/h; 60 mph)
Max rate of climb at S/L ..... 300 m (984 ft)/min
T-O run: land ..... 300 m (985 ft)
water ..... 470 m (1,545 m)
Landing run: land ..... 300 m (985 ft)
water ..... 280 m (920 m)
Range with 500 kg (1,102 lb) payload: at normal cruising speed ..... 399 n miles (1,740 km; 459 miles)
at econ cruising speed ..... 1,512 n miles (950 km; 590 miles)
ferry ..... 1,943 n miles (3,600 km; 2,236 miles)
Endurance ..... 20 h

RIDA 256

TYPE: Utility amphibian.

PROGRAMME: Reported by 2003 to be under development for Australian Coast Guard; first flight intended in late 2005 or early 2006; backing from Australian investors. No further details revealed up to early 2006; no evidence of manufacturing having begun.

DESIGN FEATURES: Twin-prop amphibian with high-mounted, high aspect ratio, strut-braced, constant-chord wing and sweptback fin with ventral fillet. Boat hull with main and rear steps; convex flare. Fixed outrigger floats at approx 75 per cent of span. Engines mounted above wings. Meets AP-23 certification requirements. Operable in wave heights up to 0.75 m (2 ft 6 in).

FLYING CONTROLS: Conventional and manual.

LANDING GEAR: Tricycle type; retractable.

POWER PLANT: Two Walter M 601 turboprops, each 560 kW (751 shp).

ACCOMMODATION: Two pilots and 19 passengers, with baggage area at rear. Seats three abreast (two plus one, with offset aisle), fifth row between mainwheel bays comprising single seat. Max nine passengers under AP-23 rules. Two-element, horizontally divided freight door, port, rear.

DIMENSIONS, EXTERNAL:

Wing span ..... 18.80 m (61 ft 8¼ in)
Length overall ..... 14.70 m (48 ft 2¾ in)
Max width of fuselage ..... 1.91 m (6 ft 3¼ in)
Freight door: Height ..... 1.41 m (4 ft 7½ in)
Width ..... 1.40 m (4 ft 7 in)

DIMENSIONS, INTERNAL:

Cabin (between bulkheads): Length: overall ..... 8.58 m (28 ft 1¾ in)
passenger area ..... 5.88 m (19 ft 3½ in)
Max width ..... 1.80 m (5 ft 10¾ in)
Max height ..... 1.88 m (6 ft 2 in)

WEIGHTS AND LOADINGS:

Weight empty ..... 3,700 kg (8,157 lb)
Max T-O weight ..... 5,700 kg (12,566 lb)
Max power loading ..... 5.09 kg/kW (8.37 lb/shp)

PERFORMANCE:

Max level speed ..... 243 kt (450 km/h; 280 mph)
Econ cruising speed ..... 211 kt (390 km/h; 242 mph)
Unstick speed ..... 76 kt (140 km/h; 87 mph)
Max rate of climb at S/L ..... 540 m (1,772 ft)/min
Cruising altitude ..... 9,000 m (29,520 ft)
T-O run: on land ..... 480 m (1,575 ft)
on water ..... 580 m (1,905 ft)
T-O to 15 m (50 ft) on land ..... 800 m (2,625 ft)
Range: with max fuel ..... 2,159 n miles (4,000 km; 2,485 miles)
with 1,600 kg (3,527 lb) payload ..... 270 n miles (500 km; 310 miles)

Artist's impression of Rida 256 amphibian 0583656

ROSAEROSYSTEMS

ROSAEROSYSTEMS S.R.A
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CHAIRMAN: Gennady Verba

RosAeroSystems was formed in October 1997 by Avgur, Moscow Aviation Institute and the Russian Aeronautical Society (RVO) as a consortium to combine the efforts of lighter than air manufacturing and operation. Other partners within Russia now include Lavochkin OKB, Babakin Space Centre, Moscow Aviation Institute and CAHI (TsAGI). Foreign partners include Kubicek (Czech Republic), Voliris (France), and the US companies Worldwide Aeros and General Aeronautics Corporation. It offers a wide range of manned and unmanned airships and other aerostats under current design; any manufacture of these would be undertaken by Avgur, with whom it is co-located, or other Russian aviation companies, although RosAeroSystems has its own envelope production unit within its 5,000 m² (53,825 sq ft) facility and can produce and test envelopes of up to 50,000 m³ (1.76 million cu ft) size. Its latest product is an 18-passenger, tethered spherical aerostat named AeroLift, which received domestic certification to FAR Pt 31 standard in July 2002 and EASA certification on 10 June 2005. RosAeroSystems' workforce totalled more than 50 in 2001. RosAeroSystems International Ltd was formed as a US marketing organisation in 2002.

ROSAEROSYSTEMS Au-11

TYPE: Helium non-rigid airship.

PROGRAMME: Construction (by Avgur) began January 1997. Planned to fly in September 1998, but delayed; eventually made first flight August 2001. On 10 February 2005, an Au-11 (RF-000034R) piloted by Leonid Putintsev established at Zhukovsky (Ramenskoye) a Class BA-02 FAI speed record of 27.0 kt (50.0 km/h; 31.1 mph).

CUSTOMERS: One acquired by Moscow traffic police in 2004 as crew trainer for Au-12. No other production known.

Description as for Au-12 except as follows:

DESIGN FEATURES: Single-seat version of Au-12; otherwise generally differs only in dimensions, power plant, gondola and range/endurance performance.

POWER PLANT: One 20.9 kW (28 hp) VAZ-1111 motorcar engine and two-blade ducted propeller; 15° up/90° down thrust vectoring; 2.5 kW (3.4 hp) stern thruster engine and auxiliary fuel tank as in Au-12.

ACCOMMODATION: Pilot only. Upward-opening door on port side of gondola. Two to four ground crew.

DIMENSIONS, EXTERNAL:

Envelope: Length	27.50 m (90 ft 2¾ in)
Max diameter	6.875 m (22 ft 6¾ in)
Fineness ratio	4.0
Height overall	9.40 m (30 ft 10 in)

DIMENSIONS, INTERNAL:

Envelope volume	669.0 m³ (23,626 cu ft)
Ballonet volume (max)	123.0 m³ (4,344 cu ft)

AREAS:

Tail surface area (total)	26.50 m² (285.2 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	465 kg (1,025 lb)
Max payload	160 kg (353 lb)
Max T-O mass	870 kg (1,918 lb)

PERFORMANCE:

Max level speed	43 kt (80 km/h; 49 mph)
Cruising speed	32 kt (60 km/h; 37 mph)
Pressure ceiling	2,000 m (6,560 ft)
Range at cruising speed:	
standard fuel	162 n miles (300 km; 186 miles)
with auxiliary fuel tank	432 n miles (800 km; 497 miles)
Endurance: at max speed	2 h 30 min
at cruising speed	5 h

RosAeroSystems Au-11 non-rigid 1158645

ROSAEROSYSTEMS Au-12

TYPE: Helium non-rigid airship.

PROGRAMME: Two-seat enlarged version of single-seat Au-11. Avgur prototype flown in 1998.

CURRENT VERSIONS: **Au-12:** *As described*; cruciform tailfins.

Au-12M: First displayed in 2003; suffix indicates modification to X tailfin configuration.

CUSTOMERS: Modified Au-12 envelope delivered to Voliris of France for that company's Voliris 900. Two Au-12s ordered in early 2003 by Russian Ministry of Transport and Communications for experimental traffic monitoring programme in Moscow; acceptance tests begun August 2004 and completed early 2005. Exhibited at Moscow Salon (RF-28975) August 2005. Moscow traffic patrol continued during that year, using two Au-12Ms and three Au-17 Bars tethered aerostats, with a larger Au-27 aerostat due to join fleet by end of 2005.

DESIGN FEATURES: Intended for advertising, demonstration or patrol flights with purpose-designed onboard equipment, command uplink and information downlink. Space for two advertising displays on envelope sides. Conventional envelope shape; cruciform tailfins, each with elevator or rudder. Design is compliant with Russian Federation and US FAA airship design criteria.

FLYING CONTROLS: Engine thrust vectored in vertical plane by movable louvres; combined manual/electromechanical rudder and elevator control (cables); stern thruster in lower tailfin. Two internal air ballonets.

STRUCTURE: Envelope of modern composites fabric on Lavsan base, with polyurethane skin and titanium oxide UV protection. Tail surfaces have tubular frames with high-strength, stretch-wrapped fabric skins. Reinforced nose with mooring cone.

LANDING GEAR: Single non-retractable and self-centring wheel, on telescopic leg, under gondola. Provision for flotation bags.

POWER PLANT: One 64.9 kW (87 hp) Subaru 1.8 piston engine, with 30° up/105° down, five-vane cascade-type thrust vectoring, mounted on rear of gondola; 2.5 kW (3.4 hp) stern thruster electric motor and propeller mounted on port side of lower tailfin. Provision for 20 litre (5.3 US gallon; 4.4 Imp gallon) auxiliary fuel tank.

ACCOMMODATION: Pilot and one passenger in gondola. Upward-opening door on each side. Ground crew of two or three.

AVIONICS: Basic VFR or IFR instrumentation. Radio modem or satcom datalink for patrol/surveillance and other special missions.

EQUIPMENT: Depending on mission, can include such items as radiation and chemical monitoring devices; electromagnetic and heat flow gauges; TV camera with video downlink; NP-1 scientific package including photon spectrometer, radiometer, polarimeter and space navigation set; and onboard computer.

DIMENSIONS, EXTERNAL:

Envelope: Length	31.40 m (103 ft 0¼ in)
Max diameter	7.85 m (25 ft 9 in)
Fineness ratio	4.0
Height overall	11.30 m (37 ft 1 in)
Advertising panel (each side):	
Length	20.00 m (65 ft 7½ in)
Depth	6.00 m (19 ft 8¼ in)

DIMENSIONS, INTERNAL:

Envelope volume	996.0 m³ (35,173 cu ft)
Ballonet volume (two, total)	250.0 m³ (8,829 cu ft)

AREAS:

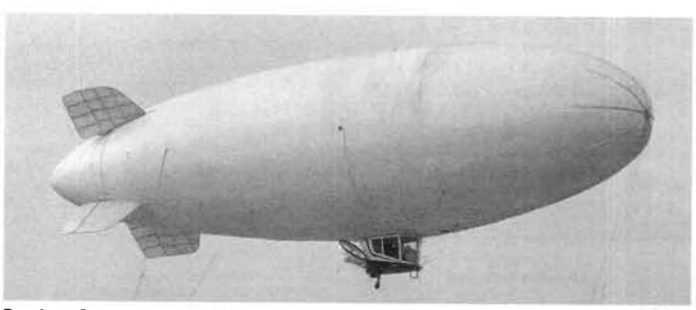
Advertising area (each side)	120.0 m² (1,291.7 sq ft)

WEIGHTS AND LOADINGS:

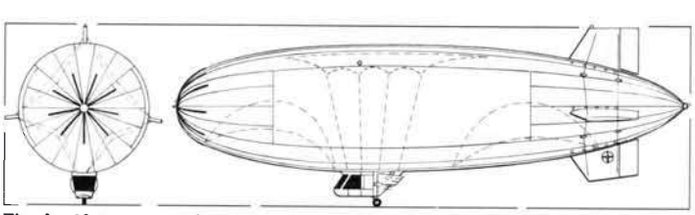
Weight empty	620 kg (1,367 lb)
Max payload	pilot + 50 kg (110 lb)

PERFORMANCE:

Max level speed	43 kt (80 km/h; 50 mph)
Cruising speed	32 kt (60 km/h; 37 mph)
Cruising altitude	1,000 m (3,280 ft)
Pressure ceiling	2,000 m (6,560 ft)
Range at cruising speed above:	
standard fuel	135 n miles (250 km; 155 miles)
with auxiliary fuel tank	324 n miles (600 km; 372 miles)
Endurance: at max speed	2 h
at cruising speed above	5 h



RosAeroSystems Au-12M, showing revised tailfin positions 1158649



The Au-12 two-seat advertising airship *(James Goulding)* 0085412

ROSTVERTOL

ROSTOVSKY VERTOLETNYI PROIZVODSTVENNYI KOMPLEKS OAO 'ROSTVERTOL'
('ROSTVERTOL' ROSTOV HELICOPTER PRODUCTION COMPLEX JSC)

ulitsa Novatorov 5, 344038 Rostov-na-Donu
Tel: (+7 8632) 30 22 31
Fax: (+7 8632) 45 01 34
e-mail: rostvertolved@rost.ru
Web: www.rostvertolplc.ru
DIRECTOR GENERAL: Boris N Slyusar
DEPUTY DIRECTOR GENERAL: Igor A Semyonov
CHIEF ENGINEER: Andrey A Varfolomeyev
ACTING DEPUTY DIRECTOR-GENERAL, MARKETING AND EXPORT SALES: Vadim V Barannikov

The company now known as Rostvertol was founded on 1 July 1939, and began by manufacturing wooden propellers. It progressed to aircraft production during the Second World War and to helicopter work in the mid-1950s. Past products at Rostov-on-Don included the UT-2M (1944), Po-2, Yak-14 glider, Il-10M, Il-40, Mi-1, Mi-6, Mi-10 and Mi-10K. Rostvertol is almost completely privately owned, with a small government share.

Is world's largest heavy transport and combat helicopter manufacturer, supplying Mi-26 (largest multirole helicopter in production); modifications of Mi-24/35 'Hind', including 'PN' night-capable, cannon-armed version and 'M' upgraded version; and, since 2004, new-build Mi-28N to Russian Army Aviation, of which 50 required by 2010. Also offers Mi-2 upgrades including new engine and main rotors. Received contract in March 2005 for one Mi-26 and three Mi-35M helicopters for Venezuelan armed forces.

Government decree of 19 February 1996 authorised Rostvertol to export civil version of Mi-26. Additionally FSUE Rosoboronexport markets Rostvertol-built Mi-24/35s and Mi-28s. Also involved in Mi-60 project.

Company has exported 650 aircraft to more than 20 countries.

In April 2003, established Aviakompania 'Rostvertol' ('Rostvertol' Aviation Company) to provide helicopter airlift, firefighting and maintenance services.

RSK 'MIG'/P A VORONIN PRODUCTION CENTRE

FEDERALNOYE GOSUDARSTVENNOYE UNITARNOYE PREDPRIYATIE, ROSSIYSKAYA SAMOLETOSTROITEL'NAYA KORPORATSIYA 'MIG'
(RUSSIAN AIRCRAFT-BUILDING CORPORATION 'MIG' FEDERAL STATE UNITARY ENTERPRISE)

1-ñ Botkinsky proezd, Dom 7, 125040 Moskva
Postal address: a/ya No 1, 103045 Moskva
Tel: (+7 095) 252 86 52
Fax: (+7 095) 250 07 70
e-mail: mig@migavia.ru
Web: www.migavia.ru
GENERAL DIRECTOR: Aleksey I Fedorov
FIRST DEPUTY GENERAL DESIGNER: Sergey V Tsivilev
DIRECTOR, MIKOYAN DESIGN BUREAU: Vladimir I Borkovsky
DEPUTY GENERAL DIRECTOR, MARKETING AND SALES: Vladimir P Vypryazhkin
DIRECTOR FEDOTOV FLIGHT TEST CENTRE: Pavel N Vlasov

PUBLIC RELATIONS AND MEDIA CENTRE:
Tel: (+7 095) 945 12 37
e-mail: migpress@mail.ru
HEAD OF PUBLIC RELATIONS: Elena L Fedorova

Original Moscow Aircraft Production Organisation (MAPO) renamed by official decree of 8 December 1999 as RSK 'MiG' and its Botkinsky manufacturing plant dedicated to former director (1938–1982) Pavel A Voronin. Up to 1999, MAPO (formerly MMZ No. 30 Znamaya Truda [Banner of Labour]) had built 25,000 aircraft of 40 types, from the Nieuport IV of 1913 to the MiG-29. On 5 October 1999, it was nominated as a production centre for the Tupolev Tu-334 airliner in return for contributing 50 per cent of certification costs. By late 2003, lack of progress by the company in launching Tu-334 manufacture had prompted government consideration of alternative production centre.

By April 2006, MIG design bureau working with Klimov engine plant on **I-21** lightweight fifth-generation fighter as private venture. Seen as single-engine companion to Sukhoi PAKFA; target first flight date improbably quoted as "2006-07".

Service activities include complete maintenance support and pilot training; is also involved in Chinese Chengdu FC-1 fighter programme, China.

Aircraft production is at the Voronin centre, which comprises original Botkinsky Street premises alongside the Mikoyan design complex in Moscow; at Kalyazin; and at LAPIK, Lukhovitsy. Personnel in 2003 totalled 14,500.

Members of RSK 'MiG' are:

GENERAL DIRECTORATE
- A I Mikoyan OKB (R&D engineering centre), Moscow (described separately)
- P A Voronin Production Centre, comprising
  - LAPIK, Lukhovitsy (described separately)
  - Botkinsky proezd, Moscow
  - Kalyazin Machine-Building Plant, Kalyazin
- A V Fedotov Flight Test Centre, Zhukovsky
- Aircraft Logistic Support Centre
- Marketing and Sales Centre
- Economic and Financial Centre
- Strategic Development and Planning Centre

ENGINE BUILDING DIVISION
- V V Chernyshev Machine-Building Enterprise, Moscow
- V Ya Klimov Plant, St Petersburg
- Krasny Oktyabr Machine-Building Enterprise, St Petersburg
- Soyuz Machine-Building Design Bureau, Tushino

INSTRUMENT BUILDING DIVISION
- Ryazan State Instrument Plant, Ryazan
- Pribor JSC, Kursk
- Elektroavtomatika Design Bureau, St Petersburg

HELICOPTER BUILDING DIVISION (VERTOLETOSTROITEL'NYI DIVIZION)
- Kamov JSC, Lyubertsy

LIGHT AIRCRAFT BUILDING DIVISION (DIVIZION LEGKOVAZHANSKOGO SAMOLETOSTROENIYA)
- MiG-MGA, Moscow (MiG-Malaya Grazhdanskaya Aviatsiya)

PRODUCTS AND SERVICES DIVISION
- MiG-Resurs JSC, Moscow
- MiG-Rost JSC, Moscow

RESEARCH, SERVICING AND TEST EQUIPMENT DIVISION
- Aviatest JSC, Rostov-on-Don

Lapik — Lukhovitsy Aviatsionnyi Proizvodstvenno-Isptatelnnyi Kompleks (Lukhovitsy Aviation Production-Testing Complex)

140500 Lukhovitsy, Moskovskaya oblast
Tel: (+7 09663) 113 76
Fax: (+7 09663) 111 80
e-mail: lmz-avia@mtu-net.ru

Founded at Tretyakovo airfield in 1953, this state-owned subsidiary of RSK 'MiG' functioned as a flight test centre until 1968 (and continues to do so for the MiG-29). It then was assigned to Znamaya Truda production plant, replacing final assembly and test airfield at Khodinka, in the Moscow suburbs, and consequently acquired extensive equipment for manufacturing high-strength aluminium, titanium and composites components in support of RSK 'MiG' production, being renamed Lukhovitsy Mashinostroitelnyi Zavod (LMZ — Lukhovitsy Machine-Building Plant). On 7 March 1996 became first (and, currently, only) Russian factory with light aircraft production approval certificate. Assembly continues at low rate of the Aeroprogress T-101 Grach and Aviatika (OSKBES MAI) lightplanes. Manufacture of the Ilyushin Il-103 (some 40 by 2004) and Interavia I-1L continues intermittently. Also participated in manufacture of parts for Sukhoi Su-29 and Su-31 sportplanes, being responsible for complete assembly from January 2001 onwards.

Announced in June 2000 that Lukhovitsy will produce Ilyushin Il-100, Naval MiG-29Ks for India will be built at LAPIK, as will MiG-110 medium transport, despite previous allocation to Sokol.

Other activities include flying school for commercial or private pilot training on Il-103; freight handling; and production of jetskis and suntanning beds.

In 2001, construction began at Lukhovitsy of a 12,600 m² (135,625 sq ft) Tu-334 assembly hall; this was commissioned in January 2003, launching move of almost all of Voronin plant out of central Moscow. However, Tu-334 programme was dormant by 2005.

LMZ adopted current name of LAPIK by January 2002.

SAZ

SARATOVSKY AVIATSIONNY ZAVOD ZAO
(SARATOV AVIATION PLANT JSC)

c/o ulitsa Pskovskaya 32, 443052 Samara
Tel: (+7 84 62) 92 66 55
Web: www.yak40.com/about.htm

Founded in 1929 as agricultural machinery manufacturer. First aircraft built at Saratov flew on 28 October 1938. During the Second World War, the Saratov plant (GAZ 292) manufactured Yakovlev Yak-1 and Yak-3 piston-engined fighters, continuing post-war with Yak-11, La-15, Yak-23, Yak-25 and Yak-27 military jet aircraft and, from May 1952, Mi-2 helicopter. In the 1960s and 1970s, production centred on the Yak-40 three-turbofan transport, with Yak-36 and Yak-141 V/STOL prototypes and Yak-38 V/STOL fighters also manufactured in the 1970s and 1980s. Yak-42 entered series production in 1982, although there have been no recent completions. Yak-54 trainer/sporting aircraft production began in 1994, but in early 2001, SAZ was unsuccessfully, as it transpired, attempting to resuscitate an American order for 48 which had previously been terminated after only six deliveries. Of five Yak-54s to have been built in 2001, only one completed before venture was abandoned for lack of funds. Restart of production conditional upon order for 25 or more. Yak-56 primary trainer is also earmarked for production at SAZ, as are Yak-142, Yak-242 (since displaced in Yakovlev's plans by the MS-21 airliner) and Moukamedov A-209M light (3,900 kg; 8,598 lb), nine-seat turboprop twin.

Meanwhile, manufacturing is turning increasingly to agricultural tractors and road sweepers. SAZ is earmarked for amalgamation within Sukhoi holding group under 2001 plans for Russian aerospace industry rationalisation. Personnel in 2003 totalled over 8,000, of whom 2,800 were engineers. Company affairs are managed by Aviacor at Samara and various schemes to recapitalise the plant have been considered including, in September 2003, a fact-finding visit by US Naval Air Systems Command.

SAZ also worked on a completely new type of lifting-body jet aircraft known as the EKIP project. It was the first company in the Russian Federation and Associated States (CIS) to receive a production certificate for commercial aircraft in compliance with international standards.

SGAU

SAMARSKY GOSUDARSTVENNYI AEROKOSMITSESKY UNIVERSITET (SAMARA STATE AEROSPACE UNIVERSITY)

Moskovskoye shosse 34, 443086 Samara
Tel: (+7 8462) 35 18 26
Fax: (+7 8462) 35 18 36

This prominent centre of aerospace learning includes a design bureau, SKB-1, in which students can develop their skills. Although this has concentrated on the small-scale manufacture of lightplanes, it has also designed — under leadership of Albert Elatonsev, its director — an executive transport designated Aist 92 (Stork 92) and has also produced space and medical equipment.

STUDENTSKOYE KONSTRUCTORSKOYE BURO 1 (Student Design Bureau 1):
Moskovskoye shosse 34, Korpus 3, 443086 Samara
Tel: (+7 8462) 35 72 81
e-mail: skb1@ssau.ru
Web: www.aero.ssau.ru/fla/skb1
DIRECTOR: Professor V M Shakhmistov

Bureau founded 1955 as part of Kuybishev Aviation Institute; absorbed into Samara State Aerospace University in 1994, following name change of home city. Has built Sverchock-1 gyroplane (1971), A-13 motor glider (1974), Shmel lightplane (1977), Strekoza lightplane (1978), Bat glider (1978), A-10 glider (1982) and A-18 Rusich motor glider (1987). More recent designs, previously described in detail, have been Che-15 and Che-25 (Chernov and Gidroplan manufacture) S-202 amphibian, A-16 aerobatic monoplane (1997), S-302 twin-engined amphibian (1995), S-400 four-seat amphibian (1998), Favorit two-seat ultralight (1998) and Crechet two-seat lightplane (1999). Current projects are the F-32 Yastreb and a flex-wing trike named Brazhnik. Yastreb was not placed in production.

SMOLENSK

SMOLENSKY AVIATSIONNYI ZAVOD OAO (SMOLENSK AIRCRAFT PLANT PLC)

ulitsa Frunze 74, 214006 Smolensk
Tel: (+7 4812) 21 85 31
Fax: (+7 4812) 21 95 50
e-mail: smaz@sci.smolensk.ru
Web: www.smaz.ru
GENERAL DIRECTOR: Aleksandr Miroshkin
CHIEF ENGINEER: Yury Litvinov
MARKETING MANAGER: Vladim Merzlyakov

Smolensk Aircraft Plant (SmAZ) was established on 8 October 1926 as an aviation repair facility. In 1934, Buro Osovikh Konstruktsii, OKB for experimental aircraft, relocated from Moscow to Smolensk GAZ 35, specialising in manufacture of prototype and experimental aircraft, including BOK series of stratospheric and ultra-long-range vehicles. Evacuated 1941–1943 and later overhauled Il-2 attack fighter. After Second World War, built Myasishchev M-17/M-55, wings for Yak-40 transports, and more than 500 Yak-18Ts from 1973. In 2005, was seeking support to complete at least two M-55s remaining partly assembled at the plant. Built small number of early production Yak-42s alongside main series at Saratov (SAZ). Constructed Buran space shuttle. Government share was 25.5 per cent.

Production of Yak-18T was resumed 1993, five years after entire original fleet had been scrapped; more than 60 built up to 1996, when 15 placed in storage due to financial problems; production resumed in 1998; deliveries have included three to Ulyanovsk Aviation School in June 2001. Built three Yak-112 lightplanes before project transferred entirely to IAPO in Irkutsk. Other work included manufacture of RPVs and cruise missiles; wings for the Yak-42, upgrading of Yak-40s for business use (including additional fuel capacity), and development and production (from 1993) of Technoavia SM-92 Finist seven-seat STOL aircraft. By 2002, was responsible for marketing Technoavia products. The SMG-92 TurboFinist is produced by Smolensk but marketed by Intracom Aero Design of Switzerland.

Has built wing and empennage for first three Sukhoi Su-38L agricultural aircraft and will be responsible for series production. Currently producing one further M-55, which has repeatedly failed to secure sufficient official annual funding to ensure completion. Also participated in Yak-130 programme, building prototype. Overhauls some 10 to 15 Yak-18Ts per year. Non-aerospace activities include manufacture of cloth processing machines, medical equipment, collapsible tubular metal furniture, and souvenir items such as badges.

In July 2004 was deleted from list of Strategic Enterprises of Russian State, permitting shares to be offered for private sale.

SMOLENSK (TECHNOAVIA) SM-92T TURBO FINIST

TYPE: Light utility turboprop.

PROGRAMME: Developed by Technoavia from radial-engined SM-92 Finist as turbo version. Prototype (conversion of RA-44482) made first flight 6 March 2002 piloted by Mikhail Moltchanuk. Publicly demonstrated at MAKS' 03; in production at Smolensk.

Design of original version to FAR Pt 23 and JAR 23 standards, started July 1992; construction of first of two prototypes (RA-44482) began January 1993; first flight, as SM-92 Finist, made 28 December 1993; Russian manufacture of radial-engine version appears to have ceased. Similar SMG-92 Turbo Finist is marketed by Intracom of Switzerland, still built by Smolensk. According to Russian folklore, the Finist is a falcon with magic powers.

CUSTOMERS: Four completed by February 2004, plus further 17 radial-engine versions.

DESIGN FEATURES: Turboprop aircraft for multipurpose use, including paradropping, towing and ambulance. Optional wing hardpoints for cargo containers.

Originally designed as rugged light transport; in approximate class of DHC-2 Beaver, but less powerful and lower in cost than most used Beavers. Sweptback fin and rudder; small dorsal fin; tailplane mounted on fin, with single bracing strut each side. Wide CG range.

Basic aircraft accommodates up to seven persons with baggage. Convertible under field conditions to transport two stretcher patients and attendant with medical equipment; to drop six trainee parachutists or four firefighters with parachutes and firefighting equipment. Can carry hopper for agricultural chemicals in cabin, with spraybar, or cameras for forest surveillance, patrolling electric power lines, gas pipeline inspection and similar duties. Wingtip fuel pods optional; tanks have aerofoil-size central cutout and are fitted slightly inboard of wingtip.

Special P-301 M-15 wing section by Technoavia and CAHI (TsAGI). No sweep; thickness/chord ratio 15 per cent; dihedral 2°; incidence 3° at root, 1° at tip.

FLYING CONTROLS: Conventional and manual. Ailerons and elevators pushrod-actuated; rudder cable-actuated. Electrically operated, three-position (0, 20, 40°), two-section single-slotted flaps on each wing; horn-balanced rudder and elevators, with fluted skin; trim tab on starboard elevator; ground-adjustable tab on rudder; three-section tab along entire trailing-edge of each aileron, centre section being adjustable on ground.

STRUCTURE: All-aluminium, stressed-skin semi-monocoque construction. Simple, reliable structure, with no expensive or exotic materials; repair possible under field conditions. Airframe life 10,000 hours or 20,000 landings, with 'on condition' extension.

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted spring steel cantilever mainwheel legs with medium-pressure mainwheel tyres, size 600×180 on KT-317 wheels. Steerable, semi-castoring tailwheel with 255×110 tyre on tubular steel strut. Tyre pressure 2.45 bar (35.5 lb/sq in) on mainwheels; 2.95 bar (43 lb/sq in) on tailwheel. Wheel/skis and amphibious or plain floats optional. Pedal-operated disc brakes, with parking lock. Minimum turning radius 6.6 m (21 ft 8 in).

Smolensk SM-92T Turbo Finist 1158647

POWER PLANT: One 559 kW (750 shp) Walter M 601E turboshaft driving an Avia V-508E/99B three-blade, fully feathering reversible-pitch propeller. Two main wing fuel tanks, total capacity 800 litres (211 US gallons; 176 Imp gallons). Optional wingtip fuel tanks, each of 200 litres (52.8 US gallons; 44.0 Imp gallons).

ACCOMMODATION: Pilot and seven passengers or 10 parachutists. Cargo version also available; quickly removable seats with folding armrests and back; dual controls standard for pilot training; adjustable rudder pedals. Small baggage container (or medical equipment stowage for ambulance version) on port side at rear of cabin. Forward-hinged, jettisonable door each side of flight deck; large rearward-sliding passenger/freight door on port side of cabin, openable in flight. Blister windows to flight deck and cabin. Steps on mainwheel legs and cable handholds for access to flight deck; removable tubular steel ladder beneath cabin door.

SYSTEMS: Optional de-icing system. Electrical system provides 36/115 V AC power at 400 Hz and 28.5 V DC power, with 20NKBN-25 battery.

AVIONICS: *Comms:* Radio, transponder and GPS system intended to be of US origin.
Radar: Optional RDS2000 weather radar beneath starboard wing.
Flight: Optional autopilot.
Data generally as for SM-92 Finist, except that below.

DIMENSIONS, EXTERNAL:

Wing span	9.97 m (32 ft 8½ in)
Height overall	3.10 m (10 ft 2 in)
Wheelbase	6.59 m (21 ft 7½ in)

WEIGHTS AND LOADINGS:

Weight empty	1,550 kg (3,417 lb)
Max T-O and landing weight	2,700 kg (5,952 lb)
Max power loading	4.83 kg/kW (7.94 lb/shp)

PERFORMANCE:

Never-exceed speed (VNE)	221 kt (410 km/h; 254 mph)
Max operating speed	162 kt (300 km/h; 186 mph)
Normal cruising speed	140 kt (260 km/h; 162 mph)
Stalling speed, power off: flaps up	68 kt (125 km/h; 78 mph)
flaps down	60 kt (110 km/h; 69 mph)
Max rate of climb at S/L	600 m (1,968 ft)/min
Service ceiling	6,000 m (19,680 ft)
T-O run	300 m (984 ft)
T-O to 15 m (50 ft)	457 m (1,500 ft)
Landing run	200 m (656 ft)
Max range	810 n miles (1,500 km; 932 miles)

SMOLENSK (TECHNOAVIA) SM-2000

TYPE: Light utility turboprop.

PROGRAMME: Turboprop version of SM-2000P development of Yakovlev Yak-18T, combining aerodynamic refinements with stretched fuselage; intended to be main version. Prototype (RA-44445) first flown 17 July 2003 and made public debut at MAKS '03, Moscow, August 2003. Russian certification obtained December 2004.

CUSTOMERS: One built and two on order by February 2004, by June 2005 three were under construction for customers in the United Kingdom..

COSTS: EUR470,000 basically equipped, ex-UK (2005).

DESIGN FEATURES: As Yak-18T and SM-2000P, but with longer fuselage, additional cabin door and wingtip pods. Airframe life 10,000 hours or 20 years.

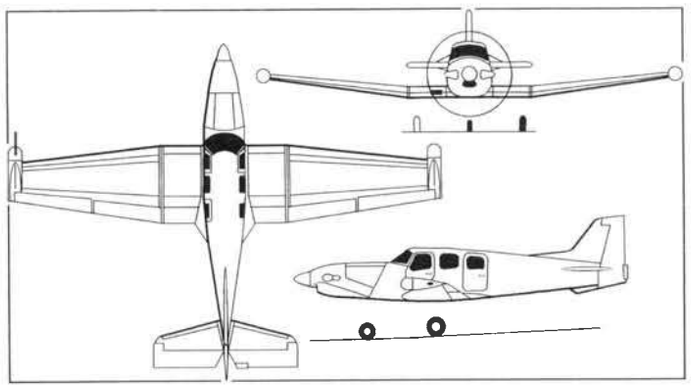
FLYING CONTROLS: As SM-2000P, but incorporating electric trim on all three axes.

STRUCTURE: As SM-2000P but with extra cabin door, wing tip pods for weather radar and landing lights.

LANDING GEAR: As SM-2000P. Pneumatic emergency landing gear extension and braking.

POWER PLANT: One 560 kW (751 shp) Walter M 601E turboprop driving an Avia V-508E/99B three-blade, fully feathering reversible-pitch propeller. Fuel capacity 860 litres (227 US gallons; 189 Imp gallons) of which 845 litres (223 US gallons; 186 Imp gallons) are useable.

Prototype Smolensk (Technoavia) SM-2000 turboprop *(Sebastian Zacharias)*
0589420



Smolensk (Technoavia) SM-2000 five-seat turboprop
0567407

ACCOMMODATION: Five persons, including one or two pilot(s); rear three in semi-club arrangement with single forward-facing rear seat. Folding table. Crew door each side; passenger door port, rear.

SYSTEMS: BFGoodrich de-icing. Oxygen system.

AVIONICS: IFR standard fit.

Radar: Weather radar optional in starboard wingtip pod.

DIMENSIONS, EXTERNAL:

Wing span over tip pods	11.88 m (38 ft 11¾ in)
Length overall	9.435 m (30 ft 11½ in)
Max width of fuselage	1.28 m (4 ft 2½ in)
Height overall	3.41 m (11 ft 2¼ in)
Wheel track	3.12 m (10 ft 2¾ in)
Wheelbase	1.95 m (6 ft 4¾ in)
Propeller diameter	2.50 m (8 ft 2½ in)
Crew doors: Width	0.78 m (2 ft 6¾ in)
Passenger door: Width	0.66 m (2 ft 2 in)

DIMENSIONS, INTERNAL:

Cabin: Length between bulkheads	3.20 m (10 ft 6 in)
Max width	1.20 m (3 ft 11¼ in)
Max height	0.90 m (2 ft 11½ in)
Floor area	3.4 m² (37 sq ft)
Volume	3.5 m³ (124 cu ft)

WEIGHTS AND LOADINGS:

Weight empty	1,350 kg (2,976 lb)
Max T-O weight	2,100 kg (4,629 lb)
Max power loading	3.75 kg/kW (6.16 lb/shp)

PERFORMANCE:

Never-exceed speed (VNE)	259 kt (480 km/h; 298 mph)
Max operating speed (VMO)	208 kt (385 km/h; 239 mph)
Max cruising speed at FL98	216 kt (400 km/h; 249 mph)
Max rate of climb at S/L	660 m (2,165 ft)/min
T-O run	150 m (495 ft)
Landing run	350 m (1,150 ft)
Range with max fuel, 30 min reserves	864 n miles (1,600 km; 994 miles)

SMOLENSK (TECHNOAVIA) SP-55M

TYPE: Aerobatic single-seat sportplane.

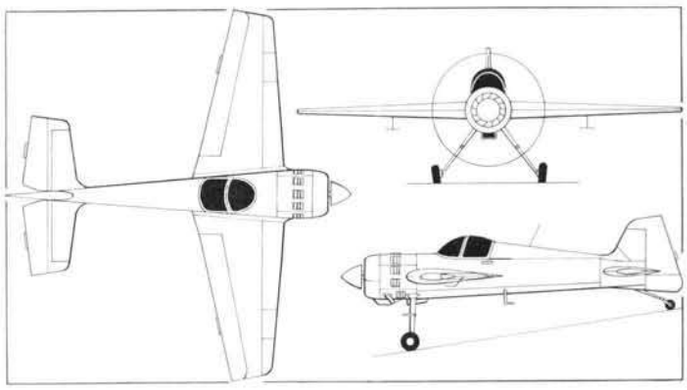
PROGRAMME: Initial batch of five aircraft under construction in 2000 at Progress plant at Arsenyev; Russian prototype unregistered and first flown 20 October 2000; initial production aircraft, RA-44547, delivered in January 2001 to Richard Goode Aerobatics in UK; later sold to Australia.

CUSTOMERS: Six delivered by January 2005, to customers in Australia (Jace Harrison, VH-JCE), France, Russia (including RF-00888 of Youriy V Shaluev), the United Kingdom and the US.

COSTS: EUR115,000 (2003).

DESIGN FEATURES: Mid-wing configuration with symmetrical section of original Technoavia design; no dihedral, anhedral or incidence. Development of Yak-55M, last described in 1998–99 *Jane's All the World's Aircraft*. Modifications include redesigned rear fuselage turtledeck; new fin and tailplane fillets; reprofiled wingtips; redesigned flying surfaces with composites skin; steel engine firewall; new engine cowling; new instrument panel with US instruments and avionics; modified fuel and oil systems to FAR Pt 23 requirements; modified pneumatic system; pilot-controlled oil and carburettor heat doors; new entry steps and assist handle on fuselage and landing gear legs; inclined seat for increased *g* tolerance; new safety harness; baggage compartment and smoke system.

Smolensk (Technoavia) SP-55M early production aircraft *(Sebastian Zachariras)*
0589396



Smolensk (Technoavia) SP-55M single-seat sportplane *(James Goulding)*
0525057

FLYING CONTROLS: Conventional and manual. Near-full-span ailerons have narrower chord than those of Yak-55M, without horn balances; elevators and rudder of greater area than Yak-55M. Trim tab on each elevator. Suspended balance tab below each aileron.

STRUCTURE: Generally similar to Yak-55M. Metal, single-spar wing with composites-covered ailerons and composites tips. Metal fuselage with steel firewall; composites-covered elevator and rudder.

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted spring steel cantilever mainwheel legs on all three units; KT-98 mainwheels with 400×150 tyres; lockable, free-castoring tailwheel.

POWER PLANT: One 265 kW (355 hp) VOKBM M-14P air-cooled, nine-cylinder radial engine driving an MT-Propeller MTV-9-B-C/CL260-27 three-blade, constant-speed (hydraulic) metal propeller. Fuel in wing tanks, total capacity 120 litres (31.7 US gallons; 23.4 Imp gallons); inverted fuel and oil systems.

ACCOMMODATION: One person in inclined seat with recess for backpack parachute; fixed windscreen and one-piece sliding canopy.

SYSTEMS: Electrical system comprises lightweight 10 Ah generator and storage battery, both of US origin.

AVIONICS: Avionics fit of US origin.

EQUIPMENT: Optional smoke generation system; or glider hook.

DIMENSIONS, EXTERNAL:

Wing span	8.00 m (26 ft 3 in)
Wing aspect ratio	5.3
Length overall	7.48 m (24 ft 6½ in)
Height overall	2.225 m (7 ft 3½ in)
Tailplane span	3.51 m (11 ft 6¼ in)
Wheel track	2.76 m (9 ft 0½ in)
Propeller diameter	2.50 m (8 ft 2½ in)

AREAS:

Wings, gross	12.17 m² (131.0 sq ft)
Ailerons (total)	2.66 m² (28.63 sq ft)
Fin	0.40 m² (4.31 sq ft)
Rudder	1.02 m² (10.98 sq ft)
Tailplane	1.40 m² (15.07 sq ft)
Elevators (total)	1.79 m² (19.27 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	690 kg (1,521 lb)
Max T-O weight: training	855 kg (1,885 lb)
ferry	955 kg (2,105 lb)
Max wing loading: training	70.3 kg/m² (14.39 lb/sq ft)
ferry	78.5 kg/m² (16.07 lb/sq ft)
Max power loading: training	3.23 kg/kW (5.31 lb/hp)
ferry	3.61 kg/kW (5.93 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	194 kt (360 km/h; 223 mph)
Max level speed	173 kt (320 km/h; 199 mph)
Stalling speed	57 kt (105 km/h; 66 mph)
Max rate of climb at S/L	1,080 m (3,543 ft)/min
Max roll rate	360°/s
T-O run	170 m (558 ft)
Range with max fuel at econ cruising speed at 1,000 m (3,280 ft), 7% fuel reserves	415 n miles (770 km; 478 miles)
g limits	+9/–6

SOKOL

SOKOL NIZHEGORODSKY AVIATSTROITELNYI ZAVOD AOOT (SOKOL NIZHNY NOVGOROD AIRCRAFT MANUFACTURING PLANT JSC)

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EXECUTIVE DIRECTOR: Valery G Drobishevsky
GENERAL DIRECTOR: Mikhail Shibaev
COMMERCIAL DIRECTORS: Oleg A Fedorov (Civil Programmes)
Viktor E Andrunun (Military Programmes)

Founded (as GAZ 21 in what was then Gorky) on 1 February 1932, this production plant concentrated on fighter aircraft manufacture until the start of the *konversiya* programme led to retooling for civilian production; registered as a JSC on 22 September 1994. Joined Kaskol group of companies in 2000.

Built 17,691 fighters up to end of Second World War and 43,557 aircraft up to 2002. From 1949, in collaboration with the Mikoyan OKB, it manufactured 2,148 MiG-15s (1949–51), 2,470 MiG-17s (1951–54), 1,125 MiG-19s (1955–58), 5,278 (or 5,752) MiG-21s (1957–85) and 1,186 MiG-25s (1966–85). Russian Ministry of Property holds 38 per cent of shares, which equivalent to 50.5 per cent of voting rights; remaining major shareholders are Financial & Industrial Bank (43.26 per cent) and Deposit Clearing Company (8.92 per cent), remaining 9,442 holders having less than 5 per cent. Current or recent products include the MiG-29UB (from kits supplied from Moscow), MiG-31 and Yak-130 jet trainer; first preproduction aircraft completed in mid-2003. It is also responsible for supplying kits for upgrading 125 Indian Air Force MiG-21s to MiG-21-93 standard, with an initial order for 36. Agreement reached in July 2000 on upgrading half of Russian Air Forces' 280 MiG-31s.

Civilian programmes include manufacture of the Myasishchev M-101 six-seat turboprop light aircraft, a prototype AeroRIC Dingo amphibious aircraft with air cushion landing gear and Avia Accord twin-engined light multipurpose aircraft; plans also exist for Myasishchev M-202 production. M-101 marketing is first task of New Regional Aircraft Company (NORS), formed 18 April 2001 by Sokol, Myasishchev and Kaskol financial group. Announced February 2005 plans to build 45 M-101s over three years to meet increase in interest; deliveries began 15 November 2005. AeroRIC Research-Industrial Company is co-located with Sokol; by 2001 its Dingo project was in suspension because of financial shortfall.

Plans to build MiG-110 twin-turboprop transport apparently not overtaken by announcement in early 2000 of its reallocation to RSK 'MiG' (LAPIK plant) and discussions on continued participation in programme under way with RSK MiG in mid-2000. Transfer of MiG-110 to LAPIK was reaffirmed in late 2002. Agreement of 2001 covers production of wings and noses for navalised MiG-29K for India, plus complete MiG-29KUB trainers.

Production of the Eurospace F-15-F Excalibur four-seat touring aircraft was halted at an early stage when a contract for almost 100 was cancelled; several partly complete airframes remained at Nizhny Novgorod in June 2000, when 10 sold to Turbine Design in USA and further 30 transferred to China. As replacement, 1998 agreement with Aermacchi covers manufacture of SF-260 airframes, while in October 2004 preliminary talks held with Diamond Aircraft of Austria regarding components manufacture and collaboration on M-101 Light version of Myasishchev M-101.

Other products, in conjunction with AeroRIC, include Volga-2 WIGE craft, air cushion vehicles and Sokol 330 hydrofoil. Offers 'familiarisation' flights in MiG-29UB, MiG-21U and L-29 Delfin.

STRELA

STRELA PROIZVODSTVENNOYE OBEDINENIE (STRELA PRODUCTION ASSOCIATION)

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SALES MANAGER: Jim Rahm

The wholly state-owned Strela plant was established as GAZ 47 on 25 October 1941 and built the UT-2, Yak-6, ShChe-2 and Ts-25 glider between then and 1946. Returned to aviation manufacture in 1950 with Yak-14, Mi-1, La-17 up to 1964, by which time heavily involved in missile work including Lunar 14, 15 and 16 and Buran space projects. Currently manufactures BrahMos missiles and Kamov Ka-226 helicopter. Assembled prototype Ka-226; plans for Ka-226 series manufacture included first three or four production helicopters in 2001, but production investment of Rb300 million was not announced until January 2002, first two Ka-226s being complete by late March 2002. Factory has orders for 27 Ka-226s including 22 for Gazprom, of which seven completed by early 2006. It has produced replica Yak-3/Yak-9s and Mitsubishi A6M2s (Zeros) for export (20 Yaks and three Zeros built by December 2003, including two of latter for Hollywood film use and one in December 2003 for Japanese customer). A replica Yak-7 was under construction in 2003. Other products include satellite TV systems, gas heating boilers, seed drills, harrows and heat exchangers.

YAKOVLEV/STRELA BEAR 360

TYPE: Aerobatic two-seat sportplane.

PROGRAMME: Designed by Sergei Yakovlev, son of Aleksandr Yakovlev, and attributed to Yakovlev Aircraft Company, which unconnected with OKB Yakovlev. Prototype built by Strela in 1998; shipped to US in 2000 and reassembled at California City Municipal Airport, where first re-flown on 3 February 2001, registered N360BR; airworthiness certificate granted 15 April 2003. Marketing in US by Bear Aviation LLC; offered in fully-finished Skip Holm Signature configuration with completion in US by Air Works Inc; or ARF (almost ready to fly) state for completion as desired by customer.

CUSTOMERS: None reported by 2006.

COSTS: USD125,000 ARF, less engine and instruments (2006).

DESIGN FEATURES: High performance, piston-engined design, recalling classic Bearcat/Hellcat and Yak-9 fighters, optimised for aerobatics, formation flying and touring; max rate of roll 180°/s. Low, trapezoidal wing and tailplane, former with leading-edge root extension; tall, trapezoidal fin with leading-edge fillet. Complies with FAR Pt 23 and also US Experimental and LSA categories.

Wing section NASA laminar flow 63-215 at root; 63-412 at tip. Dihedral 5°.

FLYING CONTROLS: Conventional and manual. Plain, piano-hinged ailerons; horn-balanced elevators with trim tab, port; mass-balanced rudder including flight-adjustable trim tab. Actuation by pushrods, except electrically actuated, slotted flaps and cable operation of trim tabs.

STRUCTURE: All metal. Wing built on single-piece, tapered main spar with stressed aluminium flush-riveted skin over stamped aluminium ribs; attached to fuselage at four points. Semi-monocoque fuselage, flush-riveted.

LANDING GEAR: Tailwheel type; retractable. Mainwheel legs, containing oleo-pneumatic struts, attached to main spar and surrounding structure, retract inwards; pneumatic actuation with gravity emergency extension. Mainwheel tyres 16×4.4 on prototype; 8.00-10 for production. Retractable tailwheel steerable with control column fully aft; castoring at other times; tyre 255×110. Cleveland wheels and hydraulic brakes.

POWER PLANT: One 265 kW (355 hp) VOKBM M-14PT nine-cylinder radial driving a Hoffmann HO-V183K-K/VL242BD three-blade, constant-speed, carbon fibre propeller. Optionally, 316 kW (424 hp) M-14NTK; MT-Propeller or Whirlwing propeller. Fuel in integral wing tanks, each 140 litres (37.0 US gallons; 30.8 Imp gallons), feeding centreline bladder collector tank; total capacity 288 litres 76.1 US gallons; 63.4 Imp gallons).

ACCOMMODATION: Two in tandem beneath rearward-sliding, single-piece blown canopy; separate, moulded windscreen of 9.5 mm (3/8 in) polycarbonate. Cockpits accommodate 99 percentile pilots; flyable at circuit speeds with canopy open. Baggage locker behind rear seat with external door, port. Dual controls.

SYSTEMS: Pneumatic system, pressure 55.2 bar (800 lb/sq in), for engine starting and landing gear actuation, using separate reservoirs. Electrical system 28 V DC, with 35 A Sukhoi SK35 alternator and 24 V battery back-up.

AVIONICS: US specification instruments, including GPS.

DIMENSIONS, EXTERNAL:

Wing span	7.00 m (22 ft 11½ in)
Wing aspect ratio	5.8
Length overall	7.05 m (23 ft 1½ in)
Wheel track	2.84 m (9 ft 3¾ in)

Yakovlev/Strela Bear 360, as marketed by Bear Aviation of US *(Paul Jackson)* 1159069

DIMENSIONS, INTERNAL:
Cabin max width at shoulder ..... 0.65 m (2 ft 1½ in)
Baggage locker volume ..... 0.12 m³ (4.2 cu ft)
AREAS:
Wings, gross ..... 8.50 m² (91.5 sq ft)
WEIGHTS AND LOADINGS:
Max baggage weight ..... 34 kg (75 lb)
Max T-O weight ..... 1,250 kg (2,755 lb)
Max wing loading ..... 147.1 kg/m² (30.12 lb/sq ft)
Max power loading ..... 4.72 kg/kW (7.76 lb/hp)
PERFORMANCE:
Never-exceed speed (VNE) ..... 305 kt (564 km/h; 351 mph)
Max level speed: at S/L ..... 250 kt (463 km/h; 288 mph)
at 1,000 m (3,280 ft) ..... 230 kt (426 km/h; 265 mph)
Manoeuvring speed ..... as VNE
Cruising speed at 75% power at S/L ..... 210 kt (389 km/h; 242 mph)
Stalling speed: flaps up ..... 72 kt (134 km/h; 83 mph)
flaps down ..... 68 kt (126 km/h; 79 mph)
Max rate of climb at S/L ..... 564 m (1,850 ft)/min
T-O run ..... 238 m (780 ft)
T-O to 15 m (50 ft) ..... 320 m (1,050 ft)
Landing from 15 m (50 ft) ..... 336 m (1,100 ft)
Landing run ..... 252 m (825 ft)
Range at S/L, 20 min reserves ..... 890 n miles (1,648 km; 1,024 miles)
g limits ..... +6/–3

SUKHOI (AVPK SUKHOI)

GOSUDARSTVENNOYE UNITARNOYE PREDPRIYATIE AVIATSIONNYI VOYENNO-PROMYSHLENNYI KOMPLEKS SUKHOI
(STATE UNITARY ENTERPRISE, AVIATION MILITARY-INDUSTRIAL COMPLEX SUKHOI)

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Web: www.sukhoi.org
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CHAIRMAN: B S Alyoshin
PRESS OFFICER: Yury Chervakov

In October 2001, decree by Russian president created Sukhoi Aviation Holding Company, which became successor to AVPK Sukhoi, conducting initial board meeting on 29 October 2003. Sukhoi is wholly owned by Russian government and has holdings in following organisations: Sukhoi Design Bureau (50 per cent, plus one share), Sukhoi Civil Aircraft (86.4 per cent), KnAAPO (74.5 per cent), NAPO (74.5 per cent), TANTK (Beriev) (38 per cent) and Irkut (13.2 per cent). In all, these companies employ 35,000 personnel. Some 2,000 Sukhoi aircraft have been exported to 20 countries and 95 per cent of current production is for export. Sukhoi is world's third-largest manufacturer of modern fighters.

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Fax: (+7 095) 945 55 70
CHAIRMAN: B D Bregman
GENERAL DESIGNER: Mikhail Petrovich Simonov

OKB named for Pavel Osipovich Sukhoi, who headed it from 1939 until his death in September 1975. It remains one of two primary Russian centres for development of fighter and attack aircraft, and it is notable that 60 per cent of front-line Russian Air Forces' aircraft are of Sukhoi design. Bureau has widened its activities to include civilian aircraft, under *konversiya* programme, establishing separate division in 2000. This offsets the drastic reduction in combat aircraft production and competition in the upgrade and overhaul market.

Sukhoi Advanced Technologies
GENERAL DIRECTOR: Boris V Rakitin

This division is responsible for promotion and sales of Sukhoi light aircraft, such as the Su-29, Su-31, Su-38L and Su-49. Related activities include conversion of Su-26s and Su-29s with SKS-94 extraction systems.

Nauchno-Proizvodstvennoe Kontsern Shturmoviki Sukhogo (Sukhoi Stormovik Scientific-Production Concern)
GENERAL DIRECTOR: Vladimir Babak

Offers of upgrades of Su-25 'Frogfoot' to Russian and export customers.

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GENERAL DIRECTOR: Andrey V Il'in
CHAIRMAN: V V Boyev

Subdivision formed May 2000, owned 86.4 per cent by Sukhoi Company and 13.16 per cent by Sukhoi Design Bureau. On 5 June 2000 signed agreement with Alliance Aircraft Corporation for joint development and production of StarLiner regional airliner. However, Sukhoi unilaterally cancelled agreement on 2 November 2000. In August 2001, Sukhoi revealed RRJ (Russian Regional Jet) programme in collaboration with Boeing. This selected in 2003 for production. Is also developing SSBJ supersonic business jet, a programme begun in 1987, at one time involving partnership with Gulfstream of US.

SUKHOI Su-27

NATO reporting name: Flanker
TYPE: Air-superiority fighter.
PROGRAMME: Development of long-range heavy fighter to meet PFI (*perspektivnyi frontovoy istrebitel:* advanced frontal fighter) requirement began 1969 under leadership of Pavel Sukhoi; augmented in high-low mix by Mikoyan LPFI (later MiG-29). T10 based on 'integral' layout of unbuilt T4MS. Construction of prototype began in 1974 under Mikhail Simonov's supervision, and it was flown 20 May 1977 by Vladimir Ilyushin. Development undertaken by nine flying **Su-27** 'Flanker-As': four prototypes (T10-1 and T10-2) produced in OKB workshops; T10-3 and T10-4 built by Komsomolsk plant and assembled by OKB); five development (T10-5, -6, -9, -10 and -11) and one static test airframe at Komsomolsk. Individual prototype designations duplicated some competing unbuilt T10 configurations. Prototypes had curved wingtips, rearward-retracting nosewheel and tailfins mounted centrally above engine housings.

Some variation between prototypes; T10-1 originally flew with 'clean' wing; four fences then added, followed by anti-flutter weights on wingtips and fins; inboard fences subsequently removed. T10-3 (first flight 23 August 1979) and T10-4 (first flight 31 October 1979) used AL-31F engines, others had AL-21F-3s. Canted tailfins from T10-3. T10-5, -6, -9, -10, and -11 had eight pylons (two below each wing) and -9 and -11 had long-chord ogival radomes; these five aircraft collectively known as T10-5 subvariant. Original configuration revealed poor controllability with inadequate stability in roll and yaw, and with poor high AoA capability; two pilots lost their lives before major airframe redesign resulted in T-10S production configuration (known internally as T10 junior).

Construction of new model began 1979, with first flight of prototype (T10-7) 20 April 1981, followed by second prototype (T10-12); T10-8 was T10S-0 static test airframe; series production by KnAAPO at Komsomolsk began with T10-15, first flown 2 June 1982; entry into service 22 June 1985 with air defence regiment co-located with Komsomolsk factory airfield; official type acceptance 23 August 1990 (Council of Ministers decree); ground attack role observed in 1991. Following purchase of complete aircraft, China signed licensed production agreement on 6 December 1996, covering further 200. Production continues for export. In late 1999, Sukhoi quoted 567 of Su-27 family in service in eight countries.

CURRENT VERSIONS: **Su-27: ('Flanker-B')** Single-seat land-based production version for air defence force (PVO); full-span leading-edge flaps, trailing-edge flaperons, 5 per cent increase in wing area, straight leading-edges, new aerofoil, square wingtips, carrying anti-flutter weights which doubled as AAM launchers; wider-spaced, uncanted tailfins outboard of engine housings; flatter canopy of reduced cross-section; extended tailcone instead of flat 'beaver-tail'; forward-retracting nosewheel; first flown (T10-7) 20 April 1981. Standard radar tracks 10 targets simultaneously, engages only one. There was early, but probably erroneous, speculation that PVO aircraft were designated Su-27P, with **Su-27S** designation applied to Frontal Aviation aircraft. All aircraft can carry Sorbtsya-S active ECM jammer pods on wingtips in place of wingtip launch rails. **Su-27S** designation little used, but differentiates production (Series) from prototype and preproduction. By 2003, Su-27S designation being used to identify those aircraft which were awaiting Su-27SM modifications. Four initial production aircraft (T10-15, -17, -18 and -22) used for State Acceptance Tests were part of small initial batch featuring horizontally cropped fin caps.

Detailed description applies to the above version, except where indicated.

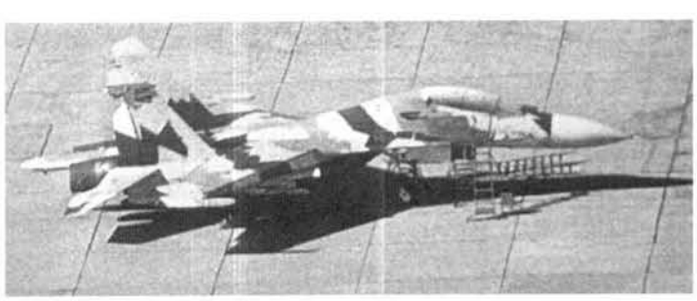
'Su-27RV': ('Flanker-B') Six replacement aircraft for Russian Knights aerobatic team feature GPS and Western-compatible communications equipment.

Su-27SK: ('Flanker-B') Export version of basic Su-27, using air-to-ground capabilities not exploited by Soviet/Russian Su-27s and using same weapons options and downgraded avionics. Armament, totalling up to 4,000 kg (8,818 lb), includes 250 kg and 500 kg bombs, B-8M1 packs of 20 × 80 mm rockets, B-13L packs of five 122 mm rockets, S-250FM 250 mm rockets, KMGU-2 cluster bombs, or podded SPPU-22 30 mm gun with optional downward-deflecting barrel for air-to-ground and air-to-air use. Dimensions, weights and performance generally similar to Su-27 but with reinforced landing gear giving increased (33,000 kg; 72,752 lb) MTOW. Chinese aircraft locally designated **J-11**, though this strictly applies only to locally manufactured examples. First Chinese-assembled aircraft flight tested in December 1998. Some later export aircraft may have upgraded radar and 6,200 kg (13,670 lb) weapon load, or even 8,000 kg (17,637 lb) according to some manufacturers' brochures.

Russian-managed upgrade of Su-27SK began 2004, including radar upgrade to N-1001VE standard with attendant ability to engage target with two Vympel RVV-AE AAMs simultaneously. Addition of indigenous PI-12 AAM has not been attempted, neither has expected an attempt made to add multirole capability.

Su-27SM: Mid-life update configuration in parallel to Su-27UBM and Su-30KN; developed by Ramenskoye Instrument Design Bureau and Sukhoi. Work undertaken at KnAAPO, Komsomolsk, where first conversion of Su-27S for Russian Air Forces flew on 27 December 2002; second followed by mid-2003. First five of contracted 24 Su-27SMs in initial three-year contract delivered to Lipetsk military test centre (4 CBPiPLS) for operational training, 25 December 2003. Further two delivered to Far East district on 23 December 2004 as initial equipment of 23 Regiment at Dzemgi (Komsomolsk); last of initial 24 due in late 2006 (2004 seven; 2005 eleven; 2006 six). Second three-year contract under negotiation in 2006.

Avionics suite includes optimised air-to-air and air-to-ground weapon control systems, improved by new constituent elements and algorithms, with MTOW increased to 30,450 kg



Eritrean Sukhoi Su-27 1158619

(67,130 lb). Items include twin 310 × 152 mm (12¼ × 6 in) MFI-10-6M LCDs plus central MFPI-6 control screen; Elektroavtomatika SILS-27M HUD; Sh101V fire-control system and NIIP RLPK-27V (N-001V) multimode radar; OLS-27M (52Sh) frontal optronics for laser missile guidance; A737 satellite navigation receiver; and L175 Khibiny-M self-protection system including L150 radar warning receiver, APP-50 flares and active jammers. Weapon capabilities include R-77 BVR AAMs; Kh-31P, Kh-31A, Kh-29T/TE and Kh-29L ASMs; and KAB-500Kr and KAB-1500Kr guided bombs. No structural or engine improvements, but K-36D-3.5E ejection seat.

However, in April 2006, Salyut engine plant announced imminent availability of AL-31F-M1, which then undergoing State Tests in Su-27P '595' to prove additional 9.79 kN (2,200 lb st) output and 1,000-hour TBO (700 to 750 hours guaranteed, compared with current 300 hours). M1 engine stated to be due for incorporation on future Su-27SM conversions. Further, State Tests completed in late 2005 of BASPB fully automatic system for aircraft recovery after pilot's disorientation; developer Russkiy Sistemy announced intention to install system in Su-27SM after 2006.

Su-27SM2: Designation of Sukhoi Su-35 (*described separately*).

Su-27SMK: Alternatively known as Su-27SK Upgrade; stated to raise aircraft to 4+ fighter generation. Available for previously exported (single-seat) Su-27SKs and with features developed for Russian Air Forces' Su-27SM. Demonstrator '305' (the former Su-30KI 4002) first flew early 2003. Changes from baseline Su-27SK include upgraded fire control system for land, sea and air targets; LCD cockpit instrumentation; improved navigation integrated with Glonass and Navstar satellite systems; new elint system to facilitate ARM launching; new electro-optical sighting system with mode for semi-active laser homing air-to-surface missiles; expanded selection of missiles; in-flight refuelling; automatic mission data loading; and increased serviceability features.

Fire control update centred on SUV-UE air-to-air system (enhanced version of SUV-27, standard fit) with additional air-to-surface channel for active radar homing of anti-ship missiles, plus SUV-P air-to-surface system, additionally capable of displaying data to cockpit MFDs. SUV-UE has upgraded RLPK radar sighting system, and new OEPS electro-optic sighting and improved SILS-27M HUD. SUV-P based on standardised high-speed computers and integrated with SUO-30PK armament control system.

Data display based on two MFDs, multifunction LCD panel and modernised HUD. Some electromechanical indicators retained as backups.

Weapon options include previous R-27ER1, R-27ET1 MRAAMs and R-73E SRAAMs, now augmented by RVV-AE with active radar homing (total six); Kh-29T (TE) and Kh-29L TV/laser-homing ASMs (four), KAB-500Kr (four) or KAB-1500Kr (one) LGBs, Kh-31P passive ARMs (four) and Kh-31A active radar ASMs (four).

Su-27PD: Long-endurance test aircraft with retractable AAR probe, offset IRST and recontoured tail 'sting'; sometimes described as single-seat Su-30, originally Su-27P.

Su-30KI: The Su-30KI prototype (4002, wearing the basic Chinese dark grey colour scheme, but with a disruptive camouflage superimposed on the wings, tailplanes and outer surfaces of the tailfins) first flew on 28 June 1998, and was then sent to Chkalov Flight Test Centre at Akhtubinsk, where it was evaluated and used for launch trials of the RVV-AE (AA-12'Adder') AAM, and for avionics and refuelling probe verification. The Su-30KI was described as a 'single-seat Su-30', and was tailored to meet an Indonesian requirement, before the Asian economic crisis halted that programme. Extent to which the aircraft incorporated the 'extended endurance' features of the Su-30 (apart from refuelling probe, GPS and Western VOR/DME navigation equipment) remains uncertain, however. Su-30KI also used as basis of Sukhoi's latest proposal to upgrade Russia's in-service Su-27s, replacing Su-27SM. Upgrade programme still confusingly referred to by Sukhoi as the Su-30KI, although Russian Air Forces understood to use neither the Su-30 designation nor the KI suffix.

Su-27UB: ('Flanker-C') Tandem two-seat trainer version of 'Flanker-B' with full combat capability (Sukhoi designation T10U); four prototypes (first of which for static testing) built at Komsomolsk; first flown 7 March 1985 (T10U-1). Series manufacture by Irkutsk Aircraft Production Association began 1986; first production UB (T10U-4) flew on 10 September 1986. Instructor in raised rear seat with 6° view forward over the nose; taller fin; length same as 'Flanker-B'; overall height 6.36 m (20 ft 10¼ in), maximum combat load 8,000 kg (17,637 lb). 1,500 kg increase in empty weight, no reduction in internal fuel capacity. Export version is **Su-27UBK**.

Su-27UBM: Russian Air Forces upgrade. First modified Su-27UB (1201 '20') delivered from Irkutsk plant to LII at Zhukovsky 6 March 2001; further seven conversions planned before end of same year; two completed by September 2001; parallel programme to Su-30KN upgrade. Equipment includes new computer, GPS, three 152 × 203 mm (6 × 8 in) MFDs, RVV-AE (AA-12) missiles and ground mapping mode for N001 radar. Later improvements may include radar-absorbent paint and refuelling probe.

Su-27UBM1: Belarussian Su-27UB upgraded to this standard by 558th aircraft repair depot at Baranovichi in 2004; at least one other by early 2006. Reportedly is identical to Su-30KN. Belarus said to be interested in acquiring 18 surplus Indian Su-30Ks for similar upgrade.

'Aircraft 02-01': ('Flanker-C') Second Su-27UB flying prototype (Komsomolsk 0201) converted as in-flight refuelling systems testbed with retractable probe and provision for centreline 'buddy' pod; first flown 6 June 1987. Later became Su-27PU.

Su-27M: Advanced development of Su-27. Still the official designation for the aircraft known to the OKB as the Su-35.

Su-27K: *Described separately.*

Su-27IB: *Described separately.*

Su-27PU: Two prototypes only; production as **Su-30**.

CUSTOMERS: About 395 in service with Russian Air Forces (or 340 plus 10 with training units by mid-2000, according to some sources); these reports refer to active inventory; evidence suggests that main production batches for former USSR contained up to 600 Su-27s and 140 Su-27UBs.

China received 26 (24 Su-27SK single-seat, two Su-27UBK two-seat) in 1991–92, followed by 24 more (14 single-seat, 10 two-seat) in 1995–96; original agreements called for licensed manufacture of 200 as J-11, at planned rate of 50 a year, in new purpose-built factory (owned by Shenyang Aircraft Company, which see) from 1998 (when first two shipsets delivered from Komsomolsk); first Chinese-assembled Su-27 rolled out December 1998; only eight delivered by late 2000, following considerable quality control problems, leading to the procurement of 28 extra Russian-built Su-27UBKs, delivered 2000–02, first four on 14 December 2000, second four in December 2000; to Nanjing/Yuxikou air base, where 10 supplied in 2001 and balance of 10 following in 2002. China's licence agreement does not allow exports. The first 50 aircraft assembled from Russian-supplied kits of diminishing completeness and the Chinese aircraft will always include at least 30 per cent Komsomolsk content; first 10 kits stated to have been 100 per cent complete but, by 2000, China seeking more in this state to expedite deliveries. No licence has been granted for Chinese production of the AL-31 engine. China's first 50 Su-27s were initially based at Wuhan, with the 9th Fighter Regiment, 3rd Air Division though 24 subsequently moved to Liancheng, where 17 were damaged (three beyond repair) in an April 1997 hurricane. Two more were written off in accidents. According to Russian sources, 75 of 78 complete Su-27 K/UBKs had been delivered by end of 2002 and all 105 sets of components representing first J-11 batch by end of 2004. At that time, China had not ordered balance of 95 sets, nor shown signs of switching local manufacture to Su-30, as once expected.

Vietnam received first batch of six (including one Su-27UB) in 1995; further six (two plus four) ordered, including two UBs delivered by airfreight on 1 December 1997 and second pair, representing balance of follow-on order, which destroyed in An-124 crash six days later. Latter replaced by single-seat aircraft, giving fleet of nine plus three; Su-30s also delivered. Upgrade expected, since Vietnam requires aircraft to use R-77 AAMs, Kh-29, Kh-31 and Kh-59 ASMs. Kazakhstan received 32 from Russia, including six in 1997, four in January 1999 and four during 2000 (with 12 then outstanding), as compensation for return of Tu-95s and for alleged environmental and ecological damage. Belarus has 22 or 23 (though these may have been sold-on, perhaps to Angola); Ukraine 66 to 70 and Uzbekistan 30; others reportedly went to Armenia, Azerbaijan and Georgia; Syria has requested 14 (some reports suggest 17 in service others that only four were in service by mid-2000, two at Minkah AB and two at Damascus).

Ethiopia received the first of eight second-hand from Russia in late 1998. Eritrea obtained four Su-27Ss and two Su-27UBs from Ukraine in 2002. In late 1999, there were reports that Angola had taken delivery of eight Su-27s at Catumbela in August, with the balance of seven expected imminently. Pilots had reportedly trained in Belarus, the presumed source of the aircraft, though technical support came from Ukraine. Indonesia announced in March 2003 that two Su-27s and two Su-35s would be purchased immediately as prelude to acquisition of total of 48 'Flanker' versions over following four years. Order signed 24 April 2003 and two Su-27SKs (and two Su-30MKs) delivered 27 August 2003 to Iswahyudi. Further six SKs (and two Su-30MKs) to follow.

Japan has been reported to be interested in two aircraft for evaluation/aggressor use, but Sukhoi unwilling to sell less than six. Two Japanese pilots underwent a USD300,000 46-day training programme on the Su-27 in early 1998, however.

On 26 November 1995, the first of two Su-27s was delivered from Belarus to the USA inside an An-124 for an unknown purpose, believed to be support of military training exercises. The UK is reported by one source to have obtained a "Su-27P" from Ukraine in 2001.

Su-27 CIS (USSR) PRODUCTION

Batch	Qty	Remarks
'Flanker-B' at Komsomolsk		
8	20	Full quantity unconfirmed
9	20	Including T10-30 (0906)
10	20	1003 with sidestick controller
11	20	Some to Ukraine
12	20	
13	20	Some to Ukraine
14	20	Some to Ukraine
15	20	Some to Ukraine
16	20	1602 to prototype Su-27M
17	20	Some to 582 IAP
18	20	
19	20	Some to 582 IAP and Ukraine
20	20	Some to 159 and 582 IAP
21	20	Some to 159 IAP and Ukraine
22	20	Some to 159 IAP
23	20	Some to 159 IAP
24	20	2404/T10-41; 2405 Su-27LMK; Some to 159 IAP
25	20	
26	20	Some to 159 and 582 IAP
27	20	Some to 159 and 582 IAP
28	20	
29	20	
30	20	Some to 61 IAP
31	20	Some to 237 GvTsPAT
32	20	
33	20	
34	20	Some to 61 IAP
35	20	
36	20	
37	20	3711 Su-27P; 3720 Su-27PD
'Flanker-C' at Irkutsk		
03	10	Some to Ukraine
04	10	
05	10	
06	10	
07	10	Some to 582 IAP
08	10	Some to 237 GvTsPAT
09	10	Some to 61 and 582 IAP
10	10	
11	10	Some to 582 IAP
12	10	Some to 582 IAP; 1201 first Su-27UBM
13	10	
14	10	
15	10	
16	10	Some to 237 GvTsPAT

Notes: Data from unofficial sources. Batches 9 and 10 may have contained fewer aircraft. IAP is Interceptor Air Regiment; GvTsPAT is Guards Centre for Display of Aviation Equipment

DESIGN FEATURES: Developed to replace Yak-28P, Su-15 and Tu-28P/128 interceptors in APVO, for dual-role ground attack/air combat and to escort Su-24 deep-penetration strike missions; basic requirement was effective engagement of F-15 and F-16 and other future aircraft and cruise missiles; exceptional range on internal fuel made flight refuelling unnecessary until Su-24s received probes when more range was required in the escort role; external fuel tanks still not considered necessary; all-swept blended fuselage/mid-wing configuration, with long curved wing leading-edge root extensions, lift-generating fuselage, twin tailfins and widely spaced engines with wedge intakes; rear-hinged doors in intakes hinge up to prevent ingestion of foreign objects during take-off and landing; integrated

Su-27SM upgraded version of Sukhoi 'Flanker' assigned to Lipetsk test centre *(Yefim Gordon)* 1158622

Sukhoi Su-27SMK demonstrator *(Paul Jackson)* 1158580

fire-control system with pilot's helmet-mounted target designator; exceptional high-Alpha performance; basic wing sweepback 42° on leading-edge, 37° at quarter-chord; no dihedral or incidence.

FLYING CONTROLS: Four-channel analogue SDU-27 fly-by-wire, with no mechanical back-up; artificial feel; relaxed longitudinal stability; no ailerons; full-span leading-edge flaps and plain inboard flaperons controlled manually for take-off and landing, computer-controlled in flight; differential/collective tailerons operate in conjunction with flaperons and rudders for pitch and roll control; flight control system limits *g* loading to +9 and normally limits angle of attack to 30 to 35°; angle of attack limiter can be overruled manually for certain flight manoeuvres; large door-type airbrake in top of centre-fuselage.

STRUCTURE: All-metal, with extensive use of aluminium-lithium alloys and titanium but no composites; comparatively conventional three-spar wings; basically circular section semi-monocoque fuselage with load-bearing spine, sloping down sharply aft of canopy; cockpit high-set behind drooped nose; large ogival dielectric nosecone; long rectangular steel blast panel forward of gun on starboard side, above wingroot extension; two-spar fins and horizontal tail surfaces; uncanted vertical surfaces on narrow decks outboard of engine housings; fin extensions beneath decks form parallel, widely separated ventral fins.

LANDING GEAR: Hydraulically retractable tricycle type, made by Hydromash, with single wheel on each unit; KT-156D mainwheels turn 90° while retracting forward into wingroots; hydraulically steerable non-braking KN-27 nosewheel, with mudguard, also retracts forward; mainwheel tyres 1,300 × 350, pressure 12.25 to 15.70 bar (178 to 227 lb/sq in); nosewheel tyre 680 × 260, pressure 9.30 bar (135 lb/sq in); hydraulic carbon disc brakes with two-signal anti-skid system; electric brake cooling fan in each mainwheel hub; further brake in nosewheel; brake-chute housed in fuselage tailcone.

POWER PLANT: Two Saturn/Lyulka AL-31F turbofans, each 122.6 kN (27,557 lb st) with afterburning. Large spring-loaded auxiliary air intake louvres in bottom of each three-ramp engine duct near primary wedge intake; two rows of small vertical louvres in each sidewall of wedge, and others in top face; fine grille of titanium hinges up from bottom of each duct to shield engine from foreign object ingestion during take-off and landing.

By 2004, Salyut offering AL-31F upgrade for export in form of 132.4 kN (29,760 lb st) AL-31F-M1, with 138 kN (31,085 lb st) AL-31F-M2 and 147.1 kN (33,070 lb st) -M3. Target TBO for these engines is 1,500 hours, increasing to 4,000.

Fuel in four integral tanks: three in fuselage and one split between each outer wing. Max internal fuel capacity approximately 11,775 litres (3,110 US gallons; 2,590 Imp gallons); normal operational fuel load 6,600 litres (1,744 US gallons; 1,452 Imp gallons). Higher figure represents internal auxiliary tank for missions in which manoeuvrability not important. No provision for external fuel tanks, except in versions where specifically indicated. Pressure or gravity fuelling. Flight refuelling capability optional; Su-27UB operated as buddy tanker during development of system.

ACCOMMODATION: Pilot only, on Zvezda K-36DM Series 2 zero/zero ejection seat, under large rear-hinged transparent blister canopy, with low sill; 14° view downward over the nose.

SYSTEMS: Automatically regulated cockpit air conditioning. Two independent, duplicated, hydraulic systems, pressure 275 bar (4,000 lb/sq in), for actuation of control surfaces, airbrake, landing gear, wheel brakes, air intake ramps and FOD screens. Electrohydraulic (flight control) parts of system quadruplicated. APU in top of rear fuselage for ground and emergency in-flight power. Pneumatic system pressure 210 bar (3,045 lb/sq in) for back-up landing gear extension avionics bay pressurisation and canopy operation and sealing. Electrical supply 27 V DC, 115 V and 200 V 400 Hz AC; two type NKBN-25 Ni/Cd batteries. AC supplied by two integral engine-driven generators with three-phase and single-phase converters. Gaseous oxygen for 4 flight hours.

AVIONICS: Systems integrated by NPO Elektroavtomatika.

Communications: R-800 UHF radio, R-864 HF, intercom and cockpit voice recorder. SO-69 ATC transponder; various IFF fits, according to production batch.

Flight: PNK-10 flight instrumentation and navigation suite encompasses the usual, traditional flight instruments (the IK-VSP altitude and speed data system), SAU-10 autopilot, Ts-050 computer, ARK-19 or ARK-20 ADF, a radio altimeter and A-317 Uron SHORAN. Aircraft capable of ICAO Cat. I autoland.

Radar: RLPK-27 radar sighting system with NIIP N001 Mech (Sword, NATO 'Slot Back') track-while-scan coherent pulse Doppler look-down/shoot-down radar (long-chord twist-cassegrain antenna diameter approximately 1.0 m; 3 ft 4 in) with search range of up to 54 n miles (100 km; 62 miles), tracking range 35 n miles (65 km; 40 miles), in forward hemisphere against MiG-21 size target (ability to track 10 targets and engage two simultaneously in current Su-27SK/UB upgrade configurations) and TsVM-80 computer.

Instrumentation: Integrated fire-control system enables radar, IRST and laser range-finder to be slaved to pilot's helmet-mounted target designator and displayed on wide-angle HUD; autopilot able to restore aircraft to right-side-up level flight from any attitude when 'panic button' depressed.

Mission: Duplex SUV-27 weapons targeting complex integrates radar and OEPS-27 electro-optic sighting system with Model 36Sh OLS-27 IR search/track (IRST) sensor, range 27 n miles (50 km; 31 miles), collimated laser range-finder, range 4.3 n miles (8 km; 5 miles), functioning through common optics in transparent housing forward of windscreen and NSTs-27 Schchel-3U helmet-mounted sight. Beryuza tactical/GCI datalink. Provision for reconnaissance pod on centreline pylon.

Self-defence: SPO-15LM Beryoza 360° radar warning antennas, outboard of each bottom air intake lip and at tail. Gardeniya active ECM jamming system. Three banks of APP-50 chaff/flare dispensers (total 96 cartridges) in bottom of long tailcone extension and top of tailsting. Tailcone widened to provide extra chaff/flare dispensers from batch 18 (mid-1987).

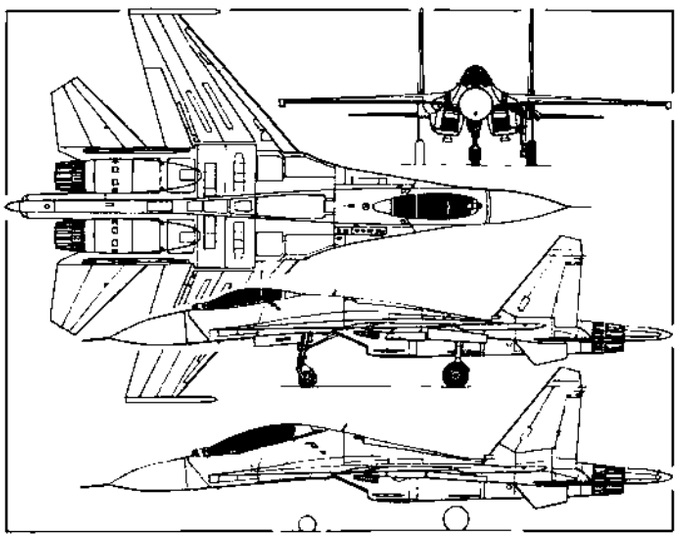
ARMAMENT: One 30 mm Gryazev/Shipunov 9A-4071K GSh-30-1 gun in starboard wingroot extension, with 150 rounds. Up to 10 AAMs in air combat role, on tandem pylons under fuselage between engine ducts, beneath each duct, under each centre-wing and outer-wing, and at each wingtip. Typically, two short-burn semi-active radar homing R-27R (NATO AA-10A 'Alamo-A') in tandem under fuselage; two short-burn IR homing R-27T (AA-10B'Alamo-B') on centre-wing pylons; and long-burn semi-active radar homing R-27ER (AA-10C 'Alamo-C') or IR R-27ET (AA-10D 'Alamo-D') beneath each engine duct. The four outer pylons carry either R-73A (AA-11'Archer') or R-60 (AA-8 'Aphid') close-range IR AAMs. R-33 (AA-9 'Amos') AAMs optional in place of AA-10s. Up to eight 500 kg bombs, sixteen 250 kg bombs or four launchers for S-8, S-13 or S-25 rockets.

DIMENSIONS, EXTERNAL (Su-27):

Wing span	14.70 m (48 ft 2¾ in)
Wing aspect ratio	3.5
Length overall, excl nose probe	21.94 m (71 ft 11½ in)
Height overall	5.93 m (19 ft 5½ in)
Fuselage: Max width	1.50 m (4 ft 11 in)
Tailplane span	9.88 m (32 ft 5 in)
Distance between fin tips	4.30 m (14 ft 1¼ in)

Su-27 EXPORT PRODUCTION

Country	Type	Qty	First Aircraft	Remarks
China	Su-27SK	24	'05'	Batch 38 and 39; delivered from Komsomolsk 1991–92
	Su-27SK	14	'35'	Batch 39; 1995–96
	Su-27SK	105	'01'	All kits received by early 2004. Local assembly in progress; further 95 to follow
	Su-27UBK	2	'01'	Delivered 1991–92 from Irkutsk
	Su-27UBK	10	'03'	1995–96
	Su-27UBK	28	'51'	2000–02
Indonesia	Su-27SK	2	TS-2701	2003
		6		On order; purchase approval delayed to June 2006; may include Su-30Ms
Vietnam	Su-27SK	5	6001	
		4		Incl two replacements for Su-27UBKs
	Su-27UBK	1	8521	
		4		Two lost in airfreight delivery



Sukhoi Su-27P, with added side elevation (bottom) of two-seat Su-27UB *(Dennis Punnett)* 1159577

Wheel track ..... 4.36 m (14 ft 3¾ in)
Wheelbase ..... 5.88 m (19 ft 3½ in)

AREAS:

Wings, gross ..... 62.04 m² (667.8 sq ft)
Wing leading-edge flaps (total) ..... 4.60 m² (49.51 sq ft)
Flaperons (total) ..... 4.90 m² (52.74 sq ft)
Fins (total) ..... 11.90 m² (128.10 sq ft)
Rudders (total) ..... 3.50 m² (37.67 sq ft)
Horizontal tail surfaces (total) ..... 12.30 m² (132.40 sq ft)

WEIGHTS AND LOADINGS (A: Su-27, B: Su-27UB, C: Su-27SK, D: Su-27SMK):

Operating weight empty: A ..... 16,380 kg (36,110 lb)
B ..... 17,500 kg (38,580 lb)
Max fuel weight: A ..... 9,400 kg (20,723 lb)
Normal T-O weight: A ..... 23,000 kg (50,705 lb)
B ..... 24,140 kg (53,220 lb)
D, with two R-73 and two R-27 missiles ..... 23,700 kg (52,250 lb)
Max T-O weight: A, C, D ..... 33,000 kg (72,750 lb)
B ..... 33,500 kg (73,850 lb)
Max wing loading: A, C, D ..... 531.9 kg/m² (108.94 lb/sq ft)
B ..... 540.0 kg/m² (110.60 lb/sq ft)
Max power loading: A, C, D ..... 135 kg/kN (1.32 lb/lb st)
B ..... 124 kg/kN (1.22 lb/lb st)

PERFORMANCE:

Max level speed: at height: A, B ..... M2.35 (1,350 kt; 2,500 km/h; 1,550 mph)
C ..... M2.3 (1,319 kt; 2,443 km/h; 1,518 mph)
D ..... M2.17 (1,241 kt; 2,300 km/h; 1,429 mph)
at S/L:
A, B ..... M1.1 (725 kt; 1,345 km/h; 835 mph)
C, D ..... M1.14 (756 kt; 1,400 km/h; 870 mph)
Stalling speed: A ..... 108 kt (200 km/h; 125 mph)
Acceleration (D):
from 324 to 594 kt (600 to 1,100 km/h; 373 to 683 mph) ..... 15 s
from 594 to 701 kt (1,100 to 1,300 km/h; 683 to 808 mph) ..... 12 s
Rate of roll: A ..... approx 270°/s
Service ceiling: A, D ..... 18,000 m (59,060 ft)
B ..... 17,500 m (57,420 ft)
C ..... 18,500 m (60,700 ft)
T-O run: A ..... 450 m (1,475 ft)
B ..... 550 m (1,805 ft)
C, D ..... 650 m (2,135 ft)
Landing run: A, D ..... 620 m (2,035 ft)
B ..... 700 m (2,300 ft)
Combat radius: A, B ..... 810 n miles (1,500 km; 930 miles)
D ..... 840 n miles (1,560 km; 970 miles)
Range with max fuel: A, C ..... 1,985 n miles (3,680 km; 2,285 miles)
B ..... 1,620 n miles (3,000 km; 1,865 miles)
Range (D): at S/L, internal fuel ..... 745 n miles (1,380 km; 857 miles)
at S/L, with external tanks (dropped when empty) ..... 894 n miles (1,656 km; 1,029 miles)
at height, internal fuel ..... 2,046 n miles (3,790 km; 2,355 miles)
at height, with external tanks (dropped when empty) ..... 2,370 n miles (4,390 km; 2,727 miles)
max, with flight refuelling ..... 2,807 n miles (5,200 km; 3,231 miles)
g limit (operational): A, B, C, D ..... +9

SUKHOI Su-30 (Su-27PU)

NATO reporting name: Flanker-F Variant 1

TYPE: Air superiority fighter.

PROGRAMME: Design started 1986; proof-of-concept T10PU (T10U-2 'Aircraft 01-02'; see Su-27 entry) first flew 6 June 1987; construction of two prototypes (T10PU-5 05' and T10PU-6 '06', converted from Su-27UBs T10U-5 and 0201/T10U-6) began at Irkutsk in 1987, as Su-27PU; first flown 31 December 1989; prototype flew 7,252 n miles (13,440 km; 8,351 miles) in 15 hours 42 minutes non-stop during round trips Moscow-Novaya Zemlia-Moscow and Moscow-Komsomolsk-Moscow. First pre-series Su-27PU flew at Irkutsk on 14 April 1992; initial two aircraft (27596 and 27597 c/ns 0101 and 0102), without military equipment, delivered to 'Test Pilots' aerobatic team at Zhukovsky flight test centre, possibly as Su-27PUDs. By 1999, 27597 was flight-testing MFI-68 152× 203 mm (6 × 8 in) LCDs for Russian 'Flanker' upgrade programmes while 27596 had been used in support of the Su-30MK programme, renumbered '603'

CURRENT VERSIONS: **Su-30:** (Sukhoi T10PU, *Izdelie* 10-4PU): Unofficial OKB designation for basic two-seat long-range interceptor for Russian Air Forces (to which it is still the Su-27PU); deliveries under way by 1996 to 54 Interceptor Air Regiment at Savostleyka advanced training base, though production very limited, and unit relies heavily on Su-27 and Su-27UB. Apparently, five Su-30s are in frontline use (Red 50, 51, 52, 53 and 54). Designed for mission of 10 hours or more with two in-flight refuellings; systems proved for extended duration sorties, including group missions with four Su-27s; only Su-30 would operate radar, enabling it to assign targets to Su-27s by radio datalink; can carry bombs and rockets but not guided air-to-surface weapons. Su-27UB training capability retained. Canards and thrust vectoring to be optional (see Su-30MKI). Export designation **Su-30K** (T10-4PK). Situation confused by tendency to describe all current Irkutsk-built two-seaters as Su-30s, even standard Su-27UB trainers and by emergence of upgrade using MiG-29SMT cockpit, using the same Su-30K designation. This Su-30K was reported to have been tested at Akhtubinsk by June 2000 but may be the same as the Su-30KM described below. Reported in early 2002 that 'Russian Knights' aerobatic team to convert to Su-30s from Su-27s.

Su-30KI: Single-seat configuration for Indonesia, subsequently offered more widely as an upgrade. Described in main Su-27 entry

Su-30I: One foreplane-equipped Su-27PU prototype only; served as Su-30MKI prototype; believed offered as upgrade for Su-27 and as naval trainer, but neither taken up.

Su-30K-2: Variant of Su-33UB and described in that entry.

Su-30KN: An undelivered production Su-30 (0302 '302') first flew in early March 1999 as the testbed (also referred to as Su-30K and Su-30KM) for a Russian Air Forces upgrade of UB Su-27s and Su-30s. Prime purpose of 'Project 302' was to convert fighter into multirole attack aircraft by adding terrain-mapping and moving target indication to the N001 radar. This achieved by adding new bypass circuit (*obvodnoy kanal*, abbreviated to *Oko* — 'eye'). Cockpit initially unchanged, apart from MFI-55 127 × 127 mm (5× 5 in) MFDs, an SUV-30K weapons control system comprising a new MVK computer added to existing SUV-27 system (permitting new types of AAM and ASM to be carried) and an A737 GPS; joint venture is undertaken by Sukhoi, Irkutsk (IAPO) and Russkaya Avionika and has high commonality with MiG-29SMT upgrade. Prototype tested at Air Forces Research Institute from mid-1999. State certification awarded 9 November 2001. Added weapons are Kh-29T short-range, or two Kh-59ME long-range TV-guided ASMs; up to six KAB-500KR bombs; four Kh-31P ARMs; and six Kh-31P/A anti-ship missiles. By late 2000, the Su-30KM designation had been replaced by Su-30KN and potential maritime capabilities were being stressed, including possible future compatibility with Kh-59, Yakhont and Alfa ASMs. Up to November 2001, upgrades comprised prototype '302' and three air force aircraft ('51' being the first), all used for trials and modernised at IAPO's expense; order signed by Russian Air Forces in October 2001 for eight upgrades in 2002, 10 in 2003 and 12 in 2004. However, by August 2003, only five upgraded aircraft had been redelivered. Su-27UBM and Su-27SM are parallel programmes. 12 Su-30Ks sought by Vietnam believed to be to this standard with Kh-29, Kh-31 and Kh-59 ASMs, KAB-500 PGMs and R-77 AAMs

Su-30KNM: Subsequent modifications to 0302 involve larger (152 × 203 mm; 6 × 8 in), MFI-68 screens (three for pilot and four for WSO), Pero ('Feather') phased-array radar and equivalent of MIL-STD-1553B databus. Project began in 2002. Upgrade of air force aircraft could begin 2005.

Su-30M: (Sukhoi T-10PM): Multirole version; described separately.

CUSTOMERS: See table. Indian aircraft to be upgraded to Su-30MKI in 2004, according to one report. This failed to occur, but in May 2006, India was negotiating for return of all 18 to Irkut production plant and their replacement by new Su-30MKIs; Belarus has shown interest in ex-Indian machines

DESIGN FEATURES: Development of Su-27/27UB, with latter's tandem seating and new avionics, and without Su-35's advanced radar, foreplanes (in basic version), advanced control system and new power plant. Designed for effective engagement of fighters at long distances from base, and to destroy bombers and intercept cruise missiles. Integral configuration similar to Su-27UB, with unstable aerodynamic characteristics. Automatic control system standard.

FLYING CONTROLS: As Su-27UB.

STRUCTURE: As Su-27UB.

LANDING GEAR: As Su-27UB

POWER PLANT: As Su-27UB, but flight refuelling probe and buddy refuelling capability standard.

ACCOMMODATION: Two crew in tandem in identical cockpits, on K-36DM zero/zero ejection seats, with rear seat raised.

SYSTEMS: As Su-27UB, except gaseous oxygen for 10 hours' flight.

AVIONICS: *Radar:* NIIP N001 Myech ('Slot Back') coherent pulse Doppler look-down/shoot-down radar offered, detection range up to 54 n miles (100 km; 62 miles), tracking range 35 n miles (65 km; 40 miles); ability to track 10 targets and engage two simultaneously; probably not available on current in-service aircraft.

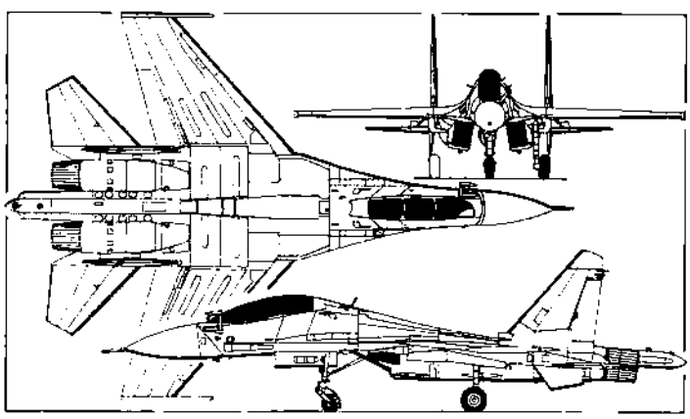
Flight: New navigation system based on GPS, Loran and Omega.

Instrumentation: Integrated fire-control system enables radar, IRST and laser range-finder to be slaved to pilot's helmet-mounted target designator and displayed on wide-angle HUD.

Mission: Provision for fitting foreign-made airborne and weapon systems at customer's request.

Self-defence: SPO-15LM Beryoza 360° radar warning system; chaff/flare dispensers.

ARMAMENT: One 30 mm GSh-301 gun, with 150 rounds; 12 hardpoints for up to six R-27R1E and R-27T1E (AA-10 'Alamo') radar homing and IR long-range AAMs, and six R-73E (AA-11 'Archer') IR close-range AAMs; alternative RVV-AE (R-77; AA-12 'Adder') AAMs; unguided bombs or rockets as Su-27; reconnaissance or EW pods.



Sukhoi Su-30 two-seat long-range combat aircraft *(Paul Jackson)* 1159576

Indian Air Force Sukhoi Su-30Ks *(French Air Force)* 1158626

Su-30 PROTOTYPES AND PRODUCTION

Batch	Qty	Identity	Remarks
Russia			
-	(1)	T10PU-5 '05'	Converted from T10U-5; became Su-30MKK
-	(1)	T10PU-6 '06'	Converted from T10U-2; became Su30MKI
1	1	'596'	Became '603' for Su-30MK programme
1	1	'597'	Testbed at Zhukovsky (LII)
2/3	5	'50' – '54'	54 IAP PVO, Savostleyka
3	1	'302'	Upgrade prototype (Su-30KN)
India			
PU	8	SB001-008	Delivered March-April 1997
K	10	SB009-018	Ordered September 1998. Delivered October 1999. Batch 5 production

DIMENSIONS, EXTERNAL: As Su-27UB

WEIGHTS AND LOADINGS:

Fuel weight: normal	5,090 kg (11,222 lb)
max	9,400 kg (20,723 lb)
Max combat load	8,000 kg (17,635 lb)
Max external stores	8,000 kg (17,635 lb)
Normal T-O weight	24,550 kg (54,123 lb)
Max T-O weight	33,000 kg (72,752 lb)

PERFORMANCE:

Max level speed:	
at height	M2.35 (1,350 kt; 2,500 km/h; 1,550 mph)
at S/L	M1.14 (756 kt; 1,400 km/h; 870 mph)
Service ceiling	17,500 m (57,420 ft)
T-O run	550 m (1,805 ft)
Landing run	700 m (2,300 ft)
Combat range: with max internal fuel	1,619 n miles (3,000 km; 1,865 miles)
with one in-flight refuelling	2,805 n miles (5,200 km; 3,230 miles)
g limit	+8.5

SUKHOI Su-30M

NATO reporting name: Flanker

TYPE: Multirole fighter.

PROGRAMME: Design started 1991; demonstration and development work by Su-27UB 0806 '321' and 0403 '56'; 'Blue 56' first flew in Su-30M configuration on 14 April 1992, but it was not then canard-equipped and did not have full avionics package. Conversion of first true prototype ('06') began 1993, using 0201/T10PU-6; 0101 '603' (formerly first prototype Su-27PU'-5) first demonstrated at Berlin Air Show 1994; thrust vectoring and canards under development as options 1997. Canards and AL-37PP engines first flown on '56' 1 July 1997, this regarded by Sukhoi as first flight of Su-30MK; second prototype (06) flew 23 April 1998. In production for India.

Late production ('72') Chinese Sukhoi Su-30MKK 1158631

Su-30M designation initially associated with canard fitment. However, this now appears to identify multirole aircraft with upgraded airframe capable of 38,800 kg (85,539 lb) MTOW, irrespective of aerodynamic configuration. Chinese Su-30MKKs are described by Sukhoi as Su-30MK family members, despite having twin nosewheels and square-topped fins previously regarded as Su-35 features.

CURRENT VERSIONS: **Su-30M:** (Flanker-F Variant 2) Basic version.

Su-30MK: Irkutsk-built. As Su-30M, for export.

Su-30MK: Designation re-used for advanced two-seater derived from Su-27SK by KnAAPO plant and combining two-seat Su-30 concept with avionics, canards and thrust vectoring of Su-37. Design, under A F Barkovsky, began 1994. Known internally (by KnAAPO) as Su-35UB (T10UBM) and Su-37UB. First and second true Su-30MKs, 01 (produced through the retrofit of canards to '56') and 06 (converted from T10PU-6 in Sukhoi OKB's own workshop) first flown on 1 July 1997 and 23 April 1998, respectively. Equipped with foreplanes and AL-37FP thrust-vectoring engines; demonstrated to Indian officials at Zhukovsky, 15 June 1998 as Su-30MK-1 and Su-30MK-6, respectively. Su-30MK-1 had the new twin-wheel nosegear, which may become a feature of the production MKI, but was lost while displaying at Paris Air Show on 12 June 1999. Additionally, 01 was exhibited at Aero India, December 1998. AL-37FP power plant, as specified for India, extends length by 40 cm (15¾ in) and incurs weight penalty of 110 kg (243 lb), engine life remaining unchanged at 5,000 hours (1,000 hours TBO). Nozzle movement is 15° up or down. Flight control system helps pilot to set power and thrust vector for each engine, according to required manoeuvre. Expected to be known as Su-30MKR if produced (at Irkutsk) for Russian Air Forces.

Su-30MKA: Algerian order of March 2006 for 28. Generally as Su-30MKI, but with certain Israeli-built components omitted (as with Su-30MKM); cockpit in French.

Su-30MKI: (Flanker-H) Version for India in four configurations, initially referred to as Su-30MKI, MKII, MKIII and MKIV. Indian contract signed 30 November 1996. First eight delivered March 1997 to basic Su-30PU (Su-30K or even Su-37UB) standard, with AL-31F engines; eight for 1998 delivery were expected to have French Sextant avionics including VEH 3000 HUDs, high-resolution colour LCD MFDs, a new flight data recorder, a Totem ring laser gyro dual INS with embedded GPS. Cockpits stated to be "practically identical" although rear seat occupant normally operates radar, systems and weapons. Israeli EW equipment, a new UOMZ OLS-30 electro-optic targeting system and rearward-facing radar in tailcone; 12 originally to have been delivered 1999 were to add canards, as on Su-37; final 12 (originally scheduled for delivery in 2000) were to have AL-37FP engines with single-axis thrust-vectoring nozzles inclined outwards 32° from the centreline for improved yaw control, especially in single-engined case. AL-37PP claimed to offer 3-D thrust vectoring, with nozzle actuation via the fuel, and not the hydraulic, system.

Completion and delivery of balance of 32 was repeatedly delayed; decision taken that all these would be completed to final standard before delivery. (In interim, India contracted on 18 December 1998 for 10 standard Su-30Ks which had been cancelled by Indonesia; all had been delivered by October 1999.) First prototype full-specification Su-30MKI flew at Irkutsk on 26 November 2000; Irkutsk built four prototypes, last of which handed over to Sukhoi design bureau on 11 August 2001.

First production aircraft flew 28 December 2001. Under renegotiated contract, IAF to receive six full-specification aircraft by 2002 and balance of 26 in batches beginning 18 to 24 months later; Batch 1 and 2 aircraft (22 in all) will be raised to full standard under agreement of 6 January 2006.

First two departed Irkutsk inside An-124 transport 22 June 2002. However, 'full-specification' still being received in three standards, first 10 being Stage I; these 10 formally accepted into service by 20 Squadron at Pune 27 September 2002. Stages II and III, (12 in 2003 followed by 10 in 2004), introduced additional weapons and upgraded flight control system. Licensed production of 140 Su-30MKIs by HAL was agreed in September 2000,

Chinese naval aviation Sukhoi Su-30MKK2

1158630

followed by contract signature in Irkutsk on 28 December 2000. Sometimes referred to by KnAAPO as Su-35UB.

Pending local manufacture, India proposing in mid-2006 to trade-in 18 Su-30s for similar number of Su-30MKIs. Locally-built aircraft expected to carry Irbis radar, developed jointly by NIIP and India's LRDE.

Su-30MKK: ('Flanker-G') Second K stands for *Kitaya*, or China. Two-seat, multirole version, with an N001VE radar (with expanded air-to-ground capabilities, including mapping); 'glass cockpit' with two 178× 127 mm (7 × 5 in) MFI-9 colour LCD MFDs in front, plus single MFI-9 and 204 × 152 mm (8 × 6 in) MFI 10 in rear; ILS-31 HUD; A737 GPS; expanded EW capability; provision for various new TV- and EO-based targeting pods.

First Su 27PU (T10PU-5) was refurbished and rebuilt to serve as an Su-30MKK development aircraft, first flying in its new guise on 9 March 1999. First KnAAPO built prototype ('501') flew 19 May 1999 (sometimes reported as 20 February 1999), with second ('502', in basic Chinese camouflage scheme but marked simply as Su-30MK, not MKK) following later in 1999. '501' and '502' representative of planned production configuration, with tall, flat-topped Su-35-type tailfins, retractable in-flight refuelling probes and (according to some sources) Su 35-type radomes. Further pair ('503' and '504') built by mid-2001.

China ordered 38 KnAAPO-built Su-30MKKs and placed supplementary order (initially quoted as 24, but later known to be 38) in June 2001. First batch of 10 Su-30MKKs left Russia on delivery to China on 20 December 2000; nine followed in March/April 2001 and 10 more on 21 August. Later Chinese aircraft, known as Series III, will switch to Zhuk-MS radars. Russian weapon deliveries began in January 2001 with Kh-59ME (AS-18 'Kazoo'), Kh-29T (AS-14 'Kedge') and Kh-31P (AS-17 'Krypton') ASMs and KAB-500Kr guided bombs. Early Su-30MKKs variously reported with 'Three Swords' Air Regiment at Yuxikou, near Nanjing or at Wuhu, Anhui; those delivered in August 2001 were supplied to Cangzhou, Hebei. Chinese local assembly of Su-30MKK (possibly as J-13) was once expected, but now in doubt.

Su-30MKK2: First shown at MAKS, Moscow, August 2003; optimised for naval operations; development work undertaken by some of four retained Chinese Su-30MKKs ('501' to '504'). Improved precision attack capability and expanded command and control potential. Implied capability with Kupol (unconfirmed) M400 reconnaissance pod (carrying various options including SLAR, TV or LOROP); and UOMZ Sapsan-E electro-optic/laser targeting pod. Improved version of NIIP N001VE radar (simultaneous aerial engagements and ground mapping). Other weapons include KH-31A, Kh-29T/EE/L, KAB-500Kr/1500Kr, R-27, R-73 and RVV-AE, while Chinese PL-12 first noted in 2006. Deliveries began (six aircraft) February 2004.

Su-30MKK3: Further Chinese variant for naval use; deliveries said to have been due from 2005. MTOW 38,000 kg (83,775 lb); NIIR Zhuk-MSE radar; Kh-59ME and Kh-31A anti-ship missiles. Initial order for 24 aircraft. No evidence of delivery.

Su-30MKM: Malaysian version; USD900 million contract initialled 19 May 2003. Manufacture by Irkut; deliveries from mid-2006, for completion by end of 2007. Generally as Su-30MKI, but Avitronics of South Africa contracted in April 2004 to supply 18 multisensor warning systems comprising MAW-300 missile approach warners, LWS-310 laser warners and associated control systems. Elint system, jammer and chaff/flare systems of Russian manufacture. Both avionics changes remove Israeli equipment of Su-30MKI. Other items include Thales wide angle HUD, LCDs and thermal imaging pod; Sagem Sigma 95 navigation system; Russian helmet-mounted sight with Ukrainian Sura-M designator; plus Russian weapons already procured for Malaysian MiG-29s (R-73E and R-77).

CUSTOMERS: Indian Air Force initial USD1.8 billion order for 40 signed 30 November 1996; deliveries from Irkutsk began to No. 24 'Hunting Hawks' Squadron at Pune in March 1997; declared operational 11 June 1997; 10 more ordered September 1998, increasing total to 50, including 18 unmodified Su-30Ks for training. First MKIs to 20 'Lightning' Squadron in May 2002. Final deliveries in December 2004. Option taken up on licensed production of 140 more by HAL, India; however statement of November 2002 noted IAF had reduced quantity to 120, but this later discounted. In 2006, Russian sources predicted completion of 140th Indian-built Su-30 in 2012; to facilitate this, early kit deliveries will be in a more advanced state of assembly than previously planned.

On 29 August 1997, Indonesia signed for eight 'single-seat Su-30s' and four two-seat, but this was cancelled on 9 January 1998. Interest reportedly renewed in 2001, and in 2003 plan to acquire 48 of 'Flanker' family was announced, initial purchase being two each of Su-27 and Su-30. Malaysia ordered 18 on 19 May 2003 and Vietnam contracted for four (plus eight options) on 3 December 2003, the four Vietnamese delivered in December 2004.

Thailand reported in December 2005 to have reached preliminary agreement on purchase of 12 aircraft similar to Malaysian version. Algeria ordered 28 in March, while Venezuelan contract for 30 announced 21 July 2006.

COSTS: Indian aircraft quoted as USD20 million each (flyaway, 1998), with USD8 million extra per aircraft to integrate Indian-specific systems and avionics. Chinese order for 40 Su-30MKKs valued at USD1.5 billion (2002). Algerian contract for 28 valued at USD1.2 billion (2006).

Description refers to two-seat Su-30MK which generally as for Su-30, except as follows:

DESIGN FEATURES: Improvement on combat capabilities of Su-30 by compatibility with high-precision guided air-to-surface weapons with standoff launch range up to 65 n miles (120 km; 75 miles), in addition to Su-30's ability to engage two airborne targets simultaneously.

POWER PLANT: Two Saturn/Lyulka AL-35F turbofans, each 123 kN (27,558 lb st).

AVIONICS: In addition to standard Su-30 systems, Su-30M has more accurate navigation system, a TV command guidance system, a guidance system for anti-radiation missiles, a larger monochrome TV display system in rear cockpit for ASM guidance, and ability to carry one or two pods, typically for laser designation or ARM guidance in association with Pastel RWR and APK-9 datalink. Western avionics, guidance pods and weapons can be fitted optionally. Sextant Avionique package for Indian aircraft includes VEH3000 or Elop HUD, Totem or Sigma 9SN/MF INS/GPS and liquid-crystal multifunction displays (six 127 × 127 mm; 5 × 5 in MFD 55 and one 152 × 152 mm; 6 × 6 in MFD 66 per aircraft).

ARMAMENT: One 30 mm GSh-301 gun, with 150 rounds; 12 external stations for 8,000 kg (17,635 lb) of stores, including FAB-250, FAB-500, OFAB-250-270, OFAB-100-120 and

Su-30M PROTOTYPES AND PRODUCTION

Batch	Qty	Identity	Remarks
-	(1)	'56'; later '01'	Lost 12 June 1999
-	(1)	06	Previously T10PU-6
Algeria			
MKA	28		Ordered 2006; deliveries from Irkutsk between 2008 and 2009
China			
MKK	4	501-504 Trials aircraft; apparently not part of contract	
MKK	38	'01'-38	Ordered 1999. Delivered 2000–01 from Komsomolsk
MKK	38	'39'-'76'	Ordered June 2001; delivered 2002–03
MKK2	28	'01'-'28'	Ordered January 2003; delivered from January 2004
India			
MKI	4	'02' - '05'	Development, built 2000–01
MKI	10	SB019-028	Delivered from Irkutsk 20 May 2002
MKI	12	SB029-040	Delivered from Irkutsk October to December 2003
MKI	10	SB041-048	Delivered from Irkutsk in December 2004
MKI	18		Replacements for Su-30s returned to Irkutsk; deliveries from 2008
MKI	140		Production in India from 2007
Indonesia			
MK	2	TS-3001	Delivered August 2003
	2		On order from Komsomolsk
Malaysia			
MKM	18		Deliveries 2007-09 from Irkutsk
Venezuela			
MK	30		On order
Vietnam			
MK2	4		Deliveries December 2004 from Komsomolsk

guided KAB-500KR and KAB-1500KR bombs; B-8M-1 (20 × 80 mm), B-13L (5 × 130 mm) and O-25 (single 266 mm) rocket packs; up to six R-27ER (AA-10C 'Alamo-C'), R-27ET (AA-10D 'Alamo-D') or RVV-AE (R-77; AA-12 'Adder') medium-range AAMs; or two R-27ETs and six R-73E (AA-11 'Archer') IR homing close-range AAMs; and a variety of air-to-surface weapons such as four ARMs, six guided bombs or short-range missiles with TV homing, six laser homing short-range missiles, or two long-range missiles with TV command guidance; these include Kh-29L/T (AS-14 'Kedge'), Kh-31A/P (AS-17 'Krypton') and Kh-59M; (AS-18 'Kazoo') with APK-9 pod.

DIMENSIONS, EXTERNAL: As Su-27 except:

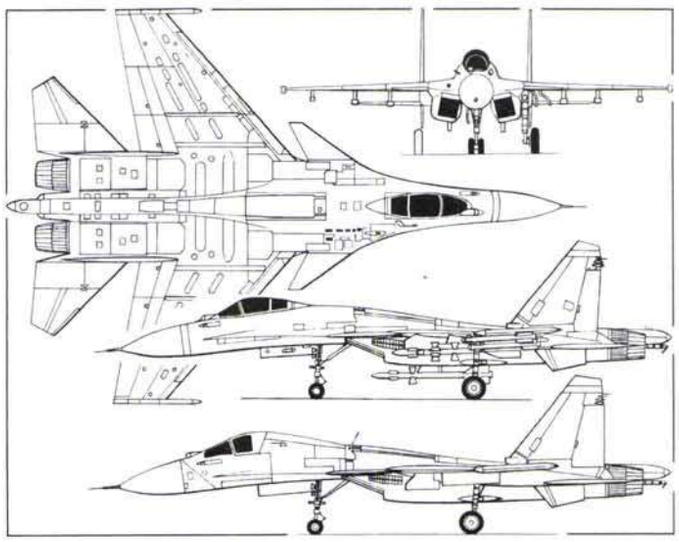
Height overall	6.355 m (20 ft 10¼ in)

WEIGHTS AND LOADINGS (Su-30MK):

Weight empty	17,700 kg (39,022 lb)
Max external weapon load	8,000 kg (17,637 lb)
Max internal fuel weight	9,640 kg (21,253 lb)
T-O weight: normal	24,960 kg (55,027 lb)
max	34,500 kg (76,059 lb)
overload	38,800 kg (85,539 lb)

PERFORMANCE (Su-30MK):

Max level speed: at height	(1,144 kt; 2,120 km/h; 1,317 mph)
at S/L	M1.14 (729 kt; 1,350 km/h; 839 mph)
Max rate of climb at S/L	13,800 m (45,275 ft)/min
Service ceiling	17,300 m (56,760 ft)
T-O run, normal weight	550 m (1,805 ft)
Landing run with parachute	750 m (2,460 ft)
Combat range: internal fuel	1,620 n miles (3,000 km; 1,865 miles)
with one in-flight refuelling	2,805 n miles (5,200 km; 3,230 miles)
g limit	+9



Sukhoi Su-33 single-seat carrierborne fighter, with additional side view (lower) of two-seat Su-33UB operational trainer *(James Goulding)* 1159578

SUKHOI Su-33UB (Su-27KUB)

TYPE: Multirole fighter.

PROGRAMME: Su-33 (Su-27K 'Flanker-D') single-seat naval fighter flew 17 August 1987; some 18 built in early 1990s for service aboard *Admiral of the Fleet Kuznetsov*; no further production.

Need for dedicated trainer for Su-33 became increasingly clear, and development of T10KM-2-based **Su-27KUB** (*korabelnyi uchebno boevoi;* as T10KU shipborne fighter trainer) began in late 1990s. Formally acknowledged 21 October 1998. Probably being developed as a private venture, with no firm commitment from Russian Navy. Likely to become **Su-33UB,** following redesignation of carrierborne single-seat Su-27K as Su-33.

Three prototypes, with noses built by KnAAPO, as T10KU-1, -2, and -3, incorporating lessons from the *Kuznetsov*'s 1996 Mediterranean cruise. Construction of T10KU-1 began in 1998 mating a new nose and new wings and tailplanes to an existing T10K prototype (T10K-4). Powered by AL-31F engines, the aircraft first flew on 29 April 1999 and made first arrested landing on dummy deck at NIUTK ('Nitka') test centre, Saki, 3 September 1999; first take-off from deck ramp followed on 6 September; first landing and take-off from carrier *Kuznetsov* on 6 October 1999. Initially unmarked, but later camouflaged and given side number '21'. Total 260 sorties by early 2006, including 100 at NIUTK and 25 from actual carrier deck.

T10KU-2 and -3 reported to be under construction in 1999, perhaps using new-build airframes. By early 2004, first of these reported to have flown, with two further airframes undergoing static tests (probably not destined to fly) and two more on order. Despite this, '21' (also assigned tail number '717' from 2005) remained sole aircraft positively identified up to late 2005, and 2006 Russian reports continued to use future tense for T10KU-2, which will have double wing-folding mechanism; nosewheel door on port side; and cockpit of reduced cross-section, with windscreen moved forward and single hatch covering both pilots, each with K-36DM seat. T10KU-1 test flown by Indian pilots, September 1999, but Su-27 judged too large for planned carriers. Further test series at Saki begun December 2000. In 2003, '21' was fitted with Fazotron-NIIP Zhuk-MSFEh radar, implying use as a testbed.

Any production is likely to be by KnAAPO; baseline variant due to be extrapolated to produce trainer, reconnaissance and AEW versions, the last-mentioned with a phased-array mounted on the spine, between the composites antenna tailfins. Increased thrust, thrust-vectoring AL-31FP, AL-31FM or AL-41F engines mooted for production version.

CURRENT VERSIONS: **Su-33UB:** *As described.*

Su-30K-2: Two-seat interceptor version based on Su-33 fuselage under construction at Komsomolsk, late 1999; due to fly late 2000, but no further reports received.

DESIGN FEATURES: Has navalised features of Su-33, including folding wing (with fold further outboard and with a larger fold angle). Some sources suggest that the Su-33UB's tailplanes do not fold, since they reach only as far as the new outboard wing fold. Double slotted flaps, unslotted, 'adaptive' leading-edge, arrester hook, datalink and carrier landing system. However, compared with Su-27IB, forward fuselage is slightly narrower, with seats closer together and has much less pronounced dorsal hump. New 'glass cockpit' with five colour LCD displays (one 53 cm; 21 in diagonally; rest 38 cm; 15 in) with provision for central or sidestick and with helmet-mounted sighting system. Aircraft has OBOGS and OBIGGS and so does not need oxygen or nitrogen bottles. N014 solid-state, phased-array radar, with enhanced air-to-ground and over-water capabilities, planned eventually, but prototypes have ballast or Zhuk-MS and production aircraft may initially use NIIR N610-27 (Zhuk 27); circular-section radomes replace flattened 'platypus' nose associated with Su-27IB.

Su-33UB has new wing which is 12 per cent larger in span (16.40 m; 53 ft 9¾ in) and area (71.40 m²; 768.5 sq ft), as are the canards and tailplanes. Production Su-27KUB will feature a higher set, square-section, lengthened tail-sting, possibly mounting rear warning radar; tailcone folds (upwards) to reduce stowed length; prototypes have the standard Su-33 tailcone.

SUKHOI Su-34

NATO reporting name: Fullback
Export designation: Su-32
Design bureau designation: Su-27IB

TYPE: Attack fighter.

PROGRAMME: Side-by-side two-seat long-range fighter-bomber (*istrebitel bombardiroshchik*) Su-27 variant intended as tactical strike/attack replacement for Su-24 and Su-25; project designation T10V; redesignated Su-34 by Sukhoi ("to stress father-and-son relationship" to Su-24), but Russian Air Forces retained Su-27IB until late 2003, when Su-34 adopted, with Su-32 reserved for export. Su-32FN/Su-32MF assigned to proposed export versions but, in 2000, all Su-34s were redesignated Su-32.

Conceptual design ordered 21 January 1983, production authorised 19 June 1986. Designed under the direction of Rollan Martirosov. Prototype (T10V-1 '42') built in Sukhoi's own workshops and first flown 13 April 1990; first seen in Tass photograph showing this aircraft approaching (but not landing on) the carrier *Admiral of the Fleet Kuznetsov*; described as deck landing trainer, but no wing folding or deck arrester hook; although with foreplanes and twin nosewheels like Su-27K. Designation Su-27KU quoted, though dedicated side-by-side carrier trainer then officially known as T10KM-2 or Su-27KM-2 for which the new side-by-side cockpit had been designed. Russian unofficial name 'Platypus'; exhibited to Russian Federation and Associated States (CIS) leaders at Machulishche airfield, Minsk, February 1992, with simulated attack armament on 10 external stores pylons (under each intake duct, on each wingtip, three under each wing);

Prototype Sukhoi Su-33UB *(Yefim Gordon)* 1158627

Cockpit of Sukhoi Su-34 1158620

Lavatory and cockpit access of Sukhoi Su-34 1159774

Kh-31A/P (AS-17 'Krypton') ASMs under ducts, R-73A (AA-11 'Archer') AAMs on wingtips; a 500 kg laser-guided bomb inboard, TV/laser-guided Kh-29 (AS-14 'Kedge') ASM on central pylon and RVV-AE (R-77; AA-12 'Adder') AAM outboard under each wing.

Production originally planned for Irkutsk, but eventually located at Novosibirsk. First series production aircraft flew 28 December 1994, although apparently second airframe, first having been delayed for equipment installation. Four were in assembly at Novosibirsk by early 1997. Twelve were once scheduled for delivery by 1998; intention was to replace all Su-24s by 2005; reconnaissance and electronic warfare versions reportedly under development. In September 2000, following increase in funding, Russian Air Forces C-in-C predicted first Su-32 deliveries in 2004, although by early 2002 this had slipped further to "after 2005". Statement of August 2003 indicated delivery between 2006 and 2010 of "a batch" of aircraft to Russian Air Forces, perhaps numbering "several dozen", although first receipts in 2005 or 2006, intended to be 10 aircraft of which half to go to bomber regiment in Chita region of Siberia (possibly 48th Division of 14th Air Force). In April 2005, Novosibirsk plant confirmed first production batch of five to be in hand. Senior officials, speaking in April 2006, predicted arrival of first two production aircraft before end of that year and completion of first regiment of 24 by 2010. Delivery of initial order for 18 contracted as two in 2006, six in 2007 and 10 in 2008; further orders intended to follow at 10 per year, giving fleet of 58 before 2015.

In mid-2001, Sukhoi predicted completion of State testing of Su-32 by end of 2001, using five aircraft based at Akhtubinsk and Zhukovsky. Trials tempo intensified in 2002, work including tests of Sh141 mission avionics suite as replacement for earlier systems found to have been unsatisfactory. However, first phase of State Tests not completed until mid-2003, when second phase begun; this involved three aircraft at Akhtubinsk test centre and four at Zhukovsky. Precision weapon trials, 2004, including bombing with use of Platran E-O system.

Side-by-side cockpit to form basis of proposed Su-30-2 long-range interceptor and Su-33UB (Su-27KUB) carrier trainer.

First production Su-34 rolled out at Novosibirsk on 6 July 2006; this and second earmarked for Chkalov flight test centre at Lipetsk. On 15 June 2006 Air Forces' C-in-C announced selection of AL-31F-M1 engine for production Su-34s.

CURRENT VERSIONS (specific): **T10V-1 '42'**: First flying prototype; detailed above. Converted from Su-27UB airframe by Sukhoi OKB workshops, with new nose built at Novosibirsk, and reportedly fitted with Su-33 main landing gear.

T10V-2 '43': Flown 18 December 1993; first aircraft to be built at Novosibirsk; introduced twin mainwheel bogies. Sometimes described as first production Su-34, in that it had Su-35-type four-hardpoint wing panels and larger internal fuel cells, reinforced wing centre-section, new main landing gear and fixed-geometry engine air intakes. However, Sukhoi now identifies this aircraft as Su-32 prototype, designed to meet Russian Air Forces requirement of 1998.

T10V-3: Static test airframe.

T10V-4 '44': First flown late 1996. Reported at Leninets radar plant, Pushkino, early 1997; first with full avionics and weapons systems, except EW package. Exhibited at Paris Air Show, June 1997. Also became known as Su-32.

T10V-5 '45': First Su-27IB with full Leninets mission avionics fit. Sometimes described as first series-produced T10V. First flew 28 December 1994.

T10V-6 '46': First flown January 1998. Being upgraded in 2005 to full production standard, matching T10V-8.

T10V-7 '47': First flown 22 December 2000. Shown at Moscow in August 2003. Being upgraded in 2005 to full production standard, matching T10V-8.

T10V-8 '48': "First flight" 20 December 2003, but may have flown shortly before. Confirmed as fifth built at Novosibirsk. Full range of avionics and sensors. Shown at Moscow Salon, August 2005.

CURRENT VERSIONS (general): **Su-27R**: Proposed version to replace Su-24MR and MiG-25RB in tactical reconnaissance roles. BKR (*bortovoi kompleks razvedki*: onboard reconnaissance complex) suite expected to include nose-mounted Pika SLAR and ESM, electro-optical, laser and IRLS reconnaissance equipment.

Su-27IBP: Proposed tactical jammer to replace Yak-28PP and Su-24MP.

'Su-27IB Interceptor': Proposed ultra-long endurance combat air patrol variant. OKB's internal designation not known. May be confused reference to Su-33UB-based Su-30K-2 project.

Su-32: Export version. Clearance for marketing was expected in 2006.

Su-32FN/MF: Preseries Su-32FN (T10V-4 '45') first flown 28 December 1994, exhibited at 1995 Paris Air Show; then incorrectly stated to be in production to replace Su-24s of Russian Naval Aviation; programme reportedly suspended early 1997 before a fully equipped true prototype could fly. Su-32MF designation first appeared in 1999 to describe a 'multifunction', export version. Both Su-32 FN and Su-32MF being offered for export from 2006 onwards.

Su-32FN designed to attack hostile submarines and surface vessels by day and night in all weathers, although official drawing shows slightly different shape to nose compared with land attack version; was intended for parallel manufacture at Novosibirsk. Probably common to both types are Su-32MF's active artificial intelligence system to support pilot in critical situations; active gust alleviation smooth-flight system to damp turbulence in low-level flight at high speeds; liquid-crystal EFIS with seven CRTs; and Sorbtsya active ECM jamming pods on wingtips. Planned specialised equipment includes Leninets Sea Dragon avionics suite, with 'Sea Snake' coherent maritime search radar, a ventral sonobuoy pod containing 72 buoys of various types, MAD, IIR, IRTV system and laser range-finder. By early 2002, NIIP offering Osa electronically scanned radar for rear protection and precision weapon targeting because of reported development delays with Leninets suite.

Su-32 'Escort Jammer': Proposed in 2001 by Knirti Institute; four podded jammers (including two at wingtips) and two anti-radiation missiles.

Su-34: Russian Air Forces version.

Details generally as for single-/tandem-seat Su-27, except those below.

CUSTOMERS: Initial production batch of 18 due for delivery between 2006 and 2008.

COSTS: RUR850 million each (2006).

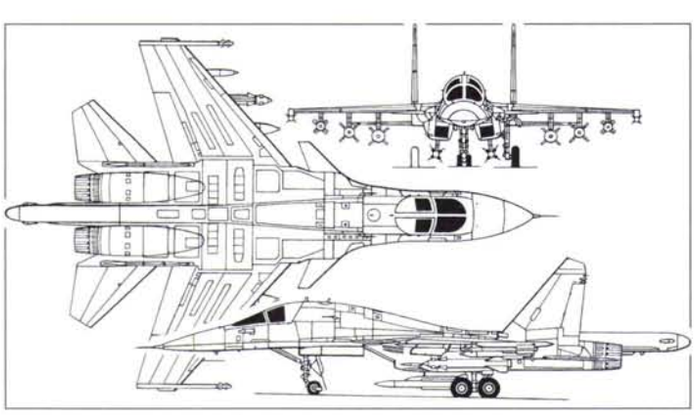
DESIGN FEATURES: One third heavier empty weight, with 50 per cent increase in MTOW, 30 per cent increase in internal capacity, 10 per cent increase in mid-section. Completely new and wider front fuselage built as titanium armoured tub, 17 mm ($^{11}/_{16}$ in) thick; armour adds 1,480 kg (3,262 lb); new EFIS cockpit containing two seats side by side; side-by-side arrangement avoids some duplication of controls and instruments, while promoting better crew co-operation. New avionics suite integrated by Ramenskoye Instrument-making Design Bureau; wing extensions taken forward as chines to blend with dielectric nose housing nav/attack and terrain-following/avoidance radar; deep fairing behind wide humped canopy; small foreplanes; louvres on engine air intake ducts reconfigured; new landing gear; broader chord and thicker tailfins, containing fuel; no ventral fins; and a longer, larger diameter tailcone. This has been raised and now extends as a spine above the rear fuselage to blend into the rear of the cockpit fairing. It houses at its tip a rearward-facing radar to detect aircraft approaching from the rear.

LANDING GEAR: Retractable tricycle type; strengthened twin nosewheel unit with KN-27 wheels, tyre size 680×260, farther forward than on Su-27 and retracting rearward; main units have small tandem KT-206 wheels with tyres size 950×400, carried on links fore and aft of oleo. New down-lock fairings. Twin cruciform brake-chutes repositioned in spine to rear of spine/fairing juncture.

POWER PLANT: Two Salyut-built AL-31F-M1 turbofans, each 132.4 kN (29,760 lb st) in production version. Prototypes had two Saturn/Lyulka AL-31F turbofans; each 74.5 kN (16,755 lb st) dry and 122.6 kN (27,557 lb st) with afterburning. Additional fuel in tailfins and increased capacity No. 1 tank raising total to 12,100 kg (26,676 lb) plus provision for three external tanks totalling 7,200 kg (15,873 lb). Retractable flight refuelling probe beneath port windscreen.

ACCOMMODATION: Two crew side by side on modified K-36DM zero/zero ejection seats with built-in massage function. Access to cockpit via built-in extending ladder to door in nosewheel bay; area protected with 17 mm ($^{2}/_{3}$ in) thick titanium armour; lavatory and galley with air-stove inside deep fuselage section aft of cockpit.

Sukhoi Su-34 T10V-8, fifth Novosibirsk-built *(Yefim Gordon)* 1158623



Sukhoi Su-27IB twin-turbofan theatre bomber *(Mike Keep)* 1159580

AVIONICS: *Radar:* Leninets B004 multifunction phased-array radar with high resolution; rearward-facing radar in tailcone.

Instrumentation: Colour CRT, multifunction displays and helmet-mounted sight for pilot and navigator

Mission: Built-in UOMZ EO IRST sighting system with TV and laser channels, optimised for air-to-ground use. Separate Geofizika podded thermal imaging system planned. New Argon main computer. Sorbtsya active ECM jamming pods under test on Su-27IB prototype 1995.

Self-defence: TsNIRTI electronic warfare system.

ARMAMENT: One 30 mm GSh-301 gun with 150 rounds. Twelve pylons for high-precision self-homing and guided ASMs, comprising Kh-59ME Ovod, Kh-31P/Kh-31A(P) (AS-17 'Krypton'), Kh-29T/TE/L (AS-14 'Kedge') and Kh-41/3M80 Moskit; and KAB-500 and KAB-1500 laser-guided bombs with ranges of 0 to 135 n miles (250 km; 155 miles); R-27 (AA-10' Alamo'), R-73 (AA-11 'Archer') and RVV-AE (R-77; AA-12 'Adder') AAMs

DIMENSIONS, EXTERNAL:

Wing span	14.70 m (48 ft 2¾ in)
Wing aspect ratio	3.5
Foreplane span	6.40 m (21 ft 0 in)
Length (without probe)	23.335 m (76 ft 6¾ in)
Height overall	6 50 m (21 ft 4 in)
Wheel track	4.40 m (14 ft 5¼ in)
Wheelbase	6.60 m (21 ft 7¾ in)

AREAS:

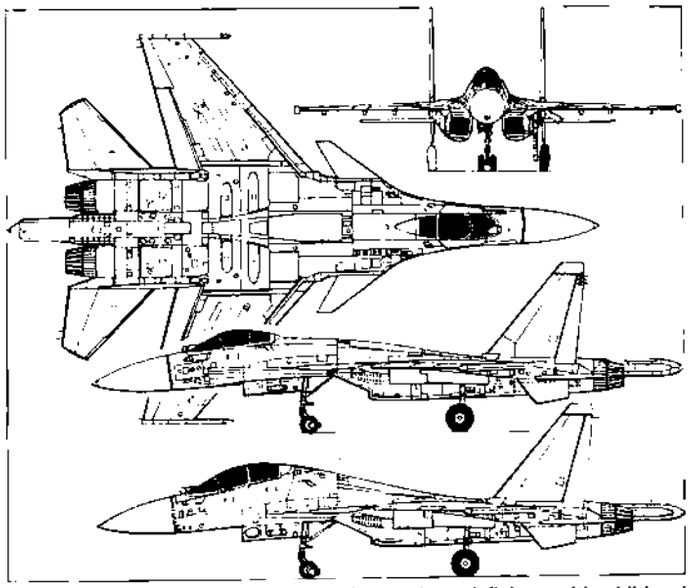
Wings, gross	62 00 m^2 (667.4 sq ft)

WEIGHTS AND LOADINGS (Su-32):

Max external stores	8,000 kg (17,637 lb)
T-O weight: normal	38,240 kg (84,304 lb)
max	44,350 kg (97,774 lb)

PERFORMANCE:

Max speed:	
at height	M1.8 (1,025 kt; 1,900 km/h; 1,180 mph)
at S/L	M1.14 (756 kt; 1,400 km/h; 870 mph)
Service ceiling	15,000 m (49,220 ft)
Combat radius (internal fuel):	
hi-hi-hi	594 n miles (1,100 km; 683 miles)
lo-lo-lo	324 n miles (600 km; 372 miles)
Range with max internal fuel	2,159 n miles (4,000 km; 2,485 miles)



Sukhoi Su-35 single-seat counter-air and ground attack fighter, with additional side view (lower) of Su-35UB *(James Goulding)* 1159579

SUKHOI Su-35 and Su-37 (Su-27SM2)

NATO reporting name: Flanker

TYPE: Multirole fighter.

PROGRAMME: Development of Su-27M authorised on 29 December 1993 by Council of Ministers. Experimental version of Su-27 with foreplanes (T10-24) flew May 1985; improved FBW system and refuelling probe tested by T10U-2. Five prototypes produced by conversion of production Su-27s, retaining single nosewheel and standard tailfins: T10M-1 '701' (ex-1602), then lacking radar and weapon control system (successively T10S-70, T10M, Su-27M, Su-35) flew 28 June 1988; T10M-2 flown 18 January 1989; T10M-5, T10M-6 '706' and T10M-7 '707'; used mainly by NII VVS at Akhtubinsk, flown by service pilots.

Production at KnAAPO, Komsomolsk, beginning with static test airframe T10M-4; first flight (T10M-3 '703') 1 April 1992; latter exhibited at 1992 Farnborough Air Show. Of further six ordered (T10M-8 to 13; '708' to '713'), final aircraft was cancelled. NIIP N011M Bars phased-array radar tested in '711' and '712'. Large-scale series production originally planned 1996–2005 as interim fighter pending availability of (also cancelled) Mikoyan MFI.

Three production aircraft (Blue 86, 87 and 88) delivered to Akhtubinsk from Komsomolsk in 1996 or 1997. In November 2002 it was announced that six Su-35s would be delivered to 237th Aviation Display Regiment (*Russian Knights*) at Kabinka, Moscow. These delivered August 2003. In October 2005, Sukhoi general director announced launch of further Su-35 production at Komsomolsk in 2006. Air Forces' plans being for receipt of 24 by 2010. These expected to have AL-31F-M1 engines, but agreement of 8 June 2006 covered development of upgraded engine (*Izdelie* 117C) by Sukhoi OKB (40 per cent funding), Saturn and UMPO (30 per cent each).

KnAAPO revealed in 2001 that production Su-35s and Su-35UBs will have thrust vectoring AL-31FP engines, thereby negating Su-37 designation.

CURRENT VERSIONS: **Su-35**: (Flanker-E Variant 1): Designation Su-27SM2. Baseline single-seater: *as described.*

Su-35UB: Two-seat (tandem) derivative of the Su-35 with same FCS, canard foreplanes, tall square-topped tailfins, 12-pylon wing, Zhuk main AI radar and N012 rearward-facing, tailcone-mounted radar. Developed as a demonstrator and trainer for the Su-35, the construction of the prototype (Blue 801) at Komsomolsk may have been prompted by the needs of Sukhoi's campaign to sell the Su-35 to South Korea. The aircraft first flew on 7 August 2000 and was reported to be undergoing trials at Akhtubinsk in October 2000. Has 123 kN (27,558 lb st) AL-31FP (AL-31F) thrust-vectoring engines.

Su-35UB has 38,800 kg (83,775 lb) MTOW; 8,000 kg (17,637 lb) combat load; 12,400 litres (3,276 US gallons; 2,728 Imp gallons) internal fuel load; 1,090 kt (2,020 km/h; 1,255 mph) max speed; 1,619 n mile (3,000 km; 1,864 mile) unrefuelled range; wing span 14.70 m (48 ft 2¾ in); length overall 21.94 m (71 ft 11½ in) (shorter tailboom); and height overall 6 355 m (20 ft 10¾ in).

Su-37: (Flanker-E Variant 2) Technology demonstrator for proposed production fighter resulting from vectored-thrust programme of the Su-27UB-PS, Su-27UBL, Su-27LMK No. 2405 and the penultimate prototype Su-35 ('711') which made its first flight, with nozzles fixed, on 2 April 1996 (or 12 April, according to some sources). This aircraft had previously been first of two N011M radar testbeds, flying in blue/grey camouflage. Designated Su-37 by Sukhoi bureau. By September 1996, when demonstrated at Farnborough Air Show (Western debut), in tropical camouflage, '711' had made 50 flights with hydraulically actuated nozzles able to move ±15° in pitching plane at rate of 30°/s under control of aircraft's flight control system. Probably toed-out 32° from the centreline, like Su-30 MKI, generating powerful yawing moment when actuated differentially. An emergency pneumatic system returns the nozzles to level flight setting in the event of system failure.

Any production Su-37 was expected to feature uprated AL-31FU engines (142.2 kN; 31,967 lb st). In 1999, Sukhoi was using designation Su-37MR for proposed production version, apparently reflecting a major avionics upgrade then under way. By 2001, '711' had been retrofitted with non-vectoring AL-31F engines, revised Ramenskoye instrumentation and a new flight control system which was stated to provide TV-type agility without recourse to vectoring; used in trials for Indian Su-30MKI Stage 3.

Second Su-37 reportedly converted from T10M-12 and first flew in mid-1998, initially powered by AL-31F; installation of thrust-vectoring AL-37FPs was expected in late 1998; status of this aircraft, if still extant, remains unclear. Development of AL-31F engine being undertaken unilaterally by MMPP Salyut, version promising 10 to 15 per cent extra thrust having first flown on 24 January 2002 (on Su-27 testbed and lacking Klivit thrust vectoring nozzle).

Su-37 "Terminator": In November 2003, Sukhoi announced that it is developing an upgraded version of Su-37, with capabilities equivalent to a "4++" generation fighter, as a means to securing further export orders before the next-generation Su-47 is available in 2010-12. AL-31F engines, although AL-41F also quoted in relation to **Su-35BM**, which appears to be an alternative designation.

T-50: Design under way by mid-2005 for offer to Russian Air Forces as interim fighter, pending availability of PAKFA in 2015, or later. Preliminary work due for completion in 2006; based on Su-35, but with later standard of avionics.

CUSTOMERS: Once scheduled for entry into Russian Air Forces service as Su-27M from 1995 onwards, for effective operation until 2015–2020; programme in suspension. Indonesia announced imminent purchase in March 2003 of two Su-35s and two Su-27s, to be followed over four years by further 44 'Flankers' of undisclosed type.

COSTS: Estimated USD35 million to USD40 million (2002).

DESIGN FEATURES: Advanced multirole development of Su-27 to counter latest versions of USAF F-15 Eagle and F-16 Fighting Falcon, with better dogfighting characteristics, higher AoA limits, lighter weight and new BVR armament; proposed to include 216 n mile (400 km; 248 mile) range AAM-L (one AAM-L contender was Novator KS- 172). Also planned to have greater autonomy from GCI control. Airframe, power plant, avionics and armament all upgraded; quadruplex digital fly-by-wire controls under development by Avionika, though prototypes retain analogue system; longitudinal static instability; 'tandem triplane' layout, with foreplanes; double-slotted flaperons; taller, square-tip twin tailfins with integral fuel tanks; reprofiled front fuselage for larger-diameter radar antenna; enlarged

Su-35 PROTOTYPES AND PRODUCTION

Batch	Qty	Identity	Remarks
	(1)	T10M-1 '701'	Previously Su-27 1602
	(1)	T10M-2 '702'	Previously Su-27
	(1)	T10M-5 '705'	Previously Su-27
	(1)	T10M-6 '706'	Previously Su-27
	(1)	T10M-7 '707'	Previously Su-27
10	1	T10M-4	Static test airframe
10	1	T10M-3 '703'	First Komsomolsk-built; 237th Regiment '1'
11	1	T10M-8 '708'	
11	1	T10M-9 '709'	
11	1	T10M-10 '710'	
11	1		Static test airframe
11	1	T10M-11 '711'	Converted to Su-37; reverted to Su-35; crashed 19 December 2002
12	3	'86' *et seq*	Production; to 237th Regiment as '3' to '5'
n/k	1	T10M-12 '712'	Radar testbed; 237th Regiment '2'
n/k	1	'801'	Su-35UB

Notes: Former Su-27 aircraft may include 2209 and 2219; numbers '716' and '717' assigned to an Su-30MKI and Su-33UB, respectively

Prototype Sukhoi Su-35UB *(Yefim Gordon)* 1158634

tailcone for rearward-facing radar; twin-wheel nose landing gear; axisymmetric thrust-vectoring nozzles under development for use on production aircraft (see Su-37).

STRUCTURE: Higher proportion of carbon fibre and aluminium-lithium alloy in fuselage; composites used for components such as leading-edge flaps, nosewheel door and radomes.

POWER PLANT: Two Saturn/UFA 117C versions of AL-31F turbofan, each 142.2 kN (31,970 lb st) with afterburning; prototypes retain standard AL-31F. Increased internal tankage through use of welded aluminium-lithium tanks and new tanks in tailfins and finroots. Total fuel capacity 12,900 litres (3,408 US gallons; 2,838 Imp gallons). Retractable flight refuelling probe on port side of nose.

ACCOMMODATION: Pilot(s), on Zvezda K-36D-3.5E zero/zero ejection seat, this now angled back 30°.

AVIONICS: *Radar:* Originally planned to incorporate NIIP N011 Zhuk-27 multimode low-altitude terrain-following/avoidance radar. By 2006, NIIP Irbis being phased-array radar predicted as equipment of production version. N012 rearward-facing radar, range approximately 2 n miles (4 km; 2.5 miles), may enable firing of rearward-facing IR homing AAMs. N011 and N012 constitute RLSU-27 system.

Flight: Fully automatic flight modes and armament control against ground, maritime and air targets, including automatic low-altitude flight and automatic target designation. RPKB nav system includes laser-gyro INS and Glonass GPS.

Instrumentation: Two-seat variant has side-by-side MFI-10-5 screens and HUD in front cockpit; vertically stacked MFI-10-5 screens in rear.

Mission: New-type IRST moved to starboard; small external TV pod; all combat flight phases computerised. Shown at Farnborough with GEC-Marconi TIALD (thermal imaging airborne laser designator) night/adverse visibility pod fitted for possible future use.

Self-defence: Entirely new integrated EW suite with ECM, including active jammer and wingtip Sorbtsa-S G- or J-band ECM/ESM pods; Pastel RWR; Mak IR-based MAWS.

ARMAMENT: One 30 mm GSh-30 gun in starboard wingroot extension, with 150 rounds. Mountings for up to 14 stores pylons, including R-27 (AA-10 'Alamo-A/B/C/D'), R-40 (AA-6 'Acrid'), R-60 (AA-8 'Aphid'), R-73E (AA-11 'Archer') KS-172S-1 and RVV-AE (R-77; AA-12 'Adder') AAMs, Kh-25ML (AS-10 'Karen'), Kh-25MP (AS-12 'Kegler'), Kh-29T (AS-14 'Kedge'), Kh-31P (AS-17 'Krypton') and Kh-59 (AS-18 'Kazoo') ASMs, S-25LD laser-guided rockets, S-25IRS IR-guided rockets, GBU-500L and GBU-1500L laser-guided bombs, GBU-500T and GBU-1500T TV-guided bombs, KMGU cluster weapons, KAB-500 bombs, rocket packs and BrahMos supersonic cruise missile. Maximum weapon load 8,200 kg (18,077 lb).

DIMENSIONS, EXTERNAL:

Wing span over ECM pods	15.16 m (49 ft 8¾ in)
Wing aspect ratio	3.5
Length overall	22.185 m (72 ft 9½ in)
Height overall	6.36 m (20 ft 10¼ in)

AREAS:

Wings, gross	62.04 m² (667.8 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	17,000 kg (37,479 lb)
Max fuel weight	10,250 kg (22,597 lb)
Max combat load	8,500 kg (18,739 lb)
T-O weight: normal max	34,000 kg (74,957 lb)
overload	38,800 kg (85,539 lb)
Max wing loading (normal)	548.4 kg/m² (112.32 lb/sq ft)
Max power loading (normal)	139 kg/kN (1.36 lb/lb st)

PERFORMANCE:

Max level speed:	
at height	M2.35 (1,350 kt; 2,500 km/h; 1,555 mph)
at S/L	M1.14 (756 kt; 1,400 km/h; 870 mph)
Service ceiling	17,200 m (56,440 ft)
Balanced runway length	1,200 m (3,940 ft)
Range: with max internal fuel	1,835 n miles (3,400 km; 2,112 miles)
with flight refuelling	3,401 n miles (6,300 km; 3,914 miles)
g limit	+9

SUKHOI I-21 PAKFA

TYPE: Multirole fighter.

PROGRAMME: Successor programme to original quest for fifth-generation fighter, for which MiG 1.42 and Sukhoi S-37/Su-47 Berkut demonstrators were built. Development began in 1998 to meet Russian Air Forces TTZ (tactical technical assessment) of the same year. Sukhoi-led co-operative project launched May 2001; initially termed LFS (*legkiy frontovoy samolet*: Light Frontline Aircraft), although competition also known as LFI (*legkiy frontovoy istrebitel*: Light Frontline Fighter). Air Forces' project name is PAKFA (*perspektivnyi aviatsionnyi kompleks frontovoi aviatsyi*: Prospective Aviation Complex for Frontal Aviation). In January 2006, Air Forces' C-in-C quoted designation **I-21** for PAKFA, previous T-50 designation now being linked with upgraded Su-37 to function as interim fighter until service entry of PAKFA.

Examining committee established 10 January 2002 to assess competing bids from RSK 'MiG' and AVPK Sukhoi, each of which nominated Yakovlev as associate. On 26 April 2002, Russian Federation Ministry of Industry, Science and Technology declared Sukhoi as lead developer of new aircraft, to be assisted by RSK 'MiG' and Yakovlev as subcontractors. In May 2002, development agreement signed by AVPK Sukhoi, Sukhoi OKB, State Research Institute of Aviation Systems (Gos-NIIAS), Central Aero- and Hydrodynamic Institute (TsAGI), Research Institute of Aero Engine Technology and Production (TsIAM), Central Research Institute of Material (VIAM), National Institute of Aviation Technologies (NIAT), Lyulka/Saturn engine bureau, Ramenskoye Instrument Design Bureau (RPKB), Aviapribor holding company, Aviakosmitcheskoye Oborudvanyye and Vympel and Strela weapon companies. Several manufacturing plants expected to join at later stage. Participation of KnAAPO production plant was agreed in June 2002.

Timetable for PAKFA initially was draft design by end of 2002; first flight in 2006; production from 2010. Official funding equivalent to USD1.5 billion promised for R & D, but this considered inadequate, representing some 20 per cent of needs, excluding production investment. Unit cost expected to be USD35 million to USD40 million (2002 prices), based on production of between 500 and 600 aircraft. By early 2006, schedule had slipped to first flight in 2009 and, according to Air Forces' deputy C-in-C, first delivery in "2015 to 2016". Sukhoi had spent USD100 million on PAKFA by mid-2005.

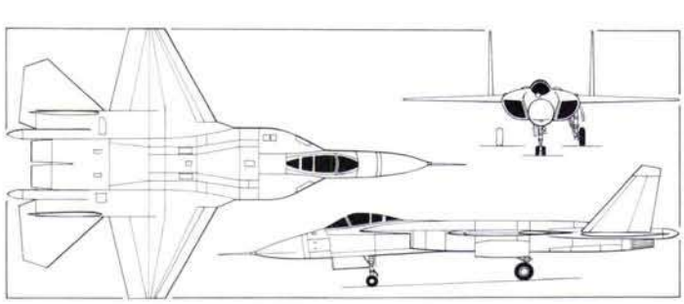
Parameters believed to include 20 tonne MTOW — between MiG-29 and Su-27 types it is due to replace — supersonic cruising speed, low observables, high manoeuvrability and short-field performance. In January 2006, Air Forces revealed that target max level speed had been reduced from Mach 2.15 to 2.0 to assist design. Engine choice yet to be made, but NPO Saturn is offering a derivative of AL-41F1, which was delivered to the Gromov test centre at Zhukovsky in November 2003 to be installed in a flight test aircraft. By November 2005, this Su-27M had flown nearly 30 sorties, initially with one, then with two test engines installed. Suggested that improved AL-31F will power initial PAKFAs, however.

In January 2003, India discussed terms of invitation by Russia to join PAKFA design team. Preliminary details and a probable configuration were unofficially circulating by mid-2003, showing an aircraft similar to the Su-47 Berkut, apart from more conventional wings. Reports of imminent agreement described in November 2005 as premature, although not dismissed.

During 2005, Russian Air Forces' C-in-C, Gen Vladimir Mikhailov, revealed preference for a high/low mix combining PAKFA with a lightened, **single-engine version**, which nevertheless almost identical in other aspects, including avionics. No funding is known for this project.

DIMENSIONS, EXTERNAL:

Wing span	15.5 m (51 ft)
Length overall	23.0 m (75 ft)



Provisional general arrangement of Sukhoi T-50 PAKFA *(James Goulding)* 0567236

Technology demonstrator Sukhoi Su-47 Berkut *(Yefim Gordon)* 1158646

WEIGHTS AND LOADINGS:
T-O weight: normal ..... 24,000 kg (53,000 lb)
max ..... 33,000 kg (72,750 lb)
PERFORMANCE:
Max level speed M2.0
Supercruise speed ..... M1.6+
Radius of action ..... 647 n miles (1,200 km; 745 miles)
Ferry range ..... 2,159 n miles (4,000 km; 2,485 miles)

SUKHOI Su-29

TYPE: Aerobatic two-seat sportplane.

PROGRAMME: Announced at Moscow Air Show '90; design started 1990; construction of first of three prototypes and two static test airframes began 1991; prototype first flew 1991, first production aircraft May 1992; entered service July 1992. AP-23 type certificate awarded in 1994. Assessed by Russian Air Forces experimental centre at Akhtubinsk in 1996–97, but no orders placed.

Following structural failure of Su-29 wing in 1996, remedial manufacturing practices in place and recertified by 1998. Resumed civilian export production now featured M-14PF engine and new propeller, but M-9F engine introduced in 1999. Retrospective installation of SKS-94 pilot's emergency extraction system offered by Sukhoi from 2000.

Production transferred to LAPIK division of RSK 'MiG' (formerly LMZ) at Lukhovitsy from early 2001, earlier aircraft having been built by Sukhoi Advanced Technologies using components manufactured by LMZ, Dubna and others. Only one built in 2001. Six Su-29s and Su-31s reported under construction during 2004, although no reports of delivery up to mid-2006.

CURRENT VERSIONS: **Su-29:** Basic two-seat training/aerobatic aircraft.

Description applies to baseline Su-29.

Su-29AR: Aircraft for Argentina have German propeller, Swiss canopies and US wheel assemblies and avionics, including GPS.

Su-29KS: Development vehicle for Zvezda SKS-94 lightweight crew extraction system. Weight empty, equipped 800 kg (1,764 lb). First exhibited at 1994 Farnborough Air Show. One only (RA-01485); carries designation 'Su-29KS'.

Su-29M: Production version from 1999 (initial series of 10 under construction); M-9F engine; weights as Su-29; no extraction system.

Su-49: Proposed military trainer.

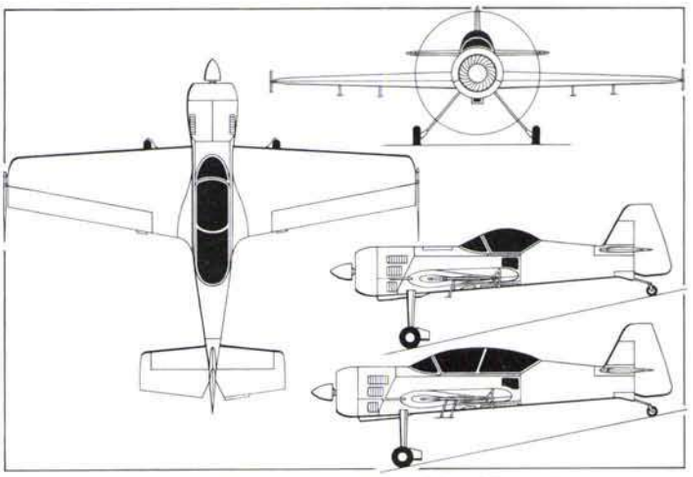
CUSTOMERS: Total 52 basic Su-29s and one Su-29KS built and sold by 1997; many exported to Pompano Air Center, Florida, USA, for reassembly and delivery worldwide (including eight in 1992; 12 in 1993; seven in 1994 and four in 1995); others to Australia (three), Italy, South Africa (two) and UK. Relaunched production from 1999 (initial batch of 10). Eight ordered by Argentine Air Force, for training, March 1997; delivery between September 1997 and August 1998 to Escuadrilla Cruz del Sur (Southern Cross Squadron) based at Mendoza AFB. By mid-2001, Sukhoi had built 166 aerobatic light aircraft of the Su-26/29/31 series, of which all but 10 had been exported, including 80 to the USA. Sukhoi presented two to ruler of unspecified Gulf state, but these not used and eventually sold. Deliveries scheduled in 2002 to customers in the Czech Republic, Germany, Russia, South Korea and Switzerland were, apparently, not effected and there has been no known production since 2003.

COSTS: USD220,000 to USD260,000 (2002).

DESIGN FEATURES: Typical aerobatic competition aircraft; mid-wing of specially developed symmetrical section, variable along span, slightly concave in region of ailerons to increase their effectiveness; leading-edge somewhat sharper than usual to improve responsiveness to control surface movement. Two-seat development of Su-26M single-seat aerobatic competition aircraft; wing span and overall length increased; improved aerodynamics and reduced stability margin for enhanced manoeuvrability. Service life 1,250 hours.

Wing leading-edge sweepback 3° 28', symmetrical section, thickness/chord ratio 16 per cent at root, 12 per cent at tip, dihedral 0°, incidence 0°.

FLYING CONTROLS: Conventional and manual. Elevators and rudder horn-balanced; elevator trim; two suspended triangular balance tabs under each aileron. Later Su-29s have Su-31-type wing with ailerons extending to wingtips. No flaps.



Sukhoi Su-29 with additional side view (upper) of Su-31T *(Mike Keep)* 0015120

STRUCTURE: Composites comprise more than 60 per cent of airframe weight; one-piece wing, covered with honeycomb composites panels; foam-filled front box spar with CFRP booms and wound glass fibre webs; channel section rear spar of CFRP; titanium truss ribs; plain ailerons have CFRP box spar, GFRP skin and foam filling; fuselage has basic welded truss structure of VNS-2 high-strength stainless steel tubing; lower nose section of truss removable for wing detachment; quickly removable honeycomb composites skin panels; light alloy engine cowlings; integral fin and tailplane construction same as wings; rudder and elevator construction same as ailerons; titanium exhaust, battery box and firewall; forged magnesium control linkages. Aircraft assembled by Sukhoi from components produced by LMZ, Dubna (DMZ) and NPO Technologia (at Omsk).

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted spring titanium alloy cantilever mainwheel legs; mainwheels size 400×150, with hydraulic disc brakes; steerable tailwheel, on titanium spring, connected to rudder. Optional composites fairings for mainwheels.

POWER PLANT: One 265 kW (355 hp) VOKBM M-14PT or 294 kW (394 hp) M-14PF nine cylinder radial engine; three-blade MT-Propeller MTV-3-8-S/L250-21 or MTV-9-260 propeller. Current production employs VOKBM M-9F (M-14 derivative) rated at 309 kW (414 hp). Steel tube engine mounting. Fuel tank in fuselage forward of front spar; capacity 63 litres (16,6 US gallons; 13,8 Imp gallons); tank in each wing leading-edge; capacity 106,5 litres (28,15 US gallons; 23,4 Imp gallons); total fuel capacity 276 litres (72,9 US gallons; 60,6 Imp gallons); gravity fuelling. Oil capacity 20 litres (5,3 US gallons; 4,4 Imp gallons). Fuel and oil systems adapted for inverted flight; pneumatic engine starting system.

ACCOMMODATION: Pilot only for aerobatic competition, two persons in tandem for training. Canopy normally opens sideways to starboard; but upward and rearward in emergency to jettison. Dual controls standard. Space for 5 kg (11 lb) baggage in rear fuselage.

SYSTEMS: Electrical system 24/28 V, with 3 kW generator, batteries and external supply socket.

AVIONICS: *Comms:* Briz VHF radio; optional Becker or Bendix/King com/nav and Garmin GPS.

EQUIPMENT: Optional provision for smoke generation.

DIMENSIONS, EXTERNAL:
Wing span ..... 8.20 m (26 ft 10¾ in)
Wing chord: at root ..... 1.985 m (6 ft 6¼ in)
at tip ..... 1.04 m (3 ft 4¾ in)
Wing aspect ratio 5.5
Length overall ..... 7.285 m (23 ft 10¾ in)

Sukhoi Su-29 competition/display aerobatics lightplane *(Paul Jackson)* 1121846

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Sukhoi Su-29 two-seat sportplane *(Yefim Gordon)* 1158182

Height overall	2.885 m (9 ft 5¾ in)
Tailplane span	2.90 m (9 ft 6¼ in)
Wheel track	2.40 m (7 ft 10½ in)
Wheelbase	5.08 m (16 ft 8 in)
Propeller diameter	2.50 m (8 ft 2½ in)
Propeller ground clearance	0.425 m (1 ft 4¾ in)
DIMENSIONS, INTERNAL:	
Cockpit: Length	2.60 m (8 ft 6¼ in)
Max width	0.82 m (2 ft 8¼ in)
Max height	1.05 m (3 ft 5¼ in)
AREAS:	
Wings, gross	12.20 m² (131.4 sq ft)
Ailerons (total)	2.32 m² (24.97 sq ft)
Fin	0.28 m² (3.01 sq ft)
Rudder	0.90 m² (9.69 sq ft)
Tailplane	0.98 m² (10.55 sq ft)
Elevators (total)	1.56 m² (16.79 sq ft)
WEIGHTS AND LOADINGS (two persons):	
Weight: empty	735 kg (1,620 lb)
empty, equipped	780 kg (1,720 lb)
Max fuel	207 kg (456 lb)
Max T-O weight: pilot only	860 kg (1,896 lb)
two persons	1,200 kg (2,645 lb)
Max wing loading	98.4 kg/m² (20.15 lb/sq ft)
Max power loading: M-14PT	4.53 kg/kW (7.45 lb/hp)
M-14PF	4.09 kg/kW (6.71 lb/hp)
M-9F	3.89 kg/kW (6.39 lb/hp)
PERFORMANCE (M-14PT engine):	
Never-exceed speed (VNE)	242 kt (450 km/h; 279 mph)
Max level speed	175 kt (325 km/h; 202 mph)
Landing speed	65 kt (120 km/h; 75 mph)
Stalling speed	62 kt (115 km/h; 72 mph)
Max rate of climb at S/L	960 m (3,150 ft)/min
Service ceiling	4,000 m (13,120 ft)
Max rate of roll	360°/s
T-O run	120 m (395 ft)[1]
Landing run	380 m (1,250 ft)[1]
Range with max fuel	647 n miles (1,200 km; 745 miles)
g limits	+12/−10

[1] *at 914 kg (2,015 lb) AUW*

SUKHOI Su-31

TYPE: Aerobatic single-seat sportplane.

PROGRAMME: Design started 1991; prototype construction began 1992, flew June 1992 as Su-29T, demonstrated at 1992 Farnborough Air Show; followed by two more prototypes and two static test airframes; first production aircraft by Sukhoi Advanced Technologies (RA-01405) flown 1994. Su-31M2 introduced in 1999. Manufacture transferred to RSK 'MiG' (LAPIK at Lukhovitsy) in early 2001; two Su-31Ms, one Su-31 built in 2001.

In XXI World Aerobatic Championships, June 2001, Su-31s gained first place and seven of next 14 places.

CURRENT VERSIONS: **Su-31:** Basic version; non-retractable landing gear. Alternatively known as **Su-31T** (*Turnirnyi*: Competition). See Su-29 drawings for side view.

Su-31M: As Su-31T but with Zvezda SKS-94 pilot's extraction system under modified canopy with deeper frame. Empty weight 760 kg (1,676 lb); normal T-O weight 880 kg (1,940 lb). Prototype RA-01486 converted from Su-31T.

Su-31M2: Improved version of Su-31M with larger wing, airframe weight reduced by approximately 80 kg (176 lb), ergonomically redesigned cockpit, and upgraded Zvezda SKS-94M pilot's extraction system. Prototype scheduled to fly in mid-2003 but completion of engineering mockup was delayed to 2005. This expected to have VOKBM M-9F nine-cylinder radial of 294 kW (394 hp) in view of possible termination of M-14 production.

Su-31X: Export version of Su-31T.

Su-31U: As Su-31T but retractable landing gear. None yet built.

Sukhoi Su-31 flown by Jurgis Kairys *(Paul Jackson)* 1158183

Su-31ChM: Improved version of Su-31M2 under development in 2003 for World Aerobatic Championships competitions; features include airframe weight reduced by 25 kg (55 lb), and 313 kW (420 hp) VOKBM M-9F engine.

CUSTOMERS: Total 25 (including five Su-31Ms) built by late 1998 and exported to Australia, Brazil, Italy, Lithuania, South Africa, Spain, Switzerland, Ukraine, UK and USA. Su-31Ms operated in Italy, Russia and Switzerland. Production batch of five Su-31M2s, 1999–2000, of which at least two to USA; RSK 'MiG' to build initial batch of nine at its LAPIK division (three Su-29s and six Su-31s). Total of six Su-31s were scheduled for delivery in 2002, including two Su-31Ms for the Czech Republic and one Su-31M for a Swiss customer, but only known delivery was of Czech examples (OK-HXB and 'XC) in 2005, increasing total built to 31.

COSTS: USD220,000 to USD260,000 (2003).

DESIGN FEATURES: Basically single-seat version of Su-29 with uprated engine; new landing gear; 35° inclination of seat enables pilot to employ repeatedly a *g* load of +12/−10, giving advantages in controlling aircraft within limited flying area and to perform very complicated manoeuvres; improved field of view; two baggage compartments.

STRUCTURE: More than 70 per cent composites by weight; centre-fuselage is welded truss of high-strength stainless steel tube, with detachable skin panels of honeycomb-filled composite sandwich; rear fuselage is semi-monocoque of composites with honeycomb filler; one-piece two-spar wing with carbon fibre main spar, titanium ribs, covered with honeycomb sandwich skin; tail unit is all-composites; mainwheel legs titanium.

LANDING GEAR: As Su-29.

POWER PLANT: One 294 kW (394 hp) VOKBM M-14PF nine-cylinder radial engine in Su-31T/M; MTV-9 three-blade propeller. Basic fuel capacity 78 litres (20.6 US gallons; 17.2 Imp gallons), in fuselage tank; provision in Russian version for 210 litre (55.5 US gallon; 46.2 Imp gallon) centreline drop tank for ferrying; alternatively, in export version, two tanks in wings, total capacity 200 litres (52.8 US gallons; 44.0 Imp gallons).

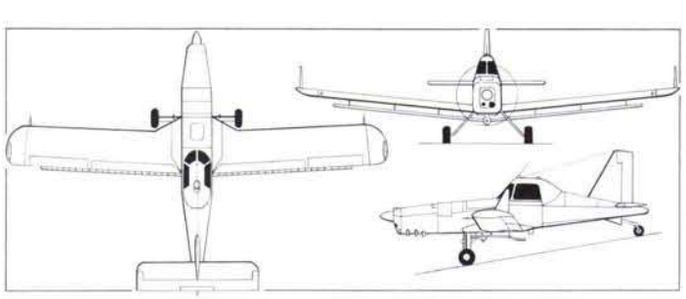
ACCOMMODATION: Pilot only; windscreen and separate canopy, opening as Su-29, except single-piece windscreen/canopy and pilot extraction system in Su-31M and Su-31M2.

DIMENSIONS, EXTERNAL (Su-31T):	
Wing span	7.80 m (25 ft 7 in)
Wing chord: at root	1.99 m (6 ft 6¼ in)
at tip	1.04 m (3 ft 4¾ in)
Wing aspect ratio	5.2
Length overall	6.83 m (22 ft 4¾ in)
Height overall	2.76 m (9 ft 0¾ in)
Tailplane span	2.90 m (9 ft 6¼ in)
Wheel track	2.40 m (7 ft 10½ in)
Wheelbase	4.90 m (16 ft 1 in)
Propeller diameter	2.50 m (8 ft 2½ in)
Propeller ground clearance	0.425 m (1 ft 4¾ in)
AREAS (Su-31T): As Su-29 except:	
Wings, gross	11.83 m² (127.3 sq ft)
WEIGHTS AND LOADINGS (Su-31T, except where otherwise indicated):	
Weight: empty	680 kg (1,499 lb)
empty, equipped: Su-31T	740 kg (1,631 lb)
Su-31M	750 kg (1,653 lb)
Max fuel: internal	53 kg (117 lb)
external	209 kg (461 lb)
T-O weight: normal	835 kg (1,841 lb)
max	968 kg (2,134 lb)
Max wing loading	82.0 kg/m² (16.80 lb/sq ft)
Max power loading: Su-31T/M	3.25 kg/kW (5.34 lb/hp)
PERFORMANCE (Su-31T):	
Never-exceed speed (VNE)	243 kt (450 km/h; 280 mph)
Max level speed	178 kt (330 km/h; 205 mph)
Stalling speed	61 kt (113 km/h; 71 mph)
T-O speed	60 kt (110 km/h; 69 mph)
Landing speed	62 kt (115 km/h; 72 mph)
Max rate of climb at S/L	1,440 m (4,725 ft)/min
Service ceiling	4,000 m (13,120 ft)
Max rate of roll	400°/s
T-O run	110 m (360 ft)
Landing run	300 m (985 ft)
Range, internal fuel	156 n miles (290 km; 180 miles)
Ferry range	432 n miles (800 km; 497 miles)
g limits	+12/−10

SUKHOI Su-38L

TYPE: Agricultural sprayer.

PROGRAMME: Design started, as Su-38, under Boris Rakitin, August 1993; originally based closely on Su-29 sportplane; construction of prototype began January 1994 but curtailed due to financial situation in Russia. Promotion resumed in 1998, under S-38L designation and with considerable change of detail design, including replacement of VOKBM M-14P radial engine. Announced June 2000 that order signed to build prototype, now known as Su-38L. Prototypes fabricated by SmAZ; target of five complete (including two static test) aircraft by second quarter of 2002; first two under assembly at Sukhoi OKB workshops by September 2000. First flight (01) 27 July 2001; public debut at Moscow Salon, 14–19 August 2001, when 01 shown with (static) and without (flying) winglets and then unflown 02 exhibited statically. Compared with earlier drawings and mockup, prototypes have increased length due to additional fuselage plug ahead of wings. By June 2002 two (of three planned) prototypes had completed 60 missions of projected 100- to 150-sortie flight programme, intended to lead to initial certification in September or October 2003. Third prototype's maiden flight delayed from August 2002 to end 2002/early 2003. Initial



Sukhoi Su-38L agricultural aircraft *(James Goulding)*

Prototype Sukhoi Su-38L *(Yefim Gordon)* 0576509

production by SmAZ with target of 20 in 2003, rising to 40 in 2004, and potential for up to 100 aircraft per year. Second production line intended by Razdanmash AOZT of Armenia, subject to acquisition of US$23 million for flight test and tooling. By August 2006 no further progress reports had been received.

CUSTOMERS: Estimated market for 500 in Russia.

COSTS: Unit cost USD100,000 to USD150,000 (2002); direct operating cost USD300 per hour (2001).

DESIGN FEATURES: Conventional low-wing monoplane. Constant-chord wings swept slightly forward and with winglets and root nibs; sweptback fin, plus underfin doubling as tailwheel mount. Chemical hopper between engine and cockpit, capacity 500 litres (132 US gallons; 110 Imp gallons). Service life 3,000 hours/10 years.

FLYING CONTROLS: Conventional and manual. Horn-balanced single-piece elevator and rudder; trim tab in elevator; trailing-edge flaps.

LANDING GEAR: Tailwheel type; fixed. Mainwheel size 8.00-6, tailwheel size 310×135. Hydraulic brakes.

POWER PLANT: One 184 kW (247 hp) LOM M337S six-cylinder engine operating on a 1:2 mix of A-76 and A-92 mogas; LOM B-546 three-blade ground-adjustable propeller. Plans for uprated, 186 kW (250 hp) version in production aircraft. Fuel tank in each wing; total capacity 210 litres (55.5 US gallons; 46.2 Imp gallons).

ACCOMMODATION: Pilot only on energy-absorbing seat; baggage shelf behind seat. Cockpit is pressurised to prevent ingress of chemicals, and incoming air is filtered.

EQUIPMENT: Transland underwing spraybar. Cable cutter/deflector standard.

DIMENSIONS, EXTERNAL:

Wing span	11.53 m (37 ft 10 in)
Length overall	8.10 m (26 ft 6¾ in)
Height overall	2.655 m (8 ft 8½ in)

WEIGHTS AND LOADINGS:

Normal T-O and landing weight	1,200 kg (2,646 lb)

PERFORMANCE (estimated):

Operating speed	81–97 kt (150–180 km/h; 93–112 mph)
Stalling speed	41 kt (76 km/h; 48 mph)
Typical operating altitude	1 to 15 m (3 to 50 ft)
Ferry range:	
with spraybars	486 n miles (900 km; 559 miles)
without spraybars	648 n miles (1,200 km; 745 miles)

SUKHOI Su-80

TYPE: Twin-turboprop transport.

PROGRAMME: First, largest and most advanced design by Sukhoi under *konversiya* programme of former Soviet industry; to replace L-410, An-28, Yak-40 and An-24; certification intended to FAR Pt 25, JAR 25 and AP-25. Work began 1989 on medical evacuation aircraft, then designated S-80, under order from Ministry of Public Health, by Sukhoi-Europe/Asia joint stock company, with founder members Sukhoi Design Bureau ASIC, KnAAPO (which see), Rybinsk Motor Engineering Design Bureau, Ramenskoye Instrument Engineering Design Bureau, and Instrument Engineering R&D Institute. Included in government's civil aviation plan, but minimal funding by public money. Model displayed 1989 Paris Air Show; funding ended with collapse of USSR; project revived 1992, with priority on more marketable passenger and passenger/cargo variants, with imported engines, propellers and avionics.

Manufacture of flying prototype and test airframe under way at KnAAPO's Komsomolsk-on-Amur plant by 1993; Rybinsk TVD-500 turboprop engines originally intended; agreement with General Electric to fit CT7-9 turboprops early 1995; design further refined and military versions reintroduced 1996; first flight scheduled second half 1996 but repeatedly postponed; prototype (RA-82911, in Su-80GP configuration) shown on production line on 15 May 1998 to representatives of Border Guards, MoD, and Magadan, Khabarovsk and Petropavlovsk-Kamchatski airlines; was handed over to Sukhoi for flight test preparation in January 2000 and relocated to Zhukovsky; first flight 4 September 2001; had flown 40 sorties by May 2002.

One static test airframe delivered to SIBNIA at Novosibirsk in early 1998. First four pre-series aircraft manufactured at KnAAPO; initially Nos. 02 and 04 assigned to static testing, but by 2006 this changed to one static and three flying, all four to be of stretched version with additional 1.40 m (4 ft 7 in) fuselage length, increasing passenger capacity from 26 to 30. Work suspended for several years, although resumed in 2005. Initial pre-production aircraft first flew, unregistered, at Komsomolsk on 29 June 2006.

Further batch of eight aircraft under assembly at KnAAPO by mid-2006. Dal'Avia at Khabarovsk expected to be first recipient (three aircraft) in 2009, suggesting further delay of planned March 2008 AP-23/FAR Pt 23 certification.

Nothing further reported of 2003 discussions for possible licensed production in China, South Korea and the United Arab Emirates.

CURRENT VERSIONS: **Su-80GP:** Basic cargo/passenger (*gruzo/passazhirski*) version.

Detailed description applies specifically to Su-80GP; generally to all versions.

Su-80M: Medical evacuation (10 casualties) version.

Su-80P: Passenger (*passazhirski*) version.

Su-80PT: Patrol transport, embodying Leninets Strizh (martin) avionics suite, with undernose 360° search radar and rotating electro-optic (FLIR/LLLTV) sensor turret under centre-fuselage; one operator's console in cabin. Able to perform 6 to 9 hour patrol missions over sea and land frontiers up to 189 n miles (350 km; 217 miles) from base; personnel and cargo transportation; and airdropping up to 20 paratroops and/or cargo. Flight crew of two or three.

Maiden flight of first pre-production Sukhoi Su-80GP at Komsomolsk on 29 June 2006 1162402

First take-off of pre-production Su-80GP 1162403

Su-80TD: Troop, paratrooop (total 21), freight and medevac transport, generally similar to civil S-80GP, but with mechanised cargo-handling equipment.

CUSTOMERS: Market for 160 to 200 domestic sales estimated in 2001. Interest from 15 domestic customers in late 2002; export prospects include Argentina, China, Czech Republic, Indonesia, Malaysia, Thailand and Vietnam. Proposed for Russian Air Forces' future tactical military transport aircraft requirement and for Malaysian maritime patrol aircraft requirement. Total of 64 orders held by late 2002.

COSTS: Notionally funded by Russian Federation government but, by early 1997, KnAAPO had invested over RUR20 billion in development, compared with RUR1.5 billion received from official sources. KnAAPO investment raised to RUR1.7 billion by 2006. Of USD20 million expended by mid-2000, two-thirds provided by KnAAPO; thereafter, Sukhoi providing funds for flight test programme, estimated as further USD20 million. Flyaway price RUR230 to RUR280 million (2006 estimate).

DESIGN FEATURES: Utility freighter with unobstructed rear access for loading and wide track landing gear. Basically conventional high-wing, podded fuselage, twin-boom, rear-loading configuration, but with short tandem-wing surfaces between each tailboom and rear fuselage; unswept wings of high-aspect ratio with no dihedral or anhedral; large-span constant chord inner panels; small sweptback winglets on tapered outer panels; sweptback vertical tail surfaces, toed slightly inward, with bridging horizontal surfaces. Systems, accessories and components of Su-25, Su-27 and Su-35 embodied in Su-80. Automatic built-in systems testing.

FLYING CONTROLS: Conventional and manual. Actuation by rods and cables; flaps in three sections per wing with one section inboard of boom; split ailerons with two trim tabs on port side and one on starboard, electrically actuated; electrically actuated trim tab in each rudder.

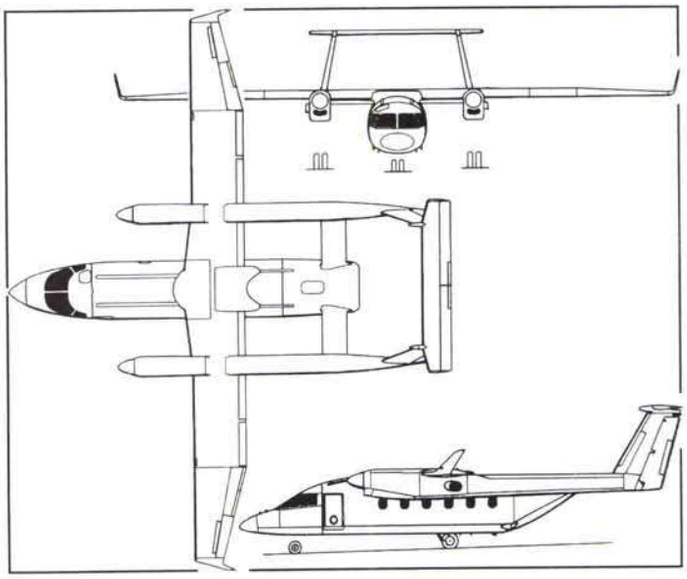
STRUCTURE: Materials used in construction comprise 70 per cent aluminium alloy, 8 per cent composites, 6 per cent steel, 6 per cent titanium, 2.5 per cent stainless steel, 7 per cent other non-metals and 0.5 per cent other metals.

Fuselage reinforcement band in line with propellers.

LANDING GEAR: Retractable tricycle type; main units retract rearwards and are enclosed by four sequenced doors per side; nose unit retracts rearwards with two sequenced doors; twin wheels on each unit; main units retract into tailbooms; mainwheel tyre size 660×200-356; nosewheel tyres 500×170-254; nosewheels steerable ±38°.

POWER PLANT: Two 1,305 kW (1,750 shp) General Electric CT7-9B turboprops; production aircraft with engines built locally by GE-Saturn Aero Engines; Hamilton Sundstrand 14RF-35 feathering and reversible-pitch four-blade propellers. Provision for engine to function as APU with propeller stationary. Two fuel tanks, total capacity 3,656 litres (966 US gallons; 804 Imp gallons).

ACCOMMODATION: Two pilots and 30 passengers in four-abreast seating at 76 cm (30 in), or 3,300 kg (7,275 lb) of freight or mission equipment. All accommodation pressurised and air-conditioned. Baggage space, lavatory, wardrobe or galley at front, as specified by



Production version of Sukhoi Su-80 1162418

customer. Rear ramp space utilised for luggage racks. Available in 'Salon' configuration with nine, 12 or 16 passenger seats. Typical freighter has a row of seats behind flight deck and unobstructed main hold for a small vehicle or cargo. Door at centre of cabin on port side; hydraulically actuated; rear-loading ramp; emergency door on starboard side, opposite main door.

SYSTEMS: Electrical system developed by Lucas Aerospace and Auxilec. Anti-icing system by Goodrich. APU for autonomous operation at remote, unprepared sites.

AVIONICS: Integration by Elektroavtomatika.

Comms: Com/nav, identification and ATC equipment. VOR/DME/ILS for ICAO Cat. II operation of Russian manufacture.

Flight: Elektroavtomatika PNK-80 navigation system. AFCS and autopilot and satellite nav system of Russian manufacture.

Instrumentation: Russian-manufactured five-screen EFIS proposed for production aircraft.

EQUIPMENT: Options include equipment for air photography.

ARMAMENT: (Su-80PT) Typically 23 mm GSh-23L gun pod pylon-mounted on starboard side of cabin; four underwing pylons for electro-optical ASM, 20-round rocket pack, cluster of eight Vikhr tube-launched missiles and R-60 (AA-8 'Aphid') self-defence AAM.

DIMENSIONS, EXTERNAL:

Wing span	23.17 m (76 ft 0¼ in)
Wing chord: at root	2.16 m (7 ft 1 in)
at tip	1.20 m (3 ft 11¼ in)
Wing aspect ratio	12.2
Length overall	18.26 m (59 ft 10¾ in)
Height overall	5.52 m (18 ft 1¼ in)
Tailplane span	7.00 m (22 ft 11½ in)
Wheel track	6.30 m (20 ft 8 in)
Wheelbase	6.34 m (20 ft 9½ in)
Propeller diameter	3.35 m (11 ft 0 in)
Propeller ground clearance	1.10 m (3 ft 7¼ in)
Distance between propeller centres	6.30 m (20 ft 8 in)
Passenger door/rear loading ramp:	
Height	1.82 m (5 ft 11¾ in)
Width	1.89 m (6 ft 2½ in)
Crew door/Type II emergency exit:	
Height	1.275 m (4 ft 2¼ in)
Width	0.76 m (2 ft 6 in)
Type II emergency exits (each):	
Height	1.315 m (4 ft 3¾ in)
Width	0.51 m (1 ft 8 in)
Type III emergency exits (each):	
Height	0.915 m (3 ft 0 in)
Width	0.51 m (1 ft 8 in)

DIMENSIONS, INTERNAL:

Cabin: Length, excl ramp	7.75 m (25 ft 5 in)
Max width	2.17 m (7 ft 1½ in)
Max height	1.82 m (5 ft 11¾ in)
Volume, incl ramp	approx 30.65 m³ (1,082 cu ft)

AREAS:

Wings, gross	44.36 m² (477.5 sq ft)
Ailerons (total)	3.72 m² (40.04 sq ft)
Trailing-edge flaps (total)	7.10 m² (76.42 sq ft)
Fins (total)	5.75 m² (61.89 sq ft)
Rudders (total)	2.55 m² (27.45 sq ft)
Horizontal tail surfaces	8.17 m² (87.94 sq ft)
Elevators (total)	3.22 m² (34.66 sq ft)

WEIGHTS AND LOADINGS (A: Su-80GP passenger; B: Su-80GP cargo):

Max payload: A	2,730 kg (6,019 lb)
B	3,300 kg (7,275 lb)
Max fuel: A, B	2,870 kg (6,327 lb)
Payload with max fuel: A	1,280 kg (2,822 lb)
B	1,630 kg (3,594 lb)
Max T-O weight: A, B	14,200 kg (31,306 lb)
Max ramp weight: A, B	14,350 kg (31,636 lb)
Max wing loading: A, B	326.8 kg/m² (66.95 lb/sq ft)
Max power loading: A, B	5.56 kg/kW (9.13 lb/shp)

PERFORMANCE(estimated):

Max cruising speed	254 kt (470 km/h; 292 mph)
Normal cruising speed	232 kt (430 km/h; 267 mph)
Econ cruising speed	227 kt (420 km/h; 261 mph)
Max certified altitude	6,000 m (19,685 ft)
Service ceiling	7,600 m (24,934 ft)
T-O run	840 m (2,756 ft)
T-O balanced field length	1,300 m (4,265 ft)
Landing run with propeller reversal	460 m (1,509 ft)
Range: with max payload:	
A	755 n miles (1,400 km; 869 miles)
B	567 n miles (1,050 km; 652 miles)
Range with max fuel: A, B	1,322 n miles (2,450 km; 1,522 miles)
Ferry range: A, B	1,457 n miles (2,700 km; 1,677 miles)

OPERATIONAL NOISE LEVELS: Designed to conform to FAR Pt 36 standards

SUKHOI SUPERJET 100

TYPE: Regional jet airliner.

PROGRAMME: On 13 April 2001, Rosaviakosmos and The Boeing Company agreed to joint development and marketing of the Russian Regional Jet (RRJ; transliterated into Cyrillic as RRZh, but also known by Sukhoi as *grazhdanskie samolet*: Civil Aircraft). At the Paris Air Show on 21 June 2001 it was announced that AVPK Sukhoi (Sukhoi Civil Aircraft) will lead the design and manufacture of the aircraft, with Ilyushin holding responsibility for certification, and Boeing handling marketing, sales, leasing and after-sales support. Three firms signed agreement 20 July 2001.

Provisional configuration and specification announced 13 August 2001, on eve of Moscow Salon. Initial phase of feasibility studies between June and December 2001; second phase completed in July 2002. Announced as winner of Russian Aviation & Space Agency (*Rosaviakosmos*) tender on behalf of Russian government for 200 regional jets on 12 March 2003; agreement on long-term co-operation between Sukhoi and Boeing signed next day. System suppliers conference 21–23 January 2004. Preliminary design review conducted with Boeing participation between 23 and 30 April 2004; first flight of first of six planned prototypes expected in 2007, with Russian AP-25 and FAR/JAR-25 certification and service entry in October 2008. Irkut originally intended as sole production centre, but in February 2003 KnAAPO at Komsomolsk-on-Amur was nominated to build RRJ-95 version as second production centre, with alternative site under consideration in late 2005. Target combined initial output of 60 aircraft per year. Development will focus initially on this version following poor market response to proposed RRJ-60 and RRJ-95 versions. RRJ-75 and -95 to be certified simultaneously, with-60 to follow. RRJ Airline Council established November 2003 with Western members to advise on specification. A stretched 100-110-seat version was under study in early 2006.

Model of Sukhoi RRJ-95 *(Paul Jackson)* 1159167

CURRENT VERSIONS: **RRJ-60:** Formerly RRJ-55. Shrunk version; two fuselage sections, of 1.00 m (3 ft 3½ in) and 1.50 m (4 ft 11 in) respectively, removed fore and aft of wing.

RRJ-60LR: Long-range version.

RRJ-75B: Baseline version.

RRJ-75LR: Long-range version.

RRJ-95: Stretched version; two plugs, one of 1.50 m (4 ft 11 in) and one of 2.00 m (6 ft 6¾ in) respectively, inserted fore and aft of wing.

RRJ-95LR: Long-range version.

RBJ: Proposed business jet version, under study in early 2004.

CUSTOMERS: Launch customer Aeroflot ordered 30 RRJ-95s in two-class configuration for delivery between November 2008 and 2011, replacing Tuoplev TU-1345; Russian Finance Leasing Corporation has ordered 10; Concord Aviation of Dubai has signed a letter of intent for 20 RRJ-95s, plus 20 options, for lease to airline operators; Siberia Airlines has indicated a requirement for up to 50 RRJs; GTK Rossiya, which provides air transport for the President of Russia, has a requirement for four RRJs. Production expected to total 600 by 2020, and final total of 800, of which some 40 per cent are expected to be ordered by CIS airlines, the remainder for export customers.

COSTS: Development costs estimated at USD913 million, plus USD684 million for engine (both 2005). Unit cost estimated at USD27 million (2006).

DESIGN FEATURES: Low-mounted, sweptback wings with podded engine on each. Sweptback horizontal and vertical tail surfaces. Airframe design optimised on RRJ-75 with goal of maximum commonality across the range of models.

FLYING CONTROLS: Fly-by-wire, with sidestick controllers.

STRUCTURE: Primarily aluminium alloy. Announced suppliers/supply partnerships include: B/E Aerospace (cabin interior and oxygen system); Air Cruiser (emergency rescue equipment); Curtiss-Wright Autronics (fire protection system); Dassault Systèmes/IBM (product lifecycle management); Goodrich (wheels and brakes); Hamilton Sundstrand (electrical system); Honeywell/MMPP Salyut (APU); Intertechnique/OAO Apris (fuel system); IPECO (pilots' seats); Messier Dowty/OAO Gidromash (landing gear); Liebherr/OAO Ehlektropribor (FBW control system); Liebherr/OAO Teploobmennik (air-conditioning, pressurisation control and anti-icing systems); Messier-Dowty (landing gear); Parker Aerospace (hydraulic system); Sully (windows); Thales/OAO Aviaproborholding (avionics and cockpit displays) and Vibro-Meter SA (engine vibration system).

LANDING GEAR: Retractable tricycle type. Twin wheels on each unit, with option of four-wheel high flotation bogey on main units.

POWER PLANT: Two Snecma/NPO Saturn Power Jet SM146 turbofans, with FADEC, pod-mounted beneath wings, each rated at 60.0 kN (13,500 lb st) to 68.5 kN (15,400 lb st), according to version; 68.5 kN (15,400 lb st) to 77.8 kN (17,500 lb st) with automatic power reserve. Fuel capacity 13,135 litres (3,470 US gallons; 2,889 Imp gallons).

ACCOMMODATION: Overhead baggage bins allow 0.08 m³ (2.74 cu ft) per passenger. Underfloor baggage compartments beneath front and rear of cabin.

RRJ-60: Seats 60 passengers at 81 cm (32 in) seat pitch, or 68 passengers at 76 cm (30 in), all in single class accommodation in 3 + 2 abreast configuration, with two lavatories.

RRJ-75: Seats 75 passengers at 81 cm (32 in) seat pitch, or 83 passengers at 76 cm (30 in), all in single class accommodation with two lavatories and full-size or small forward galley, respectively; or 10 first class passengers at 89 cm (35 in) seat pitch and 58 tourist class passengers at 76 cm (30 in) in two-class configuration, with three lavatories and full-size forward galley.

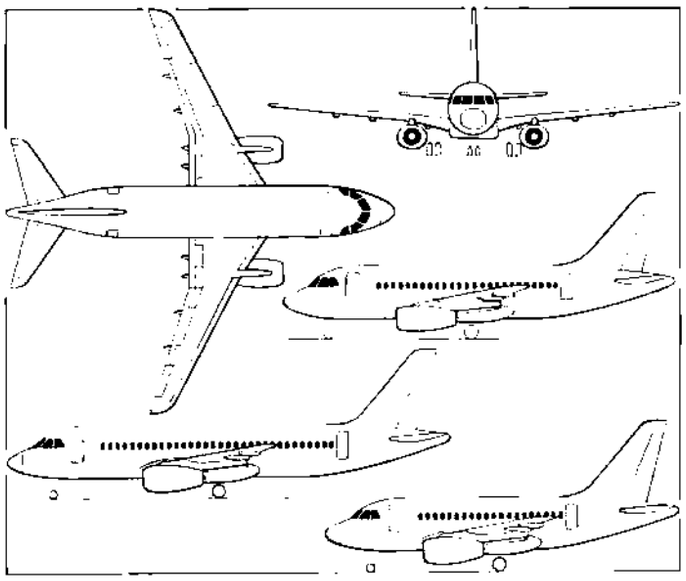
RRJ-95: Seats 95 passengers at 81 cm (32 in) seat pitch, or 105 passengers at 76 cm (30 in), all in single class accommodation with two lavatories and full-size or small forward galley respectively; or eight first class passengers at 91 cm (36 in) seat pitch and 78 tourist class passengers at 84 cm (33 in) in two-class configuration, with three lavatories and full-size forward galley.

AVIONICS: Thales 'Top Deck' five-tube EFIS cockpit based on that of Airbus A380. Cat. IIIa landing capability.

All data are provisional.

DIMENSIONS, EXTERNAL:

Wing span	27.80 m (90 ft 2¾ in)
Wing aspect ratio	9.8
Length overall: RRJ-60	23.87 m (80 ft 4½ in)
RRJ-75	26.33 m (86 ft 4½ in)
RRJ-95	29.83 m (97 ft 10½ in)
Fuselage: Max width	3.46 m (11 ft 4¼ in)
Max depth	3.62 m (11 ft 10½ in)
Height overall	10.28 m (32 ft 10½ in)
Tailplane span	10.03 m (32 ft 10¾ in)
Wheel track	5.74 m (18 ft 10 in)
Wheelbase: RRJ-60	8.40 m (27 ft 6¾ in)
RRJ-75	9.26 m (30 ft 4½ in)
RRJ-95	11.26 m (36 ft 11¼ in)
Main passenger door (port, fwd):	
Height	1.83 m (6 ft 0 in)
Width	0.86 m (2 ft 9¾ in)
Passenger door (port, rear): Height	1.83 m (6 ft 0 in)
Width	0.76 m (2 ft 6 in)
Service doors (stbd, fwd and rear): Height	1.65 m (5 ft 5 in)
Width	0.76 m (2 ft 6 in)



Sukhoi RRJ-75, with additional side views of RRJ-95 (centre) and RRJ-60 (bottom) *(James Goulding)* 0580543

Baggage doors: Height 0.89 m (2 ft 11 in)
Width 1.22 m (4 ft 0 in)

DIMENSIONS, INTERNAL:

Cabin:
Length: RRJ-60 14.65 m (48 ft 0¾ in)
RRJ-75 17.15 m (56 ft 3¼ in)
RRJ-95 20.65 m (67 ft 9 in)
Width: max 3.26 m (10 ft 8¼ in)
at floor 3.00 m (9 ft 10 in)
Max height 2.12 m (6 ft 11½ in)
Overhead bins (per passenger) 0.06 m³ (2.12 cu ft)
Baggage hold:
forward:
Length: RRJ-60 2.475 m (8 ft 1½ in)
RRJ-75 3.475 m (11 ft 4¾ in)
RRJ-95 4.975 m (16 ft 3¾ in)
Height: all 1.015 m (3 ft 4 in)
Volume: RRJ-60 4.97 m³ (175.5 cu ft)
RRJ-75 6.97 m³ (246.0 cu ft)
RRJ-95 9.99 m³ (352.8 cu ft)
aft:
Length: RRJ-60 3.47 m (11 ft 4½ in)
RRJ-75 4.97 m (16 ft 3¾ in)
RRJ-95 6.97 m (22 ft 10½ in)
Height: all 1.015 m (3 ft 4 in)
Volume: RRJ-60 6.11 m³ (215.8 cu ft)
RRJ-75 9.13 m³ (322.4 cu ft)
RRJ-95 13.15 m³ (464.4 cu ft)

AREAS:

Wings, gross 77.00 m² (828.8 sq ft)
Flaps (total) 13.90 m² (149.62 sq ft)
Fin 15.40 m² (165.76 sq ft)
Tailplane 19.60 m² (210.97 sq ft)

WEIGHTS AND LOADINGS:

Max fuel weight:
RRJ-60, RRJ-75, RRJ-95 9,550 kg (21,054 lb)
RRJ-60LR, RRJ-75LR, RRJ-95LR 12,690 kg (27, 977 lb)
Max payload:
RRJ-60, RRJ-60LR 7,350 kg (16,204 lb)
RRJ-75, RRJ-75LR 9,440 kg (20,812 lb)
RRJ-95, RRJ-95LR 12,250 kg (27,007 lb)
Max T-O weight: RRJ-60 35,790 kg (78,903 lb)
RRJ-60LR 38,950 kg (85,870 lb)
RRJ-75 38,820 kg (85,583 lb)
RRJ-75LR 42,280 kg (93,211 lb)
RRJ-95 42,520 kg (93,740 lb)
RRJ-95LR 45,880 kg (101,148 lb)
Max landing weight: RRJ-60, RRJ-60LR 32,000 kg (70,548 lb)
RRJ-75, RRJ-75LR 35,000 kg (77,162 lb)
RRJ-95, RRJ-95LR 39,400 kg (86,862 lb)
Max wing loading: RRJ-60 464.8 kg/m² (95.20 lb/sq ft)
RRJ-60LR 505.8 kg/m² (103.60 lb/sq ft)
RRJ-75 504.2 kg/m² (103.26 lb/sq ft)
RRJ-75LR 549.1 kg/m² (112.46 lb/sq ft)
RRJ-95 552.2 kg/m² (113.10 lb/sq ft)
RRJ-95LR 595.8 kg/m² (122.04 lb/sq ft)

PERFORMANCE:

Cruising speed: max M0.81
normal M0.78
Approach speed at max landing weight:
RRJ-60, RRJ-60LR 120 kt (222 km/h; 139 mph)
RRJ-75, RRJ-75LR 127 kt (235 km/h; 146 mph)
RRJ-95, RRJ-95LR 135 kt (250 km/h; 155 mph)
Initial cruise altitude 10,670 m (35,000 ft)
Max certified altitude 12,497 m (41,000 ft)
T-O field length: RRJ-60 1,277 m (4,190 ft)
RRJ-60LR 1,518 m (4,980 ft)
RRJ-75 1,585 m (5,200 ft)
RRJ-75LR 1,600 m (5,249 ft)
RRJ-95 1,620 m (5,315 ft)
RRJ-95LR 1,910 m (6,266 ft)
Landing field length:
RRJ-60, RRJ-60LR 1,264 m (4,147 ft)
RRJ-75, RRJ-75LR 1,352 m (4,436 ft)
RRJ-95, RRJ-95LR 1,493 m (4,898 ft)
Range with max payload:
RRJ-60 1,730 n miles (3,204 km; 1,990 miles)
RRJ-60LR 2,629 n miles (4,870 km; 3,026 miles)
RRJ-75 1,727 n miles (3,200 km; 1,988 miles)
RRJ-75LR 2,629 n miles (4,870 km; 3,026 miles)
RRJ-95 1,684 n miles (3,120 km; 1,938 miles)
RRJ-95LR 2,478 n miles (4,590 km; 2,852 miles)

TUPOLEV

TUPOLEV OAO
(TUPOLEV JSC)
AVIATSIONNY NAUCHNO-TEKHNISHESKY KOMPLEKS IMENI A N TUPOLEVA OAO
(AVIATION SCIENTIFIC-TECHNICAL COMPLEX NAMED FOR A N TUPOLEV JSC)

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HEAD OF ECONOMIC RELATIONS: Evgeny Efimov

Under decree of 30 June 1999, Tupolev PSC (Public Stock Company) formed 30 July 1999, combining Tupolev design bureau and Aviastar production plant at Ulyanovsk, with financial interest from Russian government amounting to 51 per cent, plus 43.6 per cent from Aviastar. PSC also holds intellectual rights to Tupolev designs previously owned by government. New entity was recertified by Interstate Aviation Committee Aviation Registrar in December 2000. Kazan plant will be incorporated later.

Other activities include sales and leasing of jet transports, aircraft operation and after-sales support. Tupolev Aviation Leasing Company supplies Tu-204, Antonov An-124 and Yakovlev Yak-40 transports.

Tupolev Bureau was founded by Andrey N Tupolev (1888–1972) on 22 October 1922 and concentrated primarily on large military and civil aircraft until the early 1990s; Andrey A Tupolev (1925–2000) succeeded his father as General Designer; since 1922, Bureau has designed 300 aircraft, of which nearly 90 were built as prototypes and 35 placed in production; current effort is 80 per cent civil programmes.

It was suggested in 1998 that Tupolev had begun preliminary design of a new bomber to replace the Tu-160 and, probably, Tu-95/142; this would enter service some time after 2010 and may be based on earlier studies, such as the Tu-202 bomber of the 1980s or the more recent Tu-404 700/850-seat airliner. Continued work was confirmed in late 2002, although as a private study and "based on a new concept", which "is at the very earliest stage". By December 2004, C-in-C of Russian Strategic Air Force was hinting that 'fifth generation' bomber would be based on Tu-160, noting that, "It is not necessary to create a principally new aeroplane, since the Tu-160 has achieved only 60 per cent of its capabilities".

In addition, Bureau remains heavily committed to the development of a civil supersonic transport aircraft and of cryogenic fuels for jet and turboprop transports.

Tupolev's head office, main design bureau and experimental facility are in Moscow; Tomilino branch and flight research centre at Zhukovsky; and design offices at Samara, Kazan and Voronezh.

TUPOLEV Tu-160

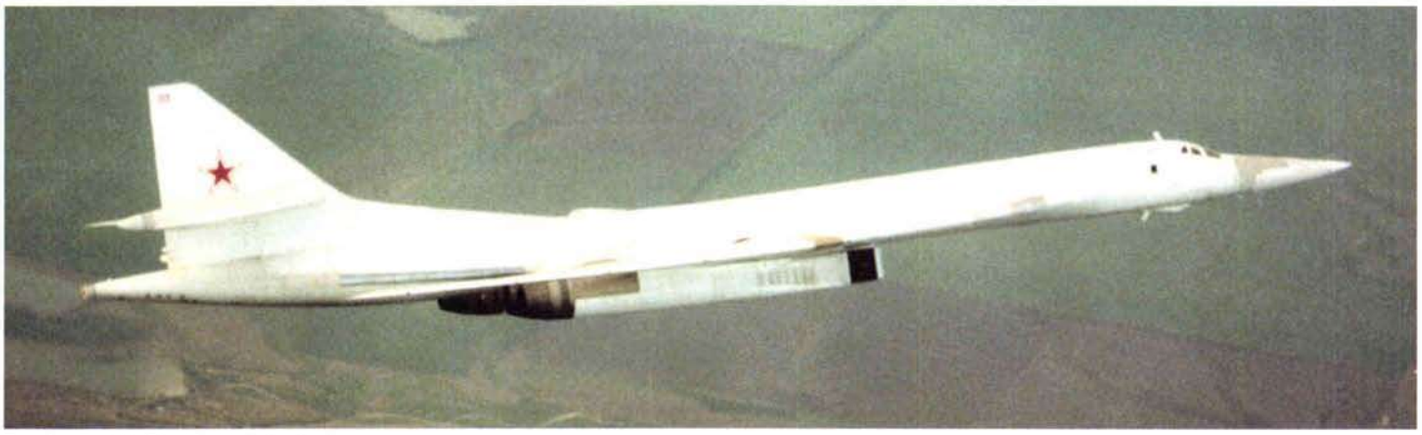
NATO reporting name: Blackjack
Unofficial name: Belyi Lebed (White Swan)

TYPE: Strategic bomber.

PROGRAMME: Designed as Article 70 (or Aircraft K) under leadership of Valentin I Bliznuk; programme began 1967, but relaunched following issue of more modest specification in 1970; competitors were Myasishchev M-18 and Sukhoi T-4MS; derived from unbuilt Tu-135 bomber and Tu-144 derivatives; won design competition in 1972; incorporated some features from M-18. First of two prototypes (70-01) observed by intelligence source at Zhukovsky flight test centre 25 November 1981 (photographed from landing airliner); first flew 18 or 19 December 1981; first exceeded M1.0 February 1985; second (production-standard) aircraft first flew 7 October 1984. Third prototype (70-03) set world records for altitude, speed in a closed circuit and weight-to-altitude on 31 October 1989. Further nine closed-circuit records established 22 May 1990 by aircraft '70-304'; total 57 records including 44 world records, held by Tu-160s at various times.

Second production aircraft lost in pre-delivery take-off crash, March 1987; US Defense Secretary Frank Carlucci invited to inspect 12th aircraft built, at Kubinka air base, near Moscow, 2 August 1988; deliveries to 184th Guards Heavy Bomber Aviation Regiment, Priluki airbase, Ukraine, began April 1987; equipment of 1096th HBAR at Engels from 16 February 1992, but only six received before production at Kazan airframe plant terminated 1992; of 100 aircraft due to be built, at least 32 (including prototypes) accounted for by mid-1990s while Tupolev confirmed in 2004 production of 33, of which 20 remaining. Figures apparently do not reflect three uncompleted airframes gradually being assembled at Kazan.

In 2001, Russia was reported to be formulating a Tu-160 upgrade, to be undertaken at Kazan, which includes provision for a conventionally armed cruise missile. Upgrade of 15 aircraft was agreed late 2001 and formally announced at Kazan on 18 January 2002; work will extend service lives to 2030; first upgrade candidate was delivered to Kazan on 5 April 2002. In October 2002, Tupolev confirmed this to be a two-stage upgrade, the first part



Tupolev Tu-160 'Blackjack' *(Yefim Gordon)* 1153783

(2003–04) concentrating on the addition of new weapons and the second, at an unspecified date, involving new avionics for navigation, attack and electronic warfare, with high degree of commonality with parallel Tu-22M and Tu-142 (Tu-95MS) upgrades.

One Tu-160 prototype will participate in development of a 'significantly different', fifth-generation bomber, according to December 2004 statement by Strategic Air Force commander, who also revealed that existing Tu-160s were then only half-way through service lives.

CURRENT VERSIONS: **Tu-160: ('Blackjack')** Strategic bomber.

Tu-160SK: Commercialised, demilitarised version, as carrier component of Burlak aviation space launch system; Burlak-Diana two-stage rocket, carrying payload, under fuselage on centreline mount. Announced at Singapore Air Show '94; proposed by Russian partners MKB-Raduga, OKB MEI and Tupolev, with German company OHB-System. At the 1995 Paris Air Show, Tu-160 0401 was exhibited statically (the type's Western debut) with a model Burlak rocket below the fuselage. Development of the system continued even after the German government withdrew funding in 1998, and may form the basis of the Ukrainian/PIC HAAL-2000 programme.

Tu-160M: Proposed stretched variant carrying two 2,700 n mile (5,000 km; 3,107 mile) range hypersonic Kh-90 missiles.

Tu-160P: Proposed very long-range escort fighter.

Tu-160PP: Proposed escort jammer.

Tu-160R: Proposed strategic reconnaissance platform.

CUSTOMERS: Manufacture totalled 33 up to 2000; believed to comprise three prototypes (70-01, 70-02 and 70-03) and 30 production aircraft (0101 to 0110, 0201 to 0210 and 0401 to 0410). In January 2001, Russia had seven operational Tu-160s; a further eight undergoing refurbishment for delivery over following months; and one actively under construction. Five more prototype and trials aircraft unserviceable at Zhukovsky during late 1990s ('18', '29', '30', '86' and '87'), plus sixth resident (0401 '63') as airworthy testbed. On 22 December 2005, 0401 was named *Boris Ivanovich Veremey*, still at Zhukovsky; at that time, total of 14 other Tu-160s in Air Forces service.

Of original deliveries, Ukraine government seized 19 at Priluki on achieving independence, pre-empting planned transfer to Engels; purchase of these by Russia was subject to protracted negotiations, and aircraft deteriorated in storage; March 1996 agreement on transfer of 10 best airframes was not implemented; attempts to purchase eight failed in March 1998 and Russia then supposedly abandoned hopes of expanding Tu-160 fleet. However, October 1999 announcement revealed eight to be returned to Russia for refurbishment (together with three Tu-95MSs, for a total of US$285 million) and these were delivered between 5 November 1999 and 21 February 2000. Six others scrapped with US assistance, last being destroyed on 4 February 2001. August 2000 report mentioned further three Tu-160s which Ukraine could return to Russia in part-payment for natural gas deliveries; these later destroyed. Eleventh and final remaining Ukrainian Tu-160 was flown to Poltava Kondratyuk-Shagray aerospace museum on 5 April 2000.

Russia maintained force of six (declared as ALCM carriers under START) at Engels (where 1096th HBAR was redesignated as part of the 121st Guards HBAR, within 22 Air Division, in 1994), plus flying testbed at Zhukovsky; at least four more were derelict at Zhukovsky by 1995. Eight more had been due to re-enter service from 2001 after purchase from Ukraine, while plan announced in June 1999 to complete one unfinished Tu-160 at Kazan. This aircraft ('07' *Aleksandr Molodchyi*) was delivered on 5 May 2000.

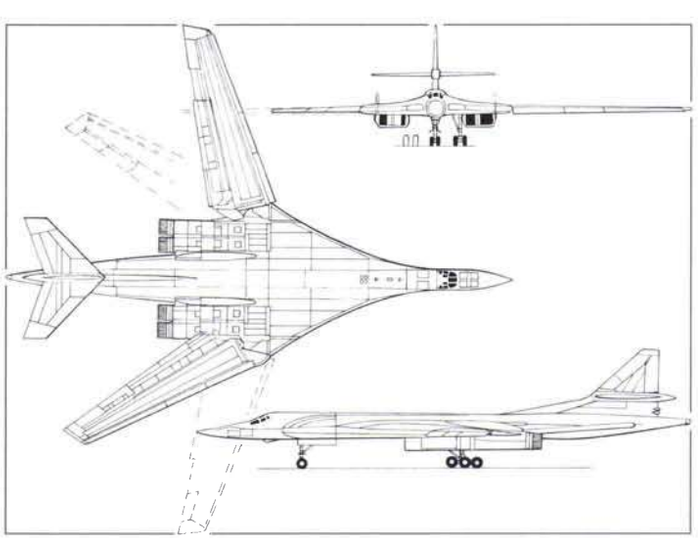
Another, brand new Tu-160 (the first of three more incomplete, unfinished aircraft at Kazan), due to be delivered in late 2002; this was rescheduled for 2005, together with redelivery of a refurbished aircraft; formal acceptance on 30 December 2005, and actual delivery to Air Forces (as 15th operational Tu-160) took place on 5 July 2006; remaining two new aircraft will follow, increasing the fleet to 18 by 2008. At one time there were plans to refurbish some (perhaps four) of the grounded aircraft at Zhukhovsky. Ex-Ukrainian aircraft failed to enter service when planned due to poor condition and need for extensive refurbishment; requirements were still being discussed in early 2002. Plans not adopted for Tu-160 to re-enter limited production, to meet a stated requirement for 25 operational 'Blackjacks' by 2003, allowing formation of a second regiment.

Original six at Engels are also named: '01' *Mikhail Gromov* (crashed 18 September 2003; second Tu-160 loss); '02' *Vasily Retsetnikov*; '03' *Pavel Taran*; '04' *Ivan Yargin*; '05' *Il'ya Muromets* (1) and '06' *Il'ya Muromets* (2). Others subsequently named: 10th (fleet number '16') *Aleksey Plokhov* on 17 April 2003; '15' became *Vladimir Sudets* on 6 December 2004; and '18' *Valentin Ivanovich Bliznyuk* (current head of Tu-160 design at Tupolev) on delivery, 5 July 2006. Another is to be named *Valery Chkalov*.

On 3 March 1999, the Russian Commonwealth Aerospace Technology Consortium (RCATC) was authorised by the Ukrainian government to sell three demilitarised Ukrainian Air Force Tu-160s, plus spares, to Platforms International Corporation of the USA, with which it has finalised a strategic partnership. The US$20 million deal includes a 20 per cent interest in Orbital Network Services Corporation, which plans to use the aircraft as reusable communications satellite launchers in its HAAL-2000 high-altitude Air Launch programme. The aircraft would probably be modified to Tu-160sK standards and continue to be based at Priluki, maintained and flown by Ukrainian crews, but flown to customer countries for individual space launch missions.

TUPOLEV Tu-160 DISPOSITION
(at August 2006)

Russian Federation; original deliveries	7
Russian Federation; ex-Ukraine	8
Ukraine; Scrapped	10
Ukraine; museum	1
USSR; crashed pre-delivery	1
Russian Federation; crashed 2003	1
Prototypes	3
Flyable testbed	1
Unairworthy former testbeds	2
Subtotal	**34**
Under construction	2
Total	**36**



Tupolev Tu-160 strategic bomber *(James Goulding)* 0507635

DESIGN FEATURES: Intended for high-altitude standoff role carrying ALCMs and for defence suppression, using short-range attack missiles similar to US Air Force SRAMs, along path of bomber making low-altitude penetration to attack primary targets with free-fall nuclear bombs or missiles; this implies capability of subsonic cruise/supersonic dash at almost M2 at 18,300 m (60,000 ft) and transonic flight at low altitude. About 20 per cent longer than USAF B-1B, with greater unrefuelled combat radius and much higher maximum speed; low-mounted variable geometry wings, with very long and sharply swept fixed root panel; small diameter circular fuselage; horizontal tail surfaces mounted high on fin, upper portion of which is pivoted one-piece all-moving surface; large dorsal fin; engines mounted as widely separated pairs in underwing ducts, each with central horizontal V wedge intakes and jetpipes extending well beyond wing centre-section trailing-edge; manually selected outer wing sweepback 20, 35 and 65°; when wings fully swept, inboard portion of each trailing-edge flap hinges upward and extends above wing as large fence; unswept tailfin; sweptback horizontal surfaces, with conical fairing for brake-chute aft of intersection.

FLYING CONTROLS: Quadruplex fly-by-wire with mechanical reversion. Full-span leading-edge flaps, long-span double-slotted trailing-edge flap and inset drooping aileron on each wing; five-section spoilers forward of flaps; all-moving vertical and horizontal one-piece tail surfaces.

STRUCTURE: Slim and shallow fuselage blended with wing-roots and shaped for maximum hostile radar signal deflection; 20 per cent titanium, including leading-edges and wing centre-section spar box.

LANDING GEAR: Twin nosewheels retract rearward; main gear comprises two bogies, each with three pairs of wheels; retraction very like that on Tu-154 airliner; as each leg pivots rearward, bogie rotates through 90° around axis of centre pair of wheels, to lie parallel with retracted leg; gear retracts into thickest part of wing, between fuselage and inboard engine on each side; so track relatively small. Nosewheel tyres size 1080×400; mainwheel tyres size 1260×425.

POWER PLANT: Four purpose-designed Samara NK-321 turbofans, each 137.3 kN (30,865 lb st) dry, 245 kN (55,115 lb st) with afterburning. In-flight refuelling probe retracts into top of nose. Fuel in centre-section spar box and in outer wings.

ACCOMMODATION: Four crew members in pairs, on individual Zvezda K-36LM zero/zero ejection seats, in pressurised compartment; one window each side of flight deck can be moved inward and rearward for ventilation on ground; flying controls use fighter-type sticks rather than yokes or wheels; crew enter via extending ladder in nosewheel bay. Cooking facilities, folding bed and lavatory.

AVIONICS: Systems utilise around 100 digital processors and eight digital nav computers.

Radar: Obzor (NATO 'Clam Pipe') nav/attack radar in slightly upturned dielectric nosecone with separate Sopka radar providing terrain-following capability.

Flight: K-042K astro-inertial nav with map display.

Instrumentation: Analogue instruments. No HUD or CRTs

Mission: OPB-15 strike sight fairing with flat glazed front panel, under forward fuselage, for video camera to provide visual assistance for weapon aiming

Self-defence: Baikal self-protection system, with integrated RHAWS, chaff/flare dispensers in tailcone and active jamming.

ARMAMENT: No guns. Internal stowage for free-fall bombs, mines, short-range attack missiles or ALCMs; two tandem 12·80 m (42 ft) long weapon bays; MKU-6-5U rotary launcher for six (or up to 12) Kh-55MS (AS-15 'Kent') or RKV-500B (AS-15B 'Kent-B') ALCMs or 12 to 24 Kh-15P (AS-16 'Kickback') SRAMs in each bay. Aircraft upgraded from 2002 onwards have ability to launch Kh-555 missiles; later plans envisage carriage of up to 12 non-nuclear Kh-101 ALCMs, when available

DIMENSIONS, EXTERNAL:

Wing span: fully spread (20°) ..... 55·70 m (182 ft 9 in)
35° sweep ..... 50·70 m (166 ft 4 in)
fully swept (65°) ..... 35·60 m (116 ft 9¾ in)
Wing aspect ratio: fully spread ..... 8·6
Length overall ..... 54·10 m (177 ft 6 in)
Height overall ..... 13·10 m (43 ft 0 in)
Tailplane span ..... 13·25 m (43 ft 5¾ in)
Wheel track ..... 5·40 m (17 ft 8½ in)
Wheelbase ..... 17·88 m (58 ft 8 in)

DIMENSIONS, INTERNAL:

Weapons bay (each): Volume ..... 43·0 m³ (1,518 cu ft)

AREAS:

Wings, gross: fully swept ..... 360·00 m² (3,875.0 sq ft)
fully spread ..... approx 400·00 m² (4,305.6 sq ft)
moving areas, fully swept (total) ..... approx 180·00 m² (1,937.5 sq ft)

WEIGHTS AND LOADINGS:

Weight empty ..... 110,000 kg (242,505 lb)
Weight empty, equipped ..... 117,000 kg (257,940 lb)
Max fuel ..... 171,000 kg (376,990 lb)
Max weapon load ..... 40,000 kg (88,185 lb)
Normal T-O weight ..... 267,600 kg (589,950 lb)
Max T-O weight ..... 275,000 kg (606,260 lb)
Max landing weight ..... 155,000 kg (341,710 lb)
Max power loading ..... 280 kg/kN (2.75 lb/lb st)

PERFORMANCE:

Max level speed at 12,200 m (40,000 ft) ..... M2.05 (1,200 kt; 2,220 km/h; 1,380 mph)
Cruising speed at 13,700 m (45,000 ft) ..... M0.9 (518 kt; 960 km/h; 596 mph)
Max rate of climb at S/L ..... 4,200 m (13,780 ft)/min
Service ceiling ..... 15,000 m (49,200 ft)
T-O run at max AUW ..... 2,200 m (7,220 ft)
Landing run at max landing weight ..... 1,600 m (5,250 ft)
Radius of action at M1.5 ..... 1,080 n miles (2,000 km; 1,240 miles)
Max unrefuelled range ..... 6,640 n miles (12,300 km; 7,640 miles)
g limit ..... +2

TUPOLEV Tu-204 and Tu-214

TYPE: Twin-jet airliner

PROGRAMME:

DEVELOPMENT MILESTONES

Tu-204	
Design began	1983
Programme launched	1986
First flight	2 Jan 89
Production go-ahead	1990
Certification	12 Jan 95
First delivery (204C)	Apr 95
Entered service (Vnukovo Airlines)	23 Feb 96
Subsequent versions	
Tu-204-300	
First flight	17 Aug 03
Tu-214	
First flight	21 Mar 96
Public debut	Sep 96
Certification	29 Dec 00
Entered service (Dal'avia)	23 May 01
Tu-234	
First flight	8 Jul 00

Development, to replace Tu-154 and Il-62, announced 1983; preliminary details available 1985; programme finalised 1986; first prototype (SSSR-64001), with PS-90AT engines, flown 2 January 1989 by Tupolev chief test pilot A Talalakine; two more prototypes (RA-64003, first flight 17 August 1990, and 004) followed, plus two (002 and 005) for structural and fatigue testing. Second version, with RB211-535E4-B engines, flew 14 August 1992 (fourth flying prototype, RA-64006) and was demonstrated at Farnborough Air Show in following month.

Production of basic Tu-204 series by Aviastar at Ulyanovsk began 1990, Tu-214 by KAPO at Kazan in 1994; Russian certification of basic Tu-204 received 12 January 1995; used initially only for freight services. First revenue-earning passenger flight, Moscow to Mineralnye Vody, operated by Vnukovo Airlines 23 February 1996. Restrictions on PS-90-engined Tu-204s were eventually removed in mid-1998. Deliveries outside CIS began on 2 November 1998 with handover of -120 and -120C freighter to Air Cairo on seven-year lease.

As at mid-2006, the variants certified to AP-25 and JAR 25 standards and in production were stated to be the Tu-204-100, Tu-204-120, Tu-204-120CE, Tu-204-300 and Tu-214.

Avionics upgrade under discussion with NII in mid-2000; goal is six LCD, two-pilot flight deck; estimated cost USD5 million to USD8 million. First application on Tu-204-300.

CURRENT VERSIONS: **Tu-204:** Basic medium-haul airliner for up to 210 passengers or maximum payload of 21,000 kg (46,295 lb); Aviadvigatel PS-90A turbofans. Marketed 1989. RVSM approval granted 28 December 2000. Details in earlier editions

Tu-204C: Cargo version (27 t capacity) of basic Tu-204. (Western marketing designation is Tu-204C, but correct Cyrillic designation, used in Russian literature, is **Tu-204S**.) Certification received in August 2003. Aviastar production.

Tu-204-100: Extended-range passenger version of basic Tu-204; additional fuel in wing centre-section; dimensions, payload and power plant unchanged. Marketed 1993. First flight 9 August 2001. Aviastar production.

Tu-204-100C: Freighter, as Tu-204-100. Payload increased at expense of reduced maximum range. Marketed 1994. Bulk freight volume 180.0 m³ (6,357 cu ft), not including fore and aft underfloor holds.

Tu-204-120: As Tu-204-100, but with Rolls-Royce RB211-535B75 turbofans; Russian avionics. Prototype (RA-64006) flew 14 August 1992. First production aircraft (RA-64027) flew 7 March 1997; gained limited Russian certification on 16 July 1997 and full certification 12 months later. First delivery (Air Cairo) November 1998. JAA certification effort began May 2001. First five Sirocco 120/120Cs have Russian avionics; later aircraft are Phase II with Honeywell items, including VIA 2000 suite. Aviastar production.

Tu-204-120C: As -100C freighter, but RB211 engines; two for Air Cairo (via Sirocco). First aircraft (RA-64028) flew 10 November 1997; domestic certification completed by August 1998. JAA (now EASA) certification effort began May 2001 and had completed initial testing by beginning of 2004; approval anticipated by end of that year. First delivery 2 November 1998. Aviastar production. High gross weight version (**Tu-204-120CE**, indicating English language cockpit), with 30,000 kg (66,139 lb) payload, certified under AP-25 2004 and to JAR 25 July 2006. Maiden flight (RA-64030) 14 May 2006 by first of five for China; first two due for delivery to Air China Cargo September and December 2006, to be followed in March, June and September 2007 by three for China Eastern Airlines.

Tu-204-200: Further increase in payload and T-O weight; small increase in fuel in wing centre-section and adjacent baggage hold; dimensions and power plant as Tu-204-100; strengthened landing gear; marketed 1994. First example of Series 200 was a Tu-214 freighter, first flown in March 1996; first true Tu-204-200 (RA-64036) was nearing completion at Ulyanovsk in late 1998; PS-90 engines. By mid-2000, **Tu-214** designation was also being used for this version.

Tu-204-300: Short-fuselage, extended-range version of Tu-204-100. Prototyped by KAPO (static test only) as Tu-234. First flight test aircraft (RA-64026, built by Aviastar at Ulyanovsk) rolled out as Tu-234, minus engines, in mid-1996; fitted with PS-90s in early 2000 and reportedly first flew 8 July 2000 (ahead of prototype), although this has not been confirmed. Option for 20 signed by Transaero at MAKS air show, August 2003. Aviastar first production example (PS-90P engines) in final assembly May 2003; maiden flight (RA-64026) 17 August 2003 and public debut at MAKS 2003 following day. Certification programme joined by RA-64038 (first flight 25 November 2004) and certificate received 14 May 2005; handed over to first customer (Vladivostok Avia, four ordered in August 2003) six days later. Third aircraft (RA-64039) maiden flight 4 August 2005.

Tu-204-500: Projected Aviastar version; PS-90A2 engines and fuselage stretch to 52·00 m (170 ft 7¼ in); possible wing redesign for higher cruising speeds; private venture outside government's aviation plan. Designation first reported in early 2000. Details reported in late 2004 included 'smaller' wing, 105 tonne MTOW and M0.84 max cruising speed. Development said to be continuing at that time, but no further reports by mid-2006.

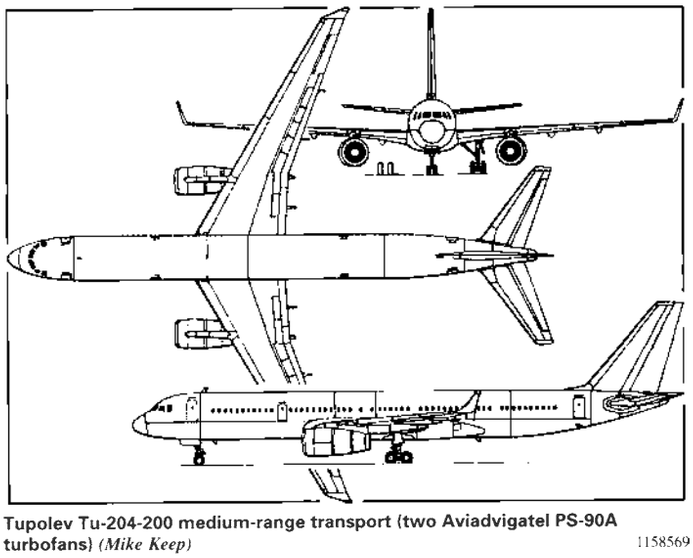
Tu-204K: Projected dual-fuel version. Previously known as Tu-204-600, then Tu-206. Inherits earlier experience gained in earlier Tu-136 and Tu-156 cryogenic propulsion programmes; 22,500 kg (49,604 lb) of liquefied natural gas (LNG) in conformal dorsal tanks, plus 5,500 kg (12,125 lb) Avgas in wings. Development stalled due to lack of funding.

Tu-214: Longer-range, increased-weight version of Tu-204-100, produced by KAPO. Prototype (RA-64501) rolled out at Kazan 5 February 1996; first flew 21 March 1996; public debut at Farnborough Air Show, September 1996. Provisional certification awarded 1998. PW2037 being assessed as an alternative to PS-90A. By early 2000, Kazan stock included seven partly complete Tu-214s from initial production batch of 18. Flight testing of prototype suspended after some 300 sorties, but resumed in May 2000 with further series of 85 flights leading to 'second class' AP-25 certification in March 2000 and full approval on 29 December 2000. First of two aircraft for Dal'avia (s/n 64502) made its first flight on 10 April 2001, and was delivered on 23 May 2001, for service on routes between Moscow and Asia; second received 20 October 2001. Prototype scheduled to flight test modified (quieter) version of PS-90A engine during 2006, to meet ICAO Chapter IV Appendix 16 noise level criteria.

Tu-214F: (previously Tu-214C or Tu-214-200C): Dedicated cargo version (30 t capacity); 3.405 × 2.18 m (11 ft 2 in × 7 ft 1¾ in) door. Prototype assembly expected to begin in 2005; Aviast (four ordered) is reported launch customer.

Tu-214ON: 'Open Skies' (*otkritoe nebo*) surveillance version. One ordered by Russian government.

Tu-214SR: Radio relay (*samolet retranslator*) version. Two ordered by Russian government; deliveries due late 2006 and second quarter 2007.



Tupolev Tu-204-200 medium-range transport (two Aviadvigatel PS-90A turbofans) *(Mike Keep)* 1158569

Tu-214VSSN: VVIP version (*vozdushnoe sudno specialnogo naznacheniya*) for Russian President. Fourth production Tu-214 (RA-64504) is in this configuration; first flight 22 June 2002.

CUSTOMERS: Total of approximately 38 production and four prototypes had flown by late 2006.

There have been many more commitments and announced intentions which have failed to materialise. According to KAPO announcements in 2003, orders for the Tu-214 were received during the year from the Russian MoD (three), GTK Rossiya (three), Dal'avia (two), Omskavia (four), Aviast (four, including one cargo), and the Bulgarian carriers Air Sofia and BH Air (total of four). Four Iranian airlines (Aria, Caspian, Iran Air Tours and Kish Air) placed an order for 20 Tu-204-100s in April 2004. Delivery of five Tu-204-120CEs ordered by China in 2001 was planned to take place in 2006-07; first (B-2879) was awaiting hand-over in November 2006. Newly reported customers in early 2006 included Cubana (two Tu-204-100s and a Tu-204C) and a new Bahraini start-up airline (three Tu-214s). Russian sources report that 2005 deliveries comprised one Tu-214 to Dal'avia and four Tu-204-300s to Vladivostok Avia.

Many early Tu-204s have changed ownership since delivery. In addition, Tupolev has four aircraft, while two were used only for static testing. KMV (Kaminvodyavia) aircraft owned by Perm engine plant, which took two Tu-204s in lieu of cash payment for PS-90s; one Perm aircraft sold to Sibir in December 1999. Siberia Airlines also planning to acquire three Tu-214s from Kazan line.

COSTS: With PS-90 engines and Russian avionics USD27 million (2001); with RB211-535 engines USD38 million (1996).

DESIGN FEATURES: Conventional low/mid-wing configuration, with all surfaces swept back, and winglets; wing dihedral from roots; semi-monocoque oval section pressurised fuselage; torsion box of fin forms integral fuel tank, used for automatic trimming of CG in flight; design life 45,000 flights, 60,000 flight hours or 20 years.

Wing section supercritical; sweepback 28°; thickness/chord ratio 14 per cent at root, 9 to 10 per cent at tip; negative twist.

FLYING CONTROLS: Triplex digital fly-by-wire, with triplex analogue back-up; conventional 'Y' control yokes selected after evaluation of alternative sidestick on Tu-154 testbed; inset aileron outboard of two-section double-slotted flap on each wing trailing-edge; two-section upper surface airbrake forward of each centre-section flap; five-section spoiler forward of each outer flap; four-section leading-edge slat over full span of each wing; conventional rudder and elevators; no tabs.

STRUCTURE: Approximately 18 per cent of airframe by weight of composites; three-piece two-spar wing, with metal structure, part composites skin; carbon fibre skin on spoilers, airbrakes and flaps; glass fibre wingroot fairings; all-metal fuselage, utilising aluminium-lithium and titanium; nose radome and some access panels of composites; extensive use of composites in tail unit, particularly for leading-edges of fixed surfaces and for rudder and elevators.

LANDING GEAR: Hydraulically retractable tricycle type; electrohydraulically steerable twin-wheel nose unit (±10° via rudder pedals; ±70° by electric steering control) retracts forward; four-wheel bogie main units retract inward into wing/fuselage fairings. Rubin KT-196 wheels on all units. Carbon disc brakes, electrically controlled. Tyre size 1,070×390 on mainwheels, 840×290 on nosewheels. Original Russian (NIIShP) or Goodyear radial tyres progressively replaced from 2000 by Michelin M12601-01 type.

POWER PLANT: *204-100, 204C, 204-300, 214:* Two 158 kN (35,582 lb st) Aviadvigatel PS-90A turbofans, underwing in composites cowlings. Longer-life PS-90A2 under development for eventual retrofit.

204-120: Two 189 kN (42,580 lb st) Rolls-Royce RB211-535B75 turbofans.

Tu-204-200 series carries fuel in six integral tanks in wings, in centre-section and adjacent baggage hold, and in tailfin, total capacity 40,730 litres (10,760 US gallons;

TUPOLEV Tu-204/214 PRODUCTION
(at late-2006)

Line No.	Srs	Registration	Operator or fate
Tu-204			
1	P	RA-64001	Storage at Zhukovsky
2		nil	Static test
3	P	RA-64003	Storage at Zhukovsky
4	P	RA-64004	Storage at Zhukovsky
5		nil	Scrapped at Novosibirsk (fatigue test)
6	204	RA-64006	Storage at Ulyanovsk (Aviastar)
7	204	RA-64007	Storage at Vnukovo (Vnukovo)
8	C	RA-64008	Derelict at Vnukovo (Vnukovo)
9	C	RA-64009	Storage at Ulyanovsk (Vnukovo)
10	100C	RA-64010	Storage at Ulyanovsk (Vnukovo)
11	100	RA-64011	Avialiny 400
12		RA-64012	Storage at Ulyanovsk (Vnukovo); for scrap
13	100	RA-64013	Storage at Ulyanovsk (Vnukovo)
14	100	RA-64014	Grounded at Bykovo
15	100	RA-64015	Grounded at Bykovo
16	100	RA-64016	Kavminvodyavia (KMV)
17	100	RA-64017	Sibir
18	100	RA-64018	Kras Air
19	100	RA-64019	Kras Air
20	100	RA-64020	Kras Air
21	C	RA-64021	Air Rep
22	100	RA-64022	Kavminvodyavia (KMV)
23	120	SU-EAH	Air Cairo
24	100C	LY-AGT	Aviastar
25	120	SU-EAI	Air Cairo
26	300	RA-64026	Vladivostok Avia
27	120	SU-EAF	Air Cairo
28	120C	SU-EAG	Air Cairo
29	120C	SU-EAJ	Air Cairo
30	120CE	B-2871	Air China Cargo
31	120CE	RA-64031	Air China Cargo; incomplete
32	C	RA-64032	Air Rep
33		SU-EAK	Assigned Sirocco/Heavylift but assembly suspended
34	120CE	nil	Air China Cargo; incomplete
35	120CE	nil	China Eastern Cargo; incomplete
36		RA-64036	Cubana; incomplete
37	120CE	RA-64037	Cubana; incomplete
38	300	RA-64038	Vladivostok Avia
39	300	RA-64039	Vladivostok Avia
40	300	RA-64040	Vladivostok Avia
41	120CE		China Eastern Cargo; incomplete
Tu-214			
001	P	RA-64501	Tupolev
002	200	RA-64502	Dal'avia
003	200	RA-64503	Dal'avia
004	200	RA-64504	Rossiya
005	200	RA-64505	Rossiya
006	200	RA-64506	Rossiya
007	200	RA-64507	Dal'avia
008	200	RA-64508	Kras Air
009	200	RA-64509	Transaero
010	200	RA-64510	Dal'avia
011	200	RA-64511	Russian Air Forces (Tu-204ON)
012	200	RA-64512	Dal'avia
013	200	RA-64513	Transaero
014	200	RA-64514	Transaero
015	200	RA-64515	(VIP interior)
016	200	RA-64516	Transaero
017	200	RA-64517	Rossiya (VIP interior)
018	200	RA-64518	Transaero
019	200	RA-64519	Transaero
020	200	RA-64520	Transaero
021	200	RA-64521	Transaero
022	200	RA-64522	Transaero
023	200	RA-64523	(VIP interior)
024	200	RA-64524	Transaero
025	200	RA-64525	(VIP interior)

First Tupolev Tu-204-120CE freighter for China 1158883

8,960 Imp gallons); torsion box of fin forms integral fuel tank for automatic trimming of CG in flight, as well as for optional standard use. See under Weights and Loadings for other fuel quantities.

ACCOMMODATION: Can be operated by pilot and co-pilot, but Aeroflot specified requirement for a flight engineer; provision for fourth seat for instructor or observer.

Standard passenger interiors are as detailed below, but other layouts are optional, configured to customer's requirements. All versions have passenger doors at front and rear of cabin on port side, with service doors opposite; Type I emergency exits fore and aft of wing each side; and inflatable slide for emergency use at each of the eight doors. Underfloor baggage/freight holds forward and aft of wing.

Tu-204-100/-120 series: Four basic single-aisle passenger arrangements, as follows: (1) 160 seats, with 24 business class four-abreast at pitch of 102 cm (40 in) at front and 136 economy class six-abreast at 84 cm (33 in) pitch at rear; (2) 175 seats, with 12 business class four-abreast at 105 cm (41 in) pitch at front plus 163 economy six-abreast at 81 cm (32 in) to rear; (3) 183 seats, comprising 24 business four-abreast at 102 cm (40 in) in front, with 159 economy six-abreast at 81 cm (32 in) in rear; and (4) 210 all-economy seats six-abreast at 81 cm (32 in) pitch. All four configurations have galley and lavatory immediately aft of flight deck, with a further two galleys, two lavatories and a wardrobe at rear of passenger accommodation. Additionally, 160- and 175-seat layouts have a further galley, lavatory, wardrobe and buffet at front of economy cabin.

Tu-204-300: Two standard layouts currently offered, namely: (1) 136 seats in two-class interior, comprising 24 four-abreast business class at 102 cm (40 in) with 112 economy six abreast at 81 cm (32 in) pitch to rear; or (2) 162 all-economy, six-abreast at 81 cm (32 in). Galley and lavatory immediately aft of flight deck, plus two galleys and a wardrobe at extreme rear of passenger cabin. All-economy version has two more lavatories behind rear row of seats; in two-class version, one of these is replaced by a wardrobe, with a second and third wardrobe situated between the business and economy class areas.

Tu-214: All-economy class, details as for Tu-204-100/-120 option 4. Alternative two-class interior seating 164 passengers: 24 business class four-abreast at 102 cm (40 in) and 140 economy class six-abreast at 84 cm (33 in) pitch.

Tu-204C and Tu-214C: Main cabin can accommodate 13 2.24 × 2.74 or 2.24 × 3.18 m (88 × 108 or 88 × 125 in) pallets, or 12 2.44 × 3.18 m (96 × 125 in) pallets, in each case with additional 1.35 × 2.24 m (53 × 88 in) AEP containers at rear. Underfloor holds can accommodate a total of eight LD3-46 international class or AK-07 containers (three in forward hold, five in rear hold). Fully automatic container loading system with manual back-up.

SYSTEMS: Triplex fly-by-wire digital control system, with triplex analogue back-up; Barco Display Systems selected in 2000 to supply EMS computers. Three independent hydraulic systems, pressure 207 bar (3,000 lb/sq in). Ailerons, elevators, rudder, spoilers and airbrakes operated by all three systems; flaps, leading-edge slats, brakes and nosewheel steering operated by two systems; landing gear retraction and extension by all three systems. Electrical power supplied by two 200/115 V 400 Hz AC generators and a 27 V DC standby system. Type TA-12-60 APU in tailcone.

AVIONICS: Avionics of Russian design or, optionally, integrated by Thales or Honeywell, with standard nav/com equipment by Rockwell Collins.

Comms: VHF and HF radio, intercom.

Radar: Weather radar.

Flight: KSPNO-204 triplex automatic flight control and navigation system (being upgraded in 2002). VOR, DME, automatic approach and landing system, for operation to ICAO Cat. IIIa minima; Series 100/200 have RLG INS (Litton LTN-101 or Honeywell HG1150BD02), GPS (Litton LTN-2001) and TCAS II (Honeywell).

Instrumentation: EFIS equipment comprises two colour CRTs for flight and nav information for each pilot, plus two central CRTs for engine and systems data. All six to have been replaced by LCDs by end of 2002.

DIMENSIONS, EXTERNAL:

Wing span	40.88 m (134 ft 1½ in)
Wing aspect ratio	9.1
Length overall: except 204-300	46.14 m (151 ft 4½ in)
204-300	40.19 m (131 ft 10¼ in)
Fuselage: Max width	3.80 m (12 ft 5½ in)
Max depth	4.10 m (13 ft 5½ in)
Height overall	13.87 m (45 ft 6 in)
Tailplane span	15.00 m (49 ft 2½ in)
Wheel track	7.82 m (25 ft 8 in)
Wheelbase: except 204-300	17.00 m (55 ft 9¾ in)
Passenger doors (each): Height: all	1.85 m (6 ft 0¾ in)
Width: all	0.84 m (2 ft 9 in)
Service doors (each): Height: all	1.60 m (5 ft 3 in)
Width: all	0.65 m (2 ft 1½ in)
Cargo door (appropriate versions):	
Height	2.18 m (7 ft 1¾ in)
Width	3.405 m (11 ft 2 in)
Emergency exit doors (each):	
Height: all	1.44 m (4 ft 8¾ in)
Width: all	0.61 m (2 ft 0 in)
Baggage holds:	
Height to sill: all	2.71 m (8 ft 10¾ in)

DIMENSIONS, INTERNAL:

Cabin, excl flight deck:	
Length: except 204-300	30.18 m (99 ft 0 in)
Max width: all	3.57 m (11 ft 8½ in)
Max height: all	2.28 m (7 ft 6 in)
Fwd cargo hold:	
Height: all	1.16 m (3 ft 9¾ in)
Volume: 204-100/-120, 204C	11.0 m³ (388 cu ft)
204-300	7.4 m³ (261 cu ft)
Rear cargo hold:	
Height: 204-100/-120, 204C, 214	1.16 m (3 ft 9¾ in)
Volume: 204-100/-120, 204C	15.4 m³ (544 cu ft)
204-300	20.4 m³ (720 cu ft)
Cargo compartment bulk volume:	
204C	44.5 m³ (1,572 cu ft)

AREAS:

Wings, gross: all	184.20 m² (1,982.7 sq ft)

Tupolev Tu-204-300 twin-jet airliner *(Yefim Gordon)* 1158628

WEIGHTS AND LOADINGS:

Operating weight empty: 204-100	58,800 kg (129,630 lb)
204-120	59,000 kg (130,075 lb)
204C	59,500 kg (131,175 lb)
Max fuel weight: 204-100/-120, 204C	32,800 kg (72,312 lb)
204-300 short range	24,500 kg (54,013 lb)
204-300 mid/long range	36,000 kg (79,366 lb)
214	35,710 kg (78,727 lb)
Max payload: 204-100/-120	21,000 kg (46,297 lb)
204-120CE	30,000 kg (66,139 lb)
204C	27,000 kg (59,525 lb)
204-300 short/mid range	18,000 kg (39,683 lb)
204-300, long range	13,600 kg (29,983 lb)
214	25,200 kg (55,556 lb)
Max T-O weight:	
204-100/-120, 204C	103,000 kg (227,075 lb)
204-300, short range	96,000 kg (211,645 lb)
204,300, mid range	105,000 kg (231,485 lb)
204-300, long range	107,500 kg (236,995 lb)
214	110,750 kg (244,160 lb)
Max landing weight: except 214	88,000 kg (194,005 lb)
214	93,000 kg (205,030 lb)
Max zero-fuel weight: 214	86,000 kg (189,595 lb)
Max wing loading:	
204-100/-120, 204C	559.2 kg/m^2 (114.53 lb/sq ft)
204-300, short range	521.2 kg/m^2 (106.74 lb/sq ft)
204-300, mid range	570.0 kg/m^2 (116.75 lb/sq ft)
204-300, long range	583.6 kg/m^2 (119.53 lb/sq ft)
214	601.2 kg/m^2 (123.15 lb/sq ft)
Max power loading:	
204-100, 204C	325 kg/kN (3.19 lb/lb st)
204-120	272 kg/kN (2.67 lb/lb st)
204-300, short range	303 kg/kN (2.97 lb/lb st)
204-300, mid range	332 kg/kN (3.25 lb/lb st)
204-300, long range	340 kg/kN (3.33 lb/lb st)
214	350 kg/kN (3.43 lb/lb st)

PERFORMANCE:

Nominal cruising speed at FL364-397:	
all	437–459 kt (810–850 km/h; 503–528 mph)
Approach speed:	
204-300, short range MTOW	119 kt (220 km/h; 137 mph)
204-300, mid range MTOW	122 kt (225 km/h; 140 mph)
Max cruising height: all	12,100 m (39,700 ft)
T-O run: 204-100, 204C	1,760 m (5,775 ft)
204-300	2,000 m (6,565 ft)
T-O field length: 204-100/-120	2,250 m (7,385 ft)
204C, 214	2,500 m (8,205 ft)
Landing run: 204-100, 204C	2,160 m (7,090 ft)
204-300	2,000 m (6,565 ft)
Range with max payload: 204-100	2,321 n miles (4,300 km; 2,671 miles)
204C	1,684 n miles (3,120 km; 1,938 miles)
204-300	3,023 n miles (5,600 km; 3,479 miles)
Range with max fuel:	
204-100/-120, 210 passengers	2,645 n miles (4,900 km; 3,044 miles)
204-100, 12 t payload	3,671 n miles (6,800 km; 4,225 miles)
204C, 13.5 t payload	3,779 n miles (7,000 km; 4,349 miles)
204-300 short range, 162 passengers	1,619 n miles (3,000 km; 1,864 miles)
204-300 mid range, 162 passemgers	3,131 n miles (5,800 km; 3,603 miles)
204-300 long range, 120 passengers	4,589 n miles (8,500 km; 5,281 miles)
214, 13.5 t payload	3,887 n miles (7,200 km; 4,473 miles)

TUPOLEV Tu-324 and Tu-414

TYPE: Regional jet airliner.

PROGRAMME: Announced at 1995 Paris Air Show; proposed manufacture by KAPO at Kazan, Tatarstan, from 2003. Specification revised 1996 and further refined in 1997 when governments of Russia and Tatarstan agreed on 20 August to 50:50 sharing of development costs, to which latter had contributed some USD70 million by late 2002. Tatarstan placed symbolic first order for a presidential transport (since superseded by Tu-214 VSSN, which see). Mockup completed by late 1997; technical documentation issued 2000. Both versions entered for 2002–03 national RRJ competition staged by Rosaviacosmos and eventually won by Sukhoi. Tupolev and KAPO planned to continue development provided non-federal funding can be found; reported in March 2003 that Tu-324 had by then been allocated some USD38 million in state funding. Further investment of USD70 million by Tatarstan government reported in July 2003, coupled with statement that prototype manufacture was about to begin. However, Tupolev spokesman confirmed in February 2004 that Tu-324 progress had been halted following loss of RRJ contract, and attention now focused on Tu-414 variant, which was continuing in 2005-06.

CURRENT VERSIONS: **Tu-324A:** (*Administrativnyy*: executive) VIP transport, carrying up to 10 passengers. In abeyance.

Tu-324R: Regional airliner: 52 seats in single-class configuration: 10 + 34 or 36 in two-class. In abeyance.

Tu-414: Stretched, 58/72-seat airliner, with Rolls-Royce BR710-48 turbofans. Initial design completed December 2003; 'electronic mockup' planned for first half of 2004. Maximum commonality with Tu-324. Described in 2006 company literature as "basic aircraft in the Russian regional aircraft family". *Description applies to this version.*

COSTS: Tu-414 estimated total programme cost USD300 million (2005), including three flying prototypes and two static/fatigue test airframes. Projected unit cost approximately USD16 million.

DESIGN FEATURES: Wings scaled down from Tu-204; TsAGI (CAHI) improved aerofoil section; illustrations show the aircraft with and, more recently, without winglets. Is first Russian aircraft programme designed entirely with use of computers. Design service life of 60,000 flight hours, 40,000 flights or 30 years.

FLYING CONTROLS: Digital fly-by-wire with standby analogue 'critical conditions' warning system. Three-segment spoilers forward of two-segment slotted flaps.

LANDING GEAR: Tricycle type; retractable. Twin wheels on each unit.

POWER PLANT: Two approx 68.9 kN (15,500 lb st) Rolls-Royce BR710-48 turbofans with FADEC, pod-mounted to pylons on sides of rear fuselage.

ACCOMMODATION: Flight crew of two, plus two cabin attendants. Standard all-economy class seating for 72 passengers at 81 cm (32 in) pitch with two galleys and lavatory forward plus second lavatory aft. Alternative layouts for 68 passengers (28 de luxe seats at 94 cm; 37 in and 40 economy at 81 cm; 32 in), or 58 seats (six business class at 119 cm; 47 in and 52 economy at 81 cm; 32 in); all seats four-abreast, with central aisle. Also offered with four- or 19-passenger VIP interiors. Passenger airstair door forward, with service door opposite; overwing emergency exit each side. Underfloor baggage/cargo holds forward and aft of wing; additional (to overhead bins) carry-on baggage area at rear of cabin.

AVIONICS: Integrated, all-digital airborne systems including aircraft and power plant controls, flight controls, PA and IFE systems, onboard control systems monitoring, and operational status of all aircraft systems and components.

DIMENSIONS, EXTERNAL:

Wing span	27.70 m (90 ft 10½ in)
Length overall	31.765 m (104 ft 2½ in)
Height overall	8.295 m (27 ft 2½ in)
Wheelbase	14.15 m (46 ft 5 in)
Baggage door sill height:	
front	1.05 m (3 ft 5¼ in)
rear	1.15 m (3 ft 9¼ in)

DIMENSIONS, INTERNAL:

Passenger cabin:	
Max height	1.92 m (6 ft 3½ in)
Aisle width	0.50 m (1 ft 7¾ in)
Baggage/cargo compartment volume:	
front	6.9 m^3 (244 cu ft)
rear	3.6 m^3 (127 cu ft)

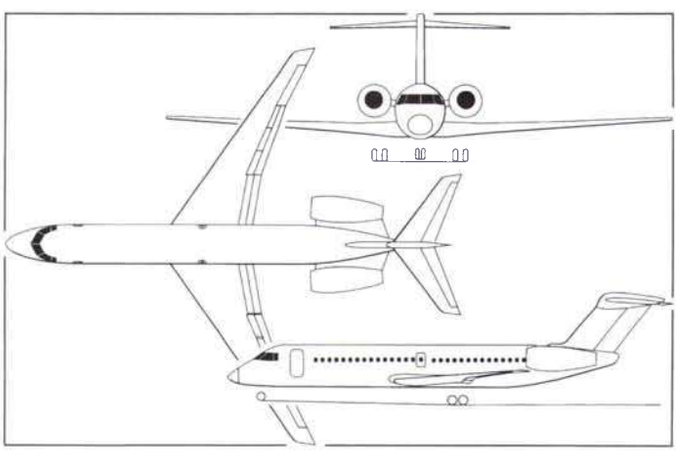
WEIGHTS AND LOADINGS:

Max fuel weight	12,000 kg (26,455 lb)
Max payload	8,000 kg (17,637 lb)
Max T-O weight	38,380 kg (84,613 lb)

PERFORMANCE (estimated):

Cruising speed	475 kt (880 km/h; 547 mph)
Max operating altitude	12,100 m (39,700 ft)
T-O/landing field length	1,800 m (5,905 ft)
Range with max payload	1,889 n miles (3,500 km; 2,174 miles)

Artist's impression of Tupolev Tu-414 1158635



Tupolev Tu-414 twin-turbofan regional jet airliner *(Paul Jackson)* 1158570

TUPOLEV Tu-330

TYPE: Twin-jet freighter.

PROGRAMME: Announced early 1993 as replacement for Antonov An-12; government support announced 23 April 1994; first 10 to be built at Kazan; first flight scheduled 1997, for service from 1998; neither target achieved. Production at both KAPO and Samara. Stated by commander of Russian Military Transport Aviation to be one of three basic types to be operated by his force in 21st century. Production drawings released by Tupolev to KAPO at Kazan in late 1997 and construction then begun. By early 2000 the venture was being offered as a potential partnership.

Tu-330 included in federal plans for civil aviation up to 2015, requiring investment of equivalent of USD340 million over seven years. Tupolev expenditure to early 2000 totalled RUR80 million. Kazan plant hoped for production launch in 2002, but funding still awaited in mid-2006. However, Russian Air Forces' reluctance to accept An-70 seen to improve Tu-330's chances of go-ahead, and named in 2003 as one of two main contenders (with Il-214) to replace An-12. No further reports by mid-2006.

CURRENT VERSIONS: **Tu-330:** *As described.*

Tu-330K (previously Tu-338): Proposed cryogenic-fuelled version with Samara NK-94 engines and 22,600 kg (49,824 lb) of liquid natural gas in conformal dorsal tank. Technical proposals completed, but not yet funded (mid-2006).

COSTS: Unit price USD25 million to USD35 million (2000, estimate). Estimated cost of two flying and two ground test aircraft, plus certification, USD100 million (2003).

Model of proposed Tupolev Tu-330 with PS-90A engines *(Paul Jackson)* 1047205

DESIGN FEATURES: See accompanying three-view drawing: said to have up to 75 per cent commonality with Tu-204. Wing design basically similar to Tu-204; engine pylons as Tu-204; rear-loading ramp. Potential secondary applications include refuelling tanker and maritime patroller.

FLYING CONTROLS: Each wing has four-section leading-edge flaps, three-section trailing-edge flaps, eight spoilers forward of flaps, and aileron. Variable incidence tailplane. Elevators and rudder each in two sections.

LANDING GEAR: Retractable tricycle type; twin-wheel, rearwards-retracting nose unit; each main unit has three pairs of wheels (one pair with brakes) in tandem. Able to operate from concrete or grass.

POWER PLANT: Two Aviadvigatel PS-90A turbofans. Rolls-Royce and Pratt & Whitney turbofans under consideration for export sales. Tu-330K is projected for LNG transportation, with three tanks in the cabin for 22,800 kg (50,265 lb) of LNG.

ACCOMMODATION: Flight crew of two.

AVIONICS: Include six colour MFDs.

DIMENSIONS, EXTERNAL:

Wing span over winglets	42.28 m (138 ft 8½ in)
Wing aspect ratio	10.1
Length overall	42.00 m (137 ft 9½ in)
Fuselage max diameter	5.30 m (17 ft 4¾ in)
Height overall	14.00 m (45 ft 1¼ in)
Rear-loading ramp: Length	4.00 m (13 ft 1½ in)
Width	4.00 m (13 ft 1½ in)

DIMENSIONS, INTERNAL:

Cargo hold:	
Length: excl ramp	19.50 m (63 ft 11½ in)
incl ramp	23.50 m (77 ft 1¼ in)
Width at floor	4.00 m (13 ft 1½ in)
Height: min	3.55 m (11 ft 7¾ in)
max	4.00 m (13 ft 1½ in)
Volume	350.0 m^3 (12,360 cu ft)

AREAS:

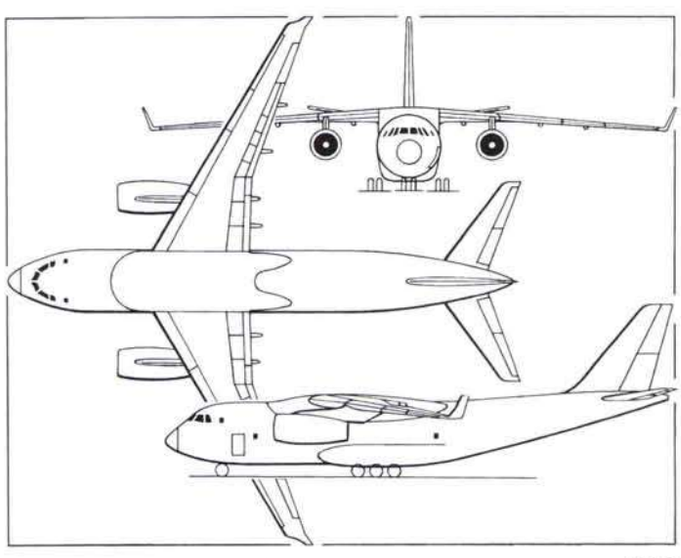
Wings, gross	177.80 m^2 (1,913.8 sq ft)

WEIGHTS AND LOADINGS:

Payload: in hold	30,000 kg (66,139 lb)
on ramp	5,000 kg (11,023 lb)
max	35,000 kg (77,162 lb)
Max T-O weight	103,500 kg (228,175 lb)
Max wing loading	582.1 kg/m^2 (119.22 lb/sq ft)

PERFORMANCE (estimated):

Nominal cruising speed at FL360	431–458 kt (800–850 km/h; 497–528 mph)
T-O and landing distance	2,200 m (7,220 ft)
Nominal range:	
with 15,000 kg (33,069 lb) payload	3,779 n miles (7,000 km; 4,349 miles)
with 20,000 kg (44,090 lb) payload	3,020 n miles (5,600 km; 3,480 miles)
with 30,000 kg (66,139 lb) payload	1,620 n miles (3,000 km; 1,865 miles)



Tupolev Tu-330 twin-turbofan freight transport *(Mike Keep)* 1158571

TUPOLEV Tu-334

TYPE: Twin-jet airliner.

PROGRAMME:

DEVELOPMENT MILESTONES

Launched	1986
Rolled out	25 Aug 95
First flight	8 Feb 99

Launched 1986, with target first flight in 1991 and service entry in 1995; chief designer Igor Kaligin. First prototype Tu-334 (RA-94001) eventually rolled out at Zhukovsky during Moscow Air Show, 25 August 1995; then scheduled to fly 1996 with D-436T1 engines, but delayed by funding shortages. Refinancing by Ukrainian government in early 1997 resulted in new target date of May/June 1997 for first Tu-334s built by Aviant at Kiev; this also missed; second and third identical, but non-flying, prototypes under construction at Zhukovsky by 1996; second (002) used for static tests at CAHI (TsAGI) 1996; test airframe 004 delivered to Aviatest LNK at Riga from Kiev in mid-2000 to simulate 20 year fatigue life; further two prototypes and three production aircraft under construction at Kiev by early 1999 (three for full assembly by Aviant; part of fuselage and wings of other two for delivery to RSK 'MiG' at Lukhovitsy). Subsequent input from Aviant of these components only, instead of originally planned second assembly line.

RA-94001 eventually flown 8 February 1999 and had achieved eight sorties by time of public debut at Moscow in August 1999. Plans for 200 flights in 2001 not achieved (114 only), and this total (of planned 900) not reached until late 2003. By mid-2003, second flying prototype (Aviant-built 005) said to be more than 90 per cent complete; was rolled out 2 August 2003; made maiden flight (RA-94005) on 21 November 2003 and delivered to Zhukovsky for flight trials 27 November. Completion of third development aircraft (003, first by RSK 'MiG'), anticipated by June 2003, but negated by Rosaviakosmos announcement in January 2004 allocating Tu-334 production to four-company consortium of KAPO, Aviant, Aviastar and Tavia (Taganrog). As of mid-2006, prototype 003 still unflown and KAPO production not yet started. Russian provisional certification of Tu-334-100 awarded 30 December 2003.

AP-25/FAR Pt 25 certification programme was due for completion in 2001, but victim of above-mentioned delays, created by erratic funding and delayed delivery of D-436 engines; full certification still awaited in mid-2006. TANTK at Taganrog was to have been second source for -100, but Russian government decree of 5 October 1999 nominated RSK 'MiG' (which is to contribute half of certification costs, first payment being made in January 2002); first Taganrog fuselage transported to Voronin Production Centre, Moscow, arriving 7 April 2000. Completion and final assembly was to have been in second quarter of 2001, but this not achieved (see above); Taganrog horizontal tail delivered early 2002. Half of all assemblies and components for RSK 'MiG' production to be supplied by Aviant; other components supplied by Kazan and Ulyanovsk factories. Approval for RSK 'MiG' production awarded 31 October 2002.

On 16 June 1997 Rolls-Royce Deutschland agreed loan of BR710 engines to build prototype of Tu-334-120; first flight of -120 had been expected late 1998, but delayed by funding shortages. Revised plans for BR710s to go into -100 prototype, after short test programme with D-436s, also thwarted by aircraft's continued grounding. R-R support now directed at versions powered by BR715 engines.

During mid-1997, AIO of Iran showed interest in establishing a kit assembly line at Esfahan for 100 Tu-334s (of which 50 for local airlines) over 15 years, based on eventual fuselage detailed assembly in Iran, with complete wings from Ukraine and empennage from Russia. No recent news received concerning this venture.

Five versions being promoted in 2003–06 were Tu-334-100, -100D, -120D, -200 and -220.

CURRENT VERSIONS: **Tu-334-100:** Basic version, with D-436T1 engines, for 72 mixed class or 102 tourist class passengers. Prototypes are of this version.

Tu-334-100C: Cargo version of -100; up to six 2.24 × 3.17 m (88 × 125 in) pallets in underfloor compartments.

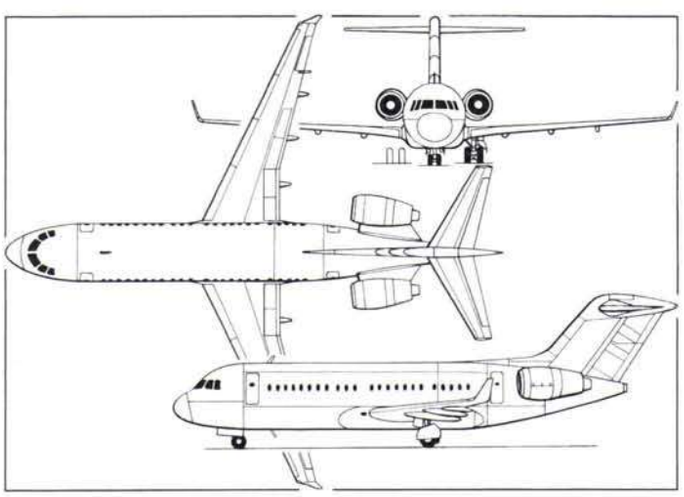
Tu-334-100D: Extended-range 102-seat version, announced at Moscow Air Show '95. Basically similar to Tu-334-100, but with increased wing span and uprated D-436T2 engines; increased fuel and maximum T-O weight. Not yet built.

Tu-334-120: As Tu-334-100, but two 88.9 kN (19,995 lb st) Rolls-Royce BR715-56 turbofans. Third flying prototype to be in this configuration.

Tu-334-120D: Rolls-Royce BR715-56 engines; increased weight and range. Announced 1998.

Tu-334-200: Basically similar to Tu-334-100D and previously known as **Tu-354**; D-436T2 engines; fuselage lengthened by 3.90 m (12 ft 9½ in) to accommodate up to 126 passengers at 81 cm (32 in) pitch; increased wing span; four-wheel bogies on main landing gear units. Construction of four by Aviacor in Samara reportedly begun by early 1997, but

Tupolev Tu-334 prototype 1158629



Tupolev Tu-334-100 twin-turbofan medium-range transport *(James Goulding)* 1158572

this apparently inaccurate and Aviacor connection with Tu-334 programme severed in 1999.

Tu-334-220: Further increased MTOW; BR715-56 engines. Announced 1998.

CUSTOMERS: Provisional orders in 1995 for approximately 40 aircraft, for Rossiya Airlines, Bashkiri Airlines, Tyumen Airlines and Tatarstan Airlines. MoU for 20 Tu-334-120s signed by Aeroflot in June 2000; other letters of intent from Atlant Soyuz (two) and Pulkovo (15 to 20) during first half of 2002. First firm orders (five Tu-334-100s each for 10-year lease by Aerofraht and Atlant Soyuz Airlines) announced by RSK 'MiG' at MAKS air show, August 2003. CIS market estimated as about 350 by Rosaviakosmos. Tupolev website reported orders from 12 airlines as at November 2003.

COSTS: Tu-334-100 USD16 million to USD18 million; Tu-334-200 USD20 million (both 2003). Break-even at 48th aircraft, according to RSK 'MiG'.

DESIGN FEATURES: Replacement for Tu-134 and Yak-42, to meet requirements of Russian Federation and Associated States (CIS) airlines. Wings have much in common with those of Tu-204 and the fuselage is shortened version of Tu-204, with identical flight deck. Configuration is all-swept low/mid-wing, with rear-mounted engines and T tail; circular-section semi-monocoque fuselage; wings have dihedral from roots. Short-stroke landing gear for minimal door sill height, to facilitate baggage handling at airports with limited loading capabilities. Service life 60,000 hours.

Wings have supercritical section, 24° sweepback, with winglets.

FLYING CONTROLS: Main and standby fly-by-wire; emergency hydraulic and mechanical back-up, except for ailerons. Two-section, single-slotted, trailing-edge flaps, two-section airbrakes forward of inner flap and two-section spoilers forward of outer flap on each wing; four-section leading-edge slat over full span each wing; conventional ailerons, elevators and two-section rudder; no tabs. Variable-incidence tailplane.

STRUCTURE: Composites and other lightweight materials make up 20 per cent of structure by weight. Metal alloy wing, fin and horizontal tail, each constructed on two spars, have composites leading-edges and covered by milled panels. Elevators, ailerons, airbrakes, spoilers, flaps, rudder and floor panels of composites honeycomb. Fuselage of metal alloy with riveted skin. Wings by Aviant at Kiev (Ukraine); final assembly by RSK 'MiG' at Lukhovitsy.

LANDING GEAR: Retractable tricycle type; twin wheels on each unit of Tu-334-100, four-wheel bogies on main units of Tu-334-200; main units retract inward into wing/fuselage fairings; trailing-link mainwheel legs on Tu-334-100; nosewheels retract forwards, forward elements of two-section door each side remaining closed except during cycling. Some recent Tupolev illustrations have shown all versions of Tu-334 with four-wheel main bogies. Tyre size 1,070×390-480R on mainwheels; 680×260-355R on nosewheels. Stout grille behind mainwheels of prototype to prevent ice and slush entering turbofans.

POWER PLANT: *Tu-334-100:* Two ZMKB Progress D-436T1 turbofans, each rated at 73.6 kN (16,535 lb st). Cascade-type thrust reversers.

Tu-334-100D/-200: Two D-436T2 turbofans, each rated at 80.4 kN (18,078 lb st).

Tu-334-120/-120D/-220: Rolls-Royce BR715-56 turbofans each rated at 88.9 kN (19,995 lb st). D-436T1 production by consortium of Motor-Sich at Zaporozhye (Ukraine), Salyut and UMPO.

Fuel in integral wing tanks, total capacity (Tu-334-100) 9,540 kg (21,032 lb) or (-100D/-120D/-200/-220) 15,700 kg (34,613 lb).

ACCOMMODATION (Tu-334-100 and -120): Crew of two (optionally three) on 'Tu-204 compliant' flight deck; provision for fourth seat for instructor or observer. Three basic single-aisle passenger arrangements: (1) 72 seats, with 12 seats four-abreast in first class cabin at front, at pitch of 102 cm (40 in) and with 73 cm (28.75 in) aisle, and 60 tourist class seats six-abreast at 81 cm (32 in) pitch with 49.5 cm (19.5 in) aisle; (2) 102 seats, all tourist, at 81 cm (32 in) pitch; and (3) 74 seats, with eight business class and 66 in economy class. All three configurations have buffet/galley, coat compartment and lavatory immediately behind flight deck, a further lavatory and service compartment at rear; 72-seater has additional galleys at front and rear; overhead stowage for hand baggage. Other arrangements at customer's option. Passenger doors at front and rear of cabin on port side; service doors opposite. Underfloor baggage/freight holds; doors on starboard side.

ACCOMMODATION (Tu-334-200): Flight deck unchanged. Two basic single-aisle passenger arrangements: (1) 110 seats, with eight seats four-abreast in first class cabin at front, at pitch of 99 cm (39 in), and 102 tourist class seats six-abreast at 81 cm (32 in) pitch; (2) 126 seats, all tourist, at 81 cm (32 in) pitch. Facilities as Tu-334-100/120, plus emergency exit over wing each side.

SYSTEMS: APU in tailcone. Hydraulic system for actuation of flying controls. Air conditioning unit in wing centre-section.

AVIONICS: *Radar:* Nose-mounted weather radar.

Instrumentation: EFIS standard, with six CRTs. Satcom optional. Equipment for landings in ICAO Cat. IIIa conditions.

DIMENSIONS, EXTERNAL:

Wing span: 100, 120	29.77 m (97 ft 8 in)
100D, 120D, 200, 220	32.61 m (107 ft 0 in)
Wing aspect ratio: 100, 120	10.2
100D, 120D, 200, 220	10.6
Length overall: 100, 120, 120D	31.26 m (102 ft 6¾ in)
100D	31.76 m (104 ft 2½ in)
200, 220	35.16 m (115 ft 4½ in)
Fuselage: Max width	3.80 m (12 ft 5½ in)
Max depth	4.10 m (13 ft 5½ in)
Height overall: 100	9.38 m (30 ft 9¼ in)
100D	9.60 m (31 ft 6 in)
Tailplane span	11.12 m (36 ft 5¾ in)
Wheel track (c/l shock struts): all	4.80 m (15 ft 9 in)
Wheelbase: 100, 120	11.75 m (38 ft 6¾ in)
Baggage door:	
forward: Height	1.03 m (3 ft 4½ in)
Width	1.165 m (3 ft 9¾ in)
Height to sill	1.26 m (4 ft 1½ in)
rear: Height	0.95 m (3 ft 1½ in)
Height to sill	0.93 m (3 ft 0½ in)

DIMENSIONS, INTERNAL:

Cabin: Length: 100, 120	17.84 m (58 ft 6¼ in)
Height:	
above aisle: all	2.185 m (7 ft 2 in)
beneath hand baggage racks: all	1.70 m (5 ft 7 in)
Max width: all	3.57 m (11 ft 8½ in)
Volume: 100, 120	118.0 m³ (4,167 cu ft)
Baggage holds:	
Max length: 100, 120, forward	4.10 m (13 ft 5¼ in)
100, 120, rear	3.00 m (9 ft 10 in)
Max width: 100, 120	2.50 m (8 ft 2½ in)
Max height: 100, 120	1.20 m (3 ft 11¼ in)
Volume: 100, forward	11.7 m³ (413 cu ft)
Total volume: 100, 120	16.2 m³ (572 cu ft)
100D, 120D	15.8 m³ (558 cu ft)
200, 220	23.3 m³ (823 cu ft)

AREAS:

Wings, gross: 100, 120	83.23 m² (895.8 sq ft)
100D, 120D, 200, 220	100.0 m² (1,076.4 sq ft)

WEIGHTS AND LOADINGS:

Operating weight empty: 100	28,950 kg (63,824 lb)
100D	31,920 kg (70,371 lb)
120D	32,320 kg (71,253 lb)
200	33,975 kg (74,902 lb)
220	34,325 kg (75,674 lb)
Design payload:	
100, 100D, 120D	9,690 kg (21,363 lb)
200, 220	11,970 kg (26,389 lb)
Max payload:	
100, 100C, 100D, 120, 120D	9,690 kg (21,363 lb)
200, 220	15,000 kg (33,069 lb)
Max fuel weight: 100	10,350 kg (22,818 lb)
100D, 120D, 200, 220	15,700 kg (34,613 lb)
Max T-O weight: 120, 120C	46,100 kg (101,630 lb)
100	47,900 kg (105,600 lb)
120D	53,750 kg (118,498 lb)
100D	54,420 kg (119,975 lb)
200	54,470 kg (120,085 lb)
220	54,800 kg (120,815 lb)
Max landing weight: 100	43,500 kg (95,900 lb)
100D	44,600 kg (98,326 lb)
Max wing loading:	
120D	537.5 kg/m² (110.09 lb/sq ft)
120	553.9 kg/m² (113.44 lb/sq ft)
100	575.5 kg/m² (117.87 lb/sq ft)
200	544.7 kg/m² (111.56 lb/sq ft)
100D, 120D	544.2 kg/m² (111.46 lb/sq ft)
220	548.0 kg/m² (112.24 lb/sq ft)
Max power loading: 100	325 kg/kN (3.19 lb/lb st)
120	334 kg/kN (3.27 lb/lb st)
100D	338 kg/kN (3.31 lb/lb st)
120D	302 kg/kN (2.96 lb/lb st)
200	339 kg/kN (3.32 lb/lb st)
220	308 kg/kN (3.02 lb/lb st)

PERFORMANCE (estimated):

Nominal cruising speed at FL360: 100, 100D, 200	431-442 kt (800-820 km/h; 497-510 mph)
Normal operating altitude	11,100 m (36,420 ft)
Balanced runway length at 30°C:	
100	2,100 m (6,890 ft)
Range with max payload, 60 min reserves:	
100	1,101 n miles (2,040 km; 1,267 miles)
100D	1,630 n miles (3,020 km; 1,876 miles)
120D	1,544 n miles (2,860 km; 1,777 miles)
200	529 n miles (980 km; 608 miles)
220	448 n miles (830 km; 515 miles)
Range with design payload:	
100, 100C	1,700 n miles (3,150 km; 1,957 miles)

100D, 120D ..... 2,213 n miles (4,100 km; 2,547 miles)
120 ..... 1,685 n miles (3,122 km; 1,939 miles)
200, 220 ..... 1,187 n miles (2,200 km; 1,367 miles)
OPERATIONAL NOISE LEVELS (ICAO, estimated):
T-O ..... 85.8 EPNdB
Approach ..... 97.4 EPNdB
Sideline ..... 92.0 EPNdB

TUPOLEV Tu-444

TYPE: Supersonic business jet.

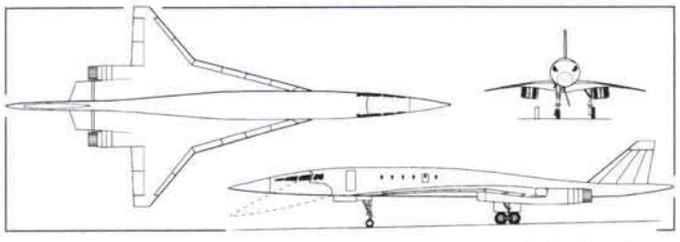
PROGRAMME: Design concept completed by December 2003; development planned to begin in first half of 2004, subject to obtaining start-up funding. Subscale supersonic passenger aircraft (SPS) as first stage towards prospective international (Europe-wide), large-capacity (provisionally SPS-2) supersonic transport.

COSTS: Approximately USD1 billion estimated to develop Tu-444; unit cost (target) USD50 million).

DESIGN FEATURES: Tail-less delta; area-ruled fuselage; low-mounted wing with large root strakes. All-flying, single-fin vertical tail. Pitch- and laterally statically unstable with FBW control. Nose droops for take-off and landing. Wing has elevons drooped during take-off and landing and adaptive deflectable leading-edges. Powerful trailing-edge trimming surfaces. May feature retractable nose multislot destabiliser similar to that of Tu-144.

Adaptive leading-edges designed to improve aerodynamic quality (L/D ratio) might not be used at the initial stage of demonstrator flight test. Wing characterised by mid-surface deformation and by geometric and aerodynamic twist along the span; aerofoil thickness ratio changes spanwise from 2.5 to 3.5 per cent. Saw-tooth leading-edge is also integral fuel tank. Wingroot houses main landing gear legs and wheel wells between engine nacelles.

Blended engine pods below wing surface have controlled air intakes for supersonic flight with vertical ramp which is scaled copy of Tu-160 units. Turbofans moved aft from under torsion box and turned slightly upwards so rear fuselage and fin act as shields to cut down side noise level during take-off run. To obtain maximum flight test data, demonstrator will be fitted with afterburning turbofans.



Provisional general arrangement of Tupolev Tu-444 supersonic business jet *(Paul Jackson)* 1158573

FLYING CONTROLS: Fly-by-wire.

STRUCTURE: The fuselage divided into three parts: (a) nose, pressurised fuselage with cockpit, equipment compartments, mainwheel wells, entrance vestibule and coat room, galley, in-built folded stairs, passenger compartment and lavatory; (b) mid-portion with integral fuel tank and air-conditioning system; (c) tail section with electrical and hydraulic system and APU compartments.

LANDING GEAR: Tricycle type; retractable. Nose gear offset to starboard. Mainwheels retract inwards; nosewheel forward.

POWER PLANT: Two non-reheated NPO Saturn AL-42 turbofans, based on military AL-31F/AL-41F-1, each 95.1 kN (21,385 lb st).

ACCOMMODATION: Two pilots; one steward; and six passengers. Optionally, 10 passengers and reduced range. Forward windscreen covered by raised nosecone when in high-speed flight; side windows only in nosecone.

AVIONICS: Demonstrator's flight and navigation equipment of open architecture design for later augmentation and transfer to production aircraft.

DIMENSIONS, EXTERNAL:
Wing span ..... 16.20 m (53 ft 1¾ in)
Wing aspect ratio 1.9
Length overall ..... 36.00 m (118 ft 1¼ in)
Max diameter of fuselage ..... 2.28 m (7 ft 5¾ in)
Height overall ..... 6.51 m (21 ft 4¼ in)
Wheel track ..... 4.41 m (14 ft 5½ in)
Wheelbase ..... 11.04 m (36 ft 2¾ in)
Door height to sill ..... 2.85 m (9 ft 4¼ in)
DIMENSIONS, INTERNAL:
Cabin: Max height ..... 1.95 m (6 ft 4¾ in)
AREAS:
Wings, gross ..... 136.0 m² (1,463.9 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 19,300 kg (42,549 lb)
Max payload ..... 6,000 kg (13,228 lb)
Max fuel weight ..... 20,500 kg (45,195 lb)
Max T-O weight ..... 41,000 kg (90,389 lb)
Max wing loading ..... 301.5 kg/m² (61.75 lb/sq ft)
Max power loading ..... 215.50 kg/kN (2.11 lb/lb st)
PERFORMANCE (estimated):
Cruising speed: supersonic ..... M2.0 (1,147 kt; 2,125 km/h; 1,320 mph)
subsonic ..... 567 kt (1,050 km/h; 652 mph)
Required runway length ..... 1,830 m (6,005 ft)
Range with NBAA reserves ..... 3,779 n miles (7,000 km; 4,349 miles)

UNIKOMTRANSO

UNIKOMTRANSO AO

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GENERAL DIRECTOR: Oleg N Voronkov

Established 1990 as Unikomtrans, a production co-operative operating an An-12 and An-74 on air freight operations, although involved in producing air cushion vehicles since 1983. Became Unikomtranso AO on 6 April 1994 and made first issue of shares in 2000. Business includes aircraft upgrades, light aircraft design, construction of lightplane prototypes and flight- and technical training on light aircraft. Manufacture in series assigned to Progress Scientific & Technical Complex under agreement of 16 March 2000.

First aircraft, the Model 11 Frigat, was exhibited at Moscow Salon in August 1995; remains available. Don was first shown in August 2001. On 3 March 2003, Unikomtranso JSC and Express Aircraft Company LLC of USA signed five-year agreement covering Russian manufacture of Express 2000, first five kits being due to arrive from USA in mid-2003. Unkcomtranso to complete 90 aircraft as agricultural sprayers for use in Samara region. Two years later, nothing further had been heard and it was presumed that the venture had lapsed.

Don lightplane flown 2002 and reportedly entered production. By 2005 had produced D-401 (registration RA-1171K), which described as development of Don.

USTINOV

VALENTIN L USTINOV

Moscow

Between 1966 and 1973 Mr Ustinov was leader of a students' gyrocopter design and construction team at the Rizhsky Institut Inzenerov Grazhdanskoy Aviatsii (Riga Civil Aviation Engineering High School) in what is now Latvia, responsible for several programmes including the Riga-50 and -50M described in the 1971-72 *Jane's All the World's Aircraft*. The project ended when Mr Ustinov left to work in the Kamov bureau, but he has recently returned to the autogyro with a new design, the Adel'. The designer was assisted in the project by the TsAGI institute and Mil design bureau.

USTINOV ADEL'

TYPE: Single-seat autogyro.

PROGRAMME: First flight 15 August 2005. Public debut at Moscow Salon 16 to 21 August 2005.

DESIGN FEATURES: Agricultural sprayer with 120 litre (31.7 US gallon; 26.4 Imp gallon) chemical hopper ahead of raised cockpit with all-round transparencies. Payload 140 kg (309 lb), excluding pilot and fuel. SportCopter 9.14 m (30 ft) or, alternatively, Rotary Air Force rotor and three-blade tractor propeller; rotor prerotator; tailplane, twin tailfins and central underfin mounted on short, circular cross-section boom immediately to rear of cockpit; all fins have rudders.

STRUCTURE: Metal throughout; generally riveted aluminium alloy.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted, spring cantilever, tubular metal mainwheel legs with drag bracing arms and oleo-damped, levered suspension for wheels; spring/oleo suspension for steerable nosewheel.

POWER PLANT: One Subaru EJ-20 flat-four driving a three-blade tractor propeller.

Valentin Ustinov and his Adel' *(Mr TwistAir)* 1159198

ACCOMMODATION: Pilot only; forward-hinged door each side of cockpit. Accommodation heated.

EQUIPMENT: Spraying booms, with two rotary atomisers each side, mounted low on forward fuselage.

UUAP

ULAN-UDENSKY AVIATSIONNYI ZAVOD OAO (ULAN-UDE AVIATION PLANT JSC)

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DEPUTY DIRECTOR-GENERAL, SALES AND MARKETING: Tsydyp Ts Galdanov
MANAGER, COMMERCIAL DEPARTMENT: Andrei Polyutin

Founded on 1 January 1939 as GAZ 99, the Ulan-Ude Aviation Plant formed on 26 October 2000 and was formally incorporated as such on 23 January 2001, having previously been known as Ulan-Ude Aviation Industrial Association. In 2005, 88 per cent of shares acquired by Oboronprom. It manufactures a wide range of items, from helicopters and aeroplanes to spares and domestic equipment. Is only Russian Federation plant currently producing both fixed- and rotary-wing aircraft. Employees in early 2006 totalled 6,200.

The factory has built I-16, Yak-3, Pe-2, La-5, La-7, La-9 and MiG-15 combat aircraft and, more recently, An-24 transports, Yak-25RV reconnaissance aircraft and MiG-27 fighter-bombers, together totalling 8,000 aeroplanes. Helicopter production began in 1956, progressing through Ka-15, Ka-18 and Ka-25 to the 1970 launch of Mi-8 manufacture; total of 3,700 Mi-8 series built.

Current, or recent products include modern developments of the Mil Mi-8/Mi-17 series of helicopters and the Sukhoi Su-25UBK combat trainer and its related Su-39 attack aircraft. In 2001 revealed Mi-171 variant with rear loading ramp of own design, thus directly competing with Kazan's Mi-8MTV-5. Gained Far East order for five Mi-171sh (Mi-8AMTsh) combat helicopters in 2001 and sold 10 Mi-171s to Malaysia, work on first being under way by September 2004, although two Mi-171s delivered to Malaysian Interior Ministry in August 2004. Four Mi-171s to Pakistan, June 2002, with 12 more following by end of that year. Supplied four Mi-171s to Slovak Police. Three Mi-17V-5s to Iraq in 2005. Substantial Mi-17/171 orders received from China, including 24 to be delivered in 2006 from total 35 to be built in that year. Trained Czech pilots for Mi-17S variants being assembled in Czech Republic from kits, beginning 2005.

Will build Kamov Ka-62 and Ka-64; early 2006 estimate was for production launch in two or three years, achieving annual rate of 30 to 40 per year by 2010, assuming immediate launch funding of USD150 million. Oboronprom plans to return Su-25 and Su-39 to production in same timescale.

Also undertakes overhaul and upgrades, including five refurbished Mi-8AMTs supplied to Iranian Navy in 1999. Joint venture with SME Aviation of Malaysia, 1999, for promotion of Mi-8/Mi-17 and Su-25.

VASO

VORONEZHSKOYE AKTSIONERNOYE SAMOLETOSTROITELNOYE OBSHCHESTVO OAO (VORONEZH SHAREHOLDER AIRCRAFT-BUILDING SOCIETY JSC)

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CHIEF DESIGNER: Mikhail N Shushpanov
HEAD OF MARKETING AND SALES: V A Tulupov

VASO is an integral part of the Ilyushin Aviation Complex, responsible for production of the Ilyushin Il-96 transport aircraft; after almost ceasing due to lack of funding, manufacture was resumed in early 2003 to meet an Aeroflot order for eight. In July 2004, VASO directors authorised a follow-on batch of five Il-96s to meet possible future orders. Production in 2005 concerned two for Cubana, in VVIP configuration for Fidel Castro. Work proceeding on Aeroflot aircraft. Further plans, as yet unfunded, call for establishment of assembly line for Ilyushin Il-76, currently built in Uzbekistan. Transfer will produce an estimated 10,000 jobs, but programme seems unlikely to be supported in view of USD250 million cost.

VASO plans to form a joint holding with Ilyushin, initially by uniting the state shareholdings (30 per cent and 60 per cent, respectively) in each company; this will later be incorporated within AVPK Sukhoi as part of aviation industry restructuring plans. Russian government holding is 20 per cent. Future products could also include Ilyushin Il-112V.

Ilyushin Il-96 built by VASO in 2005 *(Yefim Gordon)* 1159211

Overhaul and modification activities have included conversion in 2003 of two Russian Air Forces Il-76MDs to -90 standard with PS-90A-76 turbofans.

Plant originated in GAZ 18, established 1932, building Tupolev TB-3 and DB-3. Original plant evacuated to Samara (then known as Kuybushev) in 1941, forming basis of current Aviacor. Re-established at Voronezh in 1947 as GAZ 84; built Ilyushin Il-10, Il-28, Tupolev Tu-16, Antonov An-12 and Tu-128 heavy interceptor and Tu-144 supersonic airliner and Ilyushin Il-86 wide-bodied airliner. Until recently known as VAPO. Had plans to build Tupolev Tu-54 agricultural aircraft, but currently promoting rival Strizh ('Swift') designed by its own VASO-VGTU bureau (M-14 radial engine and 650 kg; 1,433 lb MTOW). Agreement of April 20[illegible] covers production of An-148 empennage, flaps and engine pylons for Antonov. An-148 production licence obtained 25 November 2005; anticipates building 250 over following 10 years. Also produces boats, agricultural machinery, washing machines, food containers, motorcar silencers and other consumer items.

VITEK

KOMPANIYA VITEK (VITEK COMPANY)

Renamed Istra.

YAKOVLEV

OPYTNO-KONSTRUKTORSKOYE BYURO IMENI A S YAKOVLEVA OAO (EXPERIMENTAL DESIGN BUREAU JSC NAMED FOR A S YAKOVLEV)

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CHIEF DESIGNERS:
Konstantin F Popovich (Yak-130)
Aleksei G Rakhimbaev (Yak-40, Yak-42)
Dmitry K Drach (Yak-52M, Yak-54, Yak-58, Yak-152, Yak-112)
Andrey I Matveev (MC-21)
Yuri I Yankevich (UAVs)
DEPARTMENTAL CHIEFS:
Anatoly S Ivanov (Marketing and Sales)
Evgeny M Tarasov (External Relations)
Yuri V Zasypkin (Information/Press Service)

More than 200 aircraft designs and variants have been completed by Yakovlev since 1927, of which about 100, in 40 main types, have been manufactured in series. About 70,000 aircraft of Yakovlev design have been built, including 40,000 in Second World War and Chinese CJ-6s (version of Yak-18A).

In 2006, Yakovlev's most prominent activities comprised production and testing of Yak-130 combat trainer as selected by Russian Air Forces; design of future Yak-130 versions; testing of Yak-52M upgraded primary trainer for Russian Air Forces; design of Yak-152 new-generation primary trainer; design of MS-21 short/medium-range airliner; upgrading Yak-42D jet airliner; and production of Yak-54 aerobatic trainer.

Production of the Yak-58 lightplane is planned in Kazakhstan by the related Yak Alacon company; no recent progress. Yakovlev designers are working with HAIC of China on the JL-15 advanced trainer. Promotion continues of Yak-48 twin-jet regional aircraft programme in 4-, 5- and 6-tonne payload versions, although no known prospects of project being launched and funded.

In October 2003, Irkut and Yakovlev signed letter of intent on merger, former to purchase 75.5 per cent share of Yakovlev; the purchase was finalised on 29 May 2004 at a price of USD70 million. Yakovlev bureau's production facility moved in 2006 from central Moscow to join flight test centre at Zhukovsky.

YAKOVLEV Yak-130

TYPE: Advanced jet trainer/light attack jet.
PROGRAMME:

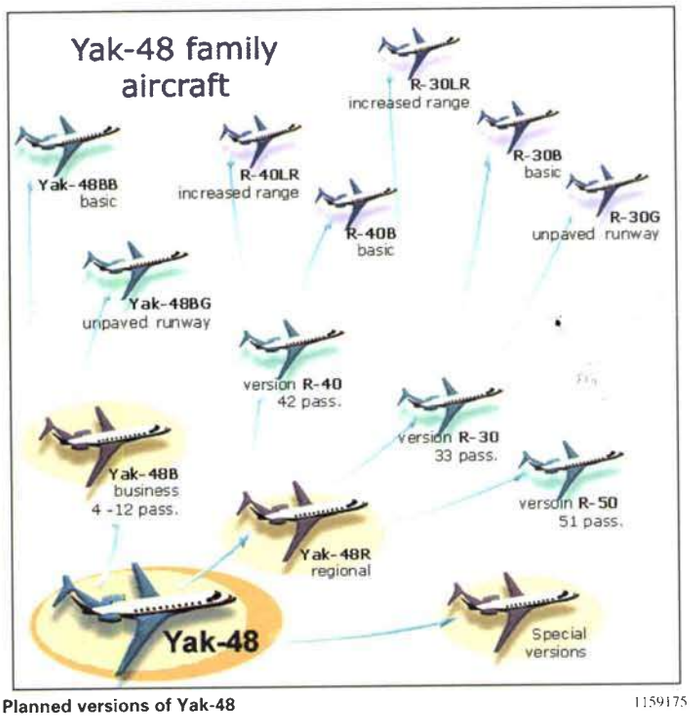
DEVELOPMENT MILESTONES

Design began	1991
Selected by Russian Air Forces	16 Mar 02
Official go-ahead	1995
First flight	25 Apr 96
Public debut	30 Nov 94
Production go-ahead	10 Apr 02
First flight, production	30 Apr 04

One of designs by five OKBs to meet official Russian requirement for 200 aircraft to replace Aero L-29 and L-39 Albatros for all aspects of flying training, basic to combat simulation, and combat; others included Sukhoi S-54, Myasishchev M-200 and MiG-AT. Known initially as Yak-UTS; work began in 1991; preliminary down-selection (with MiG-AT) in December 1991; design finalised by September 1993; construction of prototype began same

First pre-series Yakovlev Yak-130 *(Yefim Gordon)*

1159186



Planned versions of Yak-48

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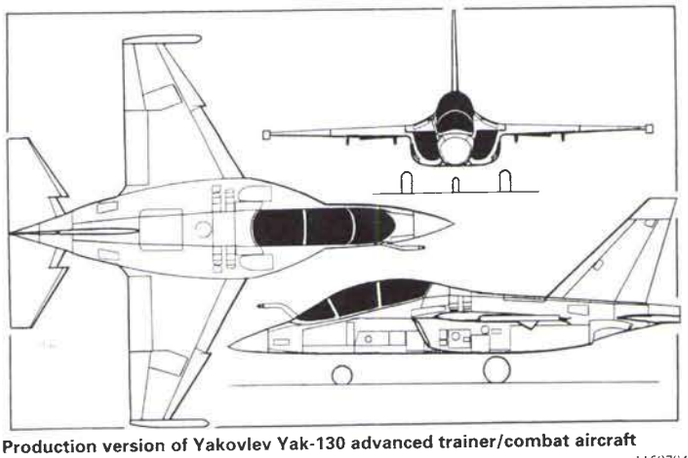


Production version of Yakovlev Yak-130 advanced trainer/combat aircraft *(Paul Jackson)*

1158784

month. In October Yakovlev had begun partnership with Aermacchi of Italy; joint definition completed in December 1999 resulting Yak/AEM-130 adopting two configurations: Yak-130 in Russia and M-346 Italian version.

Yak-130 announced as winner of Russian Air Forces' trainer competition on 10 April 2002 (decision having been reached on 16 March), in preference to MiG-AT. Yakovlev bureau funded 84 per cent of programme to this stage. Russian Air Forces' variant required for service from 2010 onwards. Aermacchi has rights to establish a second assembly line in Italy and contribute tail section and wing assemblies and FBW control system and avionics to both production lines, all components to be single-sourced. Yakovlev designed, and will manufacture, wing, tail surfaces, canopy, and digital FBW FCS and will integrate avionics and weapon systems on non-Russian Federation aircraft.

Yak-130D development aircraft shown to press 30 November 1994; first flight 25 April 1996 at Zhukovsky (later registered RA-43130). Public debut at Paris Air Show, June 2005. Flew 56 sorties (36 hours) in first year, including six without winglets, pending fitment of differently shaped units. Aircraft's equipment, including analogue flight control system, was adopted from Yak-141 V/STOL naval fighter, cancelled three years earlier. To Italy for flight trials July/August 1997, during which (18 July) the 100th sortie was flown; low-speed, high-AoA programme (30 flights) completed in Italy by prototype 31 January 1999; AoAs of up to 41° (maximum), 35° in stabilised flight and 20° in landing configuration were flown successfully. Aircraft returned to Russia for maintenance, followed by evaluation at Akhtubinsk and Armavir test centres; again in Italy by 2000. Total 305 sorties and 254 hours flown by mid-2001; 350 sorties by mid-2002; painted in tactical camouflage for display at MAKS, Moscow, August 2001. Flown 485 sorties up to February 2003. Withdrawn from use by January 2005.

Ten planned preseries aircraft, slightly smaller than prototype, were to comprise three for Zhukovsky test centre for evaluation originally planned to begin in 1998 and seven for air force evaluation planned for 1999 although development programme transferred to Italy, mid-1998, to escape financial instability in Russia, leading to far-reaching reappraisal. By September 1999 it was expected that funding for four preproduction prototypes would soon be obtained, together with three aircraft for evaluation; contract for initial four Yak-130-01s (including two — reduced in 2005 to one, the second airframe — for static tests) signed February 2001 between Yakovlev and Sokol production plant, all to be built in 2003–04; initial aircraft ('01') rolled out at Sokol plant on 30 May 2003; exhibited, unflown, at Paris in June 2003; first flight targeted for November 2003, with certification testing to be complete by end of 2004, but maiden flight not accomplished until 30 April 2004 (with AI-222-25 engines); conducted early vibration tests; by mid-2006 was engaged in flight-structural, performance and flutter testing. Static test airframe delivered by Sokol to Yakovlev Design Bureau in January 2004. Second production ('02') aircraft flew 5 April 2005; engine trials at Akhtubinsk test centre, 2006; third was due to have been completed in October 2005 for use as avionics and armament testbed; initial flight 27 March 2006, with all three Yak-130s operating from Zhukovsky test airfield, Moscow, by mid-2006, although No. 3 lost in accident on 26 July 2006. Static test airframe delivered to Yakovlev in January 2004. This had completed trials by December 2005. In August 2006, Yakovlev announced intention to re-equip one of two surviving military trials aircraft as light attack trainer following its return from Akhtubinsk; this to be private venture requiring USD10 million investment. First prototype was to receive RD-2500 engines in third quarter of 2001, while 10 interim AI-222 engines were due to be delivered in 2002 from Motor-Sich for use in pre-series aircraft. However, only first two AI-222s had been received from Ukraine by early 2003 for static trials; first two flyable engines arriving December 2003.

Announced 20 June 2003 that Russian President had approved manufacture of 200 Yak-130s; first 12 ordered for delivery in 2006-07; later extended to 2007-09.

Navalised version proposed for carrier training; tender now includes Penza (Russia)/CAE Electronics (Canada) simulators and Yak-152 for screening and primary training.

Confirmed June 2006 that Irkut plant to assemble export Yak-130s, although with some components from home production plant, Sokol.

CURRENT VERSIONS: **Yak-130D**: Development prototype RA-43130.

Yak-130UBS: For Russian air force; indigenous equipment; service entry originally scheduled for 2000.

Yak/AEM-130: Hybrid export version; also known as AY-130; programme frozen. Items listed under Systems and Avionics refer mainly to this version. Viewed as low flyaway cost solution to Western trainer requirements by using Yak's good aerodynamic configuration and by addressing poor man-machine interface, low thrust-to-weight ratio and some other "problem areas".

Yak-133: Single-seat light attack version with additional fuel in lieu of rear cockpit (1,050 litres; 277 US gallons; 231 Imp gallons); radius of action up to 594 n miles (1,100 km; 684 miles) with 1,500 kg (3,307 lb) weapon load; 27.5 kN (6,173 lb st) AI-222-28 engines. Design study only.

Yak-133IB: Fighter-bomber (*Istrebitel-Bombardirovshchik*) with nose radar, possibly Leninets Kinzhal.

Yak-133R: Reconnaissance (*Razvedchik*) version.

Yak-133PP: Electronic warfare (*Postanovshchik Pomekh*) version. Nose radar and underwing jamming pods.

Aermacchi M-346: Under development in Italy. Marketing agreement assigns NATO to Aermacchi and CIS to Yakovlev; rivals will compete in remaining markets.

CUSTOMERS: One demonstrator; three flying preseries; plus initial batch of 12 being delivered in 2007-09 for evaluation at Krasnodar Military Aviation Institute and, initially by Lipetsk test centre. Interest expressed by Slovak Republic, which received demonstration in July

1997; Slovakia announced on 5 August 1998 that debts owed by Russia will be repaid in part by delivery of 12 Yak-130s, although no firm contract yet placed. The Yak-130 remains a competitor in Slovakia's search for a subsonic multirole fighter with the AMX, L 159, Hawk and MiG-AT, but has not been officially selected. Its Slovak engines give it competitive advantage. Algerian interest was reported in early 2002, leading to requirement for 16 by 2005; in July 2006 this stated by Sokol to be an 'order' requiring deliveries to begin in 2007. Indian prospects for licensed production raised in January 2003; Mexican interest also in 2003. By mid-2006 Ghana, Libya, Syria and Venezuela identified as sales prospects. Export sales anticipated of up to 630, plus 120 to 140 for Russian Federation.

COSTS: USD12 million to USD15 million, depending on standard (2002). USD70 million reportedly already spent by Aermacchi and USD30 million by Yakovlev, with another USD100 million of R&D spending to follow.

DESIGN FEATURES: Designed from outset to conform to Western specifications for structure, flight controls and maintenance (MSG-3 and MIL-STD-470B). All-swept mid-wing monoplane, except for straight wing and tailplane trailing-edges; no dihedral or anhedral; two-piece full-span automatic leading-edge slats originally on prototype, but dogtooth leading-edge discontinuity tested on RA-43130 and adopted on production version; all-moving low-mounted tailplane, with dogtooth leading-edge; forward-hinged, door-type airbrake on spine, ahead of fin; engines in ducts under wingroots, beneath LERX extending almost to windscreen; optional air intake screens obviate ingestion damage when operating from unpaved airstrips. Wing leading-edge sweepback 31°. Prototype's winglets reduced in size and moved inboard to wingroot as 'LEX fence'; may be deleted in production version. Strakes ahead of windscreen by 1999 replicate characteristics of planned rounded nose. Series production versions will be 1 tonne lighter than the prototype with a more slender, shallower fuselage, lacking chines.

Service life 10,000 hours; extension planned to 15,000 hours, or 30 years.

FLYING CONTROLS: Avionika full-authority, analogue, four-channel fly-by-wire system, with digital 'fourth channel' and 'carefree handling', slaved to laser-gyro platform, developed from that of Yak-141 V/STOL combat aircraft. Demonstrator has two selectable FCS models, one simple, one in MiG-29 class; will be replaced by digital system developed by BAE Italy and Lear Astronics. Prototype inherently stable; production aircraft intended to have 5 per cent longitudinal instability to reproduce handling characteristics of MiG-29/Su-27 series. Handling characteristics can be reprogrammed to simulate other types. Max AoA 42°.

STRUCTURE: Mainly of light alloys, but carbon fibre composites for most control surfaces. Structural design accords to MIL-STD-1530A and MIL-A-8660A.

Fuselage built in three sections: nose (back to frame 15); centre-section (frames 15 to 28); and empennage (from frame 28). Separate wing panels built on five spars, of which three attached to fuselage. Three-spar fin and riveted rudder assembly with dielectric fintip.

Combat version has Kevlar armour around power plant, cockpits and avionics compartment aft of cockpits.

LANDING GEAR: Retractable tricycle type; single wheel on each unit; mainwheels retract into engine ducts; low-pressure tyres suitable for unpaved airfields with ground bearing ratio in excess of 6 kg/cm² (85 lb/sq in). Nosewheel steering to MIL-STD-8812 Class A. Anti-skid system.

POWER PLANT: Prototype fitted with two Povazské Strojàrne ZMK DV-2S (Klimov RD-35) turbofans each 21.58 kN (4,852 lb st). Autonomous engine starting; 20 second negative *g* fuel supply.

Production version of DV-2, designated ZMKB Progress AI-222-25, selected by Russian Air Forces and built in Russia by MMPP Salut and with indigenous FADEC. Rating 24.5 kN (5,512 lb st).

Two fuel tanks in wings; two in-fuselage; combined capacity approximately 2,240 litres (592 US gallons; 493 Imp gallons) but normal training fuel restricted to approximately 1,060 litres (280 US gallons; 233 Imp gallons). Provision for two external fuel tanks, each of 560 litres (148 US gallons; 123 Imp gallons) beneath wings. Single-point pressure refuelling; gravity filling optional. Detachable aerial refuelling probe. Prototype has intake FOD doors of MiG-29 type which will be option for production version.

ACCOMMODATION: Two crew in tandem under blister canopy, on Zvezda K-36LT3.5Ka zero/zero ejection seats with built-in computer, side-force rocket engine and extreme attitude performance. KSAP-130 emergency equipment suite for ejection sequence management; export option of Martin-Baker Mk 16 standard on M-346; explosive cord canopy penetration; rear seat raised. Accommodation air conditioned and pressurised up to differential of 0.26 bar (3.8 lb/sq in). Front pilot has maximum view over nose of −16°; rear pilot −6°.

SYSTEMS: Flight control system is quadruplex, redundant, digital, with full authority, designed by MIEA (Moscow Institute of Electromechanics and Automatics); provides artificial stability, flying qualities in accordance with MIL-STD-1797A, controllability up to at least 35° AoA, carefree handling (*g* limitation, stall/spin prevention, AoA limitation) and adaptability to various weapon configurations and degrees of automation and autopilot modes; includes automatic reversionary modes in the event of damage or failure; and built-in test capability. Aerosila TA-14-130 APU, providing normal and emergency electric, hydraulic and pneumatic power on ground and in air. Zvezda OBOGS (Russian: BKDU). Dual independent hydraulic systems, pressure 207 bar (3,000 lb/sq in); single failure leaves 75 per cent control surface movement; separate accumulators for emergency landing gear extension and brake. Pneumatic system for pressurisation of hydraulic tanks of booster and common systems; emergency opening of landing gear doors; and emergency gear lowering. Dual Rubin 20 kVA generators (one per engine); system rating 200/115 V AC, 400 Hz. Two Ni/Cd batteries. Anti-icing system for windscreen and engine inlet guide vanes. Fire suppression system for engine and APU.

AVIONICS: Western avionics optional to replace standard Russian equipment from Elektroavtomatika.

Comms: Dual V/UHF transceivers; intercom; IFF; ATC transponder.

Radar: Optional. Kopyo and Osa under consideration

Flight: Elektroavtomatika navigation computer; laser gyro INS with embedded GPS by MIEA; air data system, short-range radio nav Tacan and VOR/ILS by VNIIRA-Navigator; ADF and radio altimeter; IFF. Flight data recorder by Polyot.

Instrumentation: HUD in front cockpit as part of collimated flight and sighting display in conjunction with pilot's helmet-mounted target designator; two Elektroavtomatika square colour multifunction liquid-crystal displays in each cockpit (three 152 × 203 mm; 6 × 8 in MFDs in export aircraft) with standby electromechanical flight/nav instruments. NVG compatibility; optional HOTAS controls.

Mission: Optional laser/TV weapon guidance system; Platan and Sapsan under consideration. Mission data entry system; optical weapon aiming computer and weapons control system; simulator of moving targets, guidance commands, weapons preparation and tactical situations; flight data and crew actions recorder; TV monitor of eye and hand positions, with video recorder, in front cockpit.

Self-defence: Provision for chaff/flare dispenser, RWR and active electronic countermeasures.

ARMAMENT (optional): Nine (including wingtip AAM stations) hardpoints (including four under each wing) for up to 3,000 kg (6,614 lb) of rockets, guns, missiles, guided and unguided bombs, including eight 250 kg bombs, four 500 kg laser-guided bombs, submunitions containers, Kh-25ML (AS-10 'Karen') or AGM-65 Maverick ASMs, R-73 (AA-11 'Archer'), AIM-9L Sidewinder or Magic 2 AAMs.

DIMENSIONS, EXTERNAL (production aircraft):

Wing span	9.86 m (32 ft 4¼ in)
Wing aspect ratio	4.0
Length overall	11.495 m (37 ft 8½ in)
Height overall	4.76 m (15 ft 7½ in)
Wheel track	2.53 m (8 ft 3½ in)
Wheelbase	3.90 m (12 ft 9½ in)

AREAS:

Wings, gross	23.52 m² (253.2 sq ft)

WEIGHTS AND LOADINGS (production aircraft):

Weight empty	**4,600 kg (10,141 lb)**
Max weapon load	**3,000 kg (6,614 lb)**
Fuel weight: normal training	**850 kg (1,874 lb)**
max internal	**1,750 kg (3,858 lb)**
with two external tanks	**2,700 kg (5,952 lb)**
T-O weight: trainer, typical	**5,700 kg (12,566 lb)**
attack, normal	**8,000 kg (17,635 lb)**
attack, max	**9,000 kg (19,841 lb)**
Max wing loading: trainer	**242.3 kg/m² (49.64 lb/sq ft)**
attack/trainer	**382.7 kg/m² (78.37 lb/sq ft)**
Max power loading: trainer	**116 kg/kN (1.14 lb/lb st)**
attack/trainer	**184 kg/kN (1.80 lb/lb st)**

PERFORMANCE (clean, estimated):

Max level speed	**572 kt (1,060 km/h; 659 mph)**
Unstick speed	**108 kt (200 km/h; 124 mph)**
Landing speed	**103 kt (190 km/h; 118 mph)**
Stalling speed, 20% fuel	**89 kt (165 km/h; 103 mph) CAS**
Max rate of climb at S/L	**4,500 m (14,763 ft)/min**
Service ceiling	12,500 m (41,020 ft)
T-O run	340 m (1,115 ft)
Landing run	550 m (1,805 ft)
Radius of action, 5 min combat: interdiction, two Mk 83; 1,000 lb bombs, two AAMs, gun pod, two external tanks, hi-lo-hi	460 n miles (852 km; 529 miles)
close air support, four 500 kg; bombs, two AAMs, gun pod, hi-lo-hi	234 n miles (435 km; 270 miles)
Range: with max internal fuel	1,079 n miles (2,000 km; 1,242 miles)
with two external tanks	1,800 n miles (3,333 km; 2,071 miles)
Max rate of roll	200°/s
Sustained *g* limit at M0.8 at 4,575 m (15,000 ft) with 50% internal fuel	+5.4
g limits	+8/−3

YAKOVLEV Yak-3M and Yak-9U-M

TYPE: Aerobatic single-seat sportplane; aerobatic two-seat sportplane.

PROGRAMME: Reproduction Second World War fighter. Prototype of original wooden-skinned Yak-3 flew 1943; all-metal version flew 1945; deliveries to Soviet air forces began July 1944, totalled 4,848 (of 36,737 Yakovlev single-engined Second World War fighters); described often as lightest weight and most agile monoplane of 1939–45 period; able to turn 360° in 18.5 seconds. all-metal version now available, with Western power plant and uprated instrumentation; new-build 'prototype' (0470101, later N854DP) displayed 1993 Paris Air Show; 11 built by Strela at Orenburg to meet orders from Gunnell Museum, USA; one later to New Zealand (then Australia in 1999); and one to South Africa (then USA in 2005); one to Germany in 2004.

Production turned in 1996 to Yak-9U of similar appearance. Original Yak-9 entered service in 1942 (before Yak-3) and 16,769 were built. Total of eight all-metal Yak-9U-M replicas exported to USA by mid-1999, of which five then flying; one subsequently to France; distribution by Shadetree Aviation of Carson City, Nevada (Tel: +1 775 841 10 68; Web: www.shadetreeusa.com). Ninth Yak-9 completed by Strela in late 2001 for export to US, being registered in June 2003, but to Australia in 2004.

In all, 21 reproductions built by 2002, according to Yakovlev information, apparently including one untraced Yak-7.

UK importer, Richard Goode Aerobatics, commissioned four further Yak-9s for delivery in 2002, three having already been sold by May 2002. None of these had appeared by late 2005, however.

In August 2005, a Yak-3U/R-200 was registered in US (as N46463), apparently as a new-built aircraft produced by Avioane in Romania.

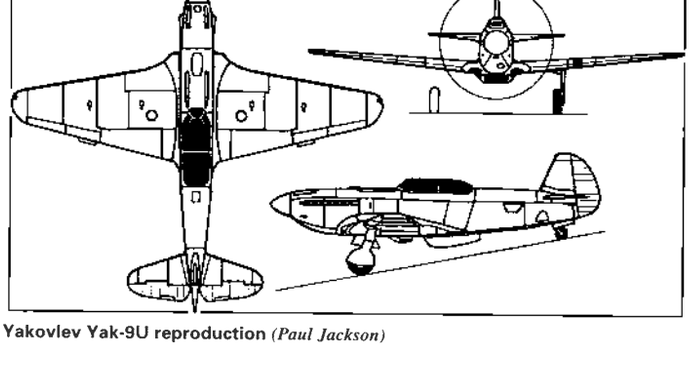
Note that further Yak-3UAs have been produced by other sources through conversion of Yak-11s, mostly with Pratt & Whitney R-1830/R-2000 Twin Wasp radial engines.

COSTS: US$385,000 plus tax (2004).

Following data apply to Yak-9.

DESIGN FEATURES: Precise reproduction in metal of Second World War airframe, except for repositioned carburettor air intake above engine cowling to suit changed engine. Conventional cantilever low-wing configuration, with tapered, round-tipped wings. Mainwheel tyres size 600×180.

POWER PLANT: Reconditioned 925 kW (1,240 hp) Allison V-1710-39 12-cylinder V liquid-cooled piston engine; three-blade propeller. Fuel capacity 526 litres (139 US gallons; 116 Imp gallons).



Yakovlev Yak-9U reproduction *(Paul Jackson)*

First Yak-3M from recent production flying with blown canopy in 2005 *(Paul Jackson)* 1151686

DIMENSIONS, EXTERNAL:
- Wing span ..... 9.20 m (30 ft 2¼ in)
- Wing aspect ratio 5.7
- Length overall ..... 8.55 m (28 ft 0½ in)
- Height overall ..... 2.39 m (7 ft 10 in)

AREAS:
- Wings, gross ..... 14.85 m² (159.8 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty ..... 2,135 kg (4,707 lb)
- Max T-O weight ..... 2,600 kg (5,732 lb)
- Stalling speed: clean ..... 103 kt (191 km/h; 119 mph)
- landing configuration ..... 81 kt (150 km/h; 94 mph)
- Max wing loading ..... 175.1 kg/m² (35.86 lb/sq ft)

PERFORMANCE:
- Max level speed ..... 377 kt (698 km/h; 434 mph)
- Max power loading ..... 2.81 kg/kW (4.62 lb/hp)

YAKOVLEV Yak-54

TYPE: Aerobatic two-seat sportplane.

PROGRAMME: Yak-54 announced, and construction began, 1992; prototype at 1993 Paris Air Show; first flown 23 December 1993; third prototype at Paris in 19[illegible] production from 1995 at Saratov Aviation Plant (SAZ), with maximum capacity of [illegible] than 100 per year. Competed successfully in World and European advanced ae[illegible]cs competitions. However, production suspended in 1998; to resume after certificatio[illegible]eved, early 2002; initial batch of five funded (and to be marketed) by ZAO Gorki Yu-[illegible]mpany, including two for Promety (Prometheus) aerobatic group (representing total 200[illegible]oduction) and one for export to Australia; a Slovakian customer has also been mer[illegible]ned. However, in February 2002, SAZ again suspended production, having built only o[illegible] aircraft (in 2001); this received Russian certification on 22 November 2002, followin[illegible] improvements to aerodynamics aimed at enhancing basic handling qualities and [illegible]erobatic capability. Arsenyev plant announced in January 2006 that batch of 10 Yak-54[illegible] under construction, with first deliveries due by end of that year.

CURRENT VERSIONS: **Yak-54**: *As described.*

Yak-56: Primary trainer derivative; also designated **Yak-54M**; red[illegible]signated **Yak-152** in late 2000 (although Yak-54M designation was still being used in 200[illegible]1); 294 kW (394 hp) M-14PF, retractable tricycle landing gear and SKS-94 crew ejectio[illegible]n system. Prototype under construction in 1999. Wing span 8.80 m (28 ft 10½ in); length[illegible]erall 7.30 m (23 ft 11½ in); height overall 2.80 m (9 ft 2¼ in); empty weight 950 kg [illegible]lb); fuel weight 200 kg (441 lb); maximum take-off weight 1,300 kg (2,866 lb); m[illegible]el speed 202 kt (375 km/h; 233 mph) manoeuvring speed 243 kt (450 km/h; 280 mph[illegible]ling speed 54 kt (100 km/h; 63 mph); maximum range 540 n miles (1,000 km; 621 [illegible]g limits +9/–7. [illegible]ukhoi Su-49.

In October 2001, Yak-152 was unsuccessful in competition aga[illegible] military train to provide new equipment for ROSTO (successor to DOSAAF); [illegible]er produc[illegible]ing organisation. Despite this, prototype intended to fly in 2003 and typ[illegible] by April 2[illegible]tion at Saratov (SAZ). Commitment reconfirmed by Yakovlev's chairm[illegible] 2,910, 2002, but engine reverted to 265 kW (355 hp) M-14Kh and MTOW 1,32[illegible] lb). Project apparently delayed or abandoned although Chinese interest was [illegible]n September 2006.

Yak-57: Single-seat sportplane; under development by 1999.

CUSTOMERS: Total 48 Yak-54s ordered in January 1997 by Northwest Aerobatic Center, Ephrata, Washington, USA, and Dancing Bear air show team, 15 built up to 1998 suspension of production; five (of six exported) flying in USA, plus one (second-hand) delivered to Australia during 1999. In March 2002, Yak-54 fleet stated to be four in Russia, five in US, plus two destroyed in accidents. US marketing by Yakovlev Aircraft USA, Scotts Mills, Oregon; e-mail: info@yak54.com. Kaiser Flugzeugbau of Germany planned acquisition of evaluation Yak-54 in 2004 with a view to becoming a distributor.

Following resumption of manufacture, Saratov delivered three Yak-54s to Central Aeroclub of Samara by December 2003, and produced further three in 2004, reportedly for Russian ROSTO training organisation. By early 2005, additional 10 on order.

COSTS: USD175,000 to USD190,000 (2006).

DESIGN FEATURES: Optimised for aerobatics; derived from Yak-55M. Conventional mid-wing configuration; symmetrical section; no dihedral, anhedral or incidence; almost full-span ailerons, elevators and rudder all horn-balanced; each aileron has large suspended balance tab. Designed on basis of systems and units of Yak-55M.

FLYING CONTROLS: Conventional and manual. Ailerons occupy 90 per cent of wing trailing-edge and have both horn balance and suspended tab; horn-balanced tail surfaces.

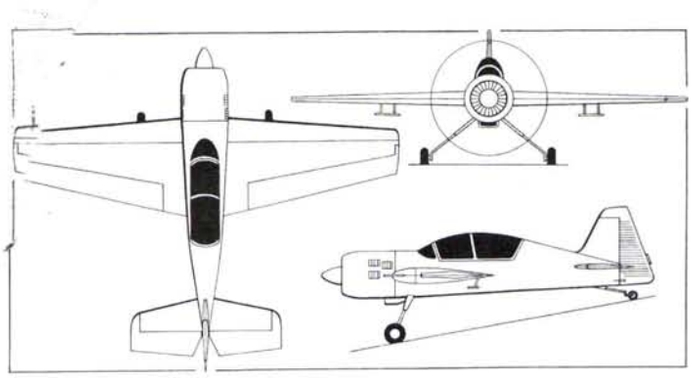
STRUCTURE: All-metal; two-spar wings; semi-monocoque fuselage; conventional tail unit.

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted titanium spring cantilever mainwheel legs and small wheels, tyre size 400×150; tailwheel tyre size 200×80.

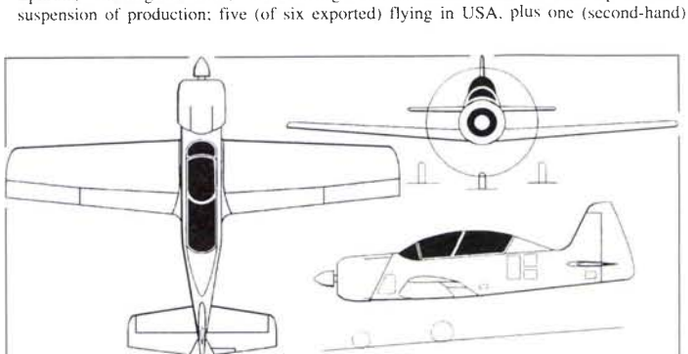
POWER PLANT: One 265 kW (355 hp) VOKBM M-14P nine-cylinder air-cooled radial engine; MTV-9-B-C/CL-250-27 three-blade variable-pitch propeller.

ACCOMMODATION: Two seats in tandem under continuous transparent canopy, hinged to starboard.

DIMENSIONS, EXTERNAL:
- Wing span ..... 8.16 m (26 ft 9¼ in)
- Wing aspect ratio 5.2
- Length overall ..... 6.91 m (22 ft 8 in)



Yak-54 sporting and aerobatic training aircraft *(Mike Keep)* 1162417



Provisional general arrangement of Yakovlev Yak-152 *(Paul Jackson)* 1158758

Yakovlev Yak-54 of Patrouille Tranchant team *(Paul Jackson)* 1162405

AREAS:
Wings, gross ..... 12.89 m² (138.75 sq ft)
WEIGHTS AND LOADINGS:
Max T-O weight: Aerobatic
one pilot ..... 901 kg (1,986 lb)
two occupants ..... 990 kg (2,182 lb)
Max Aerobatic wing loading ..... 76.8 kg/m² (15.73 lb/sq ft)
Max Aerobatic power loading ..... 3.74 kg/kW (6.15 lb/hp)
PERFORMANCE:
Never-exceed speed (VNE) ..... 224 kt (415 km/h; 257 mph)
Stalling speed ..... 60 kt (110 km/h; 69 mph)
Rate of roll ..... 360°/s
Max rate of climb at S/L ..... 900 m (2,950 ft)/min
Max certified altitude ..... 3,000 m (9,840 ft)
Ferry range ..... 377 n miles (700 km; 435 miles)
g limits ..... +9/−7

YAKOVLEV/ILYUSHIN MS-21

TYPE: Regional jet airliner.

PROGRAMME: Originated in Yak-242, which proposed as successor to Yak-42 and included in State Programme for Aviation, with maiden flight scheduled for 1998. Project lapsed, but revived in 2003 when re-launched as MS-21 (*Magistral'nyi Samolet 21 Veka*: airliner of the 21st Century), with design inputs from Ilyushin, having gained official support against Il-214 and Irkut 111 in competition decided on 21 July and formally announced 18 August 2003. Also envisaged as Tu-154M replacement.

Ilyushin expected to become lead partner on MS-21 and sign development contract with Rosaviakosmos; Yakovlev then to become subcontractor to Ilyushin. However, in December 2004, Ilyushin confirmed Yakovlev as lead developer. Tupolev signed participation agreement in mid-2005 covering joint development. Preliminary design target was mid-2006; critical design review due by end of 2008. Chief designer, Andrey Matveyev. Irkut to join programme as risk-sharing partner. First flight two years from go-ahead and service entry three years thereafter. Production will be by Aviastar.

CURRENT VERSIONS: **MS-21-100:** Shrunk version; 132 seats in all-economy layout.

MS-21-200: Baseline version. 150 seats in all-economy layout.

MS-21-300: Stretched version. 168 seats in all-economy layout.

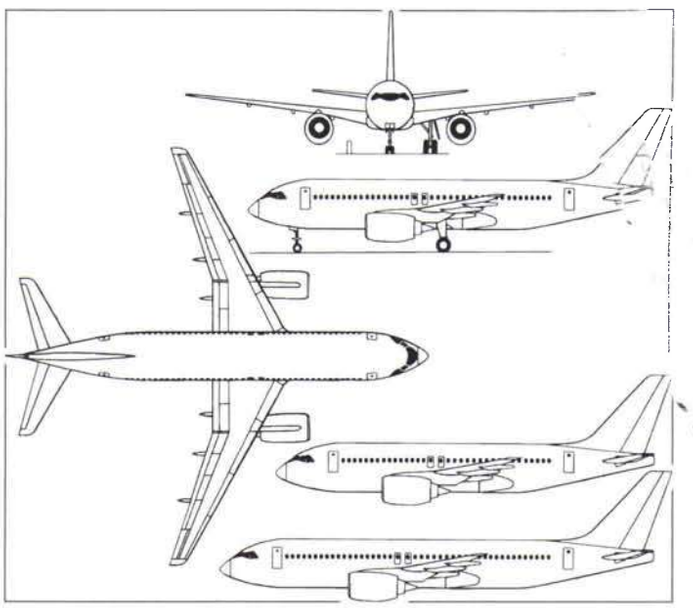
MS-21LR: Long-range version of all three fuselage lengths: **-100LR, -200LR** and **-300LR**.

MS-21K: Freighter; 17 t payload.

MS-21KP: Combi; cargo compartment length 21.43 m (70 ft 3¾ in).

CUSTOMERS: Predicted market for 600 MS-21s over 20 years, including 400 for Russian operators.

COSTS: Development estimated as USD460 million (2003), including USD200 million from Russian government. Revised in 2005 to USD1 billion. Unit cost target for MS-21-200 USD35 million (2005).



Yakovlev MS-21-200 regional airliner, with additional profiles of -100 (centre) and -300 (bottom) *(Paul Jackson)* 1159129

Model of Yakovlev MS-21 as envisaged in 2006, without winglets *(Paul Jackson)* 1159172

DESIGN FEATURES: Low-wing airliner with two podded engines underwing. Cruising speed in excess of M0.8; significant use of composites materials. To conform to equivalents of FAR Pt 25 for airframe; Pt 33 engines; Pt 34 emissions; and Pt 36/ICAO Chapter 4 noise. Intended 70 per cent engine, systems and avionics commonality with Ilyushin/Irkut/HAL Il-214. Design aims include improvements over Airbus A320 of 15 per cent structural weight efficiency, 20 per cent direct operating cost and 15 per cent fuel consumption. Service life 60,000 hours and 30,000 landings over 25 years.

Supercritical wing section designed in collaboration with TsAGI; leading-edge sweepback 25°; winglets on early impressions had been deleted by 2006.

FLYING CONTROLS: Digital fly-by-wire controls. Double-slotted flaps, four-section leading-edge slats and five-section spoilers per wing.

STRUCTURE: Combination of updated and new aluminium alloys with composites (including Airbus-developed GLARE). At time of service entry, composites to comprise 30 per cent by weight. Wing envisaged initially of conventional alloy structure, replaced in post-2015 production by all-composites structure, increasing composites fraction to 40 or 45 per cent.

LANDING GEAR: Tricycle type; hydraulically retractable. Two-wheel main bogies; tyre size 1200×410. Twin nosewheel, size 660×200. Option of four-wheel main bogies with 950×300 tyres.

POWER PLANT: Two turbofans in 108 to 117 kN (24,200 to 26,400 lb) class, such as 118 kN (26,450 lb st) Aviadvigatel PS-12 turbofans (derated PS-90A), Progress/Motor Sich/Salyut D-436TX or Western CFM56-5A1, -5B4, -7B26, or IAE V2500A/V2527-A5.

ACCOMMODATION: Two flight deck crew. Seating for 132 to 168 passengers three abreast at 81 cm (32 in) pitch with 55 cm (21½ in) aisle. Overhead bins with 0.06 m³ (2.1 cu ft) per passenger. Two underfloor freight holds for total of six LD3-46W containers. Passenger doors, port, front and rear; service doors, starboard, front and rear; two emergency exits overwing, each side. Combi and freighter versions with cargo door ahead of wing, port side; accommodates eight P1, P2 or P6 pallets.

AVIONICS: *Instrumentation:* 'Glass cockpit' with 203 × 305 mm (8 ×12 in) LCDs with Dassault EASy interface.

All data are provisional.

DIMENSIONS, EXTERNAL:
Wing span ..... 34.80 m (114 ft 2 in)
Wing aspect ratio 10.5
Length overall: 100 ..... 34.00 m (111 ft 6½ in)
200 ..... 37.03 m (121 ft 5¾ in)
300 ..... 39.50 m (129 ft 7 in)
Max diameter fuselage ..... 4.09 m (13 ft 5 in)
Freight door (forward, port, front):
Width ..... 2.90 m (9 ft 6¼ in)
Height ..... 2.10 m (6 ft 10¾ in)
AREAS:
Wings, gross ..... 115.0 m² (1,237.8 sq ft)
WEIGHTS AND LOADINGS:
Operating weight empty, equipped: 100 ..... 37,500 kg (82,673 lb)
200 ..... 38,500 kg (84,878 lb)
300 ..... 39,600 kg (87,303 lb)
Max payload: 100 ..... 12,500 kg (27,558 lb)
200 ..... 14,300 kg (31,526 lb)
300 ..... 16,000 kg (35,274 lb)
Max fuel weight ..... 21,000 kg (46,297 lb)
Max T-O weight: 100 ..... 66,000 kg (145,505 lb)
200, 300 ..... 70,500 kg (155,425 lb)
PERFORMANCE:
Cruising speed ..... 459 kt (850 km/h; 528 mph)
Balanced field length: 100 ..... 2,300 m (7,545 ft)
100LR, 200LR, 300LR ..... 2,500 m (8,205 ft)
Range: 100 ..... 2,600 m (8,530 ft)
100LR ..... 2,159 n miles (4,000 km; 2,485 miles)
100ER ..... 3,239 n miles (6,000 km; 3,728 miles)
200 ..... 2,429 n miles (4,500 km; 2,796 miles)
200LR ..... 2,969 n miles (5,500 km; 3,417 miles)
300 ..... 1,889 n miles (3,500 km; 2,174 miles)
300LR ..... 2,321 n miles (4,300 km; 2,671 miles)

Serbia

STORCH

STORCH AVIATION SCG

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Web: www.slepcevstorch.com
MANAGING DIRECTOR: Nestor Slepcev

Nestor Slepcev designed, built and flew two earlier aircraft before producing the Storch Mk 4. In August 1996, Mr Slepcev landed a Storch Mk 4 on Gran Sasso, Italy, in re-enactment of the rescue of Benito Mussolini, 53 years earlier. Previously based in Australia, Storch Aviation had moved to Serbia by 2005.

STORCH STORCH SS Mk 4

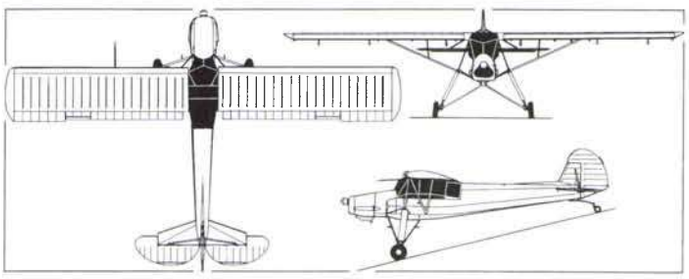
TYPE: Tandem-seat ultralight/kitbuilt.

PROGRAMME: Engineering structure designed by Bill Whitney. First flight (VH-ZOR) 1991, then with single seat and powered by 59.6 kW (79.9 hp) Rotax 912 engine; two-seat version first flown 1994; JAR-VLA certification achieved in Australia, 14 October 1999 and in Spain on 21 May 2001.

CURRENT VERSIONS: **Storch 'Ultra':** Ultralight; Australian Primary Category; CAO 19 (amateur build).

Storch 'Muster': Utility version; envisaged uses include cattle mustering. Australian CAO 24 or certified categories.

Storch 'Criquet': Powered by Rotec Fireball 7 seven-cylinder radial engine of 82.0 kW (110 hp), thus resembling Morane-Saulnier MS 502 Criquet. Prototype VH-AJH public debut at Avalon Air Show, February 2001.



Storch SS Mk 4 *(Paul Jackson)* 1158038

Storch SS Mk 4 built in UK and finished in Second World War markings *(Paul Jackson)* 1037941

Super Storch Mk 4: Higher-powered version, usually with 119 kW (160 hp) Textron Lycoming O-320 engine, top speed of 110 kt (203 km/h; 126 mph) and empty weight of 470 kg (1,036 lb) and MTOW 861 kg (1,900 lb). 13 in Australia by April 2002. At least one (N2898J) in USA with Superior (Textron Lycoming)) O-360 of 149 kW (200 hp); empty weight 554 kg (1,222 lb); MTOW 750 kg (1,653 lb).

Storch SS-FP: Floatplane; prototype, with full Lotus floats and Rotax 912S2 engine, registered VH-ANB in November 2001.

Storch Moose: M-14P radial engine (265 kW; 355 hp) installed in prototype VH-AYQ (100th Storch), which registered in November 2001. Fuel capacity 400 litres (106 US gallons; 88.0 Imp gallons). Length 7.62 m (25 ft 0 in); wing span 10.67 m (35 ft 0 in); empty weight 798 kg (1,760 lb), MTOW 1,397 kg (3,080 lb); max speed 105 kt (194 km/h; 120 mph); take-off run 61 m (200 ft).

CUSTOMERS: More than 140 sold by early 2006 (including some 50 factory-built) to customers in 21 countries in Africa, Australasia, Europe, North America and Pacific Rim. Highest known completion is No. 105, registered in 2003 and owned by Mr Slepcev. One known in 2004. Approximately 60 per cent of production is factory-built.

COSTS: USD58,000, factory-complete (2000).

DESIGN FEATURES: Three-quarters scale version of Second World War German Fieseler Fi 156 Storch STOL liaison and observation aircraft. Wings are removable for transport or storage. Quoted build time for kitbuilt version approximately 600 hours. Aerofoil derived from Clark Y.

FLYING CONTROLS: Conventional and manual. Actuation by pushrods and cables; ground-adjustable tab on each aileron. Fowler flaps and full span leading-edge slats. Horn-balanced tail surfaces. Electronic flight-adjustable tailplane incidence for pitch trim in Ultralight; VLA has fixed tailplane with trim tab in port elevator.

STRUCTURE: Welded 4130 chromoly steel tube fabric-covered fuselage and tail surfaces; metal engine cowling. Strut-braced 6061-T6 aluminium wings with stamped ribs and D-section leading-edge; latest versions aluminium-covered, except fabric flaps and ailerons. Composites wheel fairings.

LANDING GEAR: Tailwheel type; fixed. Centreline hinged, streamlined tube Vs attached to telescoping, bungee cord-sprung struts, upper ends of which fixed to apexes of tube pyramids on fuselage sides. Mainwheel size 8.00×6-6; Maule tailwheel, diameter 15 cm (6 in); hydraulic disc brakes. Float installation optional.

POWER PLANT: Standard factory-built VLA version has one 73.5 kW (98.6 hp) Rotax 912 ULS flat-four driving two-blade Bruce de Chastel or Storch Aviation PROP-004 wooden propeller; 84.6 kW (113.4 hp) turbocharged Rotax 914 optional. Fuel in two wing tanks and a belly tank, combined capacity 90 litres (23.8 US gallons; 19.8 Imp gallons); a larger belly tank, capacity 100 litres (26.4 US gallons; 22.0 Imp gallons) optional.

ACCOMMODATION: Two, in tandem, with dual controls.

DIMENSIONS, EXTERNAL:

Wing span	10.00 m (32 ft 9¾ in)
Length overall	6.80 m (22 ft 3¼ in)
Height overall	2.40 m (7 ft 10½ in)
Propeller diameter	1.88 m (6 ft 2 in)

DIMENSIONS, INTERNAL:

Cabin: Length	1.50 m (4 ft 11 in)
Max width	0.80 m (2 ft 7½ in)
Max height	1.00 m (3 ft 3¼ in)

AREAS:

Wings, gross	16.00 m² (172.2 sq ft)

WEIGHTS AND LOADINGS (Storch 'Ultra'):

Weight empty	350 kg (772 lb)
Max T-O weight	544 kg (1,200 lb)

PERFORMANCE:

Never-exceed speed (VNE)	98 kt (181 km/h; 112 mph)
Max level speed	78 kt (144 km/h; 90 mph)
Cruising speed	70 kt (130 km/h; 81 mph)
Stalling speed, flaps down, power on	22 kt (41 km/h; 26 mph)
Max rate of climb at S/L	213 m (700 ft)/min
Service ceiling	4,575 m (15,000 ft)
T-O and landing run	9 to 15 m (30 to 50 ft)
Endurance: standard fuel	3 h 0 min
optional fuel	7 h 0 min
g limits	+6/−3

UTVA

VAZDUHOPLOVNA INDUSTRIJA UTVA (SHELDRAKE AIRCRAFT INDUSTRY)

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GENERAL MANAGER: Dipl Ing Tomislav Bjelogrlić
PRODUCTION MANAGER: Dipl Ing Dragan Turkalj
AIRCRAFT DEVELOPMENT MANAGER: Dipl Ing Tonko Mihovilovic

Utva (Sheldrake) formed at Zemun, 5 June 1937; to Pančevo 1939. The 86,000 m² (925,700 sq ft) factory was heavily damaged during NATO air strikes on 24 March 1999, at which time development work on the G-4M Super Galeb, Lasta 2 primary/basic trainer and Utva-96 ceased. In late 2003 the company announced that it was restarting work on the Utva-96; in early 2004 it was announced that Utva would be separated from its parent company Lola prior to privatisation, scheduled for 7 October 2004 and that design work was under way on a new basic trainer, the Lasta 95. Privatisation was delayed, but Lola's share (amounting to 70 per cent of socially-owned capital or 23.51 per cent of total capital) was auctioned on 26 October 2006; however, the reserve price was not reached. The company is also developing unmanned aerial vehicles (UAVs) including the Gavran-I and Gavran-II, and aerial targets. No evidence of recent light aircraft activity.

UTVA-96

TYPE: Four-seat lightplane.

PROGRAMME: Resumption announced in 2003 as a development of earlier two-seat Utva-75 trainer used by air forces and flying clubs of the former Yugoslavia, at which time two prototypes were under construction; no further information.

DESIGN FEATURES: Compared to earlier Utva-75, has strengthened fuselage to meet FAR Pt 23 requirements and redesigned engine cowling. Upgrade conversion kits for Utva-75 available.

FLYING CONTROLS: Conventional and manual. Fluted skin on ailerons, flaps, fin, rudder and elevators; rudder and elevators horn-balanced; ground-adjustable tab on rudder; Flettner trim tab on each aileron; Teleflex actuator for elevator control tab.

STRUCTURE: All-metal semi-monocoque.

LANDING GEAR: Tricycle type; fixed. Wing-mounted, cantilever main legs with trailing-link suspension and oleo-pneumatic shock-absorbers. Small tail bumper. Tyres, size 7.00–8 on mainwheels; size 6.00–6 on nosewheel; hydraulic brakes.

POWER PLANT: Initially, one 224 kW (300 hp) Textron Lycoming IO-540-L1A5D flat-six was proposed, but this was changed to one 134 kW (180 hp) Textron Lycoming IO-360-B1F by early 2006. Total fuel 153 litres (40.4 US gallons; 33.7 Imp gallons) in integral wing tanks.

ACCOMMODATION: Pilot and three passengers in two pairs of seats; single-piece front windscreen and larger side windows. Separate baggage compartment.

AVIONICS: Integrated system to meet IFR requirements.

DIMENSIONS, EXTERNAL:

Wing span	9.73 m (31 ft 11 in)
Wing chord	1.55 m (5 ft 1 in)
Wing aspect ratio	6.5
Length overall	7.11 m (23 ft 4 in)
Height overall	3.15 m (10 ft 4 in)
Tailplane span	3.80 m (12 ft 5½ in)
Wheel track	2.58 m (8 ft 5½ in)
Wheelbase	1.99 m (6 ft 6¼ in)
Propeller diameter	1.93 m (6 ft 4 in)
Propeller ground clearance	0.295 m (11¾ in)

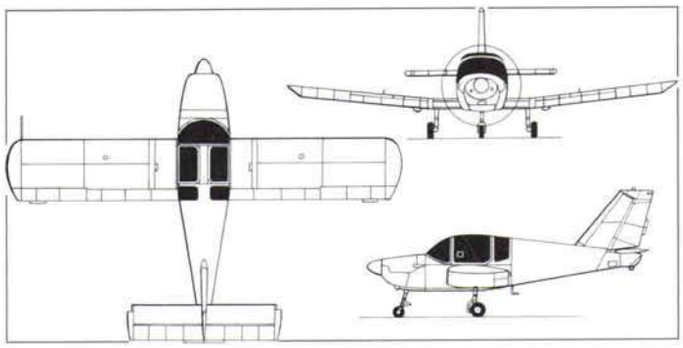
AREAS:

Wings, gross	14.63 m² (157.5 sq ft)
Ailerons (total)	1.38 m² (14.85 sq ft)
Flaps (total)	1.61 m² (17.33 sq ft)
Vertical tail surfaces (total)	1.78 m² (19.16 sq ft)
Horizontal tail surfaces (total)	3.34 m² (35.95 sq ft)

WEIGHTS AND LOADINGS (estimated):

Weight empty	710 kg (1,565 lb)
Max baggage weight	50 kg (110 lb)
Max T-O weight	1,210 kg (2,668 lb)
Max wing loading	82.7 kg/m² (16.94 lb/sq ft)
Max power loading	9.03 kg/kW (14.84 lb/hp)

Prototype Utva-96 under construction 0567734



Utva-96 four-seat lightplane *(James Goulding)* 1047690

PERFORMANCE (estimated):
- Max operating speed ... 103 kt (190 km/h; 118 mph)
- Max cruising speed ... 94 kt (175 km/h; 109 mph)
- Stalling speed ... 54 kt (100 km/h; 62 mph)
- Max rate of climb at S/L ... 240 m (787 ft)/min
- Service ceiling ... 4,000 m (13,120 ft)
- T-O run ... 200 m (660 ft)
- T-O to 15 m (50 ft) ... 400 m (1,315 ft)
- Landing from 15 m (50 ft) ... 340 m (1,115 ft)
- Landing run ... 180 m (590 ft)
- Range with max fuel ... 324 n miles (600 km; 373 miles)

Slovakia

AEROPRO

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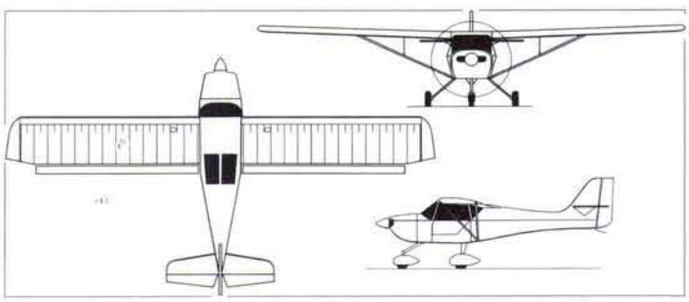
Light aviation supplies company Aeropro has been manufacturing aircraft since 1992. In 1995 it took over production of the Eurofox ultralight formerly marketed by EV-AT of Czech Republic and currently offers both tri-gear and tailwheel versions, including a towing version of the Eurofox Space.

Europro Eurofox side-by-side ultralight *(Paul Jackson)* 1158785



Aeropro Eurofox Space in its nosewheel version, with and without wheel fairings *(Paul Jackson)* 1127528

AEROPRO EUROFOX

TYPE: Side-by-side ultralight/kitbuilt.

PROGRAMME: Adapted in 1990 from SkyStar (Denney) Kitfox, primarily for sale in Germany by Ikarusflug; renamed Eurofox in 1995. Certification to German Bauvorschriften für Ultraleichtflugzeuge (BFU) and Slovakian ultralight requirements was achieved in March 1996. Eurofox Pro (now Eurofox Space) now certified in Belgium, Czech Republic, France, Italy and Netherlands. The 1999 versions introduced increased cabin width and option of Rotax 912 ULS with provision for glider towing (Eurofox TOW). Eurofox Space certified as lightplane in Slovak Republic 17 June 2005.

CURRENT VERSIONS: **Eurofox Basic:** Tailwheel ultralight version; two-blade propeller. MTOW 450 kg (992 lb).

Eurofox Space: Introduced (as Eurofox Pro) 1999; JAR-VLA version with 480 kg (1,058 lb) MTOW; nosewheel. Improvements include increased cabin width, increased leg room (partly through raised instrument panel) and modified engine cowling.

Note that many aircraft are still registered with the original type name **Fox**.

CUSTOMERS: The 100th was built in 2001 for a Dutch owner; company reported 183 built by October 2006, with examples flying in Belgium, Canada, Czech Republic, France, Germany, Italy, Morocco, Netherlands, Poland, Portugal, Slovakia and US.

COSTS: Kit: Eurofox Basic EUR27,300, Eurofox Space EUR27,850. Ready to fly: Eurofox Basic EUR45,900 (tailwheel), EUR46,290 (912 UL) or EUR47,350 (912 ULS) or EUR52,990 (TOW/912 ULS). (All prices excluding VAT, 2006.)

DESIGN FEATURES: Extensive redesign of SkyStar Kitfox (which see). Main changes are lengthened fuselage to improve longitudinal stability, NACA 4412 modified wing section, Junkers combined flaps/ailerons, more spacious cabin dimensions and revised landing gear.

FLYING CONTROLS: Conventional rudder and elevator, manually actuated (cables and pushrods respectively); 80 per cent span, rod-actuated mass-balanced Junkers-type flaperons, maximum deflection 20°.

STRUCTURE: Folding wings have two alloy tubing spars with diagonal bracing, alloy full and half ribs, glass fibre flaps and leading-edges and Ceconite or Poly-Fiber covering. Fuselage of welded 4130 chromoly steel tubing.

LANDING GEAR: Tailwheel type (fixed) on Eurofox Basic, (also known as Eurofox 2K) with cantilever main legs, hydraulic disc brakes and 15×6.00-6 (optionally 14×4/4.00-6) mainwheel tyres; tailwheel tyre size 210×65 mm. Eurofox Space has tricycle gear (Eurofox 3K) with steerable 4.00-4 nosewheel with rubber-in-compression suspension.

POWER PLANT: One 59.6 kW (79.9 hp) Rotax 912 UL flat-four four-stroke driving Woodcomp SR200 three-blade fixed-pitch wooden propeller or Faturik Fiti Eco Competition three-blade composites propeller. Alternatively, one 73.5 kW (98.6 hp) Rotax 912 ULS or one 59.7 kW (80 hp) Jabiru 2200. Fuel capacity 58 litres (15.3 US gallons; 12.8 Imp gallons) standard, of which 56 litres (14.8 US gallons; 12.3 Imp gallons) are usable. Optional capacity 82 litres (21.7 US gallons; 18.0 Imp gallons).

ACCOMMODATION: Baggage compartment behind seats. Upward-opening window/door each side.

SYSTEMS: Electrical system with 12 V 16 Ah battery and 250 W alternator.

AVIONICS: Optional avionics by Becker and Honeywell, including GPS, to customer's choice.

EQUIPMENT: USH 520 or BRS5UL4 parachute recovery system optional.

DIMENSIONS, EXTERNAL (A: Eurofox Basic, B: Eurofox Space):
- Wing span: A, B ... 9.125 m (29 ft 11¼ in)
- Wing chord, constant portion, incl flaperons ... 1.30 m (4 ft 3¼ in)
- Length: overall: A ... 6.00 m (19 ft 8¼ in)
  - B ... 5.73 m (18 ft 9½ in)
  - wings folded: A ... 6.10 m (20 ft 0¼ in)
  - B ... 6.20 m (20 ft 4 in)
- Height overall: tailwheel (top of wing) ... 1.72 m (5 ft 7¾ in)
  - nosewheel (over tail) ... 2.05 m (6 ft 8¾ in)
- Width overall, wings folded ... 2.40 m (7 ft 10½ in)
- Tailplane span ... 2.32 m (7 ft 7¼ in)
- Wheel track ... 1.94 m (6 ft 4½ in)
- Wheelbase: A ... 4.10 m (13 ft 5½ in)
  - B ... 1.23 m (4 ft 0½ in)
- Propeller diameter: Woodcomp ... 1.68 m (5 ft 6¼ in)
  - Faturik ... 1.60 m (5 ft 3 in)

DIMENSIONS, INTERNAL:
- Cabin max width: A ... 1.06 m (3 ft 5¾ in)
  - B ... 1.12 m (3 ft 8 in)

AREAS:
- Wings, gross: A, B ... 11.40 m² (122.7 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty (with parachute recovery system): A ... 279 kg (615 lb)
  - B ... 270 kg (595 lb)
- Max T-O weight: A ... 450 kg (992 lb)
  - B ... 472.5 kg (1,041 lb)

PERFORMANCE (at 450 kg; 992 lb):
- Never-exceed speed (VNE) ... 99 kt (185 km/h; 115 mph)
- Cruising speed at 75% power ... 86 kt (160 km/h; 99 mph)
- Stalling speed ... 35 kt (65 km/h; 41 mph)
- Max rate of climb at S/L ... 300 m (984 ft)/min
- T-O to 15 m (50 ft) ... 190 m (625 ft)
- Range: standard fuel ... 378 n miles (700 km; 435 miles)
  - optional fuel ... 648 n miles (1,200 km; 745 miles)

AEROSPOOL

AEROSPOOL SPOL. S R.O.

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Fax: (+421 46) 518 32 50
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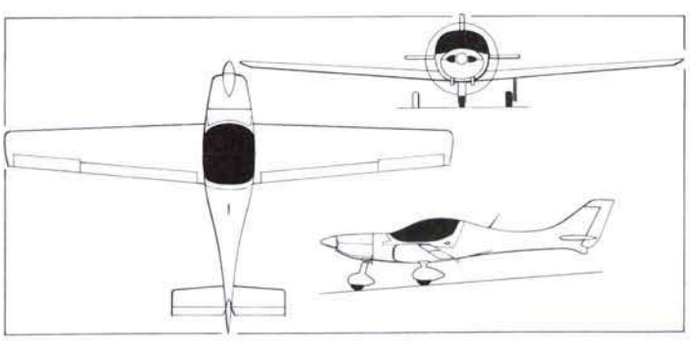
e-mail (2): dynamic@aerospool.sk
Web: www.aerospool.sk
GENERAL DIRECTOR: Jan Hrabovsky
DISTRIBUTORS:
Austria (www.avionic.at)
Benelux/Netherlands (www.fly-to-cycloon.com)
Czech Republic (www.piper.cz)
Denmark/Norway (www.ultrading.dk)
Finland (www.ronimex.com)
France (www.finesse-max.com)
Germany/Switzerland (www.ikarusflug.de)
Italy (www.flyitalia.it)
New Zealand/Australia (Drake Aviation)
Poland (Bog Group)
Portugal (www.cvb-aerolazer.com)
Slovenia/Croatia (www.airnet.si)
South Africa (www.wt9dynamic.co.za)
Sweden/Denmark (www.lsas.se)
UK/Irish Republic (www.ylac.on)
US (www.skyshops.org)

Aerospool's current product is the WT-9 Dynamic ultralight, but it also repairs and manufactures sailplanes for Schempp-Hirth and produces components for lightplanes assembled in Europe and USA. Factory covered area 1,700 m² (18,300 sq ft); workforce more than 100 in 2005.

AEROSPOOL WT-9 DYNAMIC

TYPE: Side-by-side ultralight/kitbuilt.
PROGRAMME: First flight 1999. Developed from Aerospool Impulz, designed by Tadeas Wala, winner of 1999 Slovak national prize for industrial design and subsequently marketed by Impulse Aircraft (which see). Public debut of Dynamic at Friedrichshafen, April 2001. Prototype (D-MXWT) in Speed configuration; c/n DY003 (D-MZKZ), in Club version, also exhibited. Certified by Slovak CAA 25 April 2005.
CURRENT VERSIONS: **Club:** Fixed gear and Rotax 912 UL/A/F engine. Also available from 2002 as **Club S** with more powerful Rotax 912 ULS/S.
Tow: More powerful Rotax and aero-tow equipped.
Speed: Same engine as Tow and Club S, but retractable gear.
CUSTOMERS: Total of 123 sold and further 30 ordered by March 2006.
COSTS: EUR74,900 (Club), EUR79,500 (Tow) and EUR87,600 (Speed), all including VAT (2004); avionics extra.
DESIGN FEATURES: Conventional low-wing monoplane; tapered wings; sweptback vertical tail surfaces. In 2004, WT-9 introduced extension to base of rudder in conjunction with rear fuselage 'bumper'.
Wing aerofoil section MS(1)-0313.



Aerospool WT-9 Dynamic two-seat ultralight in fixed (side view) and retractable gear (nose view) form *(James Goulding)* 1127525

Aerospool WT-9 Dynamic *(Paul Jackson)* 1158789

FLYING CONTROLS: Conventional and manual. Horn-balanced ailerons, elevators and rudder, with pushrod actuation; no tabs. Slotted flaps (settings 0/15/24/35°).
STRUCTURE: Fuselage shells, including integral fin, are three-layer sandwich structures of carbon fibre (inner), glass fibre (outer) and hardened foam filling, reinforced with advanced composites in cockpit area. Front portion of wing centre-section box accommodates integral fuel tank. Rear portion contains stiffening ribs for attachment of mainwheel legs (Club and Tow); on Speed, this area serves as main gear retraction bay. Outer wing panels are torsion box structures (main spar and auxiliary), with carbon rod spar caps and GFRP sandwich skins. Movable surfaces are of sandwich shell construction.
LANDING GEAR: Tricycle type, fixed in Club and Tow versions, electrohydraulically retractable (but no wheel doors) in Speed version. Club and Tow have glass fibre self-sprung cantilever main legs. On Speed, levered suspension main legs retract inward; rearward-retracting nosewheel. Mainwheels 350 mm diameter, nosewheel 300 mm (with laminated speed fairings on Club and Tow). Hydraulic mainwheel disc brakes (all versions).
POWER PLANT: *Club:* One 59.6 kW (79.9 hp) Rotax 912 UL/A/F and Kremen SR 2000 three-blade, variable-pitch wooden propeller.
Club S Tow and Speed: One 73.5 kW (98.6 hp) Rotax 912 ULS/S; propeller Kremen SR 2000 or SR 3000 DUC three-blade.
Standard fuel capacity (all versions) 75 litres (19.8 US gallons; 16.5 Imp gallons); inboard integral tank in each wing. Optional capacity 128 litres (33.8 US gallons) 28.2 Imp gallons).
ACCOMMODATION: Dual controls. Front-hinged, upward-opening one-piece canopy. Space for 10 kg (22 lb) baggage behind seats.
AVIONICS: Optional, to customer's choice.
EQUIPMENT: Ballistic recovery parachute optional.
DIMENSIONS, EXTERNAL:

Wing span	9.00 m (29 ft 6¼ in)
Length overall	6.37 m (20 ft 10¾ in)
Height overall	2.00 m (6 ft 6¾ in)
Propeller diameter	1.70 m (5 ft 7 in)

DIMENSIONS, INTERNAL:

Cabin max width	1.15 m (3 ft 9¼ in)
Baggage volume	0.09 m³ (3.2 cu ft)

AREAS:

Wings, gross	10.35 m² (111.4 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: Club	264 kg (582 lb)
Tow	267 kg (589 lb)
Speed	274 kg (604 lb)
Max T-O weight: all	450 kg (992 lb)[1]

[1] *472.5 kg (1,041 lb) permitted in Germany*

PERFORMANCE:

Never-exceed speed (VNE): all	151 kt (280 km/h; 174 mph)
Normal operating limit speed (VNO)	135 kt (250 km/h; 155 mph)
Stalling speed: flaps up	42 kt (77 km/h; 48 mph)
flaps down	36 kt (65 km/h; 41 mph)
Max rate of climb at S/L: Club	384 m (1,260 ft)/min
Tow, Speed	311 m (1,020 ft)/min
T-O run: Club	76 m (250 ft)
Tow, Speed	71 m (235 ft)
T-O to 15 m (50 ft): Club	254 m (835 ft)
Tow, Speed	237 m (780 ft)
Landing from 15 m (50 ft): all	255 m (840 ft)
Landing run: all	149 m (490 ft)
Max range (optional fuel): all	1,079 n miles (2,000 km; 1,242 miles)
g limits: all	+5/–3

EKOFLUG

EKOFLUG SPOL S. R. O.

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DIRECTOR: Ivo Vacek

Ekoflug builds the CH 701 ultralight which is distributed in Italy by ICP under the name of Savannah.

EKOFLUG MXP-740

TYPE: Side-by-side ultralight.
PROGRAMME: Modified version of Zenith Zenair STOL CH 701, with increased wing span and Rotax 912 engine as standard.
CURRENT VERSIONS: **MXP-740:** Baseline version.
Savannah: Italian and UK marketing name; Experimental category. *As described.*
Savannah Turbo: With 89.4 kW (120 hp) engine modified by ICP.
Savannah Hydro: Floatplane; 500 kg (1,102 lb) MTOW.
Bingo: Italian marketing name; Ultralight category; formerly Savannah Light.
CUSTOMERS: More than 300 built. Exported to Belgium, France, Germany, Israel, Netherlands, Norway, South Africa, Tanzania, UK and elsewhere.
COSTS: UK kit prices ex-Italy: airframe GBP12,250; airframe and Jabiru 2200 engine GBP19,750; both including VAT (2004).
DESIGN FEATURES: As CH 701; wing section NACA 65018 (modified). Quoted build time 400 hours.
FLYING CONTROLS: Flaperon deflections: 20° take-off; 40° landing; rudder deflection 25° each way, ailerons maximum deflection 15°.
POWER PLANT: One 59.6 kW (79.9 hp) Rotax 912 UL flat-four engine; DUC two- or three-blade propeller. Alternatively, 59.7 kW (80 hp) Jabiru 2200 or similarly rated Suzuki G10 three-cylinder inline engine. Fuel capacity 80 litres (21.1 US gallons; 17.6 Imp gallons), of which 77 litres (20.3 US gallons; 16.9 Imp gallons) usable.

For details of the latest updates to ***Jane's All the World's Aircraft*** online and to discover the additional information available exclusively to online subscribers please visit
jawa.janes.com

Data follow for Jabiru engine.

DIMENSIONS, EXTERNAL:
- Wing span ..... 9.00 m (29 ft 6¼ in)
- Length overall ..... 6.10 m (20 ft 0¼ in)
- Height overall ..... 2.90 m (9 ft 6¼ in)

AREAS:
- Wings, gross ..... 12.96 m² (139.5 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty ..... 260 kg (573 lb)
- Max T-O weight ..... 450 kg (992 lb)

PERFORMANCE:
- Max level speed ..... 78 kt (145 km/h; 90 mph)
- Max cruising speed ..... 65 kt (120 km/h; 75 mph)
- Stalling speed: flaps down ..... 28 kt (52 km/h; 32 mph)
- T-O run ..... 40 m (135 ft)
- *g* limits ..... +6/–4

Ekoflug-built, ICP-marketed MXP-740 Savannah *(Paul Jackson)* 1158584

LOBB

LOBB BANSKÁ BYSTRICA AS

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Web: www.finale24.com

Lobb was established on 1 January 1993 by renaming of the IDEIX company, formed in 1939. Current business mainly concerns electrical generation plant. However, the Falco 95 was launched in Western Europe at the Blois air show, France, in September 2004.

Lobb Falco 95 on display at Blois in September 2004 *(Bob Sage)* 1044621

LOBB FALCO 95

TYPE: Side-by-side ultralight kitbuilt.

PROGRAMME: Prototype OM-JURO. Marketing began in 2004.

COSTS: EUR18,800 plus taxes, excluding engines and instruments (2006).

DESIGN FEATURES: High wing braced by V struts with intermediate struts. Sweptback fin with fillet. Tailplane braced below to tailskid. Wings foldable for storage. Quoted build time 120 hours, excluding engine installation.

Wing section NACA 2412.

FLYING CONTROLS: Conventional and manual. Flaps.

STRUCTURE: Steel tube fuselage generally Dacron-covered, but with local aluminium sheet. Aluminium wings with Dacron covering, including control surfaces.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted, spring cantilever mainwheel legs. Trailing-link nosewheel with compressed rubber shock-absorber. Cable actuated hydraulic brakes. Mainwheels 150×240; nosewheel 12×4.

POWER PLANT: One flat-four piston engine. Air-cooled Jabiru 2200 of 59.7 kW (80 hp) initially. Water-cooled 59.6 kW (79.9 hp) Rotax 912 available from 2005. Other options include 48.0 kW (64.4 hp) Rotax 582. Fuel capacity 55 litres (14.5 US gallons; 12.1 Imp gallons).

EQUIPMENT: Optional ballistic parachute.

DIMENSIONS, EXTERNAL:
- Wing span ..... 9.58 m (31 ft 5¼ in)
- Length overall ..... 6.31 m (20 ft 8½ in)
- Height overall ..... 2.28 m (7 ft 5¾ in)

AREAS:
- Wings, gross ..... 12.92 m² (139.1 sq ft)

WEIGHTS AND LOADINGS (Jabiru engine):
- Weight empty ..... 272 kg (600 lb)
- Max T-O weight ..... 450 kg (992 lb)

PERFORMANCE:
- Max operating speed ..... 97 kt (180 km/h; 112 mph)
- Stalling speed, flaps down ..... 36 kt (65 km/h; 41 mph)
- Max rate of climb at S/L ..... 210 m (689 ft)/min
- T-O run ..... 135 m (443 ft)

Slovenia

AMS

AMS-FLIGHT D.O.O.

Kavčičeva 4, SI-1000 Ljubljana
Tel: (+386 4) 535 14 00
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e-mail: ams@ams-flight.si
Web: www.ams-flight.si
SALES MANAGER: Matjaz Slana
PRODUCTION MANAGER: Ales Cebavs

As well as producing parts for Glaser-Dirks sailplanes and distributing that company's DG-303 and DG-505 AMS-Flight has taken over production and marketing for the former Technoflug TFK-2 Carat. Starting in 1978, by 19 September 2006, AMS had produced 1,119 sailplanes and motorgliders, including 28 Carats. At this time the workforce totalled 55. Some 94 per cent of production is exported.

In 2005, preliminary design details of the Magnus series of motorgliders were released.

AMS CARAT A

TYPE: Single-seat motor glider ultralight.

PROGRAMME: First flown 16 December 1997; flight testing carried out during 1998. Initial production aircraft displayed at Aero '99, Friedrichshafen, in April 1999 under name of Technoflug TFK-2 Carat. Folding propeller certified 7 November 2000; certified by LBA 15 July 2001. Promotion and marketing transferred to AMS, which displayed fourth aircraft at Aero '03, Friedrichshafen, April 2003.

CUSTOMERS: Six built by 1 January 2004, including exports to Germany, Switzerland and US (13 aircraft by 19 September 2006). Total 28 built by April 2005.

COSTS: USD69,635 (2001) without avionics.

DESIGN FEATURES: Low wing of 21.3 aspect ratio; optional winglets; T tail. Uses wings and horizontal tail (but not water tank) of Schempp-Hirth Discus sailplane, with main spar passing under pilot's knees; wings and tailplane can be detached for storage and aircraft will fit into sailplane trailer. Optional winglets.

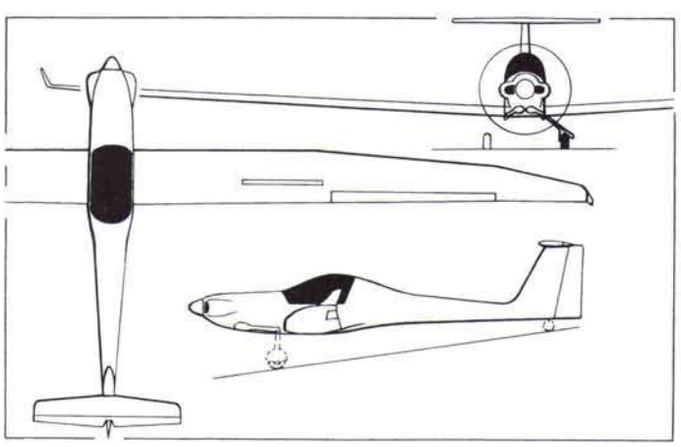
FLYING CONTROLS: Conventional and manual. Schempp-Hirth airbrakes on upper wing surfaces and 'turbulators' below.

STRUCTURE: Generally of glass fibre and carbon fibre composites. Wings have PVC foam cores.

LANDING GEAR: Tailwheel type; retractable. Mainwheels, size 4.00–4 in, retract inwards and forwards electrohydraulically with manual override; fixed steerable 210×65 mm tailwheel. Hydraulic disc brakes. Parking brake.

POWER PLANT: One 1,800 cc (109.8 cu in) Sauer E1S conversion of Volkswagen four-stroke, air-cooled motorcar engine, producing 40 kW (53.6 hp) at max continuous power, driving a 1.40 m (4 ft 7 in) Technoflug KS-F3-1A/140-1 fixed-pitch propeller, blades of which are held forward by gas damping springs located under the spinner when not turning. Other planned engines include 59.6 kW (79.9 hp) Rotax 912. Fuel capacity 53 litres (14.0 US gallons; 11.7 Imp gallons) in single fuel tank situated between cockpit and engine.

SYSTEMS: Electric starter and generator; 12 V 16 Ah battery. Electric fuel pump.



AMS Carat (Volkswagen motorcar engine) *(James Goulding)* 1158576

AMS Carat A motor glider *(Paul Jackson)* 1129257

AVIONICS: Suggested package includes ATR720A radio, Honeywell transponder and Filser DX50FAI GPS.

DIMENSIONS, EXTERNAL:
Wing span ..... 15.00 m (49 ft 2½ in)
Length overall ..... 6.21 m (20 ft 4½ in)

DIMENSIONS, INTERNAL:
Baggage compartment volume ..... 0.1 m³ (3.53 cu ft)

AREAS:
Wings, gross ..... 10.58 m² (113.9 sq ft)

WEIGHTS AND LOADINGS:
Weight empty ..... 325 kg (717 lb)
Max baggage weight ..... 145 kg (320 lb)
Max T-O weight ..... 470 kg (1,036 lb)

PERFORMANCE, POWERED:
Never-exceed speed (VNE) ..... 135 kt (250 km/h; 155 mph)
Normal cruising speed at 75% power ..... 116 kt (214 km/h; 133 mph)
Stalling speed ..... 44 kt (80 km/h; 50 mph)
Max rate of climb at S/L ..... 210 m (689 ft)/min
T-O run ..... 226 m (741 ft)
Landing run ..... 137 m (450 ft)
Range with max fuel, 30 min reserves ..... 554 n miles (1,026 km; 637 miles)
g limits ..... +5.3/−2.65

PERFORMANCE, UNPOWERED:
Stalling speed ..... 44 kt (80 km/h; 50 mph)
Best glide ratio 35
Min rate of sink ..... 0.75 m (2.46 ft)/s

AMS MAGNUS

TYPE: Side-by-side motor glider ultralight.

PROGRAMME: First announced (on company's website) 2005; development was continuing during 2006.

CURRENT VERSIONS: **AM11:** Baseline version; *as described.*

AM21: Longer wingspan version; as AM11, unless otherwise indicated.

DESIGN FEATURES: Low wing with upturned outer panels and winglets; constant-chord centre-section; two-stage sweepback outboard on AM21, or single-stage on AM11; main spar passes beneath pilot's knees. Sweptback fin and T-tail.

FLYING CONTROLS: Conventional and manual. Flaps.

STRUCTURE: Composites throughout.

LANDING GEAR: Tricycle type, fixed. Speed fairings on all wheels.

AMS Magnus AM21 1129236

POWER PLANT: Choice of 59.7 kW (80 hp) Sauer S2100 UL, or Jabiru 2200, or 73.5 kW (98.6 hp) Rotax 912ULS engine driving a three-blade, fixed-pitch Duc propeller or (AM11 only) two-blade, fixed-pitch AMS folding propeller. Fuel capacity 70 litres (17.2 US gallons; 14.3 Imp gallons).

ACCOMMODATION: Side-by-side seating under single-piece canopy/windscreen.

DIMENSIONS, EXTERNAL:
Wing span: AM11 ..... 10.60 m (34 ft 9¼ in)
AM21 ..... 13.35 m (43 ft 9½ in)
Length overall ..... 6.63 m (21 ft 9 in)
Height overall ..... 2.17 m (7 ft 1½ in)

AREAS:
Wings, gross: AM11 ..... 10.53 m² (113.3 sq ft)
AM21 ..... 11.69 m² (125.8 sq ft)

WEIGHTS AND LOADINGS:
Weight empty: AM11: Rotax ..... 250 kg (551 lb)
Sauer ..... 240 kg (529 lb)
Jabiru ..... 235 kg (518 lb)
AM21: Rotax ..... 255 kg (562 lb)
Sauer ..... 245 kg (540 lb)
Jabiru ..... 235 kg (518 lb)
Max T-O weight (all versions) ..... 470 kg (1,036 lb)

PERFORMANCE (Rotax 912 ULS):
Never exceed speed (VNE): AM11 ..... 164 kt (305 km/h; 189 mph)
AM21 ..... 156 kt (290 km/h; 180 mph)
Normal cruising speed at 75% power: AM11 ..... 138 kt (256 km/h); 159 mph)
AM21 ..... 136 kt (252 km/h; 157 mph)
Stalling speed: flaps down: AM11: ..... 35 kt (64 km/h; 40 mph)
AM21 ..... 34 kt (62 km/h; 39 mph)
Max rate of climb at S/L: AM11 ..... 498 m (1,634 ft)/min
AM21 ..... 570 m (1,870 ft)/min
T-O run: AM11 ..... 102 m (335 ft)
AM21 ..... 84 m (275 ft)
Range: AM11 ..... 669 n miles (1,240 km; 770 miles)
AM21 ..... 756 n miles (1,400 km; 870 miles)

PIPISTREL

PIPISTREL D. O. O.

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Web: www.pipistrel.si
GENERAL MANAGER: Ivo Boscarol

Pipistrel originated in mid-1980s when partners Ivo Boscarol and Bojan Sajovic began building flex-wing trikes. First major design was Ajdovščina, of which 32 built between 1989 and December 1992, including exports to Italy (these first private Yugoslav exports of light aircraft). Also began producing ground-adjustable pitch propellers, of which 1,400 built by 2000. Pipistrel Plus flex-wing entered production in 1990; more than 200 now sold. Supplied flex-wings to Croatian Army in 1991. Spider flex-wing entered production in 1992; more than 150 produced.

Company formally established as Pipistrel d.o.o. on 18 November 1992 and supplied flex-wings to Italian Army's special forces in following year. Twister flex-wing introduced 1998. Moved to new premises at Ajdovščina aerodrome in 2001; workforce 18. Production rate four aircraft per month in mid-2003. Construction of new assembly facility at Ajdovščina airport (more than 2,000 m²; 21,528 sq ft) started 5 September 2003; completed 2004; enabled immediate increase in output from four aircraft per month to seven, aiming to reach 10 per month by mid-2005. Sinus/Virus production reached 200 total in March 2006.

In 2000, Pipistrel began design of **Arcus** ultralight, no details of which have yet been published. In 2005 the company also began deliveries of the Taurus self-launching ultralight sailplane which has a 'pop-up' Rotax 503 engine and made its maiden flight on 15 May 2004. Company now also produces Taurus PureGlider (no engine), which made its first flight 25 August 2006.

PIPISTREL SINUS

TYPE: Side-by-side ultralight motor glider/kitbuilt.

PROGRAMME: Design begun 1994; project leader Franco Orlando. Prototype (S5-NBP) built and certified in Slovenia; public debut at Aero '95, Friedrichshafen, April 1995, but not flown until 1996. Series production from 1999. Marketed in France by Zen ULM and elsewhere. Kit versions introduced 1 April 2004 (51 per cent kit to meet FAA requirements and quick-build QBK).

Between 6 June and 25 August 2004, pilot Matevz Lenarcic completed a round-the-world solo flight in the Sinus 912 S5-PCT. Maiden flight 9 March 2006 of 200th member of Sinus/Virus family, a tri-gear Sinus 912 for a customer in Taiwan.

CURRENT VERSIONS:

Sinus 503: 37.0 kW (49.6 hp) Rotax 503 UL-2V two-stroke and Pipistrel variable-pitch, folding propeller. Certified in Australia, Belgium, Colombia, Croatia, France, Hungary, Italy, Japan, Poland and Slovenia.

Sinus 912: 59.6 kW (79.9 hp) Rotax 912 UL-2 flat-four with Pipistrel variable-pitch, folding propeller. *As described.* Certified in same countries as 503.

CUSTOMERS: Sold in 11 European countries, including 54 to French customers by 2002. Others to Australia, Brazil, Colombia, Congo, Eritrea, Japan, Kenya, Mexico, New Caledonia, Reunion Islands, Santo Domingo, South Africa, Taiwan, Thailand, US and Venezuela. Total sales (including Virus) 200 by March 2006.

Pipistrel Sinus displayed at African Aerospace and Defence show in September 2006 *(Jane's/Patrick Allen)* 1196458

COSTS: Sinus 503 EUR49,200; Sinus 912 EUR60,700 ready to fly. Kit versions: 912 51 per cent EUR51,900, QBK EUR56,500; 503 51 per cent EUR42,000, QBK EUR46,200. (All 2005).

DESIGN FEATURES: Meets JAR 22 specifications. Pod-and-boom fuselage with high cantilever wing (except on prototype, which was strut-braced), upturned wingtips, and strut-braced T tail. in-Flight-adjustable pitch propeller for improved engine-off performance; can be feathered for gliding.

Aerofoil section Orlando-Venuti IMD 029-b.

Wing is employed by Albastar Apis single-seat sailplane.

FLYING CONTROLS: Conventional elevator and rudder, manually operated. Flight-adjustable trim tab in starboard elevator. Flaperons on inboard 90 per cent of wing trailing-edge, deflections –5, +9, +18°. Schempp-Hirth-type spoilers in upper wing, one per side.

STRUCTURE: Principally of glass fibre, carbon fibre and Kevlar. Quoted build time 200 hours for QBK kits.

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted spring cantilever main legs with speed fairings. Hydraulic disc brakes on mainwheels.

POWER PLANT: One Rotax piston engine, as under Current Versions. Pipistrel Vario in-Flight-adjustable pitch two-blade composites propeller. Fuel in two tanks, combined capacity 60 litres (15.9 US gallons; 13.2 Imp gallons), of which 54 litres (14.3 US gallons; 11.9 Imp gallons) usable.

ACCOMMODATION: Two persons, side by side in enclosed cockpit, each with upward-opening door.

EQUIPMENT: BRS ballistic parachute systems optional.

Data for Sinus 912.

DIMENSIONS, EXTERNAL:

Wing span	14.97 m (49 ft 1¼ in)
Length overall	6.60 m (21 ft 7¾ in)
Height overall	1.70 m (5 ft 7 in)

DIMENSIONS, INTERNAL:

Cabin max width	1.10 m (3 ft 7¼ in)

AREAS:

Wings, gross	12.26 m² (132.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	284 kg (626 lb)
Max T-O weight	450 kg (992 lb)[1]

[1] *472.5 kg (1,041 lb) in France if fitted with ballistic parachute; 544 kg (1,200 lb) in Australia (AUF rules)*

PERFORMANCE, POWERED:

Never-exceed speed (VNE)	121 kt (225 km/h; 139 mph)
Max level speed	119 kt (220 km/h; 137 mph)
Cruising speed	108 kt (200 km/h; 124 mph)
Stalling speed: flaps up	36 kt (66 km/h; 41 mph)
flaps down	34 kt (63 km/h; 40 mph)
Max rate of climb at S/L	390 m (1,280 ft)/min
Service ceiling	8,800 m (28,875 ft)
T-O run	88 m (290 ft)
Range	647 n miles (1,200 km; 745 miles)
g limits	+4/–2

PERFORMANCE, UNPOWERED:

Best glide ratio at 51 kt (95 km/h; 59 mph), folded propeller	27
Min rate of sink at 49 kt (90 km/h; 56 mph), folded propeller	1.03 m (3.4 ft)/s

PIPISTREL VIRUS

TYPE: Side-by-side ultralight.

Pipistrel Virus with engine exposed *(Paul Jackson)* 1158786

PROGRAMME: Variant of Pipistrel Sinus; development began 1997; first flown (S5-PBG) 1999; series production from 2000. 912 certified in Australia, France, Italy, New Zealand and Slovenia. Company demonstration team created in 2003 with three Virus 912s (S5-PCA, 'PBR and 'PCP).

CURRENT VERSIONS: **Virus 582:** Power plant as for Sinus 582. Certified in Australia, New Zealand and Slovenia. No recent sales known.

Virus 912: Certified version; *as described*. Customers in South Africa, Thailand, US and elsewhere.

COSTS: Virus 912 EUR60,700 ready to fly; 51 per cent kit EUR51,900, QBK EUR56,500 (2005).

DESIGN FEATURES: Tricycle landing gear and shorter span standard; tailwheel version also certified in France. Otherwise generally as Sinus.

FLYING CONTROLS: As Sinus.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring cantilever mainwheel legs with wheel fairings; steerable nosewheel.

POWER PLANT: One Rotax 912 UL flat-four (59.6 kW; 79.9 hp) and Pipistrel Vario in-flight-adjustable, featherable two-blade carbon fibre propeller. Fuel capacity as Sinus.

Data for Virus 912.

DIMENSIONS, EXTERNAL:

Wing span	12.36 m (40 ft 6½ in)
Length overall	6.40 m (21 ft 0 in)
Height overall	2.00 m (6 ft 6¾ in)

AREAS:

Wings, gross	11.00 m² (118.4 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	285 kg (628 lb)
Max T-O weight	450 kg (992 lb)[1]

[1] *472.5 kg (1,041 lb) in France if fitted with ballistic parachute*

PERFORMANCE, POWERED (at 450 kg MTOW):

Never-exceed speed (VNE)	134 kt (249 km/h; 154 mph)
Max level speed, fixed prop	130 kt (240 km/h; 149 mph)
Cruising speed, fixed prop	121 kt (225 km/h; 140 mph)
Stalling speed: flaps up	39 kt (72 km/h; 45 mph)
flaps down	35 kt (64 km/h; 40 mph)
Max rate of climb at S/L	372 m (1,220 ft)/min
Service ceiling	8,100 m (26,575 ft)
T-O run	90 m (295 ft)
Range	691 n miles (1,280 km; 795 miles)
g limits	+4/–2

PERFORMANCE, UNPOWERED:

Best glide ratio at 59 kt (110 km/h; 68 mph)	24
Min rate of sink at 52 kt (96 km/h; 60 mph)	1.80 m (5.91 ft)/s

South Africa

CHAYAIR

CHAYAIR MANUFACTURING AND AVIATION

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e-mail: sycamore@limpopo.co.za
Web: www.chayair.com
DIRECTORS: Norman Shelley
Wessel Visser

Company formed January 1997 by Messrs Shelley and Visser to develop, manufacture and market Sycamore gyrocopter. Name derived from Hebrew chay (pronounced *ghay*) meaning to prosper. Also manufactured under licence in Iran by Paravar Pars Company.

CHAYAIR SYCAMORE

TYPE: Two-seat autogyro ultralight/kitbuilt.

PROGRAMME: Flight testing of Mk 1 completed in mid-1998; production began September 1998. Marketed in Iran by Paravar Pars.

CURRENT VERSIONS: **Sycamore Mk 1:** Enclosed cockpit version; can be flown with doors removed.

Sycamore Mk 2000: Open cockpit version.

CUSTOMERS: Most sales in South Africa (33 Mk 1 and five Mk 2000 registered by September 2005); total of at least 50 produced, including one each to Iran, Namibia, Sweden and US.

COSTS: Available factory-assembled; or as kit, with or without engine; prices USD63,425, USD59,890 and USD45,420, respectively (2006).

DESIGN FEATURES: Conventional small autogyro built around aluminium boom supporting empennage and seating; engine mounted on rear of rotor cabane. Mechanical prerotator (180 rpm); mechanical rotor brake. Large fin and rudder; dihedral tailplanes with large winglets plus, on later versions, auxiliary fins at half span. Option of three rotor sizes; all NACA H-8-12 section.

STRUCTURE: Chassis of bolted 6261-T6 aluminium. Composites empennage and cabin.

Chayair Sycamore Mk 1 *(Jane's/Patrick Allen)* 1110429

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted, spring cantilever mainwheel legs in current version. Tyres 400 mm; cable-operated drum brakes on mainwheels.

POWER PLANT: One 84.5 kW (113.3 hp) Rotax 914F turbocharged, water-cooled flat-four driving Arplast three- (optionally four-) blade propeller. Also offered with 127 kW (170 hp) Subaru EA81 conversion. Fuel capacity 53 litres (14.0 US gallons; 11.7 Imp gallons).

ACCOMMODATION: Two persons in tandem, with dual controls.

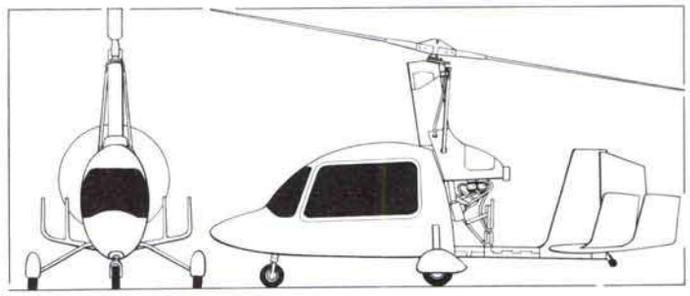
SYSTEMS: Electrical system 12 V DC.

DIMENSIONS, EXTERNAL:
- Rotor diameter: option 1 ... 8.23 m (27 ft 0 in)
- option 2 ... 8.84 m (29 ft 0 in)
- option 3 ... 9.45 m (31 ft 0 in)
- Fuselage length ... 5.40 m (17 ft 8½ in)
- Height overall ... 2.675 m (8 ft 9¼ in)
- Max width (at wheel fairings) ... 2.05 m (6 ft 8¾ in)
- Tailplane span ... 1.80 m (5 ft 10¾ in)

AREAS:
- Rotor disc: option 1 ... 53.19 m² (572.5 sq ft)
- option 2 ... 61.36 m² (660.5 sq ft)
- option 3 ... 70.11 m² (754.7 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty ... 380 kg (838 lb)
- Max T-O weight ... 590 kg (1,300 lb)

PERFORMANCE:
- Never-exceed speed (VNE) ... 87 kt (161 km/h; 100 mph)
- Cruising speed at 75% power: option 1 ... 70 kt (129 km/h; 80 mph)
- option 2 ... 65 kt (121 km/h; 75 mph)
- option 3 ... 59 kt (109 km/h; 68 mph)
- Max rate of climb at S/L ... 305 m (1,000 ft)/min



Chayair Sycamore Mk 1 *(James Goulding)* 1158065

- Service ceiling ... 4,000 m (13,120 ft)
- T-O run ... 150 m (495 ft)
- Landing run ... up to 15 m (50 ft)
- Endurance ... 2 h 30 min

DART

DART INDUSTRIES INTERNATIONAL

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PRODUCTION DIRECTOR: Dave Dormer
SALES DIRECTOR: Peter Dale
US DISTRIBUTION: Jeff Le Tempt

Dart Industries purchased the Dragonfly programme from Slipstream International of the USA in March 2004 and is offering both plans and kits.

DART DRAGONFLY

TYPE: Side-by-side ultralight kitbuilt.

PROGRAMME: Prototype first flight 16 June 1980, designed by Bob Walters; awarded Outstanding New Design trophy at EAA Oshkosh 1980. Initially marketed by Walter's Viking Aircraft as kit or as plans, passed to Viking Aircraft of Arizona in 1983, which became Viking Aircraft of Nevada in 1999. Programme sold to Slipstream International, then transferred to Dart in March 2004.

CURRENT VERSIONS: **Dragonfly Mark I:** Original configuration, with non-retractable mainwheels at tips of foreplane. EAA Oshkosh Outstanding Design, 1980.

Dragonfly Mark II: In parallel production, for operation from unprepared strips and narrow taxiways. Main landing gear in short non-retractable cantilever units under wings, with individual hydraulic toe brakes, and increased foreplane and elevator areas; wheel track 2.44 m (8 ft).

Dragonfly Mark III: Flight tested in 1985; non-retractable, narrow-track tricycle landing gear with steerable nosewheel and cantilever mainwheel legs attached to fuselage. **Mark III Millenium** displayed at EAA AirVenture, Oshkosh, July 2001 (N204AS, then unflown) as conversion of earlier aircraft. Recommended engines: 59.7 kW (80 hp) Jabiru 2200 flat-four or 89 kW (120 hp) Jabiru 3300 flat-six.

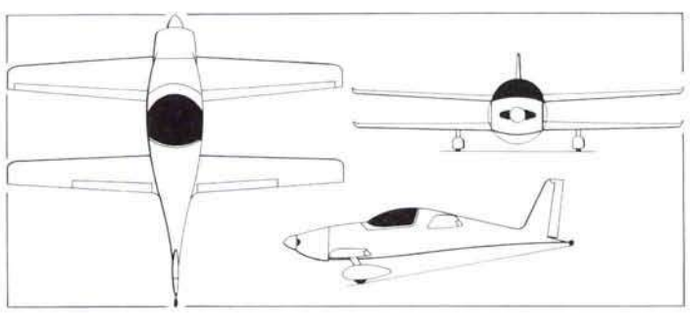
CUSTOMERS: More than 100 kits delivered, together with 2,000 sets of plans; some 70 kitbuilt and more than 430 plans-built aircraft flying.

COSTS: Standard kit, including Jabiru 2200 engine, USD38,500 (2003).

DESIGN FEATURES: Unconventional shoulder-wing monoplane with equal-span foreplane; latter also mounting landing gear in one of two alternative locations.

Quoted build time 1,000 hours, or 500 hours for quick-build kit.

Wing section Eppler 1213. Foreplane GU25 section. Thickness/chord ratio 15 per cent; dihedral 3°; no incidence or sweepback. Foreplane t/c 17 per cent; anhedral 3° on Mk I or dihedral on Mk II; incidence −1°; no sweepback.



Dart Dragonfly Mark II *(Paul Jackson)* 0016522

Dart Dragonfly registered in the Netherlands 1179037

FLYING CONTROLS: Manual. Ailerons on inboard trailing-edge of wing; near full-span elevators on foreplane; horn-balanced rudder. Flettner tab on each foreplane.

STRUCTURE: Composites wing; foreplane and tail unit structures of styrene foam, glass fibre, carbon fibre and epoxy. Semi-monocoque fuselage, formed (not carved) from 12.5 mm (½ in) thick urethane foam, with strips of 18 mm (¾ in) foam bonded along edges to allow large-radius external corners. Fuselage covered with glass fibre inside and out.

LANDING GEAR: See Current Versions; employs choice of sprung steel or glass fibre landing gear. Brakes fitted. Wheelsize 12 cm (5 in) on Mark I and II, tyre size 11×400×5, with option of 600×6 on larger wheels for Mark II.

POWER PLANT: Mks I and II have one 44.5 kW (60 hp) 1,835 cc modified Volkswagen motorcar engine; 1,600 cc engine, rated at 33.5 kW (45 hp), optional. Fuel capacity 56.8 litres (15.0 US gallons; 12.5 Imp gallons).

DIMENSIONS, EXTERNAL:
- Wing span ... 6.71 m (22 ft 0 in)
- Foreplane span ... 6.71 m (22 ft 0 in)
- Length overall ... 5.79 m (19 ft 0 in)
- Height overall: Mk I ... 1.22 m (4 ft 0 in)
- Mk III ... 1.68 m (5 ft 6 in)

DIMENSIONS, INTERNAL:
- Cabin: Max width ... 1.09 m (3 ft 7 in)
- Height ... 0.79 m (2 ft 7 in)

AREAS:
- Wings, gross ... 4.24 m² (45.6 sq ft)
- Foreplane, net ... 4.33 m² (46.6 sq ft)

WEIGHTS AND LOADINGS (Millenium, Jabiru 2200):
- Weight empty ... 272 kg (600 lb)
- Max T-O weight ... 567 kg (1,250 lb)

PERFORMANCE (Millenium, Jabiru 2200):
- Never-exceed speed (VNE) ... 156 kt (290 km/h; 180 mph)
- Cruising speed ... 113 kt (209 km/h; 130 mph)
- Stalling speed ... 48 kt (89 km/h; 55 mph)
- Max rate of climb at S/L ... 259 m (850 ft)/min
- T-O to 50 ft (15 m) ... 366 m (1,200 ft)
- Landing from 50 ft (15 m) ... 610 m (2,000 ft)
- Range ... 434 n miles (804 km; 500 miles)
- g limits ... +4.4/−2.0

DENEL

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COMMUNICATION CONSULTANT: Nancy Phala

Predecessor Atlas Aircraft Corporation founded 1964 by Bonuskor as private company; delivered first Impala Mk 1 (Aermacchi MB-326) jet trainers to SAAF 1966; manufacturing, design and development facilities for airframes, engines, missiles and avionics; developed Cheetah from Mirage III, Rooivalk from Puma, Oryx (Super Puma) from Puma, V3B and V3C dogfight missiles, and many weapons installations. Incorporated into Armscor Group 1969; restructuring of Armscor on 1 April 1992 created Denel as self-sufficient commercial industrial group, in which Atlas Aviation became military aircraft manufacturing branch of Simera in Denel Aerospace Group. Renamed Denel Aviation in April 1996. Further reorganisation of 2004 placed Aerospace Group as one of three major Denel businesses (with Land Systems Group and Commercial & IT). Aerospace Group now comprises Denel Aerospace Systems, Denel Optronics and Denel Aviation, of which last-named is further divided as follows:

Airframe Manufacturing: At Kempton Park (part of Denel Aviation); Gripen landing gear, rear fuselage and pylons; Hawk tailplane, airbrake and flaps; Rooivalk complete aircraft; Boeing 737, 747 and 777 minor parts.

Aerospace Engineering: At Kempton Park and Irene. Aerospace structural and avionics engineering, manufacture and testing.

Aircraft Logistics: At Kempton Park. Support, repair and refurbishment, including C-130 Hercules, Rooivalk and Cheetah.

OTB Test Range: At Bredasdorp. Weapons performance; satellite launch support.

South African government selected BAE Systems as strategic equity partner for a partial privatisation of Denel Aviation on 12 October 2000; approval for BAE to acquire a 30 per cent holding in Denel Aviation for ZAR375 million (USD36.8 million) was announced in May 2002, but not taken up. Alternative equity partner sought in 2003; in November that year, Denel announced intention to separate its aerostructures and component manufacturing operations as part of a move to restore profitability.

South African government provided Denel Group parent (workforce 10,750) with ZAR2 billion in early 2006, to offset losses of ZAR1.6 billion in 2005 and expected further loss in 2006. This was followed on 15 June 2006 by announcement that Saab and Denel had signed agreement to create new aerostructures company in South Africa to compete internationally in civil and defence markets. Initial ownership is Saab 20 per cent, Denel 80 per cent, with a ZAR66 million investment by Saab and a proportional investment by Denel; start-up workforce includes about 600 Denel personnel.

MoU in late 1998 provided for co-production of, and export licence for, Agusta A 119 Koala helicopter; July 2000 agreement with Agusta, covering airframe manufacture and systems installation for 25 of 30 A109s ordered by South African Air Force, was extended in 2001 to include airframes of 20 A 109Ms for Sweden. This followed in December 2001 by agreement with AgustaWestland to produce and market A 109LUH, A 109 Power and A 119 Koala for customers in specified countries in Southeast Asia, the Middle East, South America, Africa and elsewhere. Final assembly of first (Italian-built) A109LUH for South African Air Force (I-PLUH/4001) began in early 2003; first of 25 to be assembled locally by Denel (4006) made maiden flight 9 September 2004; first four (fifth/last Italian-built and first three Denel-assembled) handed over to SAAF at Bloemspruit AB on 19 October 2005; nine delivered by June 2006. SAAF has option on further 10 A109LUHs.

Beginning May 2001, Denel manufacturing, under a USD3.6 million contract, main landing gear portion of lower centre-fuselage for Swedish Air Force Lot 3 Gripen combat aircraft, plus additional sections for the 28 Gripens ordered by the South African Air Force. Initial SwAF order is for 40 units, with options for a further 60. In third quarter of 2004, Denel began assembling first eight of 23 BAE Hawk Mk 120s for South African Air Force in a programme due for completion in mid-2006. In September 2004 it was also announced that Denel had received a USD2 million contract from BAE Systems to provide Hawk tooling to Hindustan Aeronautics Ltd for HAL's production of the 66 aircraft ordered by the Indian Air Force. Denel Aviation is sole-source supplier of tailplanes, flaps and airbrakes for all current production Hawk variants.

DENEL AH-2A ROOIVALK

English name: Red Kestrel

TYPE: Attack helicopter.

PROGRAMME: Considerably modified development of French SA 330 Puma. XDM and ADM prototypes reconfigured during 1995 with original Topaz engines replaced by more powerful Makila 1K2s with digital engine control, making first flight in this form June 1995. Contract for EDM prototype awarded in March 1994; more than 1,500 hours flown by XDM, ADM and EDM by December 1998. Airframe changes included modified IR exhaust suppression and intakes on XDM; fuselage construction unchanged on XDM and ADM.

Submitted (partnered by Marshall Aerospace) for British Army requirement in 1993–94, but subsequently eliminated. SAAF order for 12 signed in July 1996. First production Rooivalk (c/n 1001, SAAF serial number 670) left airframe jig 31 July 1997 and made first public flight 17 November 1998; handed over to SAAF on 17 November 1998 and joined No. 16 Squadron on 6 January 1999, formal acceptance being on 7 May 1999. Six delivered by June 2001 and all 12 by March 2004; trials at Test Flight Development Centre, Bredasdorp.

A commissioning order signed with the SAAF on 27 August 2003 provides for new functions in the communications system; addition of a missile approach warning system (MAWS); addition of the Mistral ATM; updates to HUMS and mission planning; and establishment of depot level repair capability. One development aircraft used for deck handling trials aboard support ship SAS *Drakensberg* in late 2002 and early 2003.

MoU with Airod of Malaysia provided for co-production in that country if ordered by Royal Malaysian Air Force. No RMAF order had materialised by end-2006, but influx of government funding earlier that year enabled Rooivalk to be entered in Turkish attack helicopter competition, for which it was short-listed with A129 Mangusta after elimination of Ka-52 and Tiger. Turkish requirement is for 30, with further 20 on option.

CURRENT VERSIONS: **AH-2A:** SAAF production version; at first known as CSH-2 but redesignated in 1998. First four aircraft delivered to Block 1A standard; Nos. 5–10 Block 1B; Nos. 11 and 12 Block 1E. Block 1A is basic aircraft with functional mechanical and avionics systems; Block 1B added Topowl and Nightowl optical systems and night flying capability; Block 1E is definitive configuration, with fully operable helmet sight and weapon systems. Block 1A and 1B aircraft being updated to Block 1E standard; four so updated and two others in process by March 2003. First two Block 1E aircraft redelivered to No. 16 Squadron by September 2003 and fully operational with nine Block 1E aircraft by March 2004, remaining three then in retrofit for delivery later. Two Block 1E aircraft being used for further development purposes. Squadron carrying out OT&E on weapons system during 2004 and in exercises in 2006 as part of work-up to full day/night operational capability.

Description applies to EDM/production AH-2A except where indicated.

Maritime version: Projected version, shown as model at Farnborough Air Show, September 1998, though no commitment yet to build. Would have chin-mounted, 360° maritime search radar in place of undernose cannon; vision-enhancing E-O suite in nose; tailwheel moved forward 2 m (6.6 ft) to facilitate deck operations; flotation gear on forward sponsons and tailboom; manually operated blade folding; and enhanced ECM and communications systems. Shorter stub-wings would support four underwing Penguin or Exocet anti-ship missiles, plus tip-mounted AAMs for self-defence.

CUSTOMERS: South African Air Force, 12 ordered; possible longer-term requirement for up to 36. No. 16 Squadron reactivated 1 January 1999 at Bloemspruit AB as only squadron. Initial delivery 6 January 1999; deliveries originally scheduled at four per year until third quarter 2001 but protracted; total of 10 delivered by October 2002, with remaining two delivered by March 2004.

Intent to order eight reconfirmed by Malaysian Prime Minister in 1998, but not yet contracted (mid-2006); possible requirement for up to 24. Algeria, Australia, Singapore and Turkey have also expressed interest (named **RedHawk** for unsuccessful Australian Army bid), and ADM demonstrated to Saudi Arabia in August 1997, but no export orders up to end-2006, when candidate for Turkish Army order.

COSTS: According to September 2002 report, R&D costs were ZAR126 million, one-off restructuring costs ZAR124 million and production costs ZAR179 million; further ZAR305 million written off. Additional funding for ZAR661 million (USD81.2 million) early 2003 to complete full commissioning to Block 1E standard for service acceptance.

DESIGN FEATURES: Based on reverse engineering of SA 330 Puma dynamics system to Super Puma equivalent standard; engines moved aft to clear stepped tandem cockpits; rear drive taken inboard and forward to modified transmission. Nose-mounted target acquisition turret and chin-mounted gun; non-swept stub-wings for weapon carriage. With Makila 1K2 engines, four-blade fully articulating main rotor rotates at 267 to 290 rpm; five-blade, starboard-mounted tail rotor rotates at 1,290 rpm. Rotor brake fitted. Fixed leading-edge slat on horizontal stabiliser.

Low radar/visual/IR/acoustic signatures; optimised for NOE operation; NVG-compatible 'glass cockpit'; primary missions anti-armour and close air support; integrated digital nav/attack system.

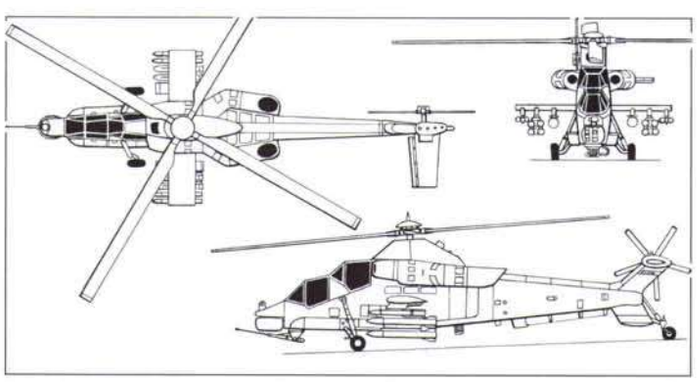
FLYING CONTROLS: Duplex digital AFCS with automatic height hold, hover capture and hover hold; HOCAS (hands on collective and stick) controls.

STRUCTURE: Crash-resistant primary structure, of aluminium alloy, is of I-beam and monocoque construction; rotor blades and fuselage secondary structures of composites sandwich. Integral access ladders in fuselage; CFRP engine cowls form work platforms.

LANDING GEAR: Forward-mounted Messier-Dowty main gear with two-stage high-absorption main legs; fully castoring tailwheel at base of lower fin. Mainwheel tyres size 615×225–10. Gear designed to withstand landing impact of up to 6 m (20 ft)/s.

POWER PLANT: Two licence-built Turbomeca Makila 1K2 turboshafts, with digital control, each rated at 1,376 kW (1,845 shp) for T-O, 1,420 kW (1,904 shp) continuous power and 1,573 kW (2,109 shp) for 30 seconds emergency operation. Rear drive turned to drive forward into rear of transmission. Infra-red heat suppressors on exhausts; particle separators on intakes. Main gearbox mounted on vibration isolation system using tuned beam to isolate fuselage from rotor vibrations (said to have one of lowest vibration levels in its

Rooivalk F2 cannon detail *(Janes/Patrick Allen)* 1196468



Denel Rooivalk combat support helicopter *(James Goulding)* 0507637

AH-2A Rooivalk of No. 16 Squadron, South African Air Force *(Janes/Patrick Allen)*

1196478

class).

Transmission rated at 2,243 kW (3,008 shp) for T-O and 1,826 kW (2,449 shp) maximum continuous from both engines; single-engine transmission ratings are 1,715 kW (2,300 shp) maximum contingency and 1,491 kW (2,000 shp) maximum continuous.

Fuel tankage (self-sealing) in fuselage, under stub-wings (three 618 litre; 163.3 US gallon; 135.9 Imp gallon tanks for total of 1,854 litres; 489.8 US gallons; 407.8 Imp gallons). Pressure refuelling and defuelling. Provision for 750 litre (198 US gallon; 165 Imp gallon) drop tank on each inboard underwing station.

ACCOMMODATION: Pilot (rear) and co-pilot/weapons officer in stepped, tandem cockpits with Martin-Baker armoured, crashworthy seats and armour protection. Forward/downward view 23°. Access to cockpits via upward-opening gull-wing starboard side window panels. All transparencies flat-plate or single-curvature. Dual flight controls.

SYSTEMS: Environmental control system for cockpit air conditioning. Two independent hydraulic systems, each at 175 bar (2,538 lb/sq in) pressure; at 170 bar (2,465 lb/sq in), flow rate is 12 litres (3.2 US gallons; 2.6 Imp gallons)/min in starboard system and 27 litres (7.1 US gallons; 5.9 Imp gallons)/min in port system.

Electrical power from two 20 kVA alternators providing 200 V three-phase and 115 V single-phase AC at 400 Hz, with two transformer-rectifiers and two 24 V 31 Ah batteries for 28 V DC power. Full or partial electric de-icing/demisting optional.

Crew oxygen system, and fire detection and extinguishing systems, standard.

AVIONICS: All-digital, interfaced to dual-redundant mission computers and MIL-STD-1553B databusses; stores management system conforms to MIL-STD-1760A. Avionics integrator is ATE (Advanced Technologies and Engineering), supported by 15 subcontractors.

Comms: Frequency-agile transceivers: dual V/UHF (30 to 400 MHz) for normal use and single HF (2 to 30 MHz) for NOE flights; intercom/audio system; IFF transponder.

Flight: Duplex four-axis digital AFCS, incorporating (in EDM) dual Thales (Sextant) Stratus three-axis strapdown ring laser gyro AHRS, Sextant NSS 100-1 eight-channel GPS receiver, Doppler radar velocity sensor, J-band radar altimeter, heading sensor unit (two magnetometers), air data unit and omnidirectional airspeed sensor, all interfaced to two redundant navigation computers. Autopilot has one-touch autohover and attitude hold. Nav/attack system programmed by preloaded cartridge; can hold up to five flight plans (100 waypoints), which can be edited in flight by either crew member.

Instrumentation: Integrated flight management system, with (in EDM) two 160 × 160 mm (6.3 × 6.3 in) Thales (Sextant) MFD 66 liquid crystal colour MFDs, two Sextant Topowl helmet-mounted sights/displays, and a position management system in each cockpit. Both cockpits have a back-up basic instrument panel for 'get home' capability in the event of computer or power failure. MFDs show flight control, navigation (including moving map on pilot's display), threat warning/EW, fire/weapons control and TDATS imagery, and can copy to each other. Cockpit instruments compatible with NVGs.

Mission: Nose-mounted, gyrostabilised turret contains target detection, acquisition and tracking system (TDATS) incorporating a three fields of view TV and FLIR with automatic guidance and tracking, an LLTV camera and a laser range-finder; associated equipment includes crew members' Thales (Sextant) helmet sights, missile command link and tracking goniometer. Helmet sights display both flight and weapon data, and can cue both the TDATS turret and the gun turret. Denel Optronics and Thales (Pilkington Optronics) PNVS (Pilot Night Vision Sensor), a two-axis turret with 40 × 30° field of view FLIR, offered as export alternative to Sextant helmet sights.

Self-defence: Optimised ECM can include radar and laser warning receivers, chaff/flare dispensers and RF, IR and laser jammers.

ARMAMENT: Long- or short-barrel version of 20 mm Armscor F2; cleared also for 30 mm weapon. F2 has 750 rounds of ammunition, firing rate of 740 rds/min, and slew rate of 90°/s. Gun linked to TDATS and helmet-mounted sight display (HMSD). Three underwing stores stations each side. Two or four M159 19-tube launchers for Forges de Zeebrugge FZ90 70 mm unguided rockets and/or four-round launchers for up to 16 Mokopa ZT-6 anti-tank missiles (semi-active laser or MMW version) on inner four underwing pylons; two or four Mistral IR air-to-air missiles on outboard pylons.

DIMENSIONS, EXTERNAL:

Main rotor diameter	15.58 m (51 ft 1½ in)
Tail rotor diameter	3.05 m (10 ft 0 in)
Length: fuselage, excl gun, tail rotor turning	16.39 m (53 ft 9¼ in)
overall, rotors turning	18.73 m (61 ft 5½ in)
Wing span (to c/l of AAM pylons)	6.355 m (20 ft 10¼ in)
Fuselage:	
Max width (excl engine fairings)	1.28 m (4 ft 2½ in)
Max depth (belly to top of rotor head)	4.00 m (13 ft 1½ in)
Height: over tail rotor	4.445 m (14 ft 7 in)
to top of rotor head	4.59 m (15 ft 0¾ in)
overall	5.185 m (17 ft 0¾ in)
Wheel track	2.78 m (9 ft 1½ in)
Wheelbase	11.77 m (38 ft 7½ in)

AREAS:

Main rotor disc	190.60 m² (2,052.1 sq ft)
Tail rotor disc	7.27 m² (78.23 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	5,910 kg (13,029 lb)
Max internal fuel weight	1,469 kg (3,238 lb)
External weapons load with full internal fuel	1,563 kg (3,446 lb)
Max external load (with 1,000 kg; 2,205 lb fuel)	2,032 kg (4,480 lb)
Typical mission T-O weight	7,500 kg (16,535 lb)
Max T-O weight	8,750 kg (19,290 lb)
Max disc loading	45.9 kg/m² (9.40 lb/sq ft)
Transmission loading at max T-O weight and power (Makila 1K2)	3.90 kg/kW (6.41 lb/shp)

PERFORMANCE (at 7,500 kg; 16,535 lb combat weight, except where indicated. A: ISA at S/L. B: ISA + 27 C at 1,525 m; 5,000 ft):

Never-exceed speed (VNE): A, B	167 kt (309 km/h; 192 mph)
Max cruising speed: A	150 kt (278 km/h; 173 mph)
B	130 kt (241 km/h; 150 mph)
Max sideways speed: A	50 kt (93 km/h; 58 mph)
Max rate of climb at S/L: A	799 m (2,620 ft)/min
B	760 m (2,493 ft)/min
Rate of climb at S/L, OEI: A	344 m (1,128 ft)/min
Service ceiling: A	6,100 m (20,000 ft)
B	5,150 m (16,900 ft)
Hovering ceiling IGE: A	5,850 m (19,200 ft)
B	3,110 m (10,200 ft)
Hovering ceiling OGE: A	5,455 m (17,900 ft)
B	2,410 m (7,900 ft)
Excess hover power margin OGE, S/L anti-tank mission	+25%
Range with max internal fuel, no reserves: A	380 n miles (704 km; 437 miles)
B	507 n miles (940 km; 584 miles)
Range at max T-O weight with external fuel: A	680 n miles (1,260 km; 783 miles)
B	720 n miles (1,335 km; 829 miles)
Endurance with max internal fuel, no reserves: A	3 h 36 min
B	4 h 55 min
Endurance at max T-O weight with external fuel: A	6 h 52 min
B	7 h 22 min
g limits	+2.6/–0.5

RAVIN

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Hannes van Ark
Francois Jordaan

Ravin's first product is the all-composite Ravin 500, based on the PA-24 Comanche. US marketing is by Ravin Aircraft USA, which received first kits for sale in December 2005.

RAVIN RAVIN 500

TYPE: Four-seat kitbuilt.

PROGRAMME: Transformation of Piper PA-24 Comanche (first flown 24 May 1956) into composites. Design and development took two years and five months. Project originated during Jan Troskie's ownership of a Comanche 260C and following joint construction of Tri-R KIS composites kitplane with Leon Joubert, who later designed Ravin's avionics suite.

Prototype ZU-CTW first flown 15 September 2002; further aircraft (ZU-DCT) first flown 13 September 2003. Also available as complete aircraft. US marketing began in 2006 upon arrival of kit No. 9.

CUSTOMERS: Total of nine flying in South Africa by April 2006.

COSTS: Kit USD89,865 plus tax, excluding engine, propeller and avionics (2006).

DESIGN FEATURES: Based on Piper Comanche, but some 7 per cent (non-uniform) smaller and with redesign to enhance aerodynamics (wing profile), drag reduction (engine cowling), occupant's comfort and operating costs. Original Fowler flaps replaced by plain units; horizontal tail surfaces changed to conventional tailplane and elevator.

Can be equipped with standard Comanche engine, engine mount, propeller, landing gear, flight control systems, avionics and instruments or with more modern equivalents.

Airframe compatible with conversion to PA-30 Twin Comanche.

Kit version quoted build time 500 hours.

FLYING CONTROLS: Conventional and manual. Single-piece, balanced elevator with flight-adjustable tab, starboard. Horn-balanced rudder with flight-adjustable tab. Actuation (including flaps) by cables. Plain flaps.

STRUCTURE: Composites throughout. Carbon fibre wing spar; metal engine mounting attached to long stringers to distribute loads along fuselage. Bonded windows.

LANDING GEAR: Tricycle type; retractable. Hydraulic actuation; mainwheels retract inwards, legs being covered by doors, but wheels exposed; nosewheel retracts rearward. Main tyres 6.00-6; nose 5.00-5.

POWER PLANT: One 194 kW (260 hp) Textron Lycoming IO-540 flat-six. Fuel in two wing tanks, combined capacity 606 litres (160 US gallons; 133 Imp gallons).

Ravin 500 four-seat composites lightplane 1158014

ACCOMMODATION: Four persons in tandem side-by-side pairs. Forward-hinged cabin door port, front. Hat shelf. Top-hinged baggage hold door starboard, rear.

DIMENSIONS, EXTERNAL:

Wing span	10.40 m (34 ft 1½ in)
Wing aspect ratio	7.4
Length overall	7.42 m (24 ft 4 in)

AREAS:

Wings, gross	14.60 m² (157.2 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	850 kg (1,874 lb)
Max T-O weight	1,620 kg (3,571 lb)
Max wing loading	111.0 kg/m² (22.73 lb/sq ft)
Max power loading	8.36 kg/kW (13.73 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	243 kt (450 km/h; 280 mph)
Max level speed	205 kt (380 km/h; 236 mph) IAS
Cruising speed at 75% power:	
S/L	185 kt (342 km/h; 213 mph) IAS
at FL65	196 kt (363 km/h; 226 mph)
Stalling speed: clean	64 kt (119 km/h; 74 mph) IAS
flaps and gear down	56 kt (104 km/h; 65 mph) IAS
Max rate of climb at S/L	457 m (1,500 ft)/min
Range with 10% reserves	1,950 n miles (3,611 km; 2,244 miles)

WHISPER

WHISPER AIRCRAFT

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Web: www.whisperaircraft.com
DESIGNER: Russell L Phillips

Whisper motor glider manufacture was transferred to Jabiru South Africa in 2006 in order to meet demand.

WHISPER WHISPER

TYPE: Motor glider.

PROGRAMME: Prototype Phillips Whisper registered ZS-GXW in September 2003; public debut at Port Elizabeth Air Show October 2004.

CUSTOMERS: Total of 47 kits delivered by late 2006, when 48th supplied to Jabiru SA as first to be built by this company. Six had received South African airworthiness certificates by September 2006.

DESIGN FEATURES: Low, trapezoidal wing; cruciform empennage with trapezoidal surfaces. Quoted build time 1,000 hours for basic kit, including builder's fabrication of some parts; fast-built kit 500 hours.

FLYING CONTROLS: Conventional and manual.

STRUCTURE: Composites throughout, except steel reinforcement for landing gear attachment; birch ply; and stainless steel firewall and engine mount.

LANDING GEAR: Tailwheel type; fixed. Speed fairings over all wheels.

POWER PLANT: One 59.0 kW (79.1 hp) Limbach L 2000 flat four driving a two-blade Hoffmann three-position propeller. Alternatively, Aero Vee or similar Volkswagen-based engine; Jabiru and Rotax alternatives being developed. Fuel capacity 85 litres (22.5 US gallons; 18.7 Imp gallons).

ACCOMMODATION: Two persons, side by side, beneath single-piece canopy/windscreen.

DIMENSIONS, EXTERNAL:

Wing span	16.00 m (52 ft 6 in)
Wing aspect ratio	17.1
Length overall	7.16 m (23 ft 6 in)

AREAS:

Wings, gross	15.00 m² (161.5 sq ft)

Prototype Whisper motor glider with Limbach engine 1158842

WEIGHTS AND LOADINGS:

Weight empty	500 kg (1,102 lb)
Max T-O weight	745 kg (1,642 lb)
Max wing loading	49.7 kg/m² (10.17 lb/sq ft)
Max power loading	12.63 kg/kW (20.75 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	135 kt (250 km/h; 155 mph)
Max level speed	100 kt (185 km/h; 115 mph)
Cruising speed at 75% power	90 kt (167 km/h; 104 mph)
Max rate of climb at S/L	213 m (700 ft)/min
T-O run	200 m (660 ft)
Range	648 n miles (1,200 km; 745 miles)

PERFORMANCE UNPOWERED:

Stalling speed	39 kt (72 km/h; 45 mph)
Best glide ratio at 57 kt (105 km/h; 65 mph)	28
Min rate of sink at 43 kt (80 km/h; 50 mph)	0.90 m (2.95 ft)/s

Spain

AEROCOPTER

AEROCOPTER SL

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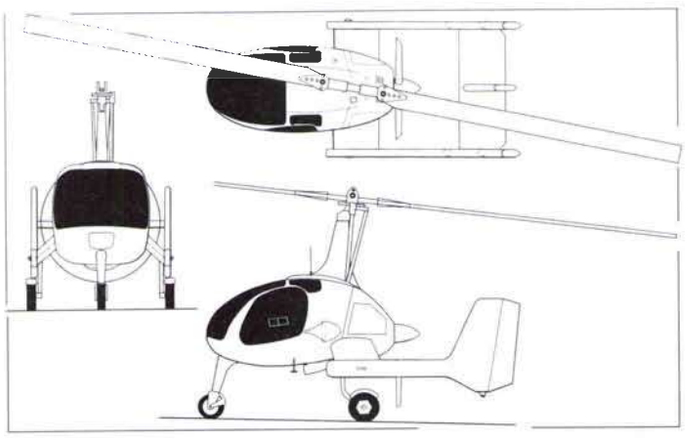
PRESIDENT: Pedro Esteban Poverda
MANAGER: Carlos Figuero Cano

AeroCopter showed the first production Futura autogyro at the Aero '03 exhibition at Friedrichshafen, Germany, in April 2003 and is now pursuing an Ultralight category version. The company employs a workforce of eight in its 800 m² (8,611 sq ft) factory.

AeroCopter Futura second prototype *(Paul Jackson)* 1129244

AEROCOPTER FUTURA

TYPE: Two-seat autogyro/ultralight.
PROGRAMME: Design began in 1998; two technology demonstrators; two prototypes flown in 2002. Initial production aircraft (unregistered; black colour scheme) flew immediately after debut at Friedrichshafen, Germany, in April 2003. Second production aircraft, incorporating detail changes including cantilever spring main landing gear (unregistered; red colour scheme) exhibited at Blois, France, in September 2004. Third aircraft (blue scheme) first in Ultralight configuration, lacking full metal chassis.
CURRENT VERSIONS: **Light:** Ultralight version. Available in Heavy-Duty, Comfort or Luxe equipment standards.
Standard: Experimental category version. Above three standards, plus Royal and Select.
COSTS: Light EUR59,000; Standard EUR60,000; Standard Luxe EUR72,050 all flyaway (2006).
DESIGN FEATURES: Objectives were "spectacular and aggressive" appearance, combined with latest technology and high level of standard equipment. Twin-tailboom configuration with enclosed cabin; tailbooms and main landing gear mounted on anhedral aerofoil-shape fairings. Main rotor pre-rotation by Bowden cable. Rotor brake. An 'F-16 style' air intake replaced upper air intake on initial production aircraft and fairing added to rotor mast.
FLYING CONTROLS: Twin rudders, plus all-moving central fin, actuated by Bowden cables.
STRUCTURE: Generally of composites and glass fibre, with chrome-molybdenum tube framework. Main rotors designed and manufactured by ASII in US, but Ultralight has Air Copter extruded aluminium rotors and tube frame restricted to cockpit area. Forward fuselage and glazing based on Rotorway Exec helicopter.
LANDING GEAR: Tricycle type; fixed. Mainwheels 400×100; nosewheel 4.00–6. Hydraulic disc brakes on mainwheels. Steerable faired-in nosewheel directly linked to rudder. Wheel guards on main wheels.
POWER PLANT: One 84.6 kW (113.4 hp) Rotax 914 flat-four driving a KievProp three-blade pusher propeller via a reduction drive including a centrifugal clutch. Optionally, 104 kW (140 hp) Subaru EA-81.
EQUIPMENT: Optional ballistic recovery parachute.
DIMENSIONS, EXTERNAL:
Main rotor diameter ..... 8.53 m (28 ft 0 in)
Width overall ..... 2.10 m (6 ft 10¾ in)
Length of fuselage ..... 4.20 m (13 ft 9¼ in)
Height overall ..... 3.20 m (10 ft 6 in)
AREAS:
Rotor disc ..... 56.74 m² (610.7 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 275 kg (606 lb)
Max T-O weight: Light ..... 450 kg (992 lb)
Light with parachute ..... 472.5 kg (1,041 lb)
Standard ..... 500 kg (1,102 lb)
PERFORMANCE:
Max level speed ..... 103 kt (190 km/h; 118 mph)
Normal cruising speed ..... 86 kt (160 km/h; 99 mph)
Minimum speed ..... 22 kt (40 km/h; 25 mph)
T-O run ..... 100 m (330 ft)
Landing run ..... 5 m (20 ft)
Endurance ..... 4 h



AeroCopter Futura two-seat autogyro in revised form *(Paul Jackson)* 0589201

AEROMORAGÓN

AEROMORAGÓN SI

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PRESIDENT: Diego Chaves

Following production of some 30 Moragón M-1s, Aeromoragón has launched the improved Stela.

Aeromoragón Stela two-seat ultralight 1037964

AEROMORAGÓN STELA

TYPE: Side-by-side ultralight.
PROGRAMME: Prototype, converted from M-1 prototype EC-EA4, shown at RSA Rally, Blois, France, in 2005.
COSTS: EUR42,000 with Jabiru engine and basic instruments (2006). Kit prices on application.
DESIGN FEATURES: High-mounted, constant-chord wing with single streamlined bracing strut each side; low, cantilever tailplane; sweptback fin.
FLYING CONTROLS: Conventional and manual. Actuation by pushrods (ailerons, elevator) and cables (rudder). Electrically actuated flaps.
STRUCTURE: Fuselage frame of 6061T6 and 2024T3 aluminium tube with carbon fibre outer shell, including integral fin and tailplane. Wing of conventional spars and ribs, with carbon fibre skin.
LANDING GEAR: Tricycle type; fixed. Fuselage-mounted, spring cantilever, carbon fibre V tube mainwheel legs; trailing link nosewheel. Lever-actuated mainwheel brakes for steering. Wheel fairings standard.
POWER PLANT: One 59.7 kW (80 hp) Jabiru 2200 flat-four driving a GT 58/38 three-blade carbon fibre propeller. Options of 58.8 kW (78.9 hp) Jabiru 912 UL; 63.4 kW (85 hp) Verner; and 73.5 kW (98.6 hp) Rotax 912 ULS.
EQUIPMENT: Optional ballistic recovery parachute.
DIMENSIONS, EXTERNAL:
Wing span ..... 9.60 m (31 ft 6 in)
Length overall ..... 6.00 m (19 ft 8¼ in)
Height overall ..... 2.47 m (8 ft 1¼ in)
AREAS:
Wings, gross ..... 12.04 m² (129.6 sq ft)
WEIGHTS AND LOADINGS (Jabiru engine):
Weight empty ..... 260 kg (573 lb)
Max T-O weight ..... 450 kg (992 lb)
PERFORMANCE:
Max cruising speed ..... 94 kt (175 km/h; 109 mph)
Stalling speed ..... 33 kt (60 km/h; 38 mph)
Endurance ..... 5 h

CAG

CONSTRUCCIONES AERONAUTICAS DE GALICIA

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PRESIDENT: Antonio Castelo Silvira

Formed in 1996, CAG operates from two sites: prototype work is performed at its 1,500 m² (16,150 sq ft) factory at Ribadeo, with series production undertaken in a new, purpose-built 5,000 m² (53,825 sq ft) facility at Villanueva de Gállego, Zaragoza, opened in 2005. A July 2003 agreement with Mooney has lapsed.

CAG TOXO

English name: Gorse Bush

TYPE: Two-seat lightplane; side-by-side ultralight kitbuilt.

PROGRAMME: Designed by José Luis Miro. Original Toxo (EC-YYU) flew in 2000, followed by second prototype (EC-YYV); Toxo II (EC-ZFB) followed in September 2001. Toxo Sportster, Cruiser and Trainer announced in 2005; however, Sportster is lead product.

CURRENT VERSIONS: **Toxo:** Ultralight; approved in France and Spain; similar registration under way in Austria, Germany and Netherlands in 2003. Typically 59.7 kW (80 hp) Jabiru 2200 flat-four engine and Duc fixed-pitch propeller. Fuel capacity 60 litres (15.9 US gallons; 13.2 Imp gallons). MTOW limited to 472.5 kg (1,041 lb).

Toxo II: VLA category, broadly similar to Sportster.

Toxo IV: Proposed four-seat version; in abeyance.

Toxo Trainer: Announced 2005; meets LSA (Light Sport Aircraft) regulations and 51 per cent homebuilt rules; renamed Sportster SLSA, first sales were due spring 2006.

Toxo Cruiser: Announced 2005; available as a kit or ready to fly; meets primary VLA requirements.

Toxo Sportster: Public debut at EAA Air Venture '05, Oshkosh; available as kit only.

CUSTOMERS: Total 23 delivered by early 2006 to customers in Brazil, France, Germany, Portugal, Spain and the United States.

COSTS: VLA EUR89,477 (2003) excluding tax, complete; VLA kit EUR54,458 (2003) including Jabiru 3300 engine, excluding tax; SLSA EUR99,792 flyaway (2006).

DESIGN FEATURES: Experimental/VLA or Ultralight category; engines between 59.7 and 134 kW (80 and 180 hp). Wide speed range and high aerodynamic efficiency, including short field performance and good stability. Streamlined, tapered low-wing design with sweptback fin and upturned wingtips.

FLYING CONTROLS: Conventional and manual. Pushrod actuation. Fowler slotted flaps. Variable incidence (electrical) tailplane for trimming. (Horn-balanced elevators and alternative all-moving tailplane of prototypes replaced by mass-balanced elevators for production Toxo II).

STRUCTURE: Mainly of vacuum-bonded glass fibre and honeycomb; aluminium and steel fittings. Wing has T-beam composites spar and integral fuel tanks.

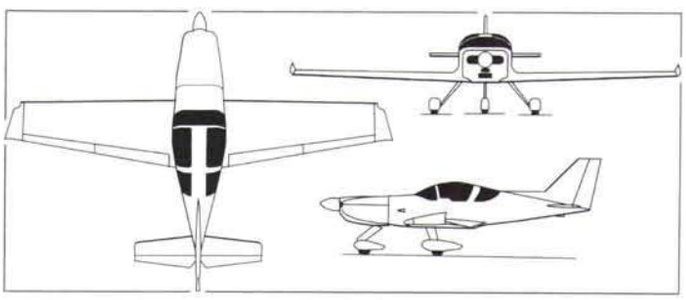
LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring cantilever mainwheel legs with wheel fairings. Steerable, trailing link nosewheel with wheel fairing. Mainwheels size 5.00. Brakes and parking brake.

POWER PLANT: Earlier versions had engines to meet customer's requirements. Typically 89 kW (120 hp) Jabiru 3300 driving a Warp Drive Airmaster three-blade, constant-speed propeller. Cruiser Sportster and Sportster SLSA all have 73.5 kW (98.6 hp) Rotax 912 ULS driving an Airmaster or MT-Propeller three-blade propeller. Usable fuel 79 litres (21.0 US gallons; 17.5 Imp gallons) in Sportster SLSA and Cruiser; 151 litres (40.0 US gallons; 33.3 Imp gallons) in Sportster.

ACCOMMODATION: Two persons, side by side, each with centreline-hinged, upward-opening door; separate windscreen; baggage space to rear of seats; rear window each side. Dual controls. Cockpit heated and ventilated.

AVIONICS: *Comms:* Optional Becker AR-4201 radio, Zennheiser intercom and Becker ATC 4401-175 Mode S transponder.

Flight: Optional Bendix/King moving map display.



CAG Toxo II (Jabiru 2200 flat-four) *(Paul Jackson)* 0589200

CAG Toxo II prototype 1159725

EQUIPMENT: Optional ballistic parachute.

DIMENSIONS, EXTERNAL:

Wing span: Cruiser	8.70 m (28 ft 6½ in)
Sportster	7.69 m (26 ft 1¼ in)
Sportster SLSA	10.70 m (35 ft 1¼ in)
Wing chord, mean: Cruiser, Sportster SLSA	1.20 m (3 ft 11¼ in)
Sportster	1.10 m (3 ft 7¼ in)
Length overall: Cruiser, Sportster SLSA	6.00 m (19 ft 8¼ in)
Sportster	5.40 m (17 ft 8½ in)
Height overall: Cruiser, Sportster SLSA	2.12 m (6 ft 11½ in)
Sportster	2.00 m (6 ft 6¾ in)

DIMENSIONS, INTERNAL:

Cabin max width: Cruiser	1.23 m (4 ft 0½ in)
Sportster	1.05 m (3 ft 5¼ in)
Sportster SLSA	1.07 m (3 ft 6 in)

AREAS:

Wings, gross: Cruiser	10.40 m² (111.9 sq ft)
Sportster	8.70 m² (93.7 sq ft)
Sportster SLSA	12.78 m² (137.6 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: Cruiser, Sportster SLSA	379 kg (836 lb)
Sportster	399 kg (880 lb)
Max baggage weight: Cruiser, Sportster SLSA	22 kg (50 lb)
Sportster	32 kg (70 lb)
Max T-O weight: Cruiser	658 kg (1,452 lb)
Sportster	698 kg (1,540 lb)
Sportster SLSA	598 kg (1,320 lb)
Max wing loading: Cruiser	63.4 kg/m² (12.98 lb/sq ft)
Sportster	80.3 kg/m² (16.44 lb/sq ft)
Sportster SLSA	46.9 kg/m² (9.60 lb/sq ft)
Max power loading: Cruiser	8.96 kg/kW (14.73 lb/hp)
Sportster	9.51 kg /kW (15.62 lb/hp)
Sportster SLSA	8.15 kg/kW (13.39 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE): Cruiser	165 kt (305 km/h; 190 mph)
Sportster SLSA	170 kt (314 km/h; 195 mph)
Sportster	217 kt (402 km/h; 250 mph)
Max operating speed: Cruiser	152 kt (282 km/h; 175 mph)
Sportster	200 kt (370 km/h; 230 mph)
Sportster SLSA	120 kt (222 km/h; 138 mph)
Normal cruising speed: Cruiser	135 kt (249 km/h; 155 mph)
Sportster	148 kt (274 km/h; 170 mph)
Sportster SLSA	104 kt (193 km/h; 120 mph)
Stalling speed: flaps up: Cruiser	57 kt (104 km/h; 65 mph)
Sportster	59 kt (107 km/h; 67 mph)
Sportster SLSA	40 kt (73 km/h; 45 mph)
flaps down: Cruiser	46 kt (84 km/h; 52 mph)
Sportster	51 kt (94 km/h; 58 mph)
Max rate of climb at S/L: Cruiser	335 m (1,100 ft)/min
Sportster	457 m (1,500 ft)/min
Sportster SLSA	305 m (1,000 ft)/min
Service ceiling: all	4,115 m (13,500 ft)
T-O run: Cruiser	142 m (465 ft)
Sportster	154 m (505 ft)
Sportster SLSA	122 m (400 ft)
Landing run: Cruiser	181 m (595 ft)
Sportster	184 m (605 ft)
Sportster SLSA	177 m (580 ft)
Range: Cruiser	730 n miles (1,352 km; 840 miles)
Sportster	1,510 n miles (2,796 km; 1,737 miles)
Sportster SLSA	645 n miles (1,194 km; 742 miles)
Endurance: Cruiser, Sportster SLSA	6 h 0 min
Sportster	10 h 0 min
g limits: Cruiser, Sportster SLSA	+5/–3
Sportster	+6/–4

COLYAER

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Company formed 11 November 1995 to develop and market Martin 3 lightplane as landplane, seaplane flying-boat. Manufacture is in 1,300 m² (14,000 sq ft) workshop at Portonovo.

COLYAER MARTIN 3

TYPE: Side-by-side ultralight.

PROGRAMME: Developed from basic design of Canelas Ranger, produced in 1983 by Martin Uhia Lima and manufactured in small numbers. Prototype was flying-boat; second was landplane. Following formation of Colyaer company, third prototype built and design information computerised for production.

CURRENT VERSIONS: **M3-S100:** Motor glider; greater wing area.

M3-S110: Shorter span (10.40 m; 34 ft 1½ in); higher cruising speed.

Colyaer Martin 3 US demonstrator 1159727

Gannet: Seaplane; described separately.

Freedom: Amphibian, described with Gannet.

DESIGN FEATURES: Intended to provide side-by-side seating for two, good outward visibility, spacious cockpit, 108 kt (200 km/h; 124 mph) cruising speed, Ultralight or JAR-VLA compatibility, range of 809 n miles (1,500 km; 932 miles), composites construction and competitive price.

High wing, without bracing struts, mounted on pod-and-boom fuselage, with T tail. Engine and pusher propeller mounted behind cockpit.

Wing section NACA 643-618.

FLYING CONTROLS: Conventional and manual. Electrically operated flaps, max deflections −7° for long-distance cruises; +50° for short landing.

STRUCTURE: Composites throughout. Carbon and glass fibre cantilever mainwheel legs; Kevlar, Nomex and epoxy resins.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring cantilever mainwheel legs with wheel fairings. Trailing-link nosewheel with wheel fairing.

POWER PLANT: Suitable engines between 45 and 75 kW (60 and 100 hp). Standard fuel capacity 40 litres (10.6 US gallons; 8.8 Imp gallons). Two optional tanks increase capacity to 90 litres (23.8 US gallons; 19.8 Imp gallons) of which 89 litres (23.5 US gallons; 19.6 Imp gallons) are usable, or 138 litres (36.5 US gallons; 30.4 Imp gallons) of which 130 litres (34.3 US gallons; 28.6 Imp gallons) are usable.

DIMENSIONS, EXTERNAL:

Wing span	12.37 m (40 ft 7 in)
Length overall	5.85 m (19 ft 2¼ in)

DIMENSIONS, INTERNAL:

Cockpit max width	1.10 m (3 ft 7¼ in)

AREAS:

Wings, gross: S100	12.00 m² (129.2 sq ft)
S110	10.50 m² (113.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	280 kg (617 lb)
Max T-O weight	599 kg (1,320 lb)

PERFORMANCE, POWERED:

Max level speed: S100	97 kt (180 km/h; 112 mph)
S110	108 kt (200 km/h; 124 mph)
Stalling speed: both	36 kt (65 km/h; 41 mph)
Max rate of climb at S/L:	
S100	300 m (984 ft)/min
S110	240 m (787 ft)/min
T-O and landing run: S100	120 m (395 ft)
S110	140 m (460 ft)
Range with max optional fuel	809 n miles (1,500 km; 932 miles)
g limits	+6/−4

PERFORMANCE, UNPOWERED:

Stalling speed	36 kt (65 km/h; 41 mph)
Best glide ratio: S100	23
S110	17
Min rate of sink: S100	1.2 m (3.9 ft)/s
S110	1.5 m (4.9 ft)/s

COLYAER GANNET and FREEDOM

TYPE: Two-seat flying boat kitbuilt; two-seat amphibian kitbuilt.

PROGRAMME: Derivation of Martin 3. Prototype completed in early 2003 and registered EC-ZJU; initially known as Mascato.

CURRENT VERSIONS: **Freedom:** Amphibian version.

Gannet: Flying boat version; has redesigned hull when compared to Freedom. US demonstrator has upturned tips to tailplane; LSA compliant.

CUSTOMERS: Around 40 examples sold worldwide by early 2006.

COSTS: Gannet USD71,820 (2005); Freedom USD117,406 flyaway (2006).

FLYING CONTROLS: Flap angle −5° for cruising; maximum deflection 50° for emergency landings.

STRUCTURE: Generally of glass fibre, carbon fibre and Kevlar, with some metal items. Fuselage divided into three watertight compartments.

LANDING GEAR: Freedom: Single-step hull with outrigger floats at two-thirds' span. Wheels retract totally under electrical power; steerable nosewheel; hydraulic brakes. Max wave height 30 cm (1 ft). Water rudder.

DIMENSIONS, EXTERNAL:

As Martin 3 S100

DIMENSIONS, INTERNAL:

Cockpit: Max width	1.22 m (4 ft 0 in)
Height	1.12 m (3 ft 8 in)

AREAS:

As Martin 3 S100

WEIGHTS AND LOADINGS: As Martin 3 S100, except:

Weight empty: Freedom	287 kg (632 lb)
Gannet	324 kg (714 lb)
Max T-O weight: both	648 kg (1,430 lb)

PERFORMANCE, POWERED: As Martin 3 S100, except:

T-O run, water, both	140 m (460 ft)
Landing run, Gannet	140 m (460 ft)
Landing run, land: Freedom	121 m (395 ft)

PERFORMANCE, UNPOWERED:

Best glide ratio	20
Min rate of sink	1.5 m (4.9 ft)/s

Colyaer Gannet demonstrating in US *(Paul Jackson)* 1159747

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Pedro Méndez (Space)

DIRECTOR, COMMERCIAL COMMUNICATIONS: Miguel Sánchez

CASA, founded in 1923 to build French Breguet XIXs under licence for Spain's military aviation arm, was owned 99.2852 per cent by the Spanish state holding company Sociedad Estatal de Participaciones Industriales (SEPI), 0.7098 per cent by DASA (Germany) and 0.005 per cent by others. It was announced on 11 June 1999 that SEPI and DaimlerChrysler had signed an MoU to unite CASA and DASA in a new single company. This company was subsequently created as EADS by Aerospatiale Matra and DaimlerChrysler Aerospace and joined by CASA as a founder member on 2 December 1999. As a result, EADS CASA was restructured. In October 2001, the company acquired a 41 per cent holding in PZL Warszawa-Okęcie. A 5 per cent share in Eurocopter, and thence a 40 per cent stake in the newly formed Eurocopter España, was established in late 2003; latter company responsible initially for final assembly of 24 Eurocopter Tigers for Spanish Army.

Military Transport Aircraft Division

This division is the Military Transport Aircraft Division of EADS and is responsible for the design, manufacture and marketing of light and medium transport aircraft such as the C-212, CN-235 and C-295. Some structural components for the CN-235 and C-295 are now manufactured by ENAER of Chile, under an eight-year co-operation agreement signed on 21 June 2001.

EADS CASA has been designing and manufacturing light and medium military transport aircraft for over 30 years for such roles as paratroop drops, aerial delivery, medevac, logistic transport or maritime patrol. These aircraft have seen service in more than 50 countries. Its former Airbus Division was fully responsible for design, development and manufacture of diverse structural parts integrated into all Airbus aircraft, having specialised in horizontal stabilisers, as well as in components manufactured in carbon fibre. The latter capability enables it to play an essential role within construction of the A380 megaliner, in which EADS participates with an 80 per cent stake. EADS CASA is the subcontractor responsible for designing and producing a tanker conversion kit for four Airbus A310MRTTs ordered by the German Air Force; is leading the A330MRTT air tanker consortium bidding for the UK Future Strategic Tanker Aircraft (FSTA) requirement; and in November 2001 launched a development programme for an advanced air refuelling boom system (ARBS) with fly-by-wire control. Phase 1 flight testing of ARBS, on an A310 testbed, took place 16 to 30 March 2006.

It also leads the future A400M heavy military transport aircraft programme, managed by Airbus Military Company in which EADS has a major stake. The A400M has been designed according to the shared requirements of seven air forces, and as a European reply to the replacement of current military transport aircraft such as the C-130 Hercules and C.160 Transall

The division offers its FITS (Fully Integrated Tactical System) for diverse applications such as maritime patrol and surveillance, or anti-submarine/anti-surface warfare. First recipient of FITS was Spanish Air Force P-3B fleet (first of five upgraded aircraft rolled out early May 2003); selected also by Brazilian Air Force to retrofit nine P-3As.

A new factory was inaugurated at Bahia de Cadiz on 2 July 2003. Replacing the older facility at Puntales, it has a total area of 78,840 m^2 (848,625 sq ft), including 20,056 m^2 (215,880 sq ft) of covered accommodation.

Military Aircraft Division

Military Aircraft Division is a 43 per cent partner within the Eurofighter consortium, being fully responsible for engineering, structural tests and systems, as well as integrated logistic support, manufacture and prototype flight tests. It is currently in the development stage.

For series production Eurofighters, it manufactures starboard wings as well as port and starboard slats for every aircraft. Final assembly of all aircraft ordered by the Spanish Air Force is also carried out by EADS CASA.

EADS CASA has more than 40 years of experience working with military and commercial operators in areas of maintenance, overhaul and modernisation of aircraft and helicopters. Recently developed modernisation programmes for Spanish Air Force F-5, C-130 Hercules and Mirage F1 fleets are offered to other countries. Modernisation programmes concerning F-18 and F-5 avionics are under way.

Space Division

This division develops structural, thermal and power distribution subsystems for launchers, satellites and orbital infrastructures. It also takes part in military satellite and mini-satellite programmes for the Spanish MoD and participates in the programmes for the development of new technologies, both in Spain and abroad.

CASA C-212 SERIES 400

US military designation (Series 200): C-41A

TYPE: Twin-turboprop transport.

PROGRAMME: Design studies for C-212 began 1964; design accepted by Spanish Air Force 1967; two prototypes (plus one static test) ordered 24 September 1968; first flights 26 March and 23 October 1971. Series 100 and 200 no longer produced, but four Series 200 in service with US Special Operations Forces belatedly allocated C-41A designation in 2002. Series 300 certified to FAR Pts 25, 121 and 135 in December 1987 but no longer offered; replaced by Series 400 from 1998. Former name Aviocar now discontinued.

CURRENT VERSIONS: **100:** Initial version; 158 built (CASA two prototypes plus 128, IPTN 28 from Spanish CKD kits).

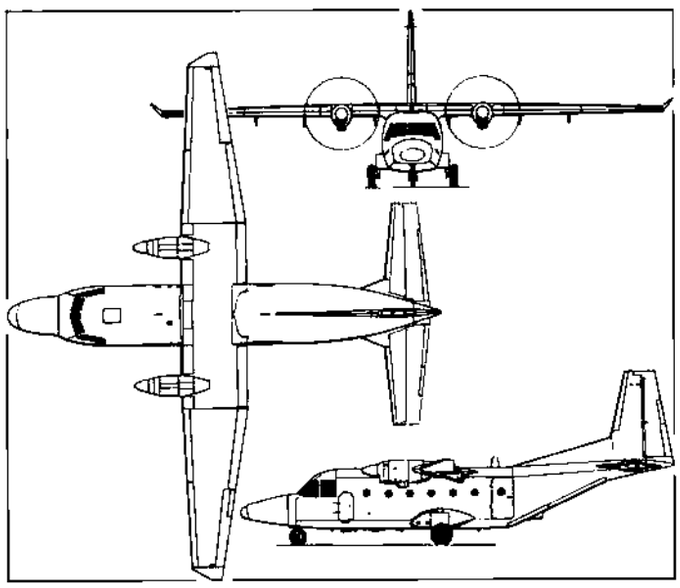
200: Succeeded Srs 100 from 1980; 151 built by CASA. Final examples (three for Indonesian Navy) reportedly nearing completion by Dirgantara in February 2006.

300: Differed from Series 200 in having winglets to improve climb performance; enlarged nose for increased payload; and enhanced cruise performance; 52 built.

400: Initiated mid-1995, but not formally launched until June 1997 (Paris Air Show), following first flight (EC-212) on 4 April that year. EFIS and re-rated TPE331-12JR engines maintaining T-O power under hot/high conditions without APR; increased maximum payload; other improvements as detailed under Design Features below. Spanish type certificate 30 March 1998. Available in configurations described below

400 Airliner: Standard seating for 26 passengers, or 24 if lavatory included.

Detailed description applies to 400 Airliner except where indicated.



CASA C-212 Series 400 *(Dennis Punnett)* 1158767

400 Utility: Standard seating for 23 passengers, or 21 if lavatory included, with maximum capacity for 26.

400M: Military troop/cargo/general purpose transport.

Patrullero: Special missions (anti-submarine and maritime patrol) versions; described separately.

CASA C-212-400 PRODUCTION AND ORDERS
(at August 2006)

Country	Customer	Total
Australia	Skytraders	2[6]
Brazil	Air Force	TBD[9]
Dominican Republic	Air Force	3[4]
Ecuador	Army	2[8]
Lesotho	Defence Force	1[5]
Paraguay	Air Force	1[7]
Spain	Min of Agriculture, Fisheries and Food	3[3]
Suriname	Air Force	2[2]
USA	EADS CASA (demonstrator)	2
	Phillips Alaska/BP	1
Venezuela	Navy	3[1]
Total		**20+**

[1] Delivered May 1998
[2] Includes one Patrullero; first delivered December 1998, second (Patrullero) in May 1999
[3] Patrullero. First delivered December 1998; second in March 2001; third in May 2003
[4] Third aircraft delivered 12 December 2000
[5] Delivered 18 September 2001
[6] Deliveries began April 2004; Antarctic operation
[7] Delivered 21 February 2004; ambulance conversion kit
[8] Deliveries began March 2005
[9] Selected August 2006; 'up to 50' requirement; contract expected by year-end

CUSTOMERS: See table. Total 475 of all versions sold by August 2006; total includes Series 200s still to be completed by Dirgantara of Indonesia. C-212s of all Series have been purchased or leased by over 40 military and 50 civil operators in 38 countries and had accumulated over 2.5 million hours by 1999.

Selected August 2006 by Brazilian Air Force (FAB) as C-95 Bandeirante replacement. Up to 50 required, with first eight to be completed from CKD kits at FAB maintenance centre, Campo de Marte, progressing to 40 per cent local manufacture by final 10 aircraft. Possible further 30 to be acquired in 2010-11 period.

DESIGN FEATURES: Typical high-wing, rear-loading military transport.

Wing section NACA 65$_3$-218; no dihedral; incidence 2° 30'; swept winglets canted upwards at 45°; meets FAR Pt 36 noise limits.

Series 400 features engine change (see Power Plant); avionics upgrade; underfloor avionics boxes relocated to former nose baggage compartment, facilitating ventral installation of a 360° scan radar and eliminating need for special-shape 'platypus' nose of earlier Patrullero versions, which allowed only 270° scan; relocated pressure refuelling point; main cabin refurbished; cargo winch option.

FLYING CONTROLS: Conventional and manual. Trim tab in port aileron; trim and geared tabs in rudder and each elevator; double-slotted flaps.

STRUCTURE: All-metal light alloy fail-safe structure; unpressurised; two-spar tailplane and fin. Wing centre-section, forward and rear passenger doors and dorsal fin manufactured by AISA

LANDING GEAR: Non-retractable tricycle type, with single mainwheels and single steerable nosewheel. CASA oleo-pneumatic shock-absorbers. Goodyear wheels and tyres, main 11.00–12 (10 ply), nose 24×7.7 (8 ply). Tyre pressure 3.86 bar (56 lb/sq in) on main units, 4.14 bar (60 lb/sq in) on nose unit. Goodyear hydraulic disc brakes on mainwheels. No brake cooling. Anti-skid system optional. Skytraders' two C-212-400s were equipped in 2004 with Kehler snow skis - the first C-212s to be fitted with this type of gear.

POWER PLANT: Two 690 kW (925 shp) Honeywell TPE331-12JR-701C engines. Dowty Aerospace R-334/4-82-F/13 four-blade, constant-speed, fully feathering, reversible-pitch propellers.

Fuel in four integral wing tanks, with total capacity of 2,040 litres (539 US gallons; 449 Imp gallons), of which 2,000 litres (528 US gallons; 440 Imp gallons) usable. Gravity refuelling point above each tank Single pressure refuelling point in starboard mainwheel fairing Additional fuel can be carried in one 1,000 litre or two 750 litre (264 or 198 US gallon; 220 or 165 Imp gallon) optional ferry tanks inside cabin, and/or two 500 litre (132 US gallon; 110 Imp gallon) auxiliary underwing tanks. Oil capacity 4.5 litres (1.2 US gallons; 1.0 Imp gallon) per engine.

ACCOMMODATION: Crew of two on flight deck; cabin attendant in civil version. Ergonomically redesigned flight deck; improved cabin soundproofing, sidewall design, lighting and toilet; 400M, foldaway seats along each side of cabin.

For troop transport role, main cabin can be fitted with 25 inward-facing seats along cabin walls, to accommodate 24 paratroops with instructor/jumpmaster; or 25 fully equipped troops. As ambulance, cabin is normally equipped to carry 12 stretcher patients and four medical attendants. As freighter, up to 2,950 kg (6,504 lb) of cargo can be carried in main cabin, including two LD1, LD727/DC-8 or three LD3 containers, or light vehicles. Cargo system, certificated to FAR Pt 25, includes roller loading/unloading system and 9 *g* barrier net. Photographic version equipped with two RC-20/30 vertical cameras and darkroom. Navigation training version has individual desks/consoles for instructor and five pupils, in two rows, with appropriate instrument installations.

Civil passenger transport version has standard seating for up to 26 in mainly three-abreast layout at 72 cm (28.5 in) pitch, with provision for quick change to all-cargo or mixed passenger/cargo interior. Lavatory, galley and 400 kg (882 lb) capacity baggage compartment standard, plus additional 150 kg (330 lb) in nose bay. VIP transport version can be furnished to customer's requirements.

Forward/outward-opening door on port side immediately aft of flight deck; forward/outward-opening passenger door on port side aft of wing; inward-opening emergency exit opposite each door on starboard side. Additional emergency exit in roof of forward main cabin. Two-section underfuselage loading ramp/door aft of main cabin can be opened in flight for discharge of paratroops or cargo, and can be fitted with optional external wheels for door protection during ground manoeuvring. Interior of rear-loading door can be used for additional baggage stowage in civil version. Entire accommodation heated and ventilated; air conditioning optional.

SYSTEMS: Freon cycle or (on special mission versions) engine bleed air air conditioning system optional. Hydraulic system, operating at service pressure of 138 bar (2,000 lb/sq in), provides power via electric pump to actuate mainwheel brakes, flaps, nosewheel steering and rear cargo ramp/door. Hand pump for standby hydraulic power in case of electrical failure or other emergency. Electrical system supplied by two 9 kW starter/generators, three

Ski-equipped CASA 212 Series 400 operated in Polar regions by Skytraders on behalf of Australian government's Antarctic Division (AAD) *(Paul Jackson)* 1158858

batteries and three static converters. Pneumatic boot and engine bleed air de-icing of wing and tail unit leading-edges; electric de-icing of propellers and windscreens. Oxygen system for crew (including cabin attendant); two portable oxygen cylinders for passenger supply. Engine and cabin fire protection systems.

AVIONICS: *Comms:* Rockwell Collins VHF, ATC transponder, intercom and PA system standard; ELT; Rockwell Collins HF, UHF and second transponder, and Fairchild CVR, optional.

Radar: Honeywell weather radar standard, RDR-1500B search radar in ventral radome on Patrullero versions.

Flight: Rockwell Collins VOR/ILS, ADF, DME and radio altimeter, and Honeywell AFCS and directional gyro, standard; second Rockwell Collins ADF, Global Omega nav, Dorne & Margolin marker beacon receiver and Fairchild flight data recorder optional. Flight management system (FMS) incorporates VOR, ADF, DME and GPS nav receiver.

Instrumentation: EFIS with four CRTs; IEDS (integrated engine data system) with two colour LCDs. Blind-flying instrumentation standard.

EQUIPMENT: 1,000 kg (2,205 lb) capacity cargo winch optional.

ARMAMENT (military versions, optional): Two machine gun pods or two rocket launchers, or one launcher and one gun pod, on hardpoints on fuselage sides (capacity 250 kg; 551 lb each).

DIMENSIONS, EXTERNAL:

Wing span	20.27 m (66 ft 6 in)
Wing chord: at root	2.50 m (8 ft 2½ in)
at tip	1.25 m (4 ft 1¾ in)
Wing aspect ratio	10.0
Length overall	16.15 m (52 ft 11¾ in)
Fuselage max width	2.30 m (7 ft 6½ in)
Height overall	6.60 m (21 ft 7¾ in)
Tailplane span	8.40 m (27 ft 6¾ in)
Wheel track	3.10 m (10 ft 2 in)
Wheelbase	5.46 m (17 ft 11 in)
Propeller diameter	2.79 m (9 ft 2 in)
Propeller ground clearance (min)	1.44 m (4 ft 8¾ in)
Distance between propeller centres	5.27 m (17 ft 3¾ in)
Passenger door (port, rear): Height	1.58 m (5 ft 2¼ in)
Width	0.70 m (2 ft 3½ in)
Crew and servicing door (port, fwd):	
Max height	1.10 m (3 ft 7¼ in)
Width	0.58 m (1 ft 10¾ in)
Rear-loading door: Max length	3.66 m (12 ft 0 in)
Max width	1.68 m (5 ft 6¼ in)
Max height	1.80 m (5 ft 10¾ in)
Emergency exit (stbd, fwd): Height	1.10 m (3 ft 7¼ in)
Width	0.58 m (1 ft 10¾ in)
Emergency exit (stbd, rear): Height	0.95 m (3 ft 1½ in)
Width	0.56 m (1 ft 10 in)

DIMENSIONS, INTERNAL:

Cabin (excl flight deck and rear-loading door):	
Length: passenger	7.27 m (23 ft 10¾ in)
cargo/military	6.55 m (21 ft 5¾ in)
Max width	2.10 m (6 ft 10¾ in)
Max height	1.80 m (5 ft 10¾ in)
Floor area: passenger	13.5 m² (145 sq ft)
cargo/military	12.2 m² (131 sq ft)
Volume: passenger	23.8 m³ (840 cu ft)
cargo/military	22.0 m³ (777 cu ft)
Cabin: volume incl flight deck and rear-loading door	30.4 m³ (1,074 cu ft)
Baggage compartment volume	3.6 m³ (127 cu ft)

AREAS:

Wings, gross	41.00 m² (441.3 sq ft)
Ailerons (total, incl tab)	1.875 m² (20.18 sq ft)
Trailing-edge flaps (total)	2.14 m² (23.03 sq ft)
Fin, incl dorsal fin	6.58 m² (70.83 sq ft)
Rudder, incl tab	2.16 m² (23.25 sq ft)
Tailplane	12.57 m² (135.30 sq ft)
Elevators (total, incl tabs)	1.78 m² (19.16 sq ft)

WEIGHTS AND LOADINGS:

Manufacturer's weight empty	3,780 kg (8,333 lb)
Weight empty, equipped (cargo)	4,550 kg (10,031 lb)
Max cargo payload	2,950 kg (6,504 lb)
Max fuel: standard	1,600 kg (3,527 lb)
with underwing auxiliary tanks	2,400 kg (5,291 lb)
Max T-O and landing weight	8,100 kg (17,857 lb)
Max ramp weight	8,150 kg (17,967 lb)
Max zero-fuel weight	7,500 kg (16,535 lb)
Max cabin floor loading	732 kg/m² (150 lb/sq ft)
Max wing loading	197.6 kg/m² (40.46 lb/sq ft)
Max power loading	6.04 kg/kW (9.92 lb/shp)

PERFORMANCE (Series 400M):

Max cruising speed at FL100	195 kt (361 km/h; 224 mph)
Econ cruising speed at FL100	163 kt (302 km/h; 188 mph)
Time to FL100	8 min
Service ceiling	7,925 m (26,000 ft)
Service ceiling, OEI	3,275 m (10,740 ft)
T-O to 15 m (50 ft)	587 m (1,925 ft)
Landing from 15 m (50 ft)	527 m (1,730 ft)
Required runway length for STOL operation	402 m (1,320 ft)
Range:	
with max payload	233 n miles (431 km; 268 miles)
with max standard fuel and 2,000 kg (4,409 lb) payload	800 n miles (1,481 km; 920 miles)
with max standard and auxiliary fuel and reduced payload	1,375 n miles (2,546 km; 1,582 miles)

CASA C-212 PATRULLERO

TYPE: Maritime surveillance twin-turboprop.

DESIGN FEATURES: Special missions versions of C-212 (various Series).

CURRENT VERSIONS: **MP:** Maritime patrol version; belly-mounted 360° search radar and FLIR/TV turret. Other features include operator's console, datalink via Inmarsat, external loudspeakers, searchlight, observation bubble windows, camera, and seating for 10 passengers. Initial C-212-400MP deliveries to Spanish Ministry of Agriculture, Fisheries and Food (one in December 1998 and a second on 29 March 2001) and Suriname Air Force (one in May 1999); third for Spanish MAFF delivered in May 2003.

Pollution control: Equipment as for MP, plus dedicated sensor for detection, measurement and control of harvest plagues, marine resources and pollution. This equipment has been fitted in Swedish Coast Guard and Portugese Air Force C-212s.

CUSTOMERS: See table with main C-212-400 entry. More than 56 Patrulleros of all Series sold by mid-2005. 'Tentative contract' for one by South Korean coast guard reported in February 2006, but not confirmed by December that year.

POWER PLANT: As relevant C-212 Series. Two 500 litre (132 US gallon; 110 Imp gallon) underwing auxiliary fuel tanks.

ACCOMMODATION: Flight crew of two; mission sensor operator and observer in MP. Two observer stations at bubble windows in rear of cabin. Operator console with search radar, FLIR/TV, moving map and communications control. Radar repeater display and searchlight control added to flight deck. Galley, lavatory and rest area equipped with commuter seats or stretchers.

AVIONICS (MP): *Comms:* Single VHF, UHF/VHF and HF radios; intercom; IFF.

Radar: 360° scan underfuselage radar.

Flight: Redundant flight management system with dual GPS nav.

Instrumentation: Four-screen EFIS; IEDS.

Mission: FLIR/TV turret, Inmarsat datalink, electronic cartography and camera in MP. Additional to, or independent of, this equipment, Pollution control version can be fitted with a SLAR, IR/UV scanner or microwave radiometer.

EQUIPMENT: Survival kit and raft launcher in rear ramp; searchlight on fuselage hardpoint.

ARMAMENT: Hardpoint (capacity 500 kg; 1,102 lb) on each side of fuselage, on which can be carried machine gun pods or rocket launchers.

PERFORMANCE:

Endurance with underwing fuel tanks	8 h 30 min

CASA C-295

Spanish Air Force designation: T.21

TYPE: Twin-turboprop transport.

PROGRAMME: Stretched derivative of Airtech CN-235M (which see). Initiated November 1996, after market survey, as unilateral development of CASA/IPTN CN-235. Announced at Paris Air Show, June 1997. Prototype (EC-295 *Ciudad de Getafe*), a converted CN-235, flew for first time 28 November 1997 and had accumulated 801 hours in 379 sorties and 555

First C-295M for Brazilian Air Force, delivered 23 October 2006 1158826

landings by 17 December 1999. First production C-295 (EC-296 *Ciudad de Sevilla*), designated S-1, made its maiden flight on 22 December 1998; had flown 516 hours in 232 sorties and 379 landings by 17 December 1999.

Certified by INTA (for military operations) on 30 November 1999; DGAC certification received 3 December 1999 and FAA (FAR Pt 25) certification on 17 December 1999; first customer aircraft (XT.21-02) demonstrated at Paris in June 2001.

CURRENT VERSIONS: **C-295M:** Military version; *as described*. Ordered by air forces of Algeria, Brazil, Jordan, Poland and Spain.

C-295MSA/MPA Persuader: Maritime patrol and anti-submarine version; equipped with CASA Fully Integrated Tactical System (FITS) mission suite. Ordered by air forces of Algeria and UAE (four each). Portuguese Persuaders described as VIMAR version.

CUSTOMERS: Total 54 ordered; see table. Spanish Air Force (launch customer) contract signed January 2000; deliveries began with handover of first (second production) aircraft, T.21-02 '35-40', to No. 35 Wing at Getafe; six delivered by October 2002 and completed by 2004. Polish Air Force ordered eight to replace An-26s of 13th Transport Squadron; delivery completed 28 July 2005; further four on option. Under a USD10.2 million amendment to the original contract, four of first eight Polish aircraft are fitted with titanium cockpit armour kits, EADS Defence Electronics AAR-60 missile launch detection systems and Indra ALR-300(V)2B radar warning receivers; the other four were wired to receive these systems later. All eight have Raytheon APX-100 IFF transponders. Brazilian 12 are to replace obsolete C-115 Buffalos. Three of Portugal's Persuaders will be equipped with FITS.

Selected by Swiss Air Force in December 2000 (two C-295M: CHF109 million funding approved 27 May 2004 but cancelled by Swiss Parliament on 17 March 2005). Four FITS-equipped C-295MSA/MPA selected 22 March 2001 by UAE (Abu Dhabi) to meet its Shaheen I requirement, but not yet under contract (December 2006). Venezuelan Air Force ordered 10 on 30 March 2005, but sale vetoed by US government in early 2006 on technology transfer grounds and abandoned by CASA October 2006.

C-295 ORDERS AND DELIVERIES
(at October 2006)

Customer	Qty	Version	Announced	First Delivery
Algeria	3	M[1]	03	Nov 05
	4	Persuader	03	?
Brazil	12	M	29 Apr 05	23 Oct 06
Finland	2[2]	M	15 May 06	?
Jordan	2	M	12 Feb 03	Sep 03
Portugal	7	M	17 Feb 06	Aug 07
	5	Persuader	17 Feb 06	?
Poland	10	M	28 Aug 01	15 Aug 03
Spain	9	M	30 Apr 99	15 Nov 01

Notes
[1] Includes two VIP
[2] Option for five more

COSTS: Eight for Poland cost USD212 million (2001); two for Jordan USD45 million (2003).

DESIGN FEATURES: Typical rear-loading, high-wing military transport. Conforms to FAR Pt 25 and MIL-STD-7700C. Compared with CN-235, has fuselage lengthened by six frames (three forward and three aft of wing); wing reinforced for higher operating weights and to support up to six optional underwing stores stations; additional 1,450 litres (383 US gallons; 319 Imp gallons) of fuel in wings; reinforced landing gear with twin nosewheels to facilitate operation from unprepared airstrips; modernised avionics identical to those of CN-235 Srs 300.

STRUCTURE: Provision for three hardpoints under each wing, capacities 800 kg (1,764 lb) inboard, 500 kg (1,102 lb) centre and 300 kg (661 lb) outboard.

LANDING GEAR: Main gear as CN-235 but reinforced for higher operating weights; twin nosewheels. Designed for sink rate of 3.05 m (10 ft)/s at normal MTOW and 2.74 m (9 ft)/s at overload MTOW; and operation from semi-prepared runways down to CBR-2 category.

POWER PLANT: Two Pratt & Whitney Canada PW127G turboprops, each with T-O rating of 1,972 kW (2,645 shp) normal, 2,177 kW (2,920 shp) with APR. Hamilton Sundstrand HS-568F-5 six-blade composites propellers with autofeathering and synchrophasing. Fuel capacity 7,650 litres (2,021 US gallons; 1,683 Imp gallons). Optional in-flight refuelling probe on starboard side of flight deck.

ACCOMMODATION: Crew of two; dual controls standard. Two or three longitudinal rows of foldaway seats in main cabin of C-295M for 71 troops; 48 paratroops (each 130 kg; 287 lb with full equipment); as a 12-stretcher intensive care unit or, in medevac configuration, 27 stretchers and four medical personnel. Lavatory, at front on port side, standard. In cargo role, can accommodate up to five 2.24 × 2.74 m (88 × 108 in) pallets, including one on rear ramp/door; or one 88 × 108 in and three 2.24 × 3.18 m (88 × 125 in) pallets; or three Land Rover-type light vehicles. Paratroop door each side at rear of cabin. Crew door aft of flight deck on starboard side, with emergency exit opposite on port side.

Persuader version accommodates, in addition to flight deck crew, two (MPA) or four (ASW) mission sensor operators, at identical, universal and configurable consoles; two observers at bubble windows in rear of cabin; radar repeater added to flight deck; galley, lavatory, and rest area equipped with commuter seats.

SYSTEMS: Pressure differential 0.38 bar (5.58 lb/sq in), giving cabin atmosphere equivalent to 2,354 m (7,723 ft) at altitude of 7,620 m (25,000 ft).

AVIONICS: All-digital, and compatible with NVGs. Thales (Sextant) Topdeck displays standard. Thales is overall systems integrator.

Comms: Two Thales (Sextant) U/VHF-AM/FM and one HF radio; Honeywell IFF transponder and solid-state FDR; ELT; air data system. Honeywell solid-state CVR. Alternative com/nav/ident functions optional.

Radar: Honeywell RDR-1400C colour weather radar with search and beacon modes and ground mapping vertical navigation capability.

Flight: Four-dimensional FMS; dual ADU 3008 air data units; dual AHRS; dual multimode receivers; dual GPS receivers; dual multifunction control and display units; Honeywell enhanced GPWS. Two central data processor/interface units and standard digital busses (ARINC 429 and MIL-STD-1553B). Options include Thales (Sextant) Totem 3000 laser gyro navigation system, enhanced TCAS, Cat. II ILS, MLS and satcom.

Instrumentation: Four 152 × 203 mm (6 × 8 in) Thales (Sextant) LCDs; one integrated electronic standby instrument; two IFC cabinets with autopilot module; radar altimeter. Video images from E-O sensors such as FLIR or cameras can be displayed on the four LCDs. Full NVG compatibility. Provision for two Thales (Sextant) HUDs.

Mission: CASA FITS suite for Persuader versions includes a central (and optionally redundant) real-time tactical processor; four identical multifunctional consoles, interconnected via a local area network, each with its own RISC processor identical to the tactical processor; a 51 cm (20 in) high-resolution LCD; two touchscreens; and a keyboard and trackball; plus such peripherals as a pilot's presentation screen, recording and data loading units, and an armament and sonobuoy management panel.

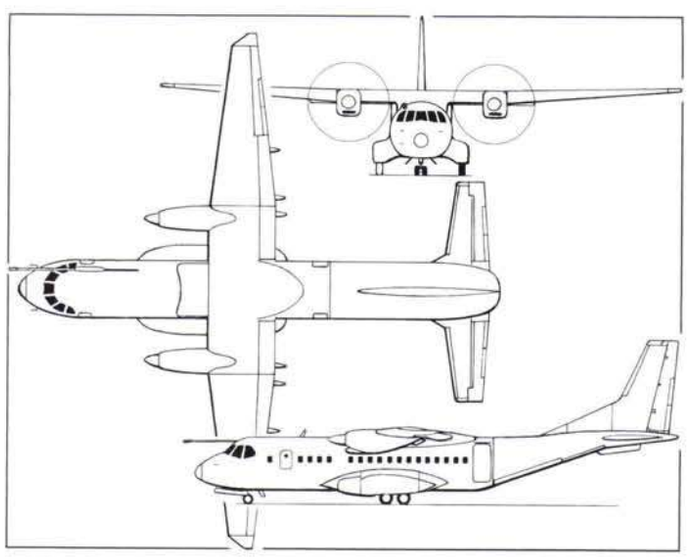
Self-defence: Self-protection suite (chaff/flare dispensers, missile approach and/or laser warning system) optional for Persuader.

EQUIPMENT (Persuader): Sonobuoy or flare and marker launcher, MAD, survival kit and raft launcher in rear ramp; externally mounted searchlight.

ARMAMENT (Persuader): Three hardpoints under each wing (capacities 800, 500 and 300 kg; 1,764, 1,102 and 661 lb) for torpedoes, ASMs or depth charges.

DIMENSIONS, EXTERNAL:

Wing span	25.81 m (84 ft 8¼ in)
Length overall	24.45 m (80 ft 2½ in)
Height overall	8.66 m (28 ft 5 in)
Tailplane span	10.60 m (34 ft 9¼ in)
Wheel track	3.98 m (13 ft 0¾ in)
Wheelbase	8.435 m (27 ft 8 in)
Propeller diameter	3.94 m (12 ft 11 in)
Distance between propeller centres	7.00 m (22 ft 11½ in)



C-295M derivative of the CN-235 *(James Goulding)* 1158768

Paratroop doors (two, each):
Height ..... 1.75 m (5 ft 9 in)
Width ..... 0.90 m (2 ft 11½ in)
Crew door (fwd, stbd): Height ..... 1.27 m (4 ft 2 in)
Width ..... 0.73 m (2 ft 4¾ in)
Emergency exit (fwd, port): Height ..... 0.91 m (3 ft 0 in)
Width ..... 0.50 m (1 ft 7¾ in)
DIMENSIONS, INTERNAL:
Cabin, excl flight deck:
Length: excl ramp/door ..... 12.69 m (41 ft 7½ in)
incl ramp/door ..... 15.73 m (51 ft 7¼ in)
Max width ..... 2.70 m (8 ft 10¼ in)
Width at floor ..... 2.36 m (7 ft 9 in)
Max height ..... 1.90 m (6 ft 2¾ in)
Volume available for cargo ..... 56.86 m³ (2,008 cu ft)
WEIGHTS AND LOADINGS (A: normal, B: overload):
Max payload: A ..... 7,050 kg (15,543 lb)
B ..... 9,250 kg (20,393 lb)
Max T-O weight: A ..... 21,000 kg (46,297 lb)
B ..... 23,200 kg (51,147 lb)
Max landing weight: A ..... 20,700 kg (45,635 lb)
B ..... 23,200 kg (51,147 lb)
Max zero-fuel weight: A ..... 18,500 kg (40,784 lb)
B ..... 20,700 kg (45,634 lb)
Max power loading: A ..... 5.32 kg/kW (8.75 lb/shp)
B ..... 5.89 kg/kW (9.67 lb/shp)
PERFORMANCE (C-295M at normal MTOW except where indicated):
Max cruising speed at optimum altitude ..... 260 kt (482 km/h; 299 mph)
Time to optimum cruising altitude ..... 12 min
Absolute ceiling ..... 9,145 m (30,000 ft)
Service ceiling, OEI ..... 4,125 m (13,540 ft)
T-O run at S/L: A, ISA ..... 844 m (2,770 ft)
A, ISA + 20°C ..... 934 m (3,065 ft)
T-O to 15 m (50 ft) at S/L:
A, ISA ..... 1,025 m (3,365 ft)
A, ISA + 20°C ..... 1,103 m (3,620 ft)
Landing from 15 m (50 ft) ..... 729 m (2,390 ft)
Landing run ..... 420 m (1,380 ft)
Range, ISA, reserves for 45 min hold at 460 m (1,500 ft):
with max payload:
A ..... 840 n miles (1,555 km; 966 miles)
B ..... 690 n miles (1,277 km; 794 miles)
with max fuel:
A with 2,940 kg (6,482 lb) payload ..... 2,477 n miles (4,587 km; 2,850 miles)
B with 8,000 kg (17,637 lb) payload ..... 1,160 n miles (2,148 km; 1,334 miles)
Ferry range ..... 2,700 n miles (5,000 km; 3,107 miles)
g limits: A 2.53
B 2.25

ELA

ELA AVIACIÓN S L

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DIRECTOR: Emilio Lopez, Sr

ELA has been designing and manufacturing autogyros since early 1990s. Current ELA-07 is also the basis of the Autogyro Europe MT-03, produced in Germany.

ELA-07

French marketing name: Raid'Air Adventure
TYPE: Two-seat autogyro ultralight.
CUSTOMERS: Total of some 90 built by early 2006.
COSTS: EUR43,000 (2005).
DESIGN FEATURES: Open, tandem-seat, pod-and-boom configuration with sweptback central fin, plus stabilising fins at tailplane ends; ELA-07S version has rear cockpit faired in and provided with additional windscreen. Large rudder on central fin only. Rotor pre-rotation to 300 rpm by metal tube drive with universal joints. In-flight trim system comprises two-way hydraulic piston at rotor head controlled electrically by switch adjacent to throttle; system doubles as rotor brake.
STRUCTURE: Welded, rectangular, stainless steel tube keel; carbon fibre pod and empennage. Extruded aluminium rotor.
LANDING GEAR: Tricycle type; fixed. Cantilever composites spring mainwheel legs with optional speed fairings and hydraulic disc brakes.
POWER PLANT: Rotax flat-four air-cooled piston engine; option of 73.5 kW (98.6 hp) 912 ULS and 84.5 kW (113.3 hp) turbocharged 914. Fuel capacity 85 litres (22.5 US gallons; 18.7 Imp gallons) in composites (welded aluminium until 2006) tank under rear seat.

ELA-07S tandem-seat autogyro 1158664

EQUIPMENT: Optional GRS ballistic recovery parachute.
WEIGHTS AND LOADINGS (Rotax 914 engine):
Weight empty ..... 244 kg (538 lb)
Max T-O weight: Europe ..... 450 kg (992 lb)
US ..... 500 kg (1,102 lb)
PERFORMANCE (Rotax 914 engine):
Cruising speed at 65% power ..... 78 kt (145 km/h; 90 mph)
Econ cruising speed ..... 62 kt (115 km/h; 71 mph)
Max rate of climb at S/L ..... 480 m (1,575 ft)/min
T-O run ..... 50 m (165 ft)
Range at 65% power ..... 351 n miles (650 km; 403 miles)

VOL MEDITERRANI

VOL MEDITERRANI SL

Promotion of the Esqual two-seat ultralight is now handled by Esqual.com of Belgium.

Sweden

SAAB

SAAB AB

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EXECUTIVE VICE-PRESIDENT AND CFO: Göran Sjöblom
SENIOR VICE-PRESIDENT, COMMUNICATIONS: Jan Nygren
PRESS DIRECTOR: Anders Stålhammar

Svenska Aeroplan AB founded at Trollhättan 1937 to make military aircraft; amalgamated 1939 with Aircraft Division of Svenska Järnvägsverkstäderna rolling stock factory at Linköping; renamed Saab Aktiebolag May 1965; merged with Scania-Vabis 1968 to combine automotive interests; Malmö Flygindustri acquired 1968. Bid for Celsius AB 16 November 1999 and acquisition completed 8 March 2000; enlarged company reorganised in 2000 into six main business areas and several independent operations:

Saab Aerospace: Combining military aircraft, future aerospace systems and commercial programmes. Described in further detail.

Saab Aviation Services: Commercial aircraft maintenance and engine and component maintenance. Comprises Celsius Aviation Services, Saab Aircraft and Saab Aircraft Leasing; holds type certificates for Saab 340 and Saab 2000 regional turboprop airliners, production of which ended in 1999.

Saab Systems and Electronics: Electronic warfare, simulation and training and radar control, including Combitech Systems and Ericsson Saab Avionics.

Saab Bofors Dynamics: Missiles, anti-armour and underwater systems.

Saab Technical Support and Services: Including aircraft maintenance.

Saab Ericsson Space: Digital, microwave and mechanical products.

It was announced on 30 April 1998 that Saab's owner, Investor AB, had approved the sale to British Aerospace plc (now BAE Systems) of a 35 per cent voting shareholding. Investor remained Saab's leading owner, with 36 per cent of the votes and 20 per cent of the capital. Purchase rights to the remaining 29 per cent of votes and 45 per cent of capital continued to be offered to Investor shareholders. Announced 7 December 2004 that from 1 January 2005, BAE share in Saab AB reduced to minimum of 20 per cent; at same time, Saab took lead in export marketing through previously equally shared Gripen International company.

More than 4,000 military and commercial aircraft delivered since 1940; has held dealership for MD Helicopters (formerly Schweizer/Hughes, McDonnell Douglas and Boeing) products in Scandinavia and Finland since 1962. In September 2000, Saab announced entry into design of UAVs, in conjunction with Swedish Defence Materiel Administration and other local industries.

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DEPUTY MANAGING DIRECTOR: Kjell Möller
MARKETING DIRECTOR: Bob Kemp
COMMUNICATIONS DIRECTOR: Owe Wagermark

On 14 July 2003, Saab's Aerospace division was restructured into two business units and a support organisation:

Saab Aerosystems: Operating areas include defence marekt, including Gripen, advanced air combat systems such as UAVs, and subsystems for other aircraft.

Saab Aerostructures: Responsible for fuselage and structural components manufacture for Gripen, Airbus, Boeing, helicopters and other aircraft.

Saab Support: Group services for business units at Linköping, co-ordinated with other sites.

Aerostructures work includes floor assemblies, pylons and landing gear doors for the Airbus A340-500/600 series and components for A320. Saab also partner in A380 and A400M programmes, having signed contract for A400M crew door development and production in November 2004. Builds A380 wing panels (first mid- and outer leading-edge delivered 24 April 2003); crew doors and wingtip panels for Boeing 737; and wing components for Boeing 777. In 2005, secured Boeing 787 Dreamliner contracts for passenger and cargo door design and manufacturing; and development, production and support of control system for slats and flaps. Developing new tactical system for NH90 helicopter under contract placed in early 2002. Saab group sales include 40 per cent exports and are 70 per cent defence-related.

Main activity of Aerosystems is development and production of Gripen multirole fighter.

Original Industrigruppen JAS AB (JAS Industry Group) formed 1981 to represent (then) Saab-Scania (65 per cent share), Ericsson (16 per cent), Volvo Flygmotor (15 per cent) and FFV Aerotech (4 per cent) in JAS 39 Gripen programme; continues to act as contractor for Försvarets Materielverk (Defence Materiel Administration, FMV) and co-ordinated JAS 39 Gripen programme within Sweden. Volvo Flygmotor became Volvo Aero in 1994 and FFV Aerotech share passed to Celsius in 1990 through merger with Bofors. International marketing of JAS 39 Gripen is now responsibility of Saab and BAE Systems, acting jointly since November 1995; current members of JAS Industry Group are subcontractors.

Workshare on export orders would be Saab 55 per cent/BAE 45 per cent under agreement signed 12 June 1995. BAE involvement also includes manufacture of main landing gear, the first of which was delivered from the Brough factory in April 1996 and incorporated in 49th production Gripen. From May 1999, BAE also responsible for assembly of wing attachment unit and associated component join-up for two-seat aircraft (single-seaters to follow).

UK and Swedish export guarantee departments signed an agreement in August 1996 to finance any third-party sales. A contract of 16 November 1995 provides for Danubian Aircraft Company of Hungary to manufacture Gripen components at Tököl as part of a wider Swedish-Hungarian defence information exchange agreement signed 18 December 1995. First Hungarian parts (tailcone fittings) delivered April 1996. Further Swedish-Hungarian agreement of 22 January 1997 provided for comprehensive industrial offsets in the event of a Gripen purchase. First South African parts — Denel-built assembly set for stores pylon — handed over April 2000. Contract awarded to Denel in March 2001 for manufacture of section of centre fuselage for 40 Lot 3 Gripens, plus 28 for SAAF aircraft. Polish part manufacture (metal subassemblies) began July 2000 at PZL (Polish Aircraft Factory).

Gripen International formed 3 September 2001 to strengthen Saab-BAE Systems marketing ventures; is jointly owned and staffed, but registered in Sweden.

SAAB JAS 39 GRIPEN

English name: Griffin

TYPE: Multirole fighter.

PROGRAMME: Funded definition and development began June 1980; initial proposals submitted 3 June 1981; government approved programme 6 May 1982; initial FMV development contract 30 June 1982 for five prototypes and 30 production aircraft, with options for next 110; overall go-ahead confirmed second quarter 1983; first test runs of RM12 engine January 1985; Gripen HUD first flown in Viggen testbed February 1987; study for two-seat JAS 39B authorised July 1989.

First of five single-seat prototypes (39-1) rolled out 26 April 1987; made first flight 9 December 1988 but lost in landing accident after fly-by-wire problem 2 February 1989; only six sorties flown. Subsequent first flights 4 May 1990 (39-2), 20 December 1990 (39-4), 25 March 1991 (39-3) and 23 October 1991 (39-5); the 2,000th Gripen sortie was flown (by 39-4) on 22 December 1995; modified Viggen (37-51) retired at end of 1991 after assisting with avionics trials (nearly 250 flights); two single-seat fatigue test airframes (39-51 discarded 1993; 39-52 began 16,000 hour programme, August 1993 and achieved 8,000 hours in early 1996). Second production batch (Lot 2: 110 aircraft) approved 3 June 1992; first production Gripen (39101) made first flight 10 September 1992 and joined test programme in lieu of 39-1; flight test programme in 1995–96, included high-AoA (at least 28° achieved) and spin trials by 39-2 and trials of an APU (for Lot 2 production) by 39-4. All development work in the original (Lot 1) contract had been completed by late 1996; total programme was over 1,800 hours in 2,300 sorties by six aircraft. By 1996 had demonstrated M1.08 cruise without reheat. Follow-on trials with mockup aerial refuelling probe conducted by 39-4 on eight sorties between 2 and 17 November 1998 from RAF VC10 K. Mk 4. First flight of JAS 39C with refuelling probe extended June 2004. Captive flight of two KEPD 150 Taurus SOMs on inner wing pylons of 39145 of F7 conducted on 27 August 1998. Live Raytheon AIM-120 AMRAAM firings by 39-5 in April 1998.

Hungarian Saab JAS 39 EBS HU Gripen *(Victor Veres)* 1159328

Initial production aircraft for Swedish Air Force (39102) made first flight 4 March 1993 and was handed over to FMV 8 June 1993; flight control software modified following loss of 39102 in crash on 8 August 1993 and installed from December 1994; further software upgrade to new-generation P11 standard (introducing 11 filters to prevent pilot-induced oscillations) first flown 22 March 1995 in trials aircraft and installed in test Gripens from late 1995; in production aircraft (known then as R11) built after early 1996 (and retrofitted from 1997 as R11:9); modified control stick introduced with production aircraft 39108 (first flight 11 April 1995). R12:3 flight control software under trial by late 1999, bringing Gripen up to original design goals; installed during following year as R12:4. Next stage is R14, increasing MTOW by some 1,000 kg (2,205 lb).

PP12 display processor for Lot 2 colour displays first flown August 1995. Thrust-vectoring under consideration for Gripen; first stage is proposed participation in further trials programme of Rockwell/DASA X-31. JAS 39B prototype rolled out 29 September 1995; first flight 29 April 1996.

Initial 30 production JAS 39As delivered 1993–96 (five in 1994; six in 1995, comprising 39108 to 112 and 120; and last of balance— 39129 — on 13 December 1996); by 2002, these all upgraded to Lot 2 standard; deliveries of second lot of 110 began 19 December 1996, and completed in 2003; Swedish Parliament authorised third batch of 64 on 13 December 1996; contract formally placed on 26 June 1997; deliveries between 2003 and 2007. Saab contracted on 24 November 1999 to supply new EWS 39 defensive aids suite, designed by Ericsson Saab Avionics and with substantial CelsiusTech content. In same month, Gripen made first flight with FADEC, as destined for Lot 3 aircraft.

First unit was F7 Wing at Såtenäs; maintenance training begun May 1994 at Linköping; conversion scheduled to begin 1 October 1995 but postponed to 1996, with pilot training centre at Såtenäs officially opened 9 June 1996; Gripen IOC achieved September 1997, following three-week field exercise by 2/F7 Squadron. Last of F7's previous Viggens withdrawn in October 1998. By mid-2002 SwAF Gripens had flown 34,000 sorties and 25,000 hours. SwAF received 100th Gripen on 12 March 2001 and 113 by 31 December that year. Final JAS 39A (and first JAS 39C) delivered 6 September 2002.

Gripen being promoted in several fighter competitions, as described in Customers section. On 18 November 1998, it was announced that the aircraft had been selected for purchase by the South African Air Force and this was confirmed by contract signature on 3 December 1999. In connection with SAAF requirement, Gripen completed initial series of trials with helmet-mounted display (Thales Optronics Guardian) in February 2001. Further testing of Cobra helmet by South African pilot aboard Gripen began December 2005. Trials of refuelling probe with South African Boeing 707 during March and April 2005 in some 400 connections; with Swedish C-130 Hercules tanker in November 2005.

CURRENT VERSIONS: **JAS 39A**: Standard single-seater. Final aircraft delivered 6 September 2002.

Description applies to JAS 39A except where indicated.

JAS 39B: Two-seater with 0.655 m (2 ft 1¾ in) fuselage plug and lengthened cockpit canopy. Primary roles conversion and tactical training, but also combat-capable. Not used for instruction until January 2002, when first students from pilot training began conversion. Avionics essentially as for JAS 39A and both cockpits identical, except no HUD in rear;

Czech Saab JAS 39C Gripen *(Jan Cadil)* 1159329

Swedish Saab JAS 39C Gripen armed with GBU-16 and GBU-10 bombs, laser designation pod and wingtip Rb 74 Sidewinders *(Per Kustvik)* 1159326

1159325

First Saab JAS 39D Gripen for South Africa *(Frans Dely)*

instead. HUD image from front seat can be presented on flight data display in rear cockpit. Boosted environmental control system (ventral air intake replaces twin scoops on fuselage sides); inflatable airbag protects rear occupant during pre-ejection canopy fracturing. Reduced internal fuel; no internal gun.

Prototype entered final assembly 1 September 1994; first flight (39800) 29 April 1996; first production two-seater (39801) completed final assembly on 29 February 1996 and flew on 22 November; production deliveries began with 39802 on 19 May 1998.

Fatigue test specimen (39-71) also built; began a simulated 16,000 hour programme in February 1996.

JAS 39C and D: New features warrant revised designations for JAS 39A and B; improvements include full-colour displays, FADEC, helmet-mounted sight, new (Modular Airborne Computer System) processor for PS-05/A radar, Saab Dynamics IR-OTIS IR search and tracking system, in-flight refuelling probe and enhanced EW systems. IR-OTIS tested on Saab Viggen in 1997.

Originally planned for introduction at start of Lot 3, but final 19 Lot 2 aircraft (plus one testbed, 39207/39-6, first flown 29 April 2002) completed to interim standards with refuelling probes and upgraded computers and designated JAS 39C. First production aircraft (JAS 39C 39208) flown 14 August 2002 and to FMV for service trials 6 September 2002. Initial JAS 39D production aircraft (39815) flew 2 June 2004.

An electronically scanned radar antenna is under development for a potential Gripen MLU in 2010. By 2000, plans in hand to deliver all 14 Lot 3 two-seat Gripens in **JAS 39D C²** configuration with entirely redesigned rear cockpit for command and control duties.

JAS 39 EBS HU: Export basic standard, Hungary. Ordered February 2003 in form of remanufactured JAS 39A/Bs.

Enhanced Gripen: First details mid-2001; service entry then envisaged in 2010; options under investigation included improved EW systems with laser warning, missile approach warning linked to towed decoys and EW function incorporated in electronically scanned radar. Range enhanced by standardisation on two-seat airframe, with fuel in place of rear cockpit, and/or conformal tanks; new engine, possibly EJ200, M88 or F414. Navalised Gripen reportedly under consideration by India in 2002.

In 2006, **Gripen DK** and **Gripen N** disclosed as being in concept stage for Denmark and Norway, respectively, following requests for information (RFI) as alternative to replacement of local F-16 Fighting Falcons by Lockheed Martin F-35 Lightning II (JSF), beginning 2013. Features include increased range; increased payload; and enhanced electronic warfare suite. Conformal tanks rejected for additional fuel, space having been identified within existing airframe, augmented by standard external tanks, to increase range by some 40 per cent. Electronically scanned version of PS-05 radar expected; GE F414 engine possible.

CUSTOMERS: Swedish Air Force requirement was originally 280, to equip 16 squadrons, second eight replacing JA and AJS Viggens; this reduced when third batch authorisation (December 1996) covered only four squadrons, thus amending requirement to 204 (including 28 JAS 39B two-seat versions); however, prototype JAS 39B added to first batch as conversion of aircraft under production, further amending contracts to 175 single-seat and 29 two-seat. By mid-2006, Swedish defence plans calling for total Gripen strength of some 100 JAS 39C/Ds, implying upgrade of some 31 earlier aircraft to C/D standard.

First 30 ordered with prototypes and full-scale development 30 June 1982; next 110 (of which first — 39131 — flew on 20 August 1996) include 14 JAS 39Bs and 20 JAS 39Cs; black radomes on 39109 to 39127; low-visibility markings from 39128, augmented by light grey (previously medium grey) radomes from 39131. Third lot of 64 (also including 14 two-seaters) for delivery between 2003 and 2007 are to JAS 39C/D standard.

Some Lot 3 improvements incorporated early in final 20 Lot 2 aircraft, (which redesignated JAS 39C), comprising refuelling probe and substantially improved computer (unofficially known as 'Mk 3') including D96 (MACS) processor to simplify possible later upgrade to colour displays.

First operational squadron was 2/F7, September 1997, followed by 1/F7 12 months later. F10 at Angelholm followed in 1999–2000, conversion of pilots (by F7) having begun on 11 March 1999, followed by arrival of first two aircraft on 30 September 1999; first squadron (2/F10) operational September 2000, with second following in mid-2001. F10 disbanded by 31 December 2002 and transferred its equipment to F17 at Kallinge, latter being inaugurated as Gripen unit on 14 June 2002. F4 at Froson-Ostersund began conversion of 1/F4 in September 2004, while F21 at Luleå received first two Gripens on 17 January 2002 (although its second squadron not operational until 2005). From 1 January 2004, 2/F17 ('172 Squadron') is Swedish Air Force Rapid Reaction Unit, for worldwide deployment at 30 days' notice, equipped with eight JAS 39As. Second squadron of F17 receiving JAS 39Cs, beginning 15 September 2004, these to SAFRRU role in 2006. However, F4 disbanded 17 June 2005 when only half-equipped. Current defence structure is six Gripen squadrons: 1/F17, 2/F17, 1/F21 and 2/F21 with JAS 39C/Ds, plus 1/F7 and 2/F7 as JAS 39A/B-equipped training unit.

Exports of some 250 anticipated over 20 years from 1996; by then, Saab and BAE engaged in 12 export campaigns; presentations made to Austria, Brazil, Czech Republic, Chile and Poland in 1996–97. Promotion in Philippines, Slovenia and South Africa, 1997. Details of competitions summarised below.

Australian Air 6000 requirement received Gripen response on 1 February 2002, but Lockheed Martin F-35 Lightning II selected June 2002.

Austrian RFP received October 2001 for up to 30 new fighters; Gripen proposal delivered 22 January 2002, based on either 24 single- and four two-seat aircraft for early delivery; or 12 leased aircraft as lead-in to later delivery of 24 plus six new-build Gripens. Revised proposals, delivered to Austria on 30 April 2002, envisaged accelerated delivery between mid-2005 and mid-2007, but Eurofighter Typhoon eventually selected by parliament on 2 July 2002, although almost immediately suspended, then reinstated.

Brazilian RFP received August 2001 for potential 24 aircraft. Revised proposals delivered to Brazil on 3 May 2002. Programme suspended 2003.

Czech Republic RFP issued 27 December 2000; invitation to tender for new fighter issued 9 January 2001; Saab response delivered 31 May 2001 for 24 or 36 aircraft with 150 per cent offsets. Plan officially confirmed on 10 December 2001 for 24 Gripens valued at Kcs50 billion, including spares and training; first squadron to be operational in 2005 and second and final in 2008. Formal approval given 22 April 2002, contract signing due before end of year, but programme was abandoned in November 2002 and replaced by quest for 12 to 14 aircraft, with Gripen still among contenders. Gripen lease recommendation made by evaluation committe on 17 December 2003, and on 14 June 2004, Czech government agreed lease of 14 Gripens (12 JAS 39Cs and two JAS 39Ds) between 2005 and 2015. Initial flight of Czech Gripen (actually fourth JAS 39C of contract, 39237) conducted on 18 October 2004; deliveries scheduled from 1 May 2005 and began with six aircraft to Caslav on 18 April, although formal acceptance delayed to 22 April; second six followed on 17/18 August 2005. First two-seater (9819) flew 21 April 2005 and both JAS 39Ds delivered 31 August 2005 to complete Czech contract. Gripen on QRA alert from 1 July 2005 onwards. Contract valued at CZK 19.65 billion. Aircraft have refuelling probes, OBOGS, colour cockpit displays with English language, NATO communications and weapons capability. Modified to carry AIM-9M-8/9 Sidewinder.

Hungary received Gripen proposal on 30 November 2000, this amended on 9 February 2001 with lease proposal; selected Gripen for air defence role on 10 September 2001, initially with lease of 14 aircraft (including two tandem-seat) for 10 years at cost of Ft130 billion to Ft140 billion. MoU signed 23 November 2001 and agreement finalised 20 December 2001 requiring initial deliveries in fourth quarter of 2004 and last in June 2005. However, negotiations reopened on 3 September 2002, following election of new Hungarian government. Parliamentary authorisation granted 10 March 2003, formalising agreement signed with Swedish Defence Material Administration on 3 February 2003 for lease/purchase of 12 single-seat ('30' to '41') and two tandem-seat ('42' and '43') aircraft with increased (multirole) capabilities, but at penalty of 2006 start to deliveries. Aircraft are remanufactured Swedish JAS 39A/Bs, designated JAS 39 EBS HU; lease is 10 years (2006-2016), following which aircraft become property of Hungarian government. Modifications from Swedish standard include NATO standard communications, retractable refuelling probe, strengthened wings for LGB carriage and instrument calibration in Imperial units. Initial AAM is AIM-9L, with AIM-120 to follow. Assembly of first aicraft began 1 October 2004; formal rollout 25 January 2005; first flight ('30' c/n 39301) 16 February 2005. First two-seat flew 27 October 2005. Operating unit, 1st TFS, 59th TFW, based at Kecskemét where deliveries due between March 2006 and 2007, for 2008 IOC and 2010 declaration to NATO. First five aircraft delivered to Kecskemét on 21 March 2006; formal acceptance on 30 March.

Polish negotiations begun September 2001 in search for 60 new fighters. Final assembly of required 44 to 60 Polish Gripens would have been by PZL Aircraft Factory, under 1997 agreement, as covered by June 1999 proposal; however, revised offer of January 2001 restricted to five-year lease of 16 aircraft, including two trainers. Poland ordered Lockheed Martin F-16s in December 2002.

South Africa selected Gripen on 18 November 1998 for planned purchase of 28; order placed 15 September 1999 for nine two-seat Gripens, with option on further 19 of single-seat version; formal signature 3 December 1999, but first deliveries postponed at that time from 2002 to mid-2006. However, only one two-seat Gripen (c/n 39-2801) due in that year for trials (having entered final assembly on 11 January 2005), followed by remaining eight between November 2007 and September 2009. Initial JAS 39D (39-2801) rolled out 28 October 2005 and first flew 11 November 2005; shipped to South Africa mid-2006. Single-seat Gripens due between November 2009 and late 2011. Base will be Makhado.

Thailand showed interest in late 2004 in 20 ex-Swedish aircraft.

United Kingdom Empire Test Pilots' School at Boscombe Down detached students to Sweden from 1999 onwards to fly two-seat Gripen in company with Swedish safety pilot. In 2005, agreement extended for three years and requirement for local pilot was abandoned. In 2006, JAS 39B 39802 decorated with blue fin and ETPS badge.

COSTS: Planned cost of SEK25.7 billion in 1982, increased to SEK48.5 billion in 1991 by inflation; FMV has reported total cost increase of SEK9.3 billion for period 1982–2001; total budget SEK60.2 billion decided by Swedish Parliament 1993. SEK22.7 billion spent by 1 July 1993, including SEK14.5 billion to IG JAS. Up to SEK300 million approved late 1991 for JAS 39B development. Costs for 300-aircraft programme (subsequently reduced to 204) estimated in 1994 as SEK15 billion for development and SEK48 billion for production. South African purchase of 28 estimated programme cost R10.9 billion (US$1.9 billion) (1998).

DESIGN FEATURES: Intended to replace AJ/SH/SF/JA/AJS versions of Saab Viggen, in that order, and remaining J 35 Drakens; to operate from 800 m (2,625 ft) Swedish V90 road strips; simplified maintenance and quick turnround with ground crew comprising one technician and five conscripts.

By 2000, Gripen demonstrating 12 mmh/fh; 7.6 hours MTBF readiness rate; and 10 minute turnround in fighter configuration, 20 minutes in attack role. Targets are 10 mmh/fh and 9.0 hours MTBF.

Saab JAS 39D Gripens over Castle Läckö, Sweden *(Victor Veres)* 1159327

Mid-mounted delta wing, with squared tips for missile rails, has three-section leading-edge, of which inboard and outboard sections sweptback at 55° and centre at 52°; foreplanes, independently movable, have leading-edge sweep of approximately 58°. Sweptback fin carries various antennas. Moderately high cockpit. Near-rectangular engine air intakes, each with splitter plate.

FLYING CONTROLS: BAE Systems (Lot 1) or Lockheed Martin SA11 (Lot 2) triplex fly-by-wire system with Moog electrically signalled servo valves on powered control units; Saab Combitech aircraft motion sensors and throttle actuator; mini-stick and HOTAS controls.

Leading-edge with dog-tooth and automatic flaps (one inboard/one outboard of dog-tooth, inner one outboard of canard) on Lucas Aerospace 'geared hinge' rotary actuators; two elevon surfaces at each trailing-edge; individual all-moving foreplanes, which also 'snowplough' for aerodynamic braking after landing; airbrake each side of rear fuselage.

STRUCTURE: Airframe is 60 per cent aluminium by weight, 6 per cent titanium and 5 per cent other metals; most of remainder is carbon fibre. First 3½ carbon fibre wing sets produced by BAE; all subsequent carbon fibre parts made by Saab, including wing boxes, foreplanes, fin and all major doors and hatches. BAE produces landing gear and, from 1999, responsible for assembly of centre fuselage for two-seat version, with single-seat to follow. Denel of South Africa contracted in 2000 to design and produce stores pylons for export Gripens. PZL-Mielec of Poland began delivering tailcones in late 2000. By 2002, late production JAS 39As had received additional 200 kg (441 lb) of strengthening to landing gear and wings for MTOW increase to 14,000 kg (30,864 lb) and service life increase from 3,000 to 4,000 hours.

LANDING GEAR: AP Precision Hydraulics retractable tricycle gear, single mainwheels retracting hydraulically forward into fuselage; steerable twin-wheel nose unit retracts rearward. Goodyear wheels. Carbon disc brakes and ABS anti-skid units. Nosewheel braking. Entire gear designed for high rate of sink. Mainwheel tyres 25.5×8.0–14 (16 ply); nosewheel 14×5.5–6 (8 ply).

POWER PLANT: One General Electric/Volvo Flygmotor RM12 (F404-GE-400) turbofan, rated initially at approximately 54 kN (12,140 lb st) dry and 80.5 kN (18,100 lb st) with afterburning. RM12UP version, in Lot 3 aircraft, incorporates FADEC, improved flame holder and redesigned turbine. Fuel in integral tanks in fuselage and wings. Intertechnique fuel management system; Dowty fuel health monitoring system for emergency (leak/battle damage) conservancy management. Optional FRL telescopic, retractable, hydraulically actuated in-flight refuelling probe mounted in port engine air intake; available on export aircraft and fitted to Swedish single-seat aircraft from 39207 (106th) onwards. External fuel carriage option of 1,136 litre (300 US gallon; 250 Imp gallon) EDTL (export drop tank, large).

ACCOMMODATION: Pilot only in JAS 39A/C, on Martin-Baker Mk 10L zero/zero ejection seat. Hinged canopy (opening sideways to port) and one-piece windscreen by Lucas Aerospace. Two seats in tandem in JAS 39B/D; command sequence in two-seat aircraft ejects rear occupant first, simultaneously inflating an airbag between the two cockpits to protect the rear pilot from Perspex splinters.

SYSTEMS: Hymatic environmental control system for cockpit air conditioning, pressurisation and avionics cooling. Hughes-Treitler heat exchanger. Two hydraulic systems, with Dowty equipment and Abex pumps. Hamilton Sundstrand main electrical power generating system (40 kVA constant speed, constant frequency at 400 Hz) comprises an integrated drive generator, generator control unit and current transformer assembly. Lucas Aerospace auxiliary and emergency power system, comprising gearbox-mounted turbine, hydraulic pump and 10 kVA AC generator, to provide auxiliary electric and hydraulic power in event of engine or main generator failure. In emergency role, the turbine is driven by engine bleed or APU air; if this is not available, the stored energy mode, using thermal batteries, is selected automatically. APU and air turbine starter for engine starting, cooling air and standby electrical power. Original APU was Microturbo TGA15-090; changed to TGA15-328 from 40th JAS 39A and retrofitted to all in early second batch; Hamilton Sundstrand APU from 106th production single-seat aircraft (39207) and will be retrofitted. Optional OBOGS on export aircraft. Lot 3 Gripens have single Ericsson Saab Avionics GECU general electronic control unit, replacing previous three controllers for air, fuel and hydraulic systems.

AVIONICS: Service entry with E11 avionics software; upgraded via E12, E12.5 and E14 to E15 in 2001 and E15.1 (full AMRAAM and additional air-to-ground modes) in 2002.

Comms: CelsiusTech dual VHF/UHF transceivers and IFF in early aircraft; Rohde & Schwarz Series 6000 in third production lot and last 20 Lot 2 aircraft; option for installation in entire fleet; Series 6000 is element of tactical radio system (TARAS), providing secure communications via Data Link 39. Export aircraft to have Avitronics (Grintek) GUS 1000 audio management system.

Radar: Ericsson/BAE PS-05/A multimode pulse Doppler target search and acquisition (lookdown/shootdown) radar (weight 156 kg; 344 lb). For fighter missions, system provides fast target acquisition at long range; search and multitarget track-while-scan; quick scanning and lock-on at short ranges; and automatic fire control for missiles and cannon. In attack and reconnaissance roles, operating functions are search against sea and ground targets; mapping, with normal and high resolution; and navigation. Upgrade with electronically scanned antenna is intended in 2010.

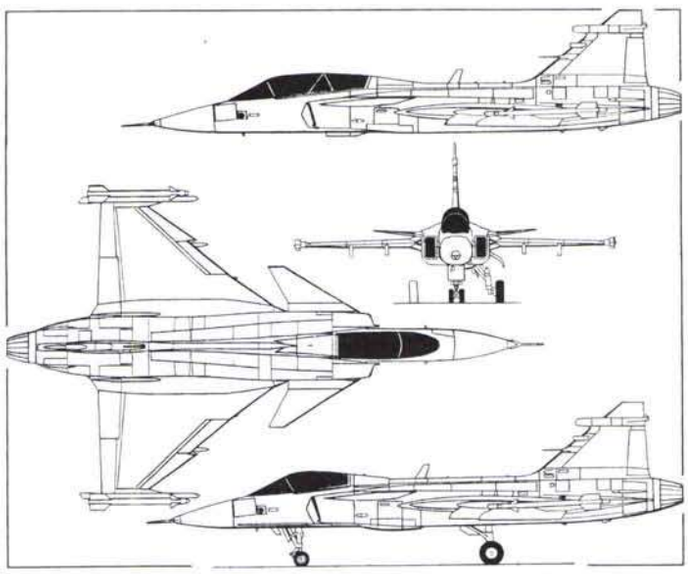
Flight: Ericsson SDS 80 central computing system (D80 computer, Pascal/D80 high-order language and programming support environment; upgraded D80E computer flown mid-1994 and introduced from 39108; D96 computer from 92nd single-seat aircraft, 39193); three MIL-STD-1553B databusses, one of which links flight data, navigation, flight control, engine control and main systems; Honeywell laser INS and radar altimeter; Nordmicro air data computer. BAE three-axis strapdown gyromagnetic unit provides standby attitude and heading information. Navigation data fusion in prospect via NINS (new integrated navigation system), under development by 1998; this to be followed by NILS (new integrated landing system) for autonomous Cat. I landing capability.

Instrumentation: Ericsson EP-17 electronic display system, incorporating Kaiser (Hughes in Lot 1) wide-angle HUD and using advanced diffraction optics to combine symbology and video images; display processor (replacing PP1 and PP2 in Lot 1) makes colour imagery possible; this facility is not required on Swedish Lot 2 aircraft), but colour capability introduced from 106th single-seat, 39207 (which will be regarded as sixth 'prototype' 39-6); three Ericsson CRT HDDs, each 120 × 150 mm (4¾ × 6 in), but 152 × 203 mm (6 × 8 in) MFID 68 active matrix LCDs in Lot 3. Left-hand (flight data) HDD normally replaces all conventional flight instruments; central display shows computer-generated map of area surrounding aircraft with tactical information superimposed; right-hand CRT is a multisensor display showing information on targets acquired by radar, FLIR and weapon sensors. Minimum of conventional analogue instruments for back-up only. Thales Guardian helmet-mounted display (HMD) undertook compatibility trials at Linköping in early 2001. BAE Systems and Cumulus of South Africa developing HMD for delivery with SAAF Gripens in 2007.

Mission: Rafael/Zeiss Optronik Litening targeting and navigation pod (Swedish designation PWS 39) under development in 2000 for carriage under starboard air intake trunk, forward of wing leading-edge, providing heat picture of target on right-hand HDD; first test flight, February 2003; trials complete by late 2004. IR-OTIS (a combined TRST and FLIR) under development by Saab Avionics for installation ahead of windscreen, slightly offset to port. CelsiusTech datalink shares information with up to four aircraft simultaneously. Contract for SEK600 million awarded to Saab in December 2001, for nine 680 kg (1,500 lb) Modular Airborne Reconnaissance System 39 (SPK 39) pods to be

SwAF JAS 39 CONTRACTS

Batch	Qty	Type	Serials	Remarks
Prototypes (5)	5	JAS 39	39-1 to 39-5	Plus 39-6 (below)
Lot 1 (30)	29	JAS 39A	39101 to 39129	39130 completed as JAS 39B
	1	JAS 39B	39800	
Lot 2 (110)	76	JAS 39A	39131 to 39206	
	14	JAS 39B	39801 to 39814	
	1	JAS 39C	39207/39-6	Testbed
	19	JAS 39C	39208 to 39226	Interim standard
Lot 3 (64)	50	JAS 39C	39227 to 39276	Including export diversions, of which 39224 to '245 to Czech Republic as 9234 to 9245
	14	JAS 39D	39815 to 39828	Including export diversions, of which 39819 and '820 to Czech Republic as 9819 and 9820
Total	**209**			



JAS 39A Gripen multirole combat aircraft for the Swedish Air Force, with additional side view (top) of two-seat JAS 39B *(Dennis Punnett)* 1159406

delivered from 2004 onwards and become operational in 2005 with F17 (four pods), F7 (two) and F21 (two). Programme delayed, and first flight not achieved (beneath JAS 39B 39800) until 24 March 2005; service postponed until 2006.

Vinten Vicon 70 Srs 72C modular reconnaissance pod available for export aircraft.

Self-defence: CelsiusTech RWR in early aircraft replaced by second-generation (Gen 2) version in 2000. CelsiusTech countermeasures, including chaff/flare and jamming. Saab EWS 39 electronic warfare suite ordered 1999 to replace existing system in Swedish aircraft, and is similar to export equipment; includes BOL 500 (BO2D) towed radar decoy under port wing, two pylon-mounted BOP 402 (BOP B) dispensers, laser warning system and missile approach warning.

ARMAMENT: Internally mounted 27 mm Mauser BK27 automatic cannon in port side of lower front fuselage (shoulder station 4P) and two wingtip-mounted Rb74 (AIM-9L) Sidewinder IR AAMs (stations 1P and 1S) standard. (No internal gun in JAS 39B.) Six other external hardpoints (2P, 2S, 3P and 3S beneath wings, one on centreline and 4S below starboard air intake trunk). Maximum loads 110 kg (243 lb) each on 1P and 1S; 600 kg (1,323 lb) each on 2P and 2S; 1,300 kg (2,866 lb) each on 3P and 3S; 250 kg (551 lb) on 4S; and 1,100 kg (2,425 lb) on 5 (centreline). Weapons include short- and medium-range air-to-air missiles such as Rb74, MICA or Rb99 (AIM-120) AMRAAM; air-to-surface missiles such as Rb75 (Maverick); anti-shipping missiles such as Saab RBS 15F; DWS 39 (BK 90) munitions dispenser; KEPD 150 and KEPD 350 SOMs; conventional or retarded bombs; air-to-surface rockets; or external fuel tanks.

Swedish MoD contract of October 2001 covers integration of LGBs, of which GBU-10,-12 and -16 (and associated Mk 82, 83 and 84 bombs) cleared by mid-2004. AGM-65G Maverick trials began with inert carriage on 8 September 2004; AGM-65H and K to follow, along with AIM-9L/M and AIM-120B/C5. IRIS-T and Meteor AAM being integrated for Swedish AF. Meteor test firing first conducted 9 May 2006, following initial carriage of instrumented missile (by 39101) on 13 December 2005. New weapons under consideration for integration include Brimstone, MUPSOW standoff weapon and V-3E A-Darter AAM for South Africa. Agreement of June 2001 adds Rafael weapons to potential armoury, initially Python 4 AAM and Spice guided bomb. Saab Aerosystems commissioned in November 2003 to integrate Meteor AAM.

DIMENSIONS, EXTERNAL:

Wing span, incl missile rails	8.40 m (27 ft 6¾ in)
Length, excl pitot tube: JAS 39A	14.10 m (46 ft 3 in)
JAS 39B	14.755 m (48 ft 5 in)
Height overall	4.50 m (14 ft 9 in)
Wheel track	2.40 m (7 ft 10½ in)
Wheelbase: JAS 39A	5.20 m (17 ft 0¾ in)
JAS 39B	5.90 m (19 ft 4¼ in)

WEIGHTS AND LOADINGS:

Operating weight empty: JAS 39A	6,622 kg (14,600 lb)
JAS 39C	approx 6,820 kg (15,036 lb)
JAS 39B	8,000 kg (17,637 lb)
Internal fuel weight	2,268 kg (5,000 lb)
T-O weight, clean	approx 8,500 kg (18,740 lb)
Max T-O weight with external stores:	
R12 software	12,500 kg (27,557 lb)
R14 software	14,000 kg (30,864 lb)

PERFORMANCE:

Min flying speed	less than 100 kt (185 km/h; 115 mph)
Max level speed	supersonic at all altitudes
T-O and landing strip length	approx 800 m (2,625 ft)
Combat radius	approx 432 n miles (800 km; 497 miles)
g limit	+9

Switzerland

INTRACOM

INTRACOM AERO DESIGN GMBH

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Intracom, formed in 1994, is an international company with diverse interests in aircraft deisgn, engineering, transport, travel, ecology and development of new technologies. It joined with the Khrunichev company of Russia to offer the GM-17 light transport in Western markets but, in November 2001, it formed a new alliance with Technoavia, and its associated SmAZ production plant. The GM-17 had its public debut at MAKS '03, Moscow, in August 2003.

It is planned to produce a diverse family of closely related aircraft, including DS-2 turboprop trainer/light attack aircraft and DS-12 light utility turboprop, which will mark a break away from collaboration with Russia and is expected to be a wholly Western European/Swiss venture.

AEROTECH (INTRACOM) SMG-92T TURBO FINIST

TYPE: Light utility turboprop.

PROGRAMME: Developed from Smolensk (Technoavia) SM-92 Finist by Aerotech of Bratislava, Slovakia, with emphasis on sport parachutist dropping; commissioned and financed by G-92 Commerce Ltd, of Nagybanyai 61, H-1025 Budapest, Hungary (e-mail: budata@euroweb.hu). Work began in early 2000, with first flight (newly built aircraft, HA-YDF) 7 November 2000; Hungarian type certificate awarded 14 December 2000; delivery to Wingglider Ltd in UK, January 2001. Second conversion, HA-YDG, produced from RA-44485, exhibited at Aero '01, Friedrichshafen, April 2001, and stationed with Skydive Center, Bad Saulgau, Germany, from June 2001. In parallel, M601-powered Finists have been produced by Smolensk plant in Russia, designated SM-92T. Total of four completed by end February 2003 (excluding conversion of prototype); programme then transferred to Intracom for further marketing, beginning 2004. Three produced under Intracom by early 2006, including one to operator in Poland and one, in May 2006, to Russian police.

Airframe and engine mounting produced by SmAZ at Smolensk; engine installation and cowling, paradrop step and handrails in vicinity of cabin door, new electrical system, instrument panel and engine controls by Aerotech.

POWER PLANT: One 400 kW (536 shp) Walter M 601D-2 turboshaft, driving an Avia V-508D-2 three-blade, fully feathering, reversible-pitch propeller. Optional ferry tank. Offered by Intracom with alternative Rolls-Royce 250 or P&WC PT-6 turboprop.

Aerotech (Intracom) SMG-92T Turbo Finist 1159005

ACCOMMODATION: Pilot and 10 parachutists; alternatively, pilot and up to seven passengers on lightweight seats.

Data generally as for Smolensk SM-92 Finist, except that below.

DIMENSIONS, EXTERNAL:

Length overall	9.925 m (32 ft 6¾ in)
Wheelbase	6.59 m (21 ft 7½ in)

WEIGHTS AND LOADINGS:

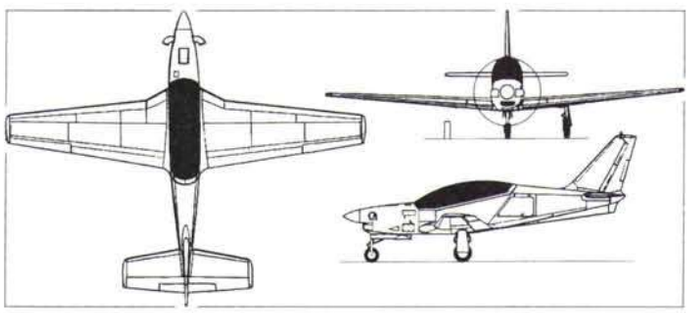
Weight empty	1,450 kg (3,197 lb)
Max T-O weight: paradrop	2,700 kg (5,952 lb)
passenger	2,350 kg (5,180 lb)
Max landing weight	2,350 kg (5,180 lb)

PERFORMANCE:

Never-exceed speed (VNE)	164 kt (305 km/h; 189 mph)
Max operating speed (VMO)	143 kt (265 km/h; 165 mph)
Max level speed at 915 m (3,000 ft)	159 kt (295 km/h; 183 mph)
Cruising speed	130 kt (240 km/h; 149 mph)
Stalling speed, engine off:	
flaps up	63 kt (115 km/h; 72 mph)
flaps down	54 kt (100 km/h; 63 mph)
Max rate of climb at S/L	457 m (1,500 ft)/min
Time to 4,000 m (13,120 ft)	11 min
Descent from 4,000 m (13,120 ft)	5 min 30 s
Max operating altitude	5,940 m (19,500 ft)
T-O run	250 m (820 ft)
T-O to 15 m (50 ft)	457 m (1,500 ft)
Landing run	280 m (920 ft)
Landing run with propeller reversal	145 m (475 ft)
Max range with optional fuel	324 n miles (600 km; 372 miles)

INTRACOM DS-2

PROGRAMME: Design of a two-seat turboprop trainer is in preliminary stage at Intracom's office. Overall details are evident in the general arrangement drawing.



Intracom DS-2 (894 kW; 1,200 shp turboprop) 1128985

INTRACOM DS-12

TYPE: Light utility turboprop.

PROGRAMME: Initially designated DS-112 when announced in 2004; design then revised, including sweptback fin, replacing unswept unit, and changes to dimensions. Construction of prototype was due to have begun in 2006.

DESIGN FEATURES: High-mounted, constant-chord wing with rounded tips; mid-mounted tailplane; sweptback fin with ventral fillet. Employs some systems of GM-17 Viper to achieve reduced cost.

Wing section P-301M-15%; dihedral 2°; incidence 3°; twist –2°. Tailplane section NACA 23010 reversed.

FLYING CONTROLS: Conventional and manual. Flaps. Trim tab in port elevator, rudder and starboard aileron. Control surface movements: ailerons +25/–10°; elevators +20/–26°; rudder ±25°; flaps 20 and 40°.

STRUCTURE: Generally of metal.

LANDING GEAR: Tailwheel type; fixed.

POWER PLANT: One 560 kW (757 shp) Walter M601F (or M601E) turboprop. Normal internal fuel capacity 820 litres (217 US gallons; 180 Imp gallons); provision for additional 400 litres (106 US gallons; 88.0 Imp gallons) ferry fuel in nose baggage hold..

ACCOMMODATION: Eleven persons, including pilot(s), to FAR Pt 23; alternatively 15 persons. Cockpit door each side; passenger/freight door both sides.

DIMENSIONS, EXTERNAL:

Wing span	16.85 m (55 ft 3½ in)
Wing chord (constant)	1.40 m (4 ft 7 in)
Wing aspect ratio	11.9
Length overall	13.40 m (43 ft 11½ in)
Height overall	3.58 m (11 ft 9 in)
Tailplane span	5.53 m (18 ft 1¾ in)
Wheel track	4.55 m (14 ft 11¼ in)
Wheelbase	7.65 m (25 ft 1¼ in)
Propeller diameter	2.50 m (8 ft 2½ in)
Propeller ground clearance	0.80 m (2 ft 7½ in)
Passenger doors (combined): Height	1.20 m (3 ft 11¼ in)
Width	1.55 m (5 ft 1 in)
Cockpit doors (each): Height	1.20 m (3 ft 11¼ in)
Width	1.05 m (3 ft 5¼ in)

DIMENSIONS, INTERNAL:

Accommodation:	
Length: between bulkheads	8.58 m (28 ft 1¾ in)
cockpit	1.68 m (5 ft 6¼ in)
passenger cabin	3.68 m (12 ft 1 in)
Max width	1.39 m (4 ft 6¾ in)
Max height	1.65 m (5 ft 5 in)

AREAS:

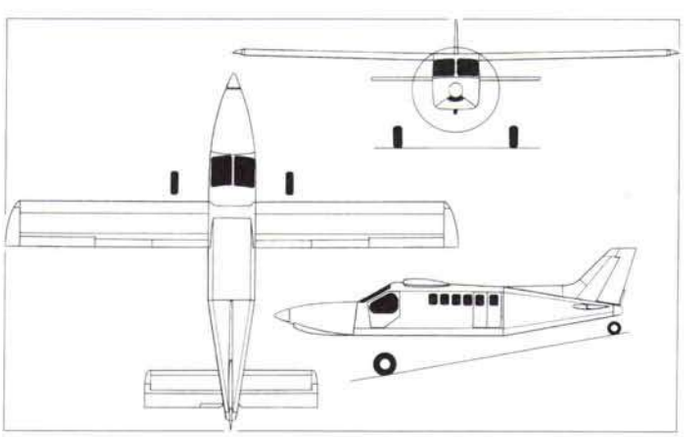
Wings, gross	23.80 m² (256.2 sq ft)
Ailerons (total)	3.05 m² (32.83 sq ft)
Flaps (total)	4.20 m² (45.21 sq ft)
Fin	3.96 m² (42.63 sq ft)
Rudder	1.76 m² (18.94 sq ft)
Tailplane	6.64 m² (71.47 sq ft)
Elevators (total, incl tabs)	3.00 m² (32.29 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	1,730 kg (3,814 lb)
Max payload	1,500 kg (3,307 lb)
Max normal fuel weight	656 kg (1,446 lb)
Max T-O weight	3,500 kg (7,716 lb)
Max wing loading	147.1 kg/m² (30.12 lb/sq ft)
Max power loading	6.20 kg/kW (10.19 lb/shp)

PERFORMANCE (estimated):

Max level speed	165 kt (305 km/h; 190 mph)
Cruising speed	154 kt (285 km/h; 177 mph)
Econ cruising speed: low level	103 kt (190 km/h; 118 mph)
high level	119 kt (220 km/h; 137 mph)
Stalling speed: flaps up	60 kt (110 km/h; 69 mph)
flaps down	52 kt (95 km/h; 59 mph)
Max rate of climb at S/L	570 m (1,870 ft)/min
Time to FL131	11 min
Descent from FL131	5 min
Max certified altitude	6,000 m (19,680 ft)
T-O run	270 m (885 ft)
T-O to 15 m (50 ft)	460 m (1,510 m)
Landing run with propeller reversal	175 m (575 ft)
Range, 40 min reserves:	
max normal fuel and 430 kg (948 lb) payload:	
low altitude: max cruise	405 n miles (750 km; 466 miles)
econ cruise	459 n miles (850 km; 528 miles)
FL197: max cruise	618 n miles (1,145 km; 711 miles)
econ cruise	718 n miles (1,330 km; 826 miles)
ferry at FL197: normal fuel	853 n miles (1,580 km; 981 miles)
ferry fuel	1,166 n miles (2,160 km; 1,342 miles)
Endurance, normal fuel	8 h



Representative diagram of DS-12 utility turboprop, proportions not conforming to most recent specification *(Paul Jackson)* 1128984

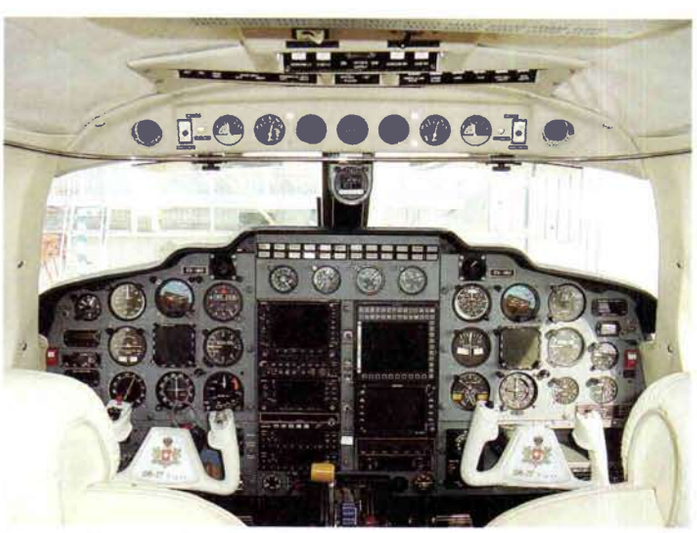
INTRACOM GM-17 VIPER

TYPE: Light utility turboprop.

PROGRAMME: Designed within Khrunichev bureau in Moscow by Evgeny P Grunin. Considerably modified Piper PA-31P Pressurised Navajo (PA-31T version also suitable for conversion.

Intracom had previously proposed a collaborative project with Piper, to be known as PA-31TXL, but this was rejected by the US company.

First flight (GM-17-000, registered RA-01559; the former N38RG) 6 December 2000; 10 sorties and 6 hours flown by February 2001, when laid-up for static testing. Further two prototypes were to have followed in 2001, using Navajos G-OIEA and SE-IGB as basis; programme delayed by change of partner company to Technoavia (chief designer



Cockpit of Intracom GM-17 Viper No.5 1159026

Intracom GM-17 Viper registered in Kyrgyzstan 1159025

Vyatcheslav Kondratiev) in November 2001 and renaming of aircraft from Feniks (Phoenix) to Viper. Khrunichev prototype transferred to SmAZ at Smolensk for disassembly and rebuild; changes included replacement of winglets by tip tanks and revised nose contours; reflown January 2003 as GM-17-000; flew 60 hours before relegation to static testing in April 2003. Three PA-31P airframes (GM-17-001, 002 and 003) delivered to SmAZ in November 2001 and entered modification; GM-17-001/RA-44471 flown March 2003 and accumulated 62 hours in first three months, Russian demonstrator and exhibition at Moscow in August 2003; GM-17-002 (RA-3042K) and GM-17-003 (RA-3043K) scheduled for August 2003 first flight and initial customer delivery in October 2003. GM-17-003 as European demonstrator, fitted with enlarged wingtip pods containing radar (starboard) and landing light. GM-17-004 (EX-051) delivered March 2004; GM-17-005 (EX-053) new demonstrator; GM-17-006 (EX-052) early 2006 delivery.

Intended conversion of further 24 aircraft between 2006 and 2009, when new version of GM-17 will be available. All 30 initial aircraft to have Experimental category certification. However, in early 2004 Technoavia withdrew from the project because of a financial dispute. New design authority appointed, in form of Aerotech of Bratislava, Slovakia, this replaced in 2006 by DASH of Switzerland.

COSTS: USD680,000 to USD860,000 (2006).

DESIGN FEATURES: Single-engined turboprop for passenger and light freight transport; suitable for executive ferry, medical evacuation, patrol, geological survey and training.

Low-mounted, tapered wing with wingtip tanks or winglets; mid-positioned, tapered tailplane and sweptback fin.

Wing section NACA $63_3$415 at root; $63_1$212 at tip; leading-edge sweepback 5°; thickness/chord ratio 14 per cent at root, 12 per cent at tip; dihedral 5°; incidence 1° 30'; twist −2° 30'. Tailplane incidence 2°; wingroot nib sweepback 28°.

FLYING CONTROLS: Conventional and manual. Trim tab in starboard aileron, rudder and both elevators. Flap settings 20° for take off; 40° for landing. Aileron deflections +24°/−14°; rudder ±35°; elevators +16°/−20°.

STRUCTURE: All retained airframe and landing gear components overhauled before reassembly. Revised structure includes fireproof steel bulkhead (Frame 3) behind engines; new engine cowlings forward of Frame 4; replacement wing panels in former engine positions; tailplane root fillets; new window frames; ventral fin; revised tailplane incidence (+2°, replacing −2°); composites fintip; replaced fuel tanks and lines, oil system, electrical system (retaining some PA-31 parts), fire warning system and hydraulic system, de-icing system and oxygen system (reduced capacity).

LANDING GEAR: Tricycle type; hydraulically actuated; mainwheels retract inward; nosewheel rearward; single wheel on each unit. Nosewheel steerable +28°; free castoring angle ±80°. Goodyear mainwheels and 6.50–10 (8 ply) tyres; Cleveland nosewheel with 6.00-6 (8 ply) tyres. Hydraulic brakes.

POWER PLANT: One 560 kW (751 shp) Walter M 601E turboprop, driving a five-blade V510 constant-speed, fully reversing propeller. (GM-17-000 and 001 have M 601D engine and VS08E/99 three blade propellers). Total fuel capacity 1,025 litres (271 US gallons; 225 Imp gallons) in wing tanks. Optional wingtip tanks of Piper design 125 litres (33.0 US gallons; 27.5 Imp gallons) each. Max fuel 1,275 litres (337 US gallons; 280 Imp gallons).

ACCOMMODATION: Two pilots and six passengers; forward four passengers in club arrangement; lavatory and baggage area at rear. Externally accessed baggage compartment in nose. Single door, port, rear. Emergency exit, starboard. Cabin protected by up to 25 mm (1 in) of soundproofing material. Accommodation pressurised and air-conditioned. Emergency oxygen masks.

SYSTEMS: Hydraulic system, pressure 150 bar (2,175 lb/sq in); 27 V electrical system; emergency oxygen. De-icing system on all leading-edges; pneumatic on initial aircraft, but alcohol or electrical system for future installation.

AVIONICS: *Comms:* Garmin GMA 430 intercom, GNS 430 and GNS 530 VHF/NAV, each with GI 106 indicator, SG 2000 HF transceiver. Twin Garmin GTX 327 transponders. C406-1 ELT.

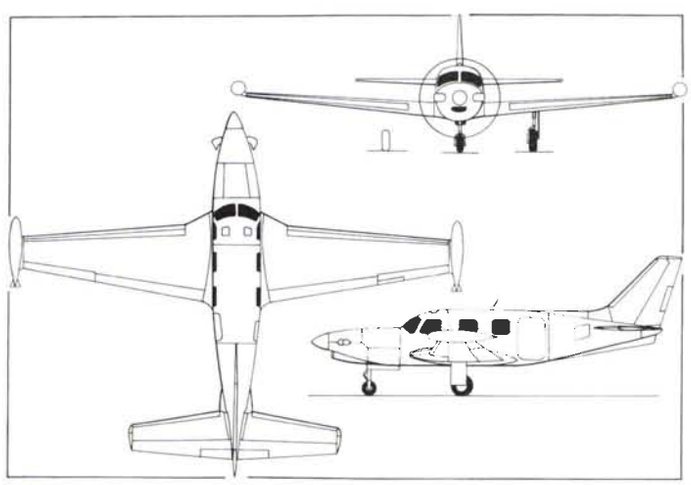
Radar: Optional Bendix/King RDR 2000 weather radar in pod on starboard wing.

Flight: Bendix/King KR 87 radio compass, KI 227 ADF indicator, MT Ultra moving map and S-Tec 55 autopilot.

EQUIPMENT: Four landing lights as standard; further optional light in wingtip tanks, if fitted.

DIMENSIONS, EXTERNAL:

Wing span over optional tanks	13.04 m (42 ft 9½ in)
Wing chord: at root	2.28 m (7 ft 5¾ in)
at tip	0.985 m (3 ft 2¾ in)
Wing aspect ratio	5.4
Length: overall	10.56 m (34 ft 7¾ in)
fuselage	9.64 m (31 ft 7½ in)
Fuselage: Max width	1.44 m (4 ft 8¾ in)
Max height	1.625 m (5 ft 4 in)



Intracom GM-17 Viper *(Paul Jackson)* 1128983

Cabin details of GM-17 Viper No.5 1159027

For details of the latest updates to *Jane's All the World's Aircraft* online and to discover the additional information available exclusively to online subscribers please visit
jawa.janes.com

Height overall ..... 4.075 m (13 ft 4½ in)
Tailplane span ..... 6.045 m (19 ft 10 in)
Tailplane chord ..... 1.155 m (3 ft 9½ in)
Wheel track ..... 4.19 m (13 ft 9 in)
Wheelbase ..... 2.63 m (8 ft 7½ in)
Propeller diameter ..... 2.50 m (8 ft 2½ in)
Propeller ground clearance ..... 0.30 m (11¾ in)
Passenger door: Height ..... 1.32 m (4 ft 4 in)
Width ..... 0.78 m (2 ft 6¾ in)
Emergency exit: Height ..... 0.55 m (1 ft 9¾ in)
Width ..... 0.41 m (1 ft 4¼ in)
Nose baggage door: Height ..... 1.20 m (4 ft 8¾ in)
Width ..... 0.70 m (2 ft 3½ in)

DIMENSIONS, INTERNAL:

Cabin (incl flight deck and baggage):
Length ..... 4.40 m (14 ft 5¼ in)
Max width ..... 1.32 m (4 ft 4 in)
Max height ..... 1.32 m (4 ft 4 in)
Baggage hold volume: cabin ..... 0.62 m³ (22 cu ft)
nose ..... 0.42 m³ (15 cu ft)

AREAS:

Wings, gross ..... 31.30 m² (336.9 sq ft)
Ailerons (total) ..... 1.235 m² (13.29 sq ft)
Trailing-edge flaps (total) ..... 3.135 m² (33.74 sq ft)
Winglets (total) ..... 2.86 m² (30.78 sq ft)
Fin ..... 2.60 m² (27.99 sq ft)
Rudder (incl tab) ..... 0.865 m² (9.31 sq ft)
Tailplane ..... 6.72 m² (72.33 sq ft)
Elevators (total) ..... 2.45 m² (26.37 sq ft)

WEIGHTS AND LOADINGS:

Weight empty ..... 1,756 kg (3,871 lb)
Max T-O and landing weight ..... 3,300 kg (7,275 lb)
Max payload ..... 1,000 kg (2,205 lb)
Max wing loading ..... 105.4 kg/m² (21.59 lb/sq ft)
Max power loading ..... 5.85 kg/kW (9.61 lb/shp)

PERFORMANCE:

Max level speed ..... 232 kt (430 km/h; 267 mph)
Normal cruising speed ..... 221 kt (410 km/h; 254 mph)
Econ cruising speed ..... 140 kt (260 km/h; 162 mph) IAS
Stalling speed, flaps down ..... 67 kt (123 km/h; 77 mph)
Max rate of climb at S/L ..... 426 m (1,398 ft)/min
Service ceiling ..... 7,165 m (23,500 ft)
T-O run ..... 460 m (1,510 ft)
Landing run with propeller reversal ..... 340 m (750 ft)
Range with tip tanks, 40 min reserves:
high speed, low altitude ..... 674 n miles (1,250 km; 776 miles)
at FL195, 205 kt ..... 1,295 n miles (2,400 km; 1,491 miles)
ferry ..... 1,598 n miles (2,960 km; 2,409 miles)
Endurance, absolute ..... 7 h 50 min

INTRACOM GM-19

TYPE: Light utility turboprop.

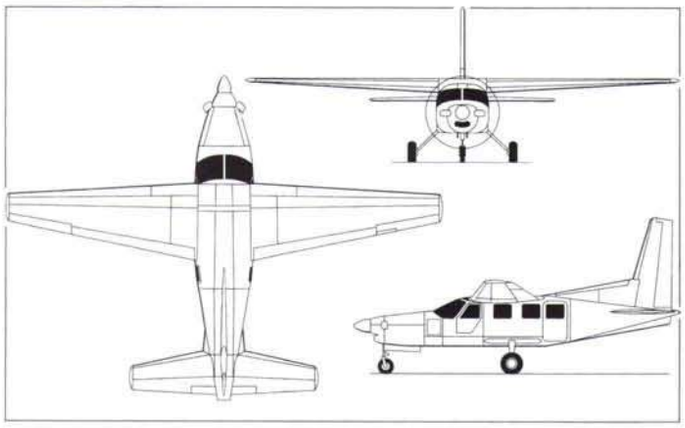
PROGRAMME: Construction of prototype was to begin in 2004.

DESIGN FEATURES: Wings and empennage of Piper PA-31 married to new fuselage, but incorporating systems already employed in GM-17 Viper for simplicity, low risk and minimum cost. High-mounted, tapered wing; mid-mounted, tapered tailplane; and fin with large fillet.

FLYING CONTROLS: Conventional and manual. Trim tabs in elevator, starboard aileron and rudder.

STRUCTURE: Generally of metal.

POWER PLANT: One 560 kW (757 shp) Walter M 601E turboprop. Fuel capacity 1,220 litres (322 US gallons; 268 Imp gallons).



Provisional general arrangement of Intracom GM-19 *(Paul Jackson)*

ACCOMMODATION: Crew door each side; main door to port, with emergency exit opposite.

SYSTEMS: Generally as for GM-17 Viper.

AVIONICS: Generally as for GM-17 Viper.

DIMENSIONS, EXTERNAL:

Wing span ..... 13.92 m (45 ft 8 in)
Wing aspect ratio 7.8
Length overall ..... 10.46 m (34 ft 3½ in)
Height overall ..... 4.84 m (15 ft 10½ in)
Tailplane span ..... 6.045 m (19 ft 10 in)
Wheel track ..... 3.40 m (11 ft 1½ in)
Wheelbase ..... 3.94 m (12 ft 11 in)
Propeller diameter ..... 2.30 m (7 ft 6½ in)
Main door: Height ..... 1.65 m (5 ft 5 in)
Width ..... 1.20 m (3 ft 11¼ in)

DIMENSIONS, INTERNAL:

Cabin (incl cockpit): Length ..... 5.20 m (17 ft 0¾ in)
Max width ..... 1.30 m (4 ft 3¼ in)
Max height ..... 1.65 m (5 ft 5 in)

AREAS:

Wings, gross ..... 24.8 m² (266.9 sq ft)

WEIGHTS AND LOADINGS:

Weight empty ..... 1,400 kg (3,086 lb)
Max payload ..... 1,400 kg (3,086 lb)
Max fuel weight ..... 976 kg (2,151 lb)
Max T-O weight ..... 3,500 kg (7,716 lb)
Max wing loading ..... 141.1 kg/m² (28.91 lb/sq ft)
Max power loading ..... 6.20 kg/kW (10.19 lb/shp)

PERFORMANCE:

Max cruising speed ..... 194 kt (360 km/h; 224 mph)
Stalling speed, power off:
flaps up ..... 67 kt (123 km/h; 77 mph)
flaps down ..... 59 kt (109 km/h; 68 mph)
Max rate of climb at S/L ..... 570 m (1,870 ft)/min
T-O run ..... 330 m (1,085 ft)
Landing run with propeller reversal ..... 230 m (755 ft)
Range:
with max fuel ..... 1,436 n miles (2,660 km; 1,652 miles)
with max payload ..... 944 n miles (1,750 km; 1,087 miles)
Endurance ..... 8 h

LIGHTWING

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TECHNICAL DIRECTOR: Alois Amstutz
DESIGNER: Hans Gygax

Having designed what is now marketed as the Ikarus C 42, Hans Gygax produced a slightly larger, utility version. This is marketed by Light Wing Aircraft AG, which was formed in September 2000 to seek launch funding for large-scale production in several applications, particularly glider towing. Manufacture is proceeding at low rate at Buochs aerodrome.

LIGHTWING AC4

TYPE: Two-seat lightplane.

PROGRAMME: Prototype first flew June 1998. Second prototype (of three) shown, substantially complete, at Aero '03, Friedrichshafen, April 2003. First production aircraft (c/n 04, registered 17-JH) awarded French certification 16 February 2005.

CURRENT VERSIONS: **AC4**: Baseline version; *as described*. Capabilities include touring and medical evacuation.

AC4 Schlepp: Glider tug; 93.2 kW (125 hp) turbocharged Rotax 914. Rate of climb, laden, 300 m (984 ft)/min.

AC4 SPC: US Sport Plane Class (LSA); otherwise as baseline AC4.

AC8: Light transport ("air van"); under development by 2003.

DESIGN FEATURES: Meets Swiss 'EcoLight' category requirements for 560 kg (1,234 lb) MTOW; certifiable to JAR requirements. High wing with V-strut bracing; tailplane braced to fin.

Lightwing AC4 prototype 1158832

FLYING CONTROLS: Conventional and manual. Flaps. Flight-adjustable trim tab on port elevator.

STRUCTURE: Glass fibre fuselage built around full-length, large diameter, circular section metal boom. Metal tailplane, elevators, fin and rudder, with composites tips; metal wing, flaps and ailerons, with composites, upturned wingtips.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring cantilever mainwheel legs with wheel fairings; steerable nosewheel with wheel fairing.

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS flat-four driving a Warp Drive three-blade, carbon fibre, fixed-pitch propeller via 1:2.4 reduction gearing; 84.5 kW (113.3 hp) Rotax 914 F optional. Optional Neuform ground-adjustable propeller on first production aircraft. Fuel capacity 100 litres (26.4 US gallons; 22.0 Imp gallons).

ACCOMMODATION: Two persons, side-by-side; large stowage space behind seats. Broad, upward-hinged door each side.

EQUIPMENT: Optional retractable towing line in rear fuselage.

DIMENSIONS, EXTERNAL:

Wing span ..... 9.60 m (31 ft 6 in)
Wing aspect ratio 7.3

Large door of Lightwing AC4 allows carriage of stretcher for medical evacuation 1158833

Length overall ..... 6.95 m (22 ft 9½ in)
Height overall ..... 2.30 m (7 ft 6½ in)
DIMENSIONS, INTERNAL:
Cabin: Length ..... 1.90 m (6 ft 2¾ in)
Max width ..... 1.27 m (4 ft 2 in)
AREAS:
Wings, gross ..... 12.70 m² (136.7 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 300 kg (661 lb)
Max T-O weight ..... 560 kg (1,234 lb)
Max wing loading ..... 44.1 kg/m² (9.03 lb/sq ft)
Max power loading ..... 7.62 kg/kW (12.52 lb/hp)
PERFORMANCE:
Never-exceed speed (VNE) ..... 113 kt (210 km/h; 130 mph)
Cruising speed at 75% power ..... 100 kt (185 km/h; 115 mph)
Stalling speed, power off, flaps down ..... 34 kt (63 km/h; 40 mph)
Max rate of climb at S/L ..... 439 m (1,440 ft)/min
T-O run ..... 92 m (300 ft)
Landing run ..... 98 m (320 ft)
Range with max fuel ..... 675 n miles (1,250 km; 776 miles)
g limts ..... +4/−2

MSW

MSW AVIATION

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PRESIDENT: Max Vogelsang

MSW Aviation was formed in 1991. Its latest product is the Votec 351, a single-seat version of the Votec 322 kitbuilt aerobatic two-seater. Construction assistance offered to builders at new 250 m² (2,691 sq ft) facility opened in October 2004 at Birrfeld airfield, near company headquarters. Similar facility available at Schwäbisch Hall in southern Germany.

MSW VOTEC 322

TYPE: Tandem-seat sportplane kitbuilt.
PROGRAMME: Designed by Max Vogelsang; name indicates Vogelsang Technik, 320 hp, 2 seats. Inspired by, and derived from, DR 107 One Design single-seater, one of which acquired by MSW and flown as HB-YJM. Prototype Votec 322 (HB-YJY) made first flight 6 April 2001 and public debut at Friedrichshafen Air Show later that month. Certified by Swiss FOCA.
CUSTOMERS: Sixth aircraft made initial flight on 26 May 2006. Customers in Austria, Germany and Switzerland.
COSTS: Kit EUR155,000 basic, excluding engine, propeller and instruments (2003).
DESIGN FEATURES: Low-wing monoplane with symmetrical aerofoil section and angular flying surfaces. Available only as a kit, but MSW provides factory-based builder's assistance programme.
FLYING CONTROLS: Conventional and manual. Near full-span ailerons; horn-balanced rudder and elevators; in-flight-adjustable trim tab in each elevator.
STRUCTURE: Welded 4130 steel tube fuselage main frame; plywood-covered wooden wings; carbon fibre wing skin, fuselage skin and tail unit.
LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted spring cantilever mainwheel legs with wheel fairings; ; steerable tailwheel. Mainwheel speed fairings.
POWER PLANT: One 246 kW (330 hp) Textron Lycoming AEIO-540 flat-six engine, driving an MT-Propeller MTV-14 four-blade constant-speed propeller. Fuel in integral 43 litre (11.4 US gallon; 9.5 Imp gallon) tank in each wingroot, plus 110 litre (29.1 US gallon; 24.2 Imp gallon) fuselage tank; total capacity thus 196 litres (51.9 US gallons; 43.2 Imp gallons).
ACCOMMODATION: Two persons in tandem under one-piece canopy which opens sideways to starboard.
AVIONICS: Described as 'glass cockpit' standard.
DIMENSIONS, EXTERNAL:
Wing span ..... 7.30 m (23 ft 11½ in)
Length overall ..... 6.50 m (21 ft 4 in)
Height overall ..... 2.50 m (8 ft 2½ in)
Propeller diameter ..... 1.95 m (6 ft 4¾ in)
AREAS:
Wing area ..... 10.50 m² (113.0 sq ft)
Ailerons (total) ..... 1.50 m² (16.15 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 630 kg (1,389 lb)
Max T-O weight ..... 950 kg (2,094 lb)
Max wing loading ..... 90.5 kg/m² (18.53 lb/sq ft)
Max power loading ..... 3.86 kg/kW (6.34 lb/hp)
PERFORMANCE:
Never-exceed speed (VNE) ..... 220 kt (407 km/h; 253 mph)
Max cruising speed ..... 174 kt (322 km/h; 200 mph)
Stalling speed ..... 55 kt (102 km/h; 64 mph)
Max rate of climb at S/L ..... 1,036 m (3,400 ft)/min
Max rate of roll ..... 420°/s
T-O run ..... 112 m (370 ft)
Landing run ..... 350 m (1,150 ft)
Range ..... 750 n miles (1,389 km; 863 miles)
Endurance ..... 3 h
g limits ..... ±10

MSW VOTEC 351

TYPE: Single-seat sportplane kitbuilt.
PROGRAMME: Introduced 2006; maiden flight of prototype (HB-YMV) 23 September 2006.
DESIGN FEATURES: Single-seat derivative of Votec 322; rudder area reduced to 1.50 m² (16.15 sq ft).
POWER PLANT: One 261 kW (350 hp) Textron Lycoming AEIO-580; propeller as for Votec 322. Fuselage fuel tank as Votec 322, wing tanks reduced to 40 litres (10.6 US gallons; 8.8 Imp gallons) each, hence total capacity 180 litres (47.6 US gallons; 39.6 Imp gallons).
DIMENSIONS, EXTERNAL:
As Votec 322
WEIGHTS AND LOADINGS:
Weight empty ..... 580 kg (1,279 lb)
Max T-O weight ..... 830 kg (1,829 lb)
Max wing loading ..... 79.05 kg/m² (16.19 lb/sq ft)
Max power loading ..... 3.18 kg/kW (5.23 lb/hp)

MSW Votec 322 built by Rolf Stalder made its first flight at Birrfeld, Switzerland, on 26 May 2006 *(Rolf Stalder)* 1158827

PERFORMANCE:
Never-exceed speed (VNE) ..... 234 kt (434 km/h; 270 mph)
Max cruising speed ..... 174 kt (322 km/h; 200 mph)
Stalling speed ..... 57 kt (105 km/h; 65 mph)
Max rate of climb at S/L ..... 1,067 m (3,500 ft)/min
Max rate of roll ..... 420°/s
T-O run ..... 110 m (360 ft)
Landing run ..... 350 m (1,150 ft)
g limits ..... ±12

PICCARD

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In 2003, Bertrand Piccard initiated the Solar Impulse project, the main objective of which is to make a round-the-world flight in five-day stages in an aircraft powered entirely by solar energy. An associate in the project is Brian Jones, Piccard's co-pilot in the 1999 round-the-world flight of the *Breitling Orbiter 3* balloon.

PICCARD SOLAR IMPULSE

TYPE: Technology demonstrator.
PROGRAMME: Announced 28 November 2003. Original timetable was for first prototype to be designed and built 2004-05; first flight planned for early 2006; milestone of 36-hour flight, including complete night in the air, targeted for 2007. Second prototype to fly at end of that year; ultra-long-distance and duration flights planned from then on, leading to round-the-world attempt in 2009. Swiss Federal Institute for Technology (EPFL) will supply an engineer/pilot and act as scientific partner, following a feasibility study which began in March 2003. However, revised schedule announced in 2005 indicated first flight now targeted for 2008 and trans-global flight for 2011.

Presentation to international media at Paris Air Show on 13 June 2005 included one-twentieth scale display model and news that 25 per cent of estimated EUR40 million had been allocated by then. Financial and technological partners were named as Solvay SA of Belgium (R&D resources), Altran Technologies SA of France (engineering) and Dassault Aviation (aeronautical design adviser). Swiss watchmaking company Omega became a principal partner in May 2006, taking total financing past the 50 per cent mark. In same year, BKW FMB Energie and Sputnik Engineering (SolarMax) were named as service suppliers. In addition, the European Space Agency is providing expertise from within the framework of its technology transfer programme.

Global flight will start by charging batteries from solar power, to provide power for take-off before dawn the following morning from a high-sun location (UAE or New Mexico have been suggested as possibles). Aircraft would reach maximum altitude shortly after noon, then descend slowly to lower altitude as solar radiation decreases during the afternoon and reverting to battery power for continued flight during the night. Travel will be between latitudes 10 and 30° in the northern hemisphere for maximum air time over land.

In addition to achieving the flight itself, the venture aims to exploit and develop solar energy technology to make it possible for an aircraft to sustain very long-term flight without the use of any kind of embarked fossil fuel and without emitting any pollutants. It defines sustainable development as "the ability of present generations to provide for their own needs without jeopardising the ability of future generations to provide for theirs".

In mid-2006, Altran was modelling a simulated long-distance flight between Dubai and China as part of the development programme.

DESIGN FEATURES: Aircraft has the general configuration of a high aspect ratio, T-tailed sailplane, with the entire wing and tailplane upper surfaces covered in solar cells.

Following data all provisional:

POWER PLANT: Twin 14.9 kW (20 hp) battery-powered electric motors, each driving a two-blade propeller. Batteries housed in four underwing pods.
ACCOMMODATION: Two-person, underslung pod, pressurised to 0.50 bar (7.3 lb/sq in).
DIMENSIONS, EXTERNAL:
Wing span ..... 80 m (262.5 ft)
AREAS:
Solar cell area ..... 250 m² (2,691 sq ft)
WEIGHTS AND LOADINGS:
Lithium ion batteries (total) ..... 400 kg (882 lb)
Max T-O weight ..... 2,000 kg (4,409 lb)
PERFORMANCE:
Cruising speed: at high altitude (day) ..... 54 kt (100 km/h; 62 mph)
at low altitude (night) ..... 27 kt (50 km/h; 31 mph)
Stalling speed ..... 19 kt (36 km/h; 22 mph) IAS
Cruising height range: upper ..... 12,200 m (40,000 ft)
lower ..... 3,050 m (10,000 ft)

PILATUS

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PRESIDENT AND CEO: Thomas Hunziker

In December 1998, as part of a move to dispose of its aerospace activities, Oerlikon-Bührle (now renamed OC Oerlikon) revealed that it was seeking a buyer for Pilatus. New owners were named on 1 March 2001 as a consortium comprising Jörg Burkart, IHAG Holding, Hoffman-LaRoche, 3i and OC Oerlikon.

Current products include PC-6 Turbo Porter, PC-7 Mk II, PC-9M Turbo Trainer, PC-12 and PC-21. Headquarters and main plant at Stans, Switzerland. Wholly owned subsidiaries include Pilatus Business Aircraft Ltd in USA, Pilatus Australia Pty Ltd, in Australia and TSA Transairco and Altenrhein Aviation in Switzerland. There are also offices in UK, Malaysia and Abu Dhabi.

Deliveries in 2005 totalled 89 (of which 82 were PC-12s), for a turnover of CHF466 million, 57.5 per cent in US and 26 per cent in Europe.

PILATUS PC-6 TURBO PORTER

US Army designations: UV-20A Chiricahua and AU-23A Peacemaker
Royal Thai Air Force designation: B.JH 2

TYPE: Light utility transport.
PROGRAMME: First flight piston-engined prototype 4 May 1959 (see contemporary Jane's); PC-6/A, A1, A2, B, B1, B2 and C2-H2 with various turboprops (see 1974–75 *Jane's All the World's Aircraft*): superseded by PC-6/B2-H4, introduced mid-1985. Remains in production, but manufacture temporarily paused in 2000; c/n 939 departed to US in October 2000.

Manufacture reinstated; c/n 940 first flew 12 May 2003 and exported to France for CERP de Maubeuge as F-GRUB.

Full description of PC-6/B2-H4 in 2001–02 All the World's Aircraft and in current Jane's Aircraft Upgrades; following is shortened version.

CURRENT VERSIONS: **PC-6/B2-H4:** Gross weight for FAR Pt 23 passenger carrying increased by 600 kg (1,323 lb) over immediately previous B2-H2, giving up to 570 kg (1,257 lb) greater payload for CAR 3 operations; changes include turned-up wingtips, enlarged dorsal fin, uprated mainwheel shock-absorbers, new tailwheel assembly and slight airframe reinforcement; H4 changes can be retrofitted to B2-H2.
CUSTOMERS: Total of 534 built by late-2006, including 45 of piston-engined versions and 92 of early turboprop versions under licence manufacture by Fairchild in USA; some 290 remain in service in more than 50 countries. Six built 2003-04 and delivered to CERP de Maubeuge, France; Jereb Airservice, Germany; Gardenia, Italy; Yajasi Aviation, Indonesia (two); and CDP du Centre, Orleans, France. Two more in 2005 and at least five in 2006. See tables.

Pilatus PC-6/B2H4 Turbo Porter 1158822

PILATUS PC-6 ANNUAL PRODUCTION

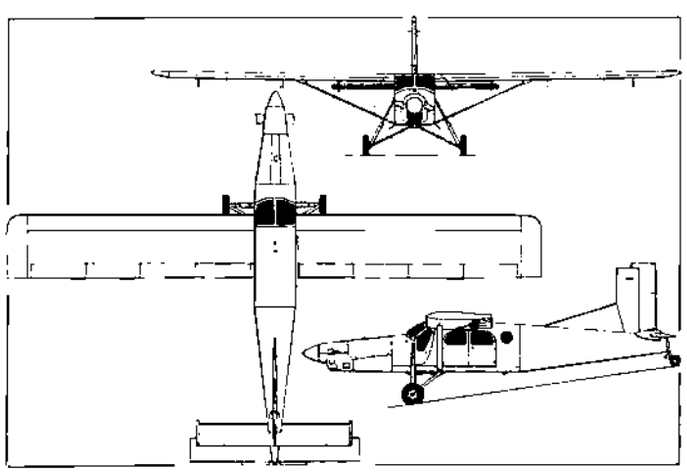
Year	Qty	Swiss Prod Cum	US Prod	Cum total
1959	4	4		4
1960	5	9		9
1961	22	31		31
1962	14	45		45
1963	14	59		59
1964	13	72		72
1965	23	95		95
1966	23	118	4	122
1967	35	153	22	179
1968	26	179	6	211
1969	27	206	8	246
1970	3	209	nil	249
1971	7	216	9	265
1972	5	221	15	285
1973	nil	221	5	290
1974	9	230	22	321
1975	15	245	1	337
1976	22	267		359
1977	17	284		376
1978	8	292		384
1979	5	297		389
1980	3	300		392
1981	5	305		397
1982	4	309		401
1983	9	318		410
1984	14	332		424
1985	2	334		426
1986	10	344		436
1987	5	349		441
1988	1	350		442
1989	7	357		449
1990	7	364		456
1991	4	368		460
1992	12	380		472
1993	12	392		484
1994	12	404		496
1995	1	405		497
1996	2	407		499
1997	3	410		502
1998	9	419		511
1999	6	425		517
2000	5	430		522
2003	1	431		523
2004	5	436		528
2005	6	442		534
Totals		**442**	**92**	**534**

DESIGN FEATURES: Rugged, light transport with STOL performance and easily accessible, versatile cabin. Braced, constant-chord, high wing with single strut each side; unswept fin with large dorsal fillet.

Wing section NACA 64-514 (constant) with span-increasing wingtips; dihedral 1°; incidence 2°.

LANDING GEAR: Non-retractable tailwheel type. Oleo shock-absorbers in all units. Steerable (±25°)/lockable tailwheel. Main tyres size 11.00–12 (8 ply), pressure 1.38 bar (20 lb/sq in), or 7.50–10 (8 ply). Tailwheel with size 5.00-4 (6 ply) tyre, pressure 3.24 bar (47 lb/sq in). Goodyear hydraulic disc brakes. Pilatus wheel/ski gear and (since July 1994) plain or amphibious floats optional.

POWER PLANT: One 507 kW (680 shp) Pratt & Whitney Canada PT6A-27 turboprop (flat rated at 410 kW; 550 shp at S/L), driving a Hartzell HC-B3TN-3D/T-10178 C or CH, or T10173 C or CH, three-blade constant-speed fully feathering reversible-pitch propeller with Beta mode control; four-blade propeller optional for operations in noise-sensitive areas. Standard fuel in integral wing tanks, usable capacity 644 litres (170 US gallons; 142 Imp gallons). Two underwing auxiliary tanks, each of 242.3 litres (64.0 US gallons; 53.3 Imp gallons), available optionally. For self-ferry, up to three 189 litre (50.0 US gallon; 41 6 Imp gallon) fuel tanks can be carried in main cabin



Pilatus PC-6/B2-H4 Turbo Porter with optional port-side double door
(Dennis Punnett) 1158777

ACCOMMODATION: Cabin has pilot's seat forward on port side, with one passenger seat alongside, and is normally fitted with six quickly removable seats, in pairs, to rear of these for additional passengers. Up to 11 persons, including pilot, can be carried in 2-3-3-3 high-density layout; or up to 10 parachutists; or two stretchers plus three attendants in ambulance configuration. Floor is level, flush with door sill, with seat rails. Forward-opening door beside each front seat. Large rearward-sliding door on each side of main cabin; fixed, external mounting step, starboard side. Optional double door, without central pillar, on port side. Hatch in floor 0.58 × 0.90 m (1 ft 10¾ in × 2 ft 11½ in), openable from inside cabin, for aerial camera or supply dropping. Starboard side door in rear fuselage permits stowage of six passenger seats or accommodation of freight items up to 5.0 m (16 ft 5 in) in length. Walls lined with lightweight soundproofing and heat insulation material. Adjustable heating and ventilation systems. Dual controls optional.

EQUIPMENT: Generally to customer's requirements, but can include gear for parajumping role; stretchers for ambulance role; aerial photography and survey gear. Agricultural version no longer produced.

DIMENSIONS, EXTERNAL:

Wing span	15.87 m (52 ft 0¾ in)
Wing chord, constant	**1.90 m (6 ft 3 in)**
Wing aspect ratio	**8.4**
Length overall	**10.90 m (35 ft 9 in)**
Height overall (to top of rudder), tail down	**3.20 m (10 ft 6 in)**
Tailplane span	5.13 m (16 ft 10 in)
Wheel track	3.00 m (9 ft 10 in)
Wheelbase	7.87 m (25 ft 10 in)
Propeller diameter	2.67 m (8 ft 9 in)

DIMENSIONS, INTERNAL:

Cabin, from back of pilot's seat to rear wall:	
Length	2.30 m (7 ft 6½ in)
Max width	1.16 m (3 ft 9½ in)
Max height (at front)	1.28 m (4 ft 2½ in)
Height at rear wall	1.18 m (3 ft 10½ in)
Floor area	2.67 m² (28.6 sq ft)
Volume	3.3 m³ (107 cu ft)

AREAS:

Wings, gross	30.15 m² (324.5 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, basic	**1,250 to 1,400 kg (2,756 to 3,086 lb)**
Max fuel weight: internal	**508 kg (1,120 lb)**
underwing	392 kg (864 lb)
Max payload: with reduced internal fuel	1,130 kg (2,491 lb)
with max internal fuel	1,200 kg (2,645 lb)
with max internal and underwing fuel	571 kg (1,259 lb)
Max T-O weight, Normal (CAR 3): wheels (standard)	2,800 kg (6,173 lb)
skis	2,600 kg (5,732 lb)
Max landing weight: wheels	2,660 kg (5,864 lb)
skis	2,600 kg (5,732 lb)
Max cabin floor loading	488 kg/m² (100 lb/sq ft)
Max wing loading (Normal):	
wheels	92.9 kg/m² (19.03 lb/sq ft)
skis	86.2 kg/m² (17.67 lb/sq ft)
Max power loading (Normal): wheels	6.83 kg/kW (11.22 lb/shp)
skis	6.34 kg/kW (10.42 lb/shp)

PERFORMANCE (Normal category):

Never-exceed speed (VNE)	151 kt (280 km/h; 174 mph) EAS
Max cruising speed at S/L	125 kt (232 km/h; 144 mph)
Econ cruising speed at 3,050 m (10,000 ft)	115 kt (213 km/h; 132 mph)
Stalling speed, power off: flaps up	58 kt (108 km/h; 67 mph) EAS
flaps down	52 kt (96 km/h; 60 mph) EAS
Max rate of climb at S/L	308 m (1,010 ft)/min
Max operating altitude	7,620 m (25,000 ft)
Service ceiling	6,250 m (20,500 ft)
T-O run at S/L: normal and STOL	197 m (650 ft)
T-O to 15 m (50 ft) at S/L: normal	475 m (1,560 ft)
STOL	440 m (1,445 ft)
Landing from 15 m (50 ft) at S/L at MLW, with propeller reversal	315 m (1,035 ft)
Landing run at S/L at MLW, with propeller reversal	127 m (420 ft)
Max range at 115 kt (213 km/h; 132 mph) at 3,050 m (10,000 ft), no reserves:	
with max payload	394 n miles (730 km; 453 miles)
with standard internal fuel	500 n miles (926 km; 576 miles)
with standard internal and underwing fuel	811 n miles (1,503 km; 933 miles)
g limits	+3.58/−1.43

PILATUS PC-7 MK II M TURBO TRAINER

SAAF name: Astra

TYPE: Basic turboprop trainer.

PROGRAMME: First production PC-7 baseline version flew 18 August 1978. Mk II launched 1992 and developed to bid for South African Air Force requirement; two prototypes (HB-HMR and -HMS), first of which made maiden flight 28 September 1992; SAAF contract announced June 1993; first production aircraft started January 1994 and made first flight August 1994. Since 1996, PC-7 Mk IIs and PC-9s were built from common fuselages, former being designated PC-7 Mk II M (for 'modular'). Final PC-7 Mk II M of first series was delivered to Malaysia in 2001.

Iran understood to be planning to build a modified PC-7 variant, known locally as IAMI (HESA) HT-80

CUSTOMERS: South Africa (60); Brunei (four); Royal Malaysian Air Force (nine in 2001). Ten scheduled for production in 2006, but none identified by December 2006.

PILATUS PC-7 AND PC-7 MK II PRODUCTION

Customer	Qty	First aircraft	First delivery
Military:			
Angola	26	R-401	1982
Austria	16	3H-FA	Oct 1983
Bolivia	24	450	Apr 1979
Bophuthatswana	3[1]	T400	Dec 1989
Botswana	8	OD-1	Feb 1990
Brunei	4[2]	ATU-301	1997
Chile	10	N-210	May 1980
France	5	576	1991
Guatemala	12	218	Apr 1980

Pilatus PC-7 Mk II 1158819

Customer	Qty	First aircraft	First delivery
Iran	35	8-9901	1983
Iraq	52	5000	Jul 1980
Malaysia	44	M33-01	Feb 1983
Mexico	88	501	Jul 1979
Myanmar	19	2300	1979
Netherlands	13	L-01	Jan 1989
South Africa	60[2]	2001	1994
Suriname	3[3]	111	Oct 1986
Switzerland	40	A-902	Aug 1979
UAE (Abu Dhabi)	31	901	Apr 1982
Uruguay	7	301	1992
Subtotal	**500**		
Civil:			
Pilatus	1 (P)	HB-HAO	
	2	HB-HOO	
	1	(stock)	
USA (various)	8	N701RB	
CIPRA	2[4]	F-GDME	
Martini	4	HB-HMA	
Total	**520**		

[1] To South African Air Force; returned to Pilatus and resold to private owners in 1998–99
[2] Mk II
[3] No longer in service
[4] Both to Chad Air Force

DESIGN FEATURES: Generally as for PC-9. Reduced-drag airframe based on that of PC-9M; higher-powered PT6A-25C engine with four-blade propeller; Martin-Baker Mk 11A ejection seats standard; optimised flying controls.

FLYING CONTROLS: Generally as for PC-9M, including trim aid device; stall strips and ventral fin added to improve stall characteristics and directional stability.

STRUCTURE: Generally as for PC-9M.

LANDING GEAR: Hydraulically actuated retractable tricycle type, with emergency manual extension. Mainwheels retract inward, nosewheel rearward. Oleo-pneumatic shock-absorber in each unit. Castoring nosewheel, with shimmy dampers. Tyres 6.50–8 (8 ply) all round, pressure 8.62 bar (125 lb/sq in) on mainwheels, 4.83 bar (70 lb/sq in) on nosewheel. Hydraulic disc brakes on mainwheels. Parking brake. Alternatively 6.50–8 main and 6.00-6 tailwheel tubeless tyres. Steering ±61° by differential braking; nosewheel steering (±12°) standard. Minimum ground turning radius 11.125 m (36 ft 6 in), based on nosewheel.

POWER PLANT: One 522 kW (700 shp) (flat-rated) Pratt & Whitney Canada PT6A-25C turboprop, driving a Hartzell HC-D4N-2A four-blade constant-speed fully feathering propeller. Two integral wing fuel tanks, each of 253 litres (66.8 US gallons; 55.7 Imp gallons) usable capacity, plus a 12 litre (3.2 US gallon; 2.6 Imp gallon) aerobatic tank in fuselage, giving total internal usable capacity of 518 litres (137 US gallons; 114 Imp gallons).

Provision for 155 litre (41.0 US gallon; 34.1 Imp gallon) long-range auxiliary tank or 246 litre (65.0 US gallon; 54.1 Imp gallon) ferry tank under each wing. Single overwing gravity fuelling point each side. Oil capacity 16 litres (4.2 US gallons; 3.5 Imp gallons). Capability for 30 seconds of inverted flight.

ACCOMMODATION: Instructor and pupil in tandem on stepped Martin-Baker Mk 11A ejection seats. One-piece canopy opens sideways to starboard. Cockpit unpressurised.

SYSTEMS: Vapour cycle environmental control system. Hydraulic system, pressure 207 bar (3,000 lb/sq in), for landing gear actuation, nosewheel steering and airbrake; system maximum flow rate 18.8 litres (4.97 US gallons; 4.14 Imp gallons)/min. Supplementary system as for PC-9M. Electrical system (28 V DC) powered by 200 A starter/generator and 24 V Ni/Cd battery. OBOGS standard.

AVIONICS: Standard IFR fit comprising:

Comms: Dual Rockwell Collins VHF-422D VHF Comm transceivers; single Honeywell KTR 909B UHF comm transceiver; TEAM audio/radio management system with CDU in each cockpit; L3 Communications FA2300 CVR; Honeywell MST 67A Mode S transponder; Martec Serpe-Iesm KANNAD 406AF ELT.

Flight: Dual Honeywell KNR 634A VHF digital navigation receivers; Chelton DME 441B DME or L3 Communications RT-1634(V) TACAN/DME receiver/transmitter; Rockwell Collins ADF-462 ADF; Honeywell KLN 900 GPS in front and rear cockpits; LITEF LCR-93 AHRS; Honeywell KDC 481T air data computer; Honeywell KRA 405B radar altimeter.

Instrumentation: Astronautics Corporation of America 152 × 203 mm (6 × 8 in) portrait format active matrix LCD flight display for PFD functions in front and rear cockpits; Meggitt Avionics 3 ATI independent secondary flight display with rear cockpit repeater; air data unit; magnetometer heading sensor; Astronautics Corporation of America EICAS with 127 × 102 mm (5 × 4 in) landscape format display in front and rear cockpits.

EQUIPMENT: As for PC-9M.

DIMENSIONS, EXTERNAL, INTERNAL AND AREAS: As for PC-9M

WEIGHTS AND LOADINGS (A: Aerobatic, U: Utility category with underwing stores):

Basic weight empty, equipped	1,670 kg (3,682 lb)
Max underwing stores load	1,040 kg (2,293 lb)
Max T-O weight: A	2,250 kg (4,960 lb)
U	2,850 kg (6,283 lb)
Max ramp weight: A	2,260 kg (4,982 lb)
U	2,860 kg (6,305 lb)
Max landing weight: A	2,250 kg (4,960 lb)
U	2,750 kg (6,062 lb)
Max zero-fuel weight: A	1,900 kg (4,189 lb)
Max wing loading: A	138.1 kg/m² (28.29 lb/sq ft)
U	175.0 kg/m² (35.83 lb/sq ft)
Max power loading: A	4.31 kg/kW (7.09 lb/shp)
U	5.46 kg/kW (8.98 lb/shp)

PERFORMANCE (A and U as above):

Max operating Mach number (MMO): A, U	0.60
Max operating speed (VMO): A, U	300 kt (555 km/h; 345 mph) EAS
Max cruising speed: A at S/L	242 kt (448 km/h; 278 mph)
A at 3,050 m (10,000 ft)	251 kt (465 km/h; 289 mph)
A at 7,620 m (25,000 ft)	225 kt (417 km/h; 259 mph)
Max manoeuvring speed: A	210 kt (389 km/h; 241 mph) EAS
U	200 kt (370 km/h; 230 mph) EAS
Max speed with flaps and/or landing gear down:	
A, U	150 kt (277 km/h; 172 mph) EAS
Stalling speed:	
flaps and landing gear up	75 kt (139 km/h; 87 mph) EAS
flaps and landing gear down	67 kt (124 km/h; 78 mph) EAS
Max rate of climb at S/L	866 m (2,840 ft)/min
T-O to 15 m (50 ft)	415 m (1,365 ft)
Landing run from 15 m (50 ft)	674 m (2,215 ft)
g limits: A	+7/–3.5
U	+4.5/–2.25
Max range	810 n miles (1,500 km; 932 miles)

PILATUS PC-9M ADVANCED TURBO TRAINER

Slovene Military Aviation name: Hudournik (Swift)
Royal Thai Air Force designation: BF. 19

TYPE: Basic turboprop trainer.

PROGRAMME: Design began May 1982; aerodynamic elements tested on PC-7 1982–83; first flights by two preproduction PC-9s: HB-HPA on 7 May 1984 and HB-HPB on 20 July 1984; aerobatic certification 19 September 1985. PC-9M introduced early 1997.

CURRENT VERSIONS: **PC-9:** Standard production version until 1997.

PC-9/A: Australian version of PC-9.

PC-9B: German target towing version of PC-9, operated for German Air Force by EIS Aircraft GmbH (previously Condor Flugdienst); increased fuel for a 3 hour 20 minute mission; two Meggitt RM-24 winches on inboard pylons with targets stowed aft of winch; TAS 06 acoustic scoring system.

PC-9 Mk II: Modified for US Air Force/Navy JPATS trainer programme; became Beech T-6A Texan II.

PC-9M: Upgraded version introduced 1997 and now the standard production model. Enlarged dorsal fin fairing (as on PC-7 Mk II M) improves longitudinal stability and reduces stick forces; modified wingroot fairings improve low-speed characteristics; 'exciter strips' on wing leading-edges improve stall characteristics; new engine/propeller control system separates flight idle and ground idle modes, reducing acceleration time and improving handling.

Detailed description applies to PC-9M.

Hudournik (Swift) Dedicated weapons training version in service with Slovene Military Aviation, modified after delivery by Radom Aviation Systems of Israel. First example to

this standard (L9-61) made first flight early May 1999. Mission systems installation includes Litton INS-100G inertial navigation with GPS; HOTAS controls; Flight Visions HUD with up-front control and rear cockpit video repeater; a central flight data recorder; chaff/flare dispenser and control panel; Honeywell EFIS and displays; new weapon selection and armament control unit and displays; MIL-STD-1553B dual databus; and RS-422/ARINC 429 datalink. Maximum external stores load increased to 1,250 kg (2,756 lb).

CUSTOMERS: Total of 276 ordered and built by 2006. Saudi aircraft prepared for delivery by British Aerospace; first pair from second batch (Nos. 31 and 32) handed over in UK on 4 December 1995. Order for eight for Irish Air Corps, with weapons hardpoints, announced 16 January 2003, for delivery and operational capability by mid-2004. First aircraft (260) flew 6 February 2004. Bulgarian Air Force ordered six, for delivery during 2004; first aircraft (663) flew on 20 September 2004 and last delivered December 2004. One PC-9 and two PC-9M scheduled for delivery to Chad and Mexico respectively during 2006.

PILATUS PC-9 PRODUCTION (EXCLUDING BEECH T-6)

Customer	Version	Qty	First aircraft	First delivery
Military				
Angola	PC-9	4	(c/n 115)	1987
Australia	PC-9/A	67[1]	A23-001	Oct 1987
Bulgaria	PC-9M	6	663	2004
Chad	PC-9	1	TT-QAG	2006
Croatia	PC-9M	17[4]	054	1997
Cyprus	PC-9	2	901	1989
Iraq	PC-9	20	5801	1987
Ireland	PC-9M	8	260	2004
Mexico	PC-9M	27	2601	Sep 2006
Myanmar	PC-9	10	3601	Apr 1986
Oman	PC-9M	12	426	1999
Saudi Arabia	PC-9	50	2201	Jan 1987
Slovenia	PC-9M	9[5]	L9-61	Nov 1998
Switzerland	PC-9	14[2]	C-401	1987
Thailand	PC-9	36	1/34	1991
US Army	PC-9	3[3]	91-071	1991
Subtotal		**261**		
Civil				
Pilatus	PC-9	2	HB-HPA	
	PC-9 Mk II	1	HB-HPC	
	PC-9M	1	HB-HPJ	
Condor	PC-9B	10[6]	D-FAMT	Sep 1990
BAE	PC-9	1	ZG969	Jul 1989
Total		**276**		

[1] First 17 (after two from Pilatus) assembled by Hawker de Havilland from Swiss kits; final 48 locally built
[2] First two for evaluation; returned to Pilatus
[3] Transferred to Slovenia in 1995; now L9-51 et seq
[4] Plus three second-hand (051 et seq)
[5] Modified to Hudournik standard in Israel after delivery
[6] Plus ex-demonstrator, August 2000
[7] Believed total 18 on order

DESIGN FEATURES: Typical turboprop trainer; stepped cockpits; aerobatic; performance and handling ease student's transition to jets. Meets FAR Pt 23 (Amendment 52) and special Swiss federal civil conditions for both Aerobatic and Utility categories; complies with selected parts of US military training specifications.

Conventional, low-wing monoplane; parallel chord wing centre-section; tapered outer panels; tailplane LERX.

Wing section PIL15M825 at root, IL12M850 at tip; quarter-chord sweepback 1°; dihedral 7° from centre-section; incidence 1° at root; twist −2°.

FLYING CONTROLS: Conventional and manual. Cable-operated elevator and rudder; ailerons operated by pushrods; mass-balanced, electrically actuated trim tab in each aileron and starboard half of elevator; electrically actuated trim/anti-balance tab in rudder controlled from rocker switch on power control lever. Trim aid device (TAD) automatically adjusts rudder trim tab setting in response to changes in engine torque or aircraft airspeed. This counteracts aircraft yaw induced by variations in effect of propeller slipstream, depending upon airspeed and engine power setting. TAD can be selected on or off by switch on trim control panel on left-hand side panel of front cockpit. Electrically operated split flaps, deflections 0°, 23° (take-off) and 50° (landing), hydraulically operated 'perforated' airbrake under centre-fuselage.

STRUCTURE: All-metal with some GFRP wing/fuselage fairings; one-piece wing with auxiliary spar, ribs and stringer-reinforced skin.

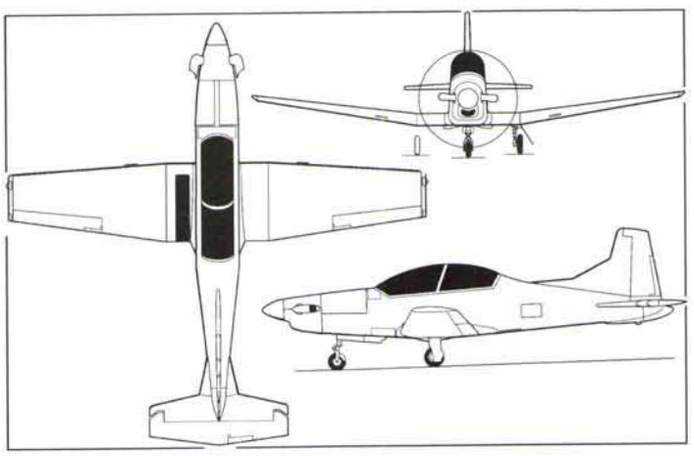
LANDING GEAR: Retractable tricycle type, with hydraulic actuation. Mainwheels retract inward to lie semi-recessed in wing centre-section covered by bulged doors; nosewheel retracts rearward; all units enclosed when retracted. Oleo-pneumatic shock-absorber in each leg. Hydraulically actuated nosewheel steering. Goodrich wheels and tubeless tyres, with Goodrich multipiston hydraulic disc brakes on mainwheels. Main tyres 20×4.4 (8 ply), nose tyre 16×4.4 (8 ply). Low-pressure tyres optional. Parking brake.

POWER PLANT: One 857 kW (1,150 shp) Pratt & Whitney Canada PT6A-62 turboprop, flat rated at 708 kW (950 shp), driving a Hartzell HC-D4N-ZA/09512A four-blade constant-speed fully feathering propeller. Single-lever engine control. Propeller is controlled by a constant-speed unit (CSU) and a variable-speed propeller governor system (VPGS). VPGS provides a linear engine power response resulting in balanced engine loads and reduced yaw moments. VPGS automatically varies the propeller speed between 1,750 and 2,000 rpm in response to engine torque. CSU adjusts the blade pitch to achieve a propeller speed as determined by the VPGS.

Fuel in two integral tanks in wing leading-edges, total capacity 540 litres (143 US gallons; 119 Imp gallons), of which 518 litres (137 US gallons; 114 Imp gallons) usable. Overwing refuelling point on each side. Fuel system includes 12 litre (3.2 US gallon; 2.6 Imp gallon) aerobatics tank in fuselage, forward of front cockpit, which permits up to 60 seconds of inverted flight. Provision for two 154 or 248 litre (40.7 or 65.5 US gallon; 33.9 or 54.5 Imp gallon) drop tanks on centre underwing attachment points. Total oil capacity 16 litres (4.2 US gallons; 3.5 Imp gallons).

ACCOMMODATION: Two Martin-Baker Mk 11A adjustable ejection seats, each with integrated personal survival pack and fighter-standard pilot equipment. Stepped tandem arrangement with rear seat elevated 15 cm (5.9 in). Seats operable, through canopy, at zero height and speeds down to 60 kt (112 km/h; 70 mph) EAS. Anti-g system. One-piece acrylic Perspex windscreen; one-piece framed canopy, incorporating roll-over bar, opens sideways to starboard. Dual controls standard. Cockpit heating, cooling, ventilation and canopy demisting standard. Space for 25 kg (55 lb) of baggage aft of seats, with external access.

Irish Air Corps Pilatus PC-9 *(Paul Jackson)* 1158186



Pilatus PC-9M turboprop trainer 1158187

SYSTEMS: Vapour cycle air conditioning system and engine bleed air for cockpit heating/ventilation and canopy demisting. Fairey Systems hydraulic system, pressure 207 bar (3,000 lb/sq in), for actuation of landing gear, mainwheel doors, nosewheel steering and airbrake; system maximum flow rate 18.8 litres (4.97 US gallons; 4.14 Imp gallons)/min. Bootstrap oil/oil reservoir, pressurised at 3.45 to 207 bar (50 to 3,000 lb/sq in). A supplementary high-pressure, one-shot nitrogen storage bottle provides power to lower the landing gear in an emergency. This bypasses the main hydraulic systems by feeding directly into shuttle valves in the down side of the main door and landing gear actuators.

Primary electrical system (28 V DC operational, 24 V nominal) powered by 30 V 300 A starter/generator and 24 V 40 Ah Ni/Cd battery. Ground power receptacle. Electric anti-icing of pitot tube, static ports and AoA transmitter standard; electric de-icing of propeller blades. Diluter demand oxygen system, capacity 1,350 litres (47.6 cu ft) selected and controlled individually from panel in each cockpit. OBOGS standard.

AVIONICS: Standard avionics, described below, can be augmented or replaced by alternative equipment to customers' requirements.

Comms: Dual Rockwell Collins VHF-422D VHF transceivers; single Honeywell KTR 909B UHF transceiver; TEAM audio/radio management system in each cockpit; L3 Communications FA2300 CVR and FDR with crash-survivable memory and underwater acoustic beacon, recording up to two hours of standard quality and a minimum of 30 minutes of high quality cockpit audio and a minimum of 25 hours of flight data, latter retrievable for fatigue life management and engine condition monitoring; Honeywell MST 67 A Mode S transponder; Martec Serpe-Iesm KANNAD 406AF ELT.

Flight: Dual Honeywell KNR 634A VHF digital navigation receivers; Chelton DME 441B DME or L3 Communications RT-1634(V) TACAN/DME receiver/transmitter; Rockwell Collins ADF-462 ADF; Honeywell KLN 900 GPS in front and rear cockpits; LITEF LCR-93 AHRS; Honeywell KDC 481T air data computer; Honeywell KRA 405B radar altimeter.

Instrumentation: Astronautics Corporation of America 152 x 203 mm (6 x 8 in) portrait format active matrix LCD flight display for PFD functions in front and rear cockpits; Meggitt Avionics 3 ATI independent secondary flight display with rear cockpit repeater; air data unit; magnetometer heading sensor; Astronautics Corporation of America EICAS with 127 x 102 mm (5 x 4 in) landscape format display in front and rear cockpits; IFR advanced avionics configuration adds CMC Electronics FV4000 HUD computer; SparrowHawk HUD (with integrated up-front control panel and front-mounted camera); front cockpit video display unit or HUD repeater; TEAC Aerospace Technologies MDR 80C rear cockpit mission data recorder; and substitutes Honeywell HG2100AB04 micro inertial reference unit and HG2021 GD02 global navigation satellite sensor unit for LITEF LCR-93 AHRS.

EQUIPMENT: Three hardpoints under each wing: inboard and centre stations each stressed for 250 kg (551 lb), outboard stations for 110 kg (242.5 lb) each. Retractable 250 W landing/taxying light in each main landing gear leg bay. Optional equipment can include smoke generators for aerial displays, target towing kit, electronic jammer for EW training, and blind-flying hood.

ARMAMENT: FN Herstal package for Hudournik/Swift comprises HMP-250 12.7 mm gun pods; LAU-7A seven-round unguided rocket launchers; Alkan Type 65 adaptor and dispensers for IBDU-33 practice bombs; and a laser range-finder pod.

DIMENSIONS, EXTERNAL:

Wing span	10.18 m (33 ft 5 in)
Wing chord: mean aerodynamic	1.65 m (5 ft 5 in)
mean geometric	1.61 m (5 ft 3½ in)
Wing aspect ratio	6.3
Length overall	10.13 m (33 ft 3 in)
Fuselage max width	0.97 m (3 ft 2¼ in)
Height overall	3.26 m (10 ft 8⅓ in)
Tailplane span	3.665 m (12 ft 0¼ in)
Wheel track	2.54 m (8 ft 4 in)
Wheelbase	2.31 m (7 ft 7 in)
Propeller diameter	2.44 m (8 ft 0 in)
Propeller ground clearance	0.18 m (7 in)

DIMENSIONS, INTERNAL:

Baggage compartment volume	0.14 m³ (4.9 cu ft)

AREAS:

Wings, gross	16.29 m² (175.3 sq ft)

Ailerons (total) ..... 1.57 m² (16.90 sq ft)
Trailing-edge flaps (total) ..... 1.77 m² (19.05 sq ft)
Airbrake ..... 0.30 m² (3.23 sq ft)
Fin ..... 0.86 m² (9.26 sq ft)
Rudder, incl tab ..... 0.90 m² (9.69 sq ft)
Tailplane ..... 1.80 m² (19.38 sq ft)
Elevator, incl tab ..... 1.60 m² (17.22 sq ft)

WEIGHTS AND LOADINGS (A: Aerobatic, U: Utility category with underwing stores):
Basic weight empty, equipped ..... 1,725 kg (3,803 lb)
Max underwing stores load ..... 1,040 kg (2,293 lb)
Max T-O weight: A ..... 2,350 kg (5,180 lb)
U ..... 3,200 kg (7,054 lb)
Max ramp weight: A ..... 2,360 kg (5,203 lb)
U ..... 3,210 kg (7,076 lb)
Max landing weight: A ..... 2,350 kg (5,180 lb)
U ..... 3,100 kg (6,834 lb)
Max zero-fuel weight: A ..... 2,000 kg (4,409 lb)
Max wing loading: A ..... 144.3 kg/m² (29.55 lb/sq ft)
U ..... 196.4 kg/m² (40.23 lb/sq ft)
Max power loading: A ..... 3.32 kg/kW (5.45 lb/shp)
U ..... 4.52 kg/kW (7.42 lb/shp)

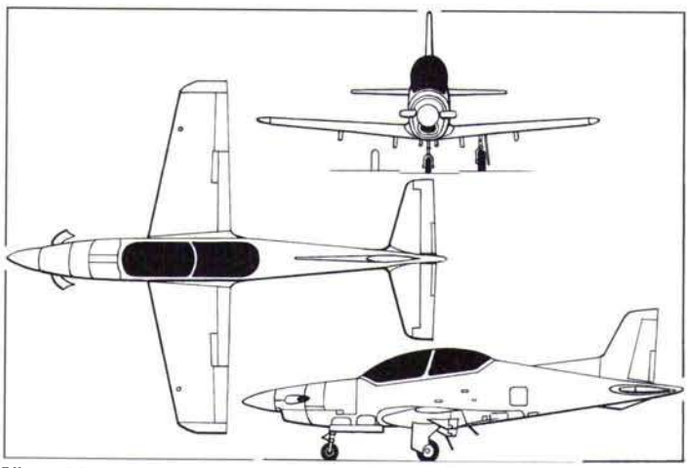
PERFORMANCE (A and U as above, propeller speed 2,000 rpm):
Max operating Mach number (MMO): A, U 0.65
Max operating speed (VMO): A, U ..... 320 kt (593 km/h; 368 mph) EAS
Max cruising speed: A at S/L ..... 271 kt (501 km/h; 311 mph)
A at 3,050 m (10,000 ft) ..... 298 kt (552 km/h; 343 mph)
A at 7,620 m (25,000 ft) ..... 300 kt (556 km/h; 345 mph)
Max manoeuvring speed: A ..... 205 kt (380 km/h; 236 mph) EAS
U ..... 200 kt (370 km/h; 230 mph) EAS
Max speed with flaps and/or landing gear down:
A, U ..... 150 kt (278 km/h; 172 mph) EAS
Stalling speed, engine idling: flaps and gear up: A ..... 76 kt (141 km/h; 87 mph) EAS
U ..... 90 kt (167 km/h; 104 mph) EAS
flaps and gear down: A ..... 69 kt (128 km/h; 80 mph) EAS
U ..... 67 kt (124 km/h; 77 mph) EAS
Max rate of climb at S/L: A ..... 1,183 m (3,880 ft)/min
Time to 4,575 m (15,000 ft): A ..... 4 min 5 s
Max operating altitude: A, U ..... 7,620 m (25,000 ft)
Service ceiling: A, U ..... 11,580 m (38,000 ft)
T-O run at S/L: A ..... 243 m (795 ft)
T-O to 15 m (50 ft) at S/L: A ..... 396 m (1,300 ft)
Landing from 15 m (50 ft) at S/L at MLW:
A ..... 687 m (2,255 ft)
Landing run at S/L at MLW:
A (normal braking action) ..... 351 m (1,150 ft)
Max range at 210 kt (389 km/h; 242 mph) at 7,620 m (25,000 ft), 5% and 20 min fuel reserves:
A ..... 830 n miles (1,537 km; 955 miles)
Max range, no reserves ..... 1,065 n miles (1,970 km; 1,225 miles)
Max endurance at 110 kt (204 km/h; 127 mph) IAS, conditions as above: A ..... 4 h 30 min
g limits: A ..... +7/−3.5
U ..... +4.5/−2.25

PILATUS PC-21

TYPE: Basic turboprop trainer.

PROGRAMME: Project launched November 1998; development began January 1999; provisional designation chosen to indicate 21st Century technology, but was retained for commercial use; first brief details revealed late 1999; modified PC-7 Mk II development aircraft (HB-HMS) flying by October 2000 with a sweptback fin, spoilers, power management system and five-blade propeller; later received PC-21 avionics and mission management system.

Prototype (HB-HZA) rolled out 1 May 2002; first flight 1 July 2002; public debut at Royal International Air Tattoo, Fairford, UK, 20–21 July 2002, at which time the aircraft had flown some 14 hours, including ferry time; more than 500 hours flown by October 2004; appeared at Farnborough Air Show from 22 July 2002. Second development aircraft (HB-HZB) flew 7 June 2004 and made first public appearance at RIAT, Fairford, UK, July 2004. Civil VFR certification achieved 23 December 2004, to be followed by IFR in mid-2006. Second development aircraft was destroyed in a crash at Buochs, Switzerland, on 13 January 2005. First series production aircraft (HB-HZC) flew 29 August 2005 and served as autopilot certification aircraft alongside HB-HZA, which assumed HB-HZB's role as systems development and demonstration airframe. Second production HB-HZD, completed early 2006.



Pilatus PC-21 advanced turboprop trainer *(James Goulding)* 1158233

On 3 November 2006, Lockheed Martin Simulation awarded 20-year contract to supply pilot training services to Republic of Singapore Air Force at RAAFB Pearce, Western Australia, with equipment including 19 PC-21s.

CUSTOMERS: Singapore 19 (via Lockheed Martin contract). Estimated market for 1,000 aircraft in class over 20-year period, of which Pilatus hopes to capture 50 per cent: Australia, Switzerland (expected to acquire six early production airframes), UAE and UK seen as primary marketing targets for launch orders. Marketing strategy includes complete Pilatus-operated training packages, employing PC-21s.

COSTS: Company-funded development cost estimated at CHF200 million; unit cost CHF10 million (2004).

DESIGN FEATURES: Optimised for advanced flying (pilot) and weapons training (pilot and WSO), but at turboprop cost; high wing loading. Avionics able to simulate aiming and release of multiple weapons (in excess of aircraft's actual carrying capability) without resort to training rounds, although addition of underwing stores pylons is possible. Jet-like response assisted by digital power management system which schedules full power at 200 kt (370 km/h; 230 mph) and above. Propeller and spinner angled 4° down and 4° starboard to offset full torque, while wing and fin slightly offset for similar reason; optional automatic yaw compensation. Design aims included superior aerodynamic performance; integrated and cost-effective training system; and (30-year) life-cycle support cost not exceeding current turboprop trainers.

Wing leading-edge sweepback 12° 42'; tailplane sweepback approximately 16°; dihedral from roots.

FLYING CONTROLS: Conventional. Manually actuated rudder and elevator; hydraulic ailerons. Door-type spoiler in each wing upper surface, ahead of outboard one-third of flaps, to enhance roll. Flight-adjustable trim tabs in rudder, each aileron and each half of tailplane. Flaps hydraulically actuated.

STRUCTURE: New design; three-spar wing; wing leading-edges of impact-absorbent material for birdstrike resistance.

LANDING GEAR: Retractable tricycle type, with single wheel on each unit. Retraction inwards (mains) and rearward (nose). Mainwheel tyres size 20×14.4R12, pressure 16.6 bar (240 lb/sq in); nosewheel tyre size 10×4.4R8, pressure 11.0 bar (160 lb/sq in).

POWER PLANT: One 1,193 kW (1,600 shp) Pratt & Whitney Canada PT6A-68B turboprop, driving a Hartzell E8991KX five-blade 'Scimitar' graphite/titanium propeller.

ACCOMMODATION: Two in tandem on Martin-Baker Mk 16L zero-zero ejection seats in pressurised cockpit. Two-section acrylic canopy manufactured by Mecaplex of Switzerland, with thickened front for birdstrike resistance without resort to separate windscreen. Rear seat height increased in comparison with PC-9; front occupant has −11° forward view; rear occupant −4° 40'.

SYSTEMS: OBOGS, ECS and VCCS standard.

AVIONICS: *Instrumentation:* 'Glass cockpit' featuring three 152 × 203 mm (6 × 8 in) AMLCD PFDs and two 76 mm (3 in) Meggitt AMLCD secondary flight displays in each cockpit; Flight Visions SparrowHawk HUD with FVD-4000 HUD symbol generator standard in front cockpit; HUD repeater in rear cockpit; displays are NVG-compatible. Digital recording of all displays for post-flight debriefing.

Mission: Inputs to mission system are made via multifunction displays MFD soft keys, up-front control panel (UFCP) in front cockpit, and HOTAS.

Embedded simulation and mission planning/debriefing. Integrated ground-based training environment.

Third (first production) Pilatus PC-21 *(Katsuhiko Tokunaga, Pilatus)* 1158825

ARMAMENT: Provision for external stores on one centreline and four underwing hardpoints.

DIMENSIONS, EXTERNAL:

Wing span	9.12 m (29 ft 11 in)
Length overall	11.25 m (36 ft 11 in)
Height overall	3.76 m (12 ft 4 in)
Fuselage: Max depth	2.015 m (6 ft 7¼ in)
Max width	1.00 m (3 ft 3¼ in)
Tailplane span	4.00 m (13 ft 1½ in)
Wheel track	2.72 m (8 ft 11 in)
Wheelbase	2.49 m (8 ft 2 in)
Propeller diameter	2.39 m (7 ft 10 in)

AREAS:

Wing, gross	15.22 m² (163.8 sq ft)

WEIGHT AND LOADINGS:

Weight empty	2,280 kg (5,027 lb)
T-O weight: Aerobatic (clean)	3,100 kg (6,834 lb)
with underwing tanks	3,600 kg (7,936 lb)
max	4,250 kg (9,370 lb)
Max external load	1,150 kg (2,535 lb)
Max wing loading	279.2 kg/m² (57.19 lb/sq ft)
Max power loading	3.56 kg/kW (5.86 lb/shp)

PERFORMANCE (estimated):

Max operating speed	370 kt (685 km/h; 426 mph)
Design diving speed	420 kt (778 km/h; 483 mph)
Max level speed: at S/L	323 kt (598 km/h; 372 mph)
at FL100	337 kt (624 km/h; 388 mph)
Stalling speed: flaps and gear up	92 kt (171 km/h; 106 mph)
flaps and gear down	81 kt (150 km/h; 94 mph)
T-O run to 15 m (50 ft)	725 m (2,380 ft)
Landing from 15 m (50 ft)	900 m (2,955 ft)
Max rate of climb at S/L	1,295 m (4,248 ft)/min
Time to climb to FL100	2 min 35 s
Max certified altitude	7,620 m (25,000 ft)
Service ceiling	11,582 m (38,000 ft)
g limits: Aerobatic	+8/-5
Utility	+4/-2.5
sustained at S/L	+3.7
Max range	720 n miles (1,333 km; 828 miles)

PILATUS PC-12

US Air Force designation: U-28A

TYPE: Light utility turboprop.

PROGRAMME: Announced at NBAA Convention October 1989; first flight P.01 (HB-FOA) 31 May 1991; first flight of P.02 second prototype (HB-FOB) 28 May 1993; Swiss certification to FAR Pt 23 Amendment 42 (covering FAR Pt 135 commercial and Pt 91 general operations) received 30 March 1994, FAA type approval 15 July 1994, and FAR Pt 25 certification for flight into known icing conditions in 1995. Deliveries (N312BC to Carlston Leasing Corporation in USA) began September 1994.

Higher gross weight option (4.5 tonnes, hence **PC-12/45**) introduced in 1996 and gained FAA certification on 31 July 1996; became production standard by 1997. FAA FAR Pt 135 approval for commercial single-engined IFR operations announced in third quarter 1997; production increased from three to four per month in August 1997. First airline scheduled service operator (1997) was Kelner Airways of Canada. Total of 76 ordered and 51 delivered in 1998 (including 100th in April); 29 ordered in first half of 1999; 200th sale announced at NBAA Convention. Worldwide fleet hours passed 1 million in February 2005. Now certified in 26 countries, 1,500th Pilatus single-engined turboprop, manufactured in mid-2001, was PC-12 N377PC. Delivery of 500th PC-12 effected in December 2004, followed by 600th in April 2006.

CMC Electronics enhanced vision system available from early 2006.

Improved version, **PC-12/47**, announced on eve of at NBAA Convention, Orlando, Florida, 8 November 2005; available from January 2006. EASA certification granted 23 June 2006. Max T-O weight increased to 4,740 kg (10,450 lb), to permit either 240 kg (529 lb) extra payload or 350 n mile (648 km; 402 mile) range extension; new design, flatter winglet based on that of PC-21 which enhanced aileron control and provides improved crosswind handling; Flettner tabs on ailerons; control harmony improved, resulting in 60 per cent reduction in roll control forces; new crew seats by Ipeco; colour balanced LED cabin lighting and LED navigation lighting.

Next Generation PC-12 announced at NBAA Convention, Orlando, October 2006. PT6A-67P engine, with 15 per cent more thermodynamic power, and Honeywell Primus Apex four-screen (two PFD, two MFD) cockpit, with cockpit styling by BMW Designworks USA; certification expected late 2007.

CURRENT VERSIONS: **Standard:** Nine-passenger commuter or passenger/cargo combi.

Detailed description applies to standard PC-12/47 except where indicated.

Executive: Six to eight passenger seats.

PC-12M and Spectre: Multi-mission versions; *described separately.*

U-28A: Announced October 2005 as designation of six (civil-registered as N419WA, N424PB, N447PC, N482WA, N666GT and N922RG) PC-12s operated by 319th Special Operations Squadron of 16th SOW, US Air Force, at Hurlburt Field, Florida.

Next Generation Pilatus PC-12 Honeywell Primus Apex cockpit 1158824

CUSTOMERS: Completion of 300th production aircraft effected in 2001; 400th in (N500ZP) in August 2003; 500th (N600PE) to the Barclay Group (Integrated Aviation Services) of Scottsdale, Arizona, in December 2004, and 600th (N600KP) on 28 April 2006 to Aviation Sales Inc for a California-based customer. Deliveries in 2000 and 2001 totalled 70 each, 45 in 2002, 55 in 2003, 70 in 2004 and 80 in 2005. Production rate increased to 90 per year in 2006. Some 59 per cent of first 400 aircraft are registered in USA; further 14 per cent in Canada (including nine with Royal Canadian Mounted Police). Sales total 18 per cent in air ambulance configuration; 8 per cent airline use; and 74 private/corporate operators. US Drug Enforcement Agency (DEA) received two in transport configuration in December 1999 and October 2000, and placed further orders for ICE surveillance version. Other customers include those in Argentina (Border Guard), Australia (Royal Flying Doctor Service with 17 aircraft, including three delivered in early 2002), Austria, Bangladesh, Belize, Bermuda, Brazil, Bulgaria, Canada, Denmark, France, Germany, Greece, India, Japan, Kenya, Mexico, Netherlands, Norway, Poland, Russia, South Africa (Red Cross), Switzerland, Thailand, Uruguay, USA and Zimbabwe.

First single-engine turboprop fractional ownership scheme involved PC-12s of Alpha Flying's PlaneSense programme. Similar scheme, based on hourly use, introduced 2001 by Lions Air TimeJet of Zurich, Switzerland, since when several other PC-12 fractional ownership schemes have been launched.

COSTS: Basic price USD2,875 million; typically equipped USD 3.4 million (2006). Direct operating cost USD440 per hour (2006).

DESIGN FEATURES: Low-wing monoplane with tapered wing and T tail; latter's mounting reduces trim changes with power; CG range 13 to 46 per cent of MAC. Modifications following early flight trials include introduction of winglets, increased wing span, paired elevators instead of single surface, sweptback tailplane/elevator tips, addition of tailplane/fin bullet fairing, and enlarged dorsal fin and ventral strakes.

Wing sections (modified NASA GA(W)-1 series), LS(1)-0417.MOD at root and LS(1)-0313 at tip.

FLYING CONTROLS: Conventional and manual. Actuation by pushrods and cables; servo tab in each aileron; electrically actuated Flettner tab in rudder; short-span mass-balanced ailerons; electrically actuated Fowler flaps cover 67 per cent of wing trailing-edge; electrically actuated (dual redundant) variable incidence tailplane.

STRUCTURE: Aluminium alloy primary skin and structure; composites for ventral strakes and dorsal fin (Kevlar/honeycomb sandwich), wingtips (glass fibre), fairings, engine cowling (glass fibre/honeycomb sandwich) and interior trim; titanium firewall; two-spar wing with integral fuel tankage; airframe proved for 20,000 hour life; complete internal and external corrosion protection.

All parts fabricated in Switzerland, but wings and fuselage assembled by OGMA in Portugal before return to Swiss production line. North American interiors installed in USA finishing centre; others outfitted at Stans.

LANDING GEAR: Pilatus hydraulically retractable tricycle type, with single wheel on each unit; nosewheel mechanically steerable ±12° by rudder pedals, or ±60° with differential braking. Emergency extension system; toe operated brakes; parking brake. Suitable for operation from grass strips. Goodrich wheels and low-pressure tyres on all units: size 22×8.50-10 on main gear, 17.5×6.25-6 on nose unit; tyre pressure 4.14 bar (60 lb/sq in) all round. Propeller ground clearance maintained with nose leg compressed and nosewheel tyre flat.

South African-registered Pilatus PC-12 with ethnic paint scheme 1158823

Trailing-link main gear retracts inward into wings, nose gear rearward under flight deck. Ground turning radius about wingtip 9.8 m (32 ft 2 in), about main gear 4.53 m (14 ft 10 in).

POWER PLANT: One 1,197 kW (1,605 shp) Pratt & Whitney Canada PT6A-67B turboprop, flat rated to 895 kW (1,200 shp) for T-O and 746 kW (1,000 shp) for climb and cruise. Hartzell HC-E4A-3D/E10477K constant-speed, fully feathering reversible-pitch four-blade aluminium propeller, turning at 1,700 rpm. Two integral fuel tanks in wings, total capacity 1,540 litres (407 US gallons; 339 Imp gallons), of which 1,522 litres (402 US gallons; 335 Imp gallons) are usable. Gravity fuelling point in top of each wing. Oil capacity 11 litres (2.9 US gallons; 2.4 Imp gallons).

ACCOMMODATION: Two-seat flight deck; approved for single pilot, with dual controls; second flight instrument panel optional. Limit of nine passengers under FAR Pt 23, or executive layout for six to eight, both with lavatory. Two or three stretcher patients, plus life support systems and medical attendants, in ambulance configuration. Downward-opening airstair crew/passenger door at front, upward-opening cargo door at rear, both on port side; Type III emergency exit above wing on starboard side.

SYSTEMS: Normalair Garrett engine bleed air ECS, maximum pressure differential 0.4 bar (5.8 lb/sq in), maintaining a 2,440 m (8,000 ft) cabin altitude at 7,620 m (25,000 ft) and a 3,050 m (10,000 ft) cabin altitude at 9,150 m (30,000 ft). Vickers Systems (Germany) hydraulic system, pressure 207 bar (3,000 lb/sq in), for landing gear actuation. Electrical power system (28 V DC) supplied by 300 A engine-driven starter/generator, 130 A back-up alternator and 24 V 40 Ah Ni/Cd or 24 V 42 Ah lead-acid battery. Second battery optional. Goodrich pneumatic boot de-icing of wing and tailplane leading-edges; Goodrich electric anti-icing of windscreen, propeller blades, pitot probes and stall warning sensor; exhaust air anti-icing of engine air intake. Oxygen system for crew and passengers.

AVIONICS: *Comms:* Bendix/King dual KX 165A VHF nav/com transceivers, KMA 24H audio control/voice activated intercom system, KT 70 Mode S transponder, KR 21 marker beacon receiver, and SEPRE-IESM kannad 121 ELT, all standard; Bendix/King KHF 950 HF radio optional.

Radar: Honeywell RDR 2000 weather radar standard, mounted in wing pod.

Flight: Honeywell KFC 325 autopilot system, KN 63 DME, KR 87 ADF, KNI 582 RMI, KRA 405 radar altimeter, KEA 130A encoding altimeter, Bendix/King KLN 90B GPS and Litef LCR-92 AHRS standard; second LCR-92, WX 1000E Stormscope, TCAS 66A, Mk VI GPWS, KMD 850 MFD, IHAS 8000 traffic and terrain awareness system, Max-Viz EVS-1000 and CMC Electronics enhanced vision systems, and co-pilot's EFIS, all optional.

Instrumentation: Bendix/King EHI 40/50 EFIS with 102 mm (4 in) display standard; 127 mm (5 in) EFIS on pilot and co-pilot panels, optional. Central Advisory and Warning System (CAWS) standard.

DIMENSIONS, EXTERNAL:

Wing span	16.28 m (53 ft 5 in)
Wing aspect ratio	10.3
Length overall	14.40 m (47 ft 3 in)
Height overall	4.27 m (14 ft 0 in)
Elevator span	5.21 m (17 ft 1 in)
Wheel track	4.52 m (14 ft 10 in)
Wheelbase	3.53 m (11 ft 7 in)
Propeller diameter	2.67 m (8 ft 9 in)
Propeller ground clearance	0.32 m (1 ft 0½ in)
Passenger door: Height	0.61 m (2 ft 0 in)
Width	0.635 m (2 ft 1 in)
Cargo door: Height	1.32 m (4 ft 4 in)
Width	1.35 m (4 ft 5 in)
Emergency exit: Height	0.66 m (2 ft 2 in)
Width	0.46 m (1 ft 6 in)

DIMENSIONS, INTERNAL:

Cabin: Length, excl flight deck	5.16 m (16 ft 11 in)
Max width	1.52 m (5 ft 0 in)
Width at floor	1.295 m (4 ft 3 in)
Max height	1.47 m (4 ft 10 in)
Volume	9.34 m³ (330 cu ft)
Baggage compartment volume	1.13 m³ (40 cu ft)

AREAS:

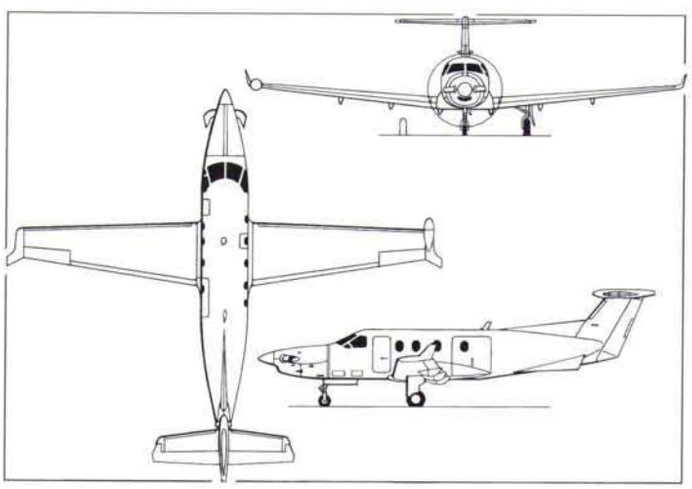
Wings, gross	25.81 m² (277.8 sq ft)
Horizontal tail surfaces	5.49 m² (59.09 sq ft)
Vertical tail surfaces	3.83 m² (41.23 sq ft)
Flaps (total)	5.56 m² (59.85 sq ft)
Ailerons (total)	1.24 m² (13.35 sq ft)
Elevators (total)	1.64 m² (17.65 sq ft)
Rudder	1.14 m² (12.27 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, commuter/airliner	2,661 kg (5,866 lb)
Basic operating weight: single pilot	2,751 kg (6,065 lb)
executive	2,978 kg (6,565 lb)
Max usable fuel	1,226 kg (2,703 lb)
Max payload, commuter/airliner	1,349 kg (2,974 lb)
executive	1,123 kg (2,476 lb)
Payload with max fuel: executive	554 kg (1,221 lb)
Max T-O and landing weight	4,740 kg (10,450 lb)
Max zero-fuel weight	4,100 kg (9,039 lb)
Max wing loading	183.7 kg/m² (37.61 lb/sq ft)
Max power loading	5.30 kg/kW (8.71 lb/shp)

PERFORMANCE:

Max operating Mach number (MMO)	0.48
Max operating speed (VMO)	240 kt (444 km/h; 276 mph) CAS
Max cruising speed at 7,620 m (25,000 ft)	270 kt (500 km/h; 311 mph)
Stalling speed:	
flaps and gear up	92 kt (171 km/h; 106 mph) IAS
flaps and gear down	66 kt (122 km/h; 76 mph) IAS
Max rate of climb at S/L	480 m (1,575 ft)/min
Max certified altitude	9,150 m (30,000 ft)
T-O run	503 m (1,650 ft)
T-O to 15 m (50 ft)	808 m (2,650 ft)
Landing from 15 m (50 ft) at MLW	558 m (1,830 ft)
Landing run at MLW	288 m (945 ft)
Max range at 7,925 m (26,000 ft), NBAA IFR reserves:	
commuter/airliner	1,782 n miles (3,300 km; 2,050 miles)
executive	1,739 n miles (3,221 km; 2,001 miles)
g limits: flaps up	+3.4/−1.36
flaps down	+2.0



Pilatus PC-12/47 pressurised light utility and business transport *(Mike Keep)*
1158189

PILATUS PC-12M and SPECTRE

TYPE: Multisensor surveillance turboprop.

PROGRAMME: Announced at Dubai Air Show in November 1995; then named Eagle, but name discontinued in 2002; renamed Spectre in 2003. Second PC-12, HB-FOB, converted as demonstrator (first flight October 1995). Second demonstrator HB-FOG (c/n 134) followed in September 1996 with airframe modifications and different equipment and third HB-FOL (c/n 166) in 1999. New Spectre version unveiled in 2003.

CURRENT VERSIONS: **PC-12M:** Multi-mission variant, formerly named PC-12 Eagle; features enhanced electrical power generator to integrate optional power consuming equipment according to customer requirements. Typical missions include navaid calibration, environmental survey, aerial photography/mapping and medevac, with quick-change facility permitting change of role to cargo, passenger/cargo, VIP transport or medevac in less than three hours. Specific modifications to current demonstrator aircraft are as follows:

HB-FOG: Sensors include WF-160DS IR/E-O system with tracker and Geotrack cueing; Raytheon Sea Vue SV 1021 radar with ISAR capability 1997 upgrade for SAR; 1998 upgrade for track-while-scan of 100 targets and MTI on SAR; communications digital datalink; 108 n mile (200 km; 124 mile) range video downlink to ground station; and sensor management system.

In late 2001, HB-FOG was delivered to Gruppe Rüstung of Swiss Defence Procurement Agency and based at Emmen for trials connected with new FLORAKO air defence ground environment. Pannier removed and fintip extension not fitted; standard PC-12 winglets. Transferred to Swiss Air Force in 2005. Further special missions upgrades were scheduled to be implemented in 2006/7.

HB-FOL: Modified in 1999 as airborne cellphone relay station, with large ventral pannier, ventral strakes and fintip extension. Sold to customer in 2005.

PC-12 Spectre: Multirole variant; prototype (N146PC), modified and mission equipped by Pilatus Business Aircraft Ltd (PILBAL) of Broomfield, Colorado. Announced 27 July 2003 at Airborne Law Enforcement Association meeting at Wichita, Kansas, having flown earlier that month. First customer was US Bureau of Immigration and Customs

PC-12 (Spectre) ICE surveillance aircraft
(US Bureau of Immigration & Customs Enforcement)
1047204

Cockpit of Pilatus PC-12 Spectre demonstrator N190PE
1158820

Enforcement. Retains PC-12 capabilities, but additionally incorporates retractable turret beneath the non-pressurised part of rear fuselage for FLIR Systems Safire II, or Safire III or Wescam MX-15 sensors and operator's position in cabin with two display monitors, video recorder and audio communications panel with broadband communications link. Spectre does not require aerodynamic modifications (enlarged fin or strakes) although N146PC retained large wingtips; it was sold to a customer in 2005.

Second-generation Spectre demonstrator (N190PE) incorporates a retractable turret beneath the rear fuselage; new ergonomically designed sensor operator's console with three display monitors, digital video recorder, and audio communications panel with downlink capability; and two executive seats, which are part of the Spectre package. Upgrades to the standard PC-12 cockpit include dual Honeywell EFIS 50, Garmin GNS 430/530 NAV/COM/GPS, Honeywell KDR 510 FIS, Honeywell 850 MFD, dual LCR 93 AHRS, Honeywell KMH 980 multi-hazard warning system, Honeywell GNS XLS FMS and L-3 Avionics WX-500 Stormscope. Additional options for the Spectre include a 400-amp generator to power additional mission equipment and a supplemental oxygen system in anticipation of a jump door that was in development in mid-2006.

PC-12 M also capable of carrying such other sensors as 2 to 18 GHz (optionally 40 GHz) elint, including automatic jammer; forward- and backward-looking sensor management systems; a passive missile warning system, including automatic chaff/flare dispensers or active laser countermeasures; radar optimised for land- or sea surveillance; and a bidirectional secure datalink to either land, sea or air units.

From the tenth production Spectre manufactured in 2006, aircraft are equipped with a sensor lift platform that can be equipped with a variety of EO/IR turrets with maximum diameter of 0.41 m (1 ft 4 in). Upgraded Spectre also features new wingtip design that reduces aileron control forces by two-thirds, and 100 kg (220 lb) increase in payload.

CUSTOMERS: One delivered to Swiss Defence Procurement Agency. Other confirmed customers for PC-12M include Argentina's Gendarmeria and Bulgarian Air Force. Pilatus in negotiations with several countries, unconfirmed reports citing Malaysia and Thailand. US Department of Homeland Security, Bureau of Customs and Border Patrol's CBP Air (formerly known as ICE) operates three Spectres; initial aircraft were N541PB in March 2004 and N497PC in June 2004; variant formally announced on 14 May 2004 as replacement for ICE's Beech King Air Fleet.

DESIGN FEATURES: FLIR turret at front of ventral pannier; winglets replaced by conventional wingtips (weather radar in starboard tip pod); undertail strakes enlarged (to maximum depth of 53 cm; 21 in) to maintain stability. HB-FOG fitted 1997 with new 'tiplets' (wingtips with small vertical winglets), newly defined undertail strakes and additional fin area above the elevator, increasing overall height by 48 cm (19 in). HB-FOG and HB-FOL fitted with fintip extensions above tailplane which, with ventral strakes, is mandatory if large ventral pannier is installed. Can undertake various reconnaissance and surveillance missions, but retains ability to revert to passenger and other missions at short notice.

DIMENSIONS, EXTERNAL: As standard PC-12/47 except: PC-12M:

Wing span	16.27 m (53 ft 4½ in)
Height overall (with fintip extension)	4.26 m (13 ft 11¾ in)

WEIGHTS AND LOADINGS: As standard PC-12/45 except:

Weight empty, Spectre	3,120 kg (6,878 lb)
Max payload	1,640 kg (3,616 lb)

PERFORMANCE:

Max cruising speed at FL260:	
Spectre	270 kt (500 km/h; 311 mph)
Stalling speed, flaps and gear down	66 kt (122 km/h; 76 mph) IAS
Max rate of climb at S/L	480 m (1,575 ft)/min
Max operating altitude	9,145 m (30,000 ft)
Max range at FL260 at 200 kt (370 km/h; 230 mph), 45 min reserves: PC-12 Spectre	1,633 n miles (3,080 km; 1,913 miles)
Time on station, two pilots, max fuel, loiter speed of 110 kt (203 km/h; 129 mph) with 30 min reserves:	
at FL50	7 h 35 min
at FL100	8 h 32 min
at FL150	9 h 24 min
at FL200	10 h 15 min

RUAG

RUAG AEROSPACE (SUBSIDIARY OF RUAG HOLDING)

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In 1996, the former Swiss Federal Aircraft Factory Emmen merged with the industrial division of the Swiss Air Force Logistic Command and parts of the Federal Ordnance Office. On 1 January 1999, it was converted from a federal ordnance establishment into a public diversified private company within the RUAG group and renamed Swiss Aircraft and Systems Enterprise Corporation. This title was changed to RUAG Aerospace in 2001, with sites at Emmen, Stans, Zweisimmen, Interlaken, Lodrino (Zürich) Airport and Alpnach. In 2006, RUAG Aerospace had 2,700 workforce; factory area totalled 92,000 m² (990,279 sq ft) and office area 25,000 m² (269,098 sq ft). A company turnover of approx CHF520 million (USD416 million) was posted in 2005.

RUAG Aerospace runs operations at several sites and subsidiaries in Switzerland and Germany, and works with customers and business partners throughout the world. The know-how and core competencies are based on more than 60 years of broad experience in development, production and maintenance of aircraft, helicopters, missiles and space products.

RUAG Aerospace's main activities are represented by four operating divisions: Military Aircraft, Commercial Aircraft, Space and Systems, and Aerostructures.

In the field of military aircraft the activities include maintenance, repair, system improvements and final assembly of F/A-18 fighters and Super Puma helicopters for the Swiss Air Force, as well as modernisation of the Bell UH-1D helicopter for the German armed forces.

Services for commercial aircraft comprise maintenance, repair, overhaul, painting, system improvements and completion of business and regional aircraft. A collaboration agreement with EADS Defence Electronics of Ulm, Germany, to develop self-protection systems for business jets, was announced in October 2006.

Aerostructures are developed and manufactured for various airframe and engine customers worldwide, using state of the art facilities. For instance, the outer fixed trailing-edges of the Airbus A380 wings are manufactured using the latest high-speed cutting and automated drilling technology.

The Space and Systems Division is responsible for a large number of products and services, both for the military and space markets. The payload fairings for the Ariane and Atlas launchers are examples of space programms going on for several decades.

RUAG Aerospace is operating three different sizes of wind tunnel, and is offering its competencies in theoretical and experimental aerodynamics to a wide range of customers, mainly from the aeronautical and automotive industries.

First activities in the UAV field date back some 20 years and led to the development, production and experience of the reconnaissance drone system Ranger, now in successful use with the Swiss and Finnish forces.

SWISSCOPTER

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Swisscopter was continuing to promote its two-seat helicopter in late 2006.

SWISSCOPTER SWISSCOPTER

TYPE: Two-seat light helicopter.

PROGRAMME: Several years in design and development before first flight in June 2002, but this followed by ground resonance problems which destroyed aircraft and delayed further flight testing. Second prototype since flown; was displayed at Dubai air show in November 2005, when company reported design now virtually vibration-free and ready for orders in 2006. Certification and first deliveries planned for fourth quarter of 2006.

Swisscopter on display at Dubai 1158834

DESIGN FEATURES: Two-blade main and tail rotors; pod and boom fuselage; sweptback upper and lower tailfins, former bearing a T tailplane. Resembles Italian Dragon Fly 333 in its original form. Fuel consumption 20 litres (5.3 US gallons; 4.4 Imp gallons) per hour at 70 per cent power.

Main rotor rpm 520.

FLYING CONTROLS: Conventional and manual.

STRUCTURE: Main frame of titanium and Ergal aluminium alloy; cabin shell of pre-preg carbon fibre, Kevlar, glass fibre/epoxy and Nomex honeycomb.

LANDING GEAR: Twin-skid type on prototypes; wheels option to be offered on production aircraft.

POWER PLANT: Two 750 cc SwissMotor two-cylinder, liquid-cooled four-stroke engines, connected through dedicated flywheel to give combined output of 101.4 kW (136 hp). FADEC system patent pending in late 2005. Fuel capacity 75 litres (19.8 US gallons; 16.5 Imp gallons).

ACCOMMODATION: Two seats side by side in fully enclosed cabin with window/door each side.

DIMENSIONS, EXTERNAL:

Main rotor diameter	6.70 m (21 ft 11¾ in)
Tail rotor diameter	1.12 m (3 ft 8 in)
Length overall	5.40 m (17 ft 8½ in)
Height: over cabin roof	1.72 m (5 ft 7¾ in)
over main rotor	2.36 m (7 ft 9 in)

DIMENSIONS, INTERNAL:

Cabin max width	1.30 m (4 ft 3¼ in)

AREAS:

Main rotor disc	35.26 m² (379.5 sq ft)
Tail rotor disc	0.98 m² (10.55 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	290 kg (639 lb)
Max T-O weight	600 kg (1,322 lb)
Max disc loading	17.01 kg/m² (3.48 lb/sq ft)

PERFORMANCE (estimated):
Never-exceed speed (VNE) ..... 102 kt (190 km/h; 118 mph)
Cruising speed at S/L, 70% power ..... 81 kt (150 km/h; 93 mph)
Max rate of climb at S/L ..... 390 m (1,280 ft)/min
Hovering ceiling: IGE ..... 4,100 m (13,450 ft)
OGE ..... 2,450 m (8,040 ft)
Max range, 20 min reserves ..... 280 n miles (520 km; 323 miles)
Endurance at cruising speed above ..... 3 h 30 min

SWISS LIGHT

SWISS LIGHT AIRCRAFT AG

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JOINT PRESIDENTS:
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Swiss Light Aircraft, formed on 3 February 2006 by three former WD customers and the company's Swiss representative, purchased the rights to the WD series of light aircraft following the latter's bankruptcy. The company expected to restart production of the Fascination D4 BK and VLA (with slight redesigns) during that year, with development on the Evolution D5 continuing. No announcement had been made regarding the Revolution D6 competition aerobatic aircraft at the time of the purchase.

Final assembly of the aircraft is likely to be undertaken in Germany.

SWISS LIGHT D4 BK FASCINATION

TYPE: Side-by-side ultralight/kitbuilt.

PROGRAMME: Original D4, of steel, wood, fabric and composites construction, designed by Jaroslav Sedáček of UL-JIH in Czech Republic; first flew in early 1996; marketed until 2006 by WD Flugzeugleichtbau of Germany; public debut (D-MOVE and D-MBWH) at the Réseau du Sport de l'Air rally at Epinal, France, in July 1996. Prototype D4 BK (D-MPMM, carrying spurious registration D-MMMM) exhibited at Aero '99, Friedrichshafen, in April 1999, shortly before maiden flight; US debut at EAA Air Venture at Oshkosh, Wisconsin, in July 2000. Production ceased 2005 with WD's bankruptcy; was due to restart late 2006.

CURRENT VERSIONS: **D4**: Initial version, last described in 1999-2000 edition. Total of 41 completed.

D4 BK: All-composites version, *as described*. BK indicates *bugrad, kraftstoff*: nosewheel, composites.

D4 Fascination VLA: Revealed at Aero '03 in mockup form; at which time certification was expected in third quarter of 2003; prototype (D-EVLA) first flew 4 October 2003 and type certificate EASA.A.019 issued 13 December 2004. Around 40 changes made compared to D4 BK; dimensions as D4 BK, except length overall 6.87 m (22 ft 6½ in). Further minor design changes envisaged by Swiss Light Aircraft.

D4 Fascination LSA: US market; generally as VLA, but fixed-pitch propeller.

D5: High-wing version; described separately.

CUSTOMERS: More than 200 sold by August 2006.

COSTS: Fully equipped D4 BK EUR84,000 excluding tax. Kit version EUR56,450 excluding tax; VLA EUR110,000 (all 2005).

DESIGN FEATURES: Wings and tail surfaces detach for storage/transport. Quoted kit build time 800 hours.

FLYING CONTROLS: Conventional and manual. Balance tabs suspended beneath each aileron; aileron gaps sealed. Horn-balanced rudder. Fowler flaps.

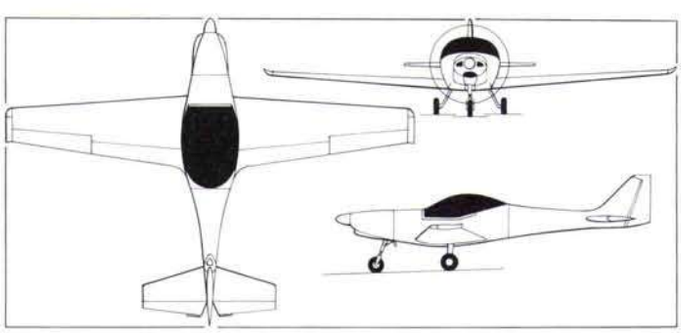
STRUCTURE: All composites.

LANDING GEAR: Standard fixed tricycle type, with nosewheel power steering. Fuselage-mounted spring cantilever mainwheel legs. Retractable optional; main units retract outwards, nosewheel rearwards. Cable-operated disc brakes.

POWER PLANT: One 59.6 kW (79.9 hp) Rotax 912 UL (standard), 73.5 kW (98.6 hp) Rotax 912 ULS (optional) or (on completion of development) 86.8 kW (116.3 hp) DZ 100 flat-four engine driving a Rospeller two-blade (912 UL) or three-blade (912 ULS) constant-speed (electric) propeller. Fuel capacity 90 litres (23.8 US gallons; 19.8 Imp gallons).

D4 Fascination VLA: One 73.5 kW (98.6 hp) Rotax 912 ULS driving a three-blade constant-speed (electric) propeller. Fuel capacity 180 litres (47.6 US gallons; 39.6 Imp gallons).

VLA version of Swiss Aircraft Fascination *(Paul Jackson)* 1159356



General arrangement of Swiss Light Aircraft Fascination D4 BK *(James Goulding)* 1133247

AVIONICS: GPS and transponder optional.

EQUIPMENT: Ballistic recovery parachute optional.

DIMENSIONS, EXTERNAL:
Wing span ..... 9.00 m (29 ft 6¼ in)
Length overall ..... 6.98 m (22 ft 10¾ in)
Height overall ..... 1.85 m (6 ft 0¾ in)

DIMENSIONS, INTERNAL:
Cockpit max width ..... 1.14 m (3 ft 9 in)

AREAS:
Wings, gross ..... 12.70 m² (136.7 sq ft)

WEIGHTS AND LOADINGS:
Weight empty: BK ..... 290 kg (639 lb)
VLA ..... 350 kg (772 lb)
Max T-O weight: BK ..... 450 kg (992 lb)
VLA ..... 650 kg (1,433 lb)

PERFORMANCE (Rotax 912 ULS):
Never-exceed speed: BK ..... 157 kt (290 km/h; 180 mph)
VLA ..... 151 kt (279 km/h; 173 mph)
Cruising speed: BK ..... 145 kt (269 km/h; 167 mph)
VLA ..... 140 kt (259 km/h; 161 mph)
Stalling speed: BK ..... 35 kt (64 km/h; 40 mph)
VLA ..... 45 kt (84 km/h; 52 mph)
Max rate of climb at S/L: BK ..... 420 m (1,378 ft)/min
VLA ..... 335 m (1,100 ft)/min
T-O run: BK ..... 77 m (250 ft)
VLA ..... 90 m (295 ft)
Landing run: BK ..... 100 m (330 ft)
VLA ..... 130 m (430 ft)
Range with max fuel: BK ..... 783 n miles (1,450 km; 901 miles)
VLA ..... 1,100 n miles (2,037 km; 1,265 miles)

SWISS LIGHT D5 EVOLUTION

US marketing name: AveoSport WD

TYPE: Side-by-side, ultralight/kitbuilt.

PROGRAMME: Announced at Aero '01 at Friedrichshafen April 2001; first flight of prototype (D-MPMM) then expected within two months but not achieved until 16 February 2002. Series production began in 2002.

CUSTOMERS: At least six built by 2005.

COSTS: Fast-build kit EUR65,450; flyaway EUR92,580; both excluding tax (2005).

DESIGN FEATURES: Utilises wings, Fowler flaps and tail surfaces of D4 Fascination. 'Glass cockpit'. Wings and tail surfaces detach for storage and transportation.

FLYING CONTROLS: Conventional and manual. Dual controls standard. Fowler flaps.

STRUCTURE: Primarily composites, with metal landing gear doors.

LANDING GEAR: Tricycle type; retractable. All three units retract rearwards, with main legs housed within lower fuselage.

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS driving Rospeller three-blade constant-speed propeller via 1:1.43 reduction gearing. Fuel capacity 120 litres (31.7 US gallons; 26.4 Imp gallons).

EQUIPMENT: Ballistic parachute recovery system optional.

DIMENSIONS, EXTERNAL:
Wing span ..... 9.10 m (29 ft 10¼ in)
Length overall ..... 6.62 m (21 ft 8½ in)
Height overall ..... 2.04 m (6 ft 8¼ in)

DIMENSIONS, INTERNAL:
Cabin max width ..... 1.25 m (4 ft 1¼ in)

AREAS:
Wings, gross ..... 10.40 m² (111.9 sq ft)

WEIGHTS AND LOADINGS:
Weight empty ..... 290 kg (639 lb)
Max T-O weight ..... 475 kg (1,047 lb)

PERFORMANCE (Rotax 912 ULS):
Max level speed ..... 157 kt (290 km/h; 180 mph)
Cruising speed ..... 146 kt (270 km/h; 168 mph)
Stalling speed ..... 35 kt (64 km/h; 40 mph)
Max rate of climb at S/L ..... 510 m (1,673 ft)/min
T-O run: solo ..... 75 m (246 ft)
dual ..... 100 m (330 ft)
Range ..... 944 n miles (1,750 km; 1,087 miles)

SWISS LIGHT REVOLUTION

TYPE: Tandem-seat sportplane kitbuilt.

PROGRAMME: Under development by 2005; scale flying model shown at Aero '05, Friedrichshafen, April 2005. To be manufactured by UL-JIH in Czech Republic. First flight was due in 2005 but did not happen due to WD's bankruptcy. Programme status unclear under new owner.

Swiss Light (WD) D5 Evolution *(Paul Jackson)* 1159357

Taiwan

AIDC

AEROSPACE INDUSTRIAL DEVELOPMENT CORPORATION

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Established 1 March 1969; became subsidiary of Chung Shan Institute of Science and Technology (CSIST) under Ministry of National Defense on 1 January 1983 and known as Aero Industry Development Center until June 1996. New 35,700 m² (384,270 sq ft) assembly facility opened in 1989. Current facilities at Taichung (28.53 ha), Kang Shan (19.16 ha) and Sha Lu (72.12 ha); total site area 119.81 ha (296.1 acres); workforce was 4,400 in mid-2001.

From 1 July 1996 was officially transferred under Ministry of Economic Affairs with title as above; completed production of IDF Ching-Kuo fighter in January 2000. AIDC is a participant (with 5 per cent share) in the Sikorsky S-92 Helibus (which see), responsible for the cockpit structure, and (from 1999) is sole-source supplier of crew and passenger doors for the S-76. Other subcontract work includes wing design and manufacture of the Ibis Aerospace Ae 270 (10 sets produced by August 2004, when production suspended); Airbus A321 (subassemblies); Boeing 747 (cabin doors); Boeing 737 (cabin and landing gear doors); Alenia C-27J Spartan (tail unit); and Bombardier Challenger 300 (rear fuselage and tail unit). Assembled 13 Bell OH-58Ds for Republic of China Army (first one delivered 16 November 1999; last in third quarter 2001). It also participates in such programmes as the Lockheed Martin F-16 combat aircraft, and the Honeywell TFE1042 and Rolls-Royce 601K gas-turbine engines. However, despite this range of work, AIDC revenue had reportedly shrunk from about USD750 million in 1999 to less than USD300 million in 2001, and additional subcontract work was sought in 2002. Bell offered AIDC a share in manufacture (tailbooms, elevators and engine cowlings) of AH-1Z and UH-1Y in September 2003, leading to agreement 27 February 2004 for initial low-rate production of 53 tailbooms and elevators, with engine cowlings contracted elsewhere. Under same agreement, AIDC to become upgrade centre for Taiwan's existing AH-1W fleet, and will be future certified maintenance centre for these aircraft. Future attack helicopter competition for Taiwan pits AH-1Z against AH-64D Apache Longbow; down-selection of winner still awaited in late 2006; up to 75 required, but armed version of Sikorsky S-70A Black Hawk reported to also be in contention at this time.

As a government-owned commercial entity, AIDC is dedicated to research and development for Taiwan's aerospace industry (military and commercial aircraft). Full privatisation, originally planned for fourth quarter of 1999, has been repeatedly postponed following a mid-2000 company restructuring based on three core activities: defence systems and technologies, aerostructures and engines. In 2002, Taiwan government set a 'must keep' privatisation deadline of December 2003, but by then had again deferred a decision by a further year or more. Further restructuring begun in July 2004 under new five-year business plan, leading to reduction in number of separate divisions from 58 to 27.

YOSHINE

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PRESIDENT: Charles Lin

Yoshine, which is a sister company of Modus Verticraft, was established to develop a safer personal helicopter equipped with a coaxial rotor. An agreement was reached with LA Systems of the UK to set up EzyCopter UK Ltd as a dealer/distributor in mid-2004. Other distributors include Helitrade (Italy), Plasgold (Philippines) and Remax (US).

EzyCopter in unmanned flight 1129246

YOSHINE EZYCOPTER

TYPE: Single-seat ultralight helicopter kitbuilt.
PROGRAMME: As of mid-2004, first of two AIDC-built prototypes was due to fly in fourth quarter of that year, and at least one has done so. Promoted also as a UAV, following a first flight in unmanned form on 24 January 2005. Production of the piloted version was planned to begin in 2005, but no evidence of kit production seen by late 2006, despite reports in 2004 of 'advance orders' for 300.
COSTS: Kit USD50,000 (2004).
DESIGN FEATURES: Few details released. Employs Yoshine YX-24 coaxial and contra-rotating rotor head with twin two-blade semi-rigid rotors. No tail rotor.
FLYING CONTROLS: Standard collective and cyclic pitch controls.
LANDING GEAR: Twin-skid type.
POWER PLANT: Offered in 2006, with following options: two 37.3 kW (50 hp) KR-RX50 single-rotor rotary engines; two 48.5 kW (65 hp) Hirth H32 two-cylinder two-strokes; or two 33.6 kW (45 hp) Mz 201 or 44.7 kW (60 hp) Mz 202 two-cylinder two-strokes.

DIMENSIONS, EXTERNAL:
Rotor diameter ..... 4.50 m (14 ft 9¼ in)
Length overall ..... 3.90 m (12 ft 9½ in)
Height overall ..... 2.50 m (8 ft 2½ in)
Skid track ..... 1.80 m (5 ft 10¾ in)
AREAS:
Rotor disc ..... 15.90 m² (171.1 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 180 kg (397 lb)
Max T-O weight ..... 300 kg (661 lb)
PERFORMANCE:
Max cruising speed ..... 65 kt (120 km/h; 75 mph)
Econ cruising speed ..... 43 kt (80 km/h; 50 mph)
Hovering ceiling: IGE ..... 2,000 m (6,560 ft)
OGE ..... 1,000 m (3,280 ft)
Endurance ..... 2 h

Turkey

ALP

ALP HAVACILIK (ALP AVIATION)

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Web: www.alp.com.tr
CHAIRMAN: Tuncer Alpata
MANAGING DIRECTOR: Senay Idil

Formed 29 July 1999 as joint venture company by Sikorsky Aircraft Turkey Inc and The Alpata Group (50 per cent each) to manufacture high-technology, precision-machined aerospace and defence components and assemblies for global market in modern 6,500 m² (70,000 sq ft) facility; site area approx 34,000 m² (36,600 sq ft). Company has 26 CNC machine tools and 2004 workforce of 142. Revenue for 2004 was USD6.5 million.

Alp manufactures components for both aircraft and aero-engines, including Sikorsky S-70 Black Hawk and Seahawk, S-76 and S-92, Boeing 737 and Lockheed Martin F-135 Joint Strike Fighter. As of 2006 it had 11 international and domestic customers, including Sikorsky Aircraft, Pratt & Whitney, Kaman Aerospace, Aero Vodochody and Goodrich Landing Gear Systems.

TAI

TURKISH AEROSPACE INDUSTRIES (TUSAS HAVACILIK VE UZAY SANAYII A S)

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Bekir Ata Yilmaz (Programmes)
Ahmet Tokmakcioglu (Quality Assurance Group Manager)
Oktay Ince (Information Technologies Manager)
MARKETING MANAGER: Yilmaz Güldoğan
PUBLIC RELATIONS CO-ORDINATOR: Nursel Köran
PUBLIC RELATIONS SPECIALIST: Mrs Bican Çelik Ates

Tusas Aerospace Industries Inc (TAI), the centre of technology in design, development, manufacturing, integration of aerospace systems, modernisation and after-sales support in Turkey, was established under the Turkish Commercial Code and Foreign Investment Encouragement Law on 15 May 1984. At the 'share Purchase Agreement' signing ceremony held at TAI facilities on 12 January 2005, Lockheed Martin of Turkey Inc (42 per cent) and

General Electric International Inc (7 per cent) shares of TAI were transferred to Turkish Aircraft Industries Inc (Tusas). Turkish Aircraft Industries Inc (Tusas) and Tusas Aerospace Industries Inc (TAI) merged under the roof of TAI on 28 April 2005. The shareholders of the company are: Turkish Armed Forces Strengthening Foundation (TSKGV); Undersecretariat for Defense Industries (SSM); and Turkish Aeronautical Association (THK). Workforce in March 2006 was 2,184.

Located in Ankara, TAI facilities cover an area of 500 ha (1,235 acres) with an industrial facility of 150,000 m² (1.6 million sq ft) under roof. The company has a modern aircraft facility furnished with high technology machinery and equipment that provide extensive manufacturing capabilities ranging from parts manufacturing to aircraft assembly, flight tests and delivery. Quality system of the company meets the stringent world standards including NATO AQAP-110, ISO-9001:2000, AS EN 9100 and AECMA-EASE.

TAI's experience includes co-production of F-16 fighters, CN-235 light transport/maritime patrol/surveillance aircraft, SF-260 trainers, Cougar AS 532 search and rescue (SAR), combat search and rescue (CSAR) and utility helicopters as well as design and development of unmanned aerial vehicles, target drones and agricultural aircraft. Moreover TAI is the prime contractor of the Turkish unmanned aerial vehicle programme.

TAI's core business also includes modernisation, modification and systems integration programmes and after-sales support of both fixed- and rotary-wing military and commercial aircraft in the inventory of Turkey and friendly countries. Major programmes are electronic warfare retrofit and structural modifications on TuAF F-16s, modification of the S-2E Tracker maritime patrol aircraft into fire fighting aircraft, Black Hawk modifications for Special Forces, modification of CN-235 platforms for MPA/MSA missions for the Turkish Navy and Coast Guard, modification and modernisation of Cougar AS 532, 'glass cockpit retrofit of S-70 helicopters, as well as structural modification and systems integration activities required for the conversion of B737-700 aircraft into AEW&C aircraft. By utilising capabilities of the Turkish Armed Forces' Maintenance Centres, TAI also gives maintenance, repair and overhaul services to its customers.

TAI is engaged in manufacturing aerostructures for fixed- and rotary-wing, military and commercial aircraft for worldwide customers. The company's experience in the aircraft and aerostructures manufacturing business makes it a uniquely qualified partner of Agusta, Airbus, Boeing, CASA, Eurocopter, Lockheed Martin, Northrop Grumman, Sikorsky, Sonaca and many more. TAI manufactures section 18 fuselage panels for Airbus A319/320/321, wingtips and flight deck panels for Boeing 737, rear doors and engine cowlings for Eurocopter EC-135 helicopters, horizontal stabilisers, tail rotor pylons and tailbooms for Sikorsky S-70A and MH-60 helicopters, horizontal stabilisers for Sikorsky S-76 helicopters and AB139 fuselages for Agusta. Furthermore, TAI, which manufactures nose landing gear doors for B747, dorsal fin for B777 and parts/subassembly parts for B737/767/777, manufactures seven components of the Cougar AS-532.

As a full member of Airbus Military SAS, TAI is engaged (7.15 per cent work share) in the development of the A400M, for which it will produce forward centre and rear upper fuselages, ailerons, spoilers, paratroop doors, hatches and tailcone. Its first components for this programme were shipped to Bremen in 2006: a rear fuselage upper shell on 4 April and a forward centre fuselage on 7 July. In 2002 it became the seventh international participant in the Lockheed Martin JSF programme.

TAI HURKUS

TYPE: Basic turboprop trainer.

PROGRAMME: Primary Trainer Aircraft Design and Development protocol signed 28 September 2005 by Undersecretariat for Defence Industries (SSM) and TAI, initiating eight-month design phase. However, this superseded by new protocol of 15 March 2006, now retitled Primary and Basic Trainer Aircraft Development Programme, starting eight-month conceptual design phase of an overall 59-month programme. Latter calls for two flying and two static/fatigue test prototypes. Named in December 2006 after Vecihi Hurkus, a veteran contributor to Turkish aviation history, marking beginning of preliminary design phase.

DESIGN FEATURES: Specification calls for a single-turboprop aircraft with tandem seating, zero/zero ejection seats, pressurised cockpits, anti-*g* and oxygen systems, and ability to perform primary and basic training functions of SF-260 and T-37. Objectives include EASA certification and export sales.

Conceptual profile of TAI primary/basic trainer 1158856

Ukraine

AEROKOPTER

AEROKOPTER OOO (AEROCOPTER LTD)

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Web: www.copter.com.ua
SALES DIRECTOR: Aleks Miroshnichenko

Aerokopter was established on 14 December 1999 by I V Polituchy, A N Zapishny and A I Polituchy to develop light rotorcraft. It was briefly associated with what, on 3 May 2000, became the separate Aviaimpex design bureau, also active in Ukraine. First product was ZA-6 (or AK1-5) San'ka proof-of-concept light helicopter, now known to have flown for the first time on 12 October 2001.

Factory floor area 1,200 m² (12,900 sq ft).

AEROKOPTER AK1-3

TYPE: Two-seat helicopter/kitbuilt.

PROGRAMME: Derived from company's ZA-6 San'ka demonstrator via five-blade AK1-5 (GL-0478), which was shown at Manufacturing & Security Exhibition, Kiev, September 2002, but did not proceed further. Incomplete AK1-3 prototype shown at same event, eventually flying in July 2003.

South African marketing began in 2006, for import only in factory-built guise.

CURRENT VERSIONS: **AK1-3:** *As described.*

AK1-3SKh: Agricultural version with spraybars and tank. Promoted in West as AK1-3CX, the untransliterated cyrillic designation.

CUSTOMERS: First production batch of five began in 2005. Target manufacture of 10 in 2006, including five earmarked for South Africa.

COSTS: USD135,000 flyaway; USD110,000 kit (both 2006).

DESIGN FEATURES: Pod-and-boom configuration with three-blade, bearlingless main rotor and two-blade anti-torque rotor to starboard. Conforms to AP-27 certification criteria. Service life 2,000 hours.

Power transfer from engine to conical reduction gear drive-shaft via seven V-belts, flexible rubber clutch and freewheel roller clutch. Reduction gearbox at tail rotor.

Main rotor blade section NACA 63012/63015; non-linear twist –9° 30'; tip velocity 205 m (673 ft)/s. Tail rotor blade section NACA 63012; tip velocity 186 m (610 ft)/s.

FLYING CONTROLS: Conventional and manual.

STRUCTURE: Main rotor blades of T-25 glass fibre; tail rotor of metal alloy and Rohacell styrofoam. Airframe basic structure, including skids, of welded 30 HGSA GOST 4543-86 steel, plus D-16T GOST 4784-97 alloy and VT3-1 GOST 19807-91 titanium; pod of carbon-Kevlar cloth, with acrylic transparencies and 16 mm (⅝ in)plywood floor; steel rotor hubs; tailboom of riveted steel plate.

LANDING GEAR: Skid type; fixed.

POWER PLANT: One 123 kW (165 hp) Subaru EJ-25 liquid-cooled, flat-four piston engine. Fuel tank between engine and cockpit; capacity 80 litres (21.1 US gallons; 17.6 Imp gallons) of which 75 litres (19.8 US gallons; 16.5 Imp gallons) usable.

ACCOMMODATION: Two crew, side by side on fixed seats. Cockpit heated and ventilated.

SYSTEMS: Electrical system 12 V and 27 V DC, plus 36 V 400 Hz three-phase AC, with 70 A generator and 60 Ah battery.

DIMENSIONS, EXTERNAL:

Main rotor diameter	6.84 m (22 ft 5¼ in)
Main rotor blade chord	0.17 m (6¾ in)
Tail rotor diameter	1.29 m (4 ft 2¾ in)
Tail rotor blade chord	0.115 m (4½ in)
Length: overall, rotors turning	8.095 m (26 ft 6¾ in)
fuselage	5.805 m (19 ft 0½ in)
Height overall	2.27 m (7 ft 5¼ in)
Skid track	1.645 m (5 ft 4¾ in)
Skid length	1.825 m (5 ft 11¾ in)
Distance between rotor centres	4.025 m (13 ft 2½ in)
Doors (two): Max height	1.00 m (3 ft 3¼ in)
Max width	0.95 m (3 ft 1½ in)

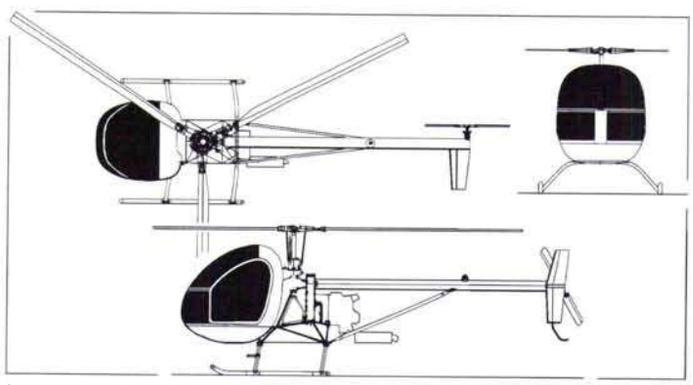
DIMENSIONS, INTERNAL:

Cockpit: Length	1.50 m (4 ft 11 in)
Max width	1.355 m (4 ft 5¼ in)
Max height	1.20 m (3 ft 11¼ in)

AREAS:

Main rotor disc	36.75 m² (396 sq ft)

Aerokopter AK1-3 light helicopter 1159007



Aerokopter AK1-3 (Subaru EJ-25 engine) *(Paul Jackson)* 1128986

Tail rotor disc ..... 1.29 m² (13.89 sq ft)
Fins (total) ..... 0.27 m² (2.91 sq ft)
Horizontal stabilisers (total) ..... 0.15m² (1.61 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 380 kg (838 lb)
Max T-O weight ..... 650 kg (1,433 lb)
Max zero-fuel weight ..... 590 kg (1,301 lb)
PERFORMANCE:
Never-exceed speed (VNE) ..... 102 kt (189 km/h; 117 mph)
Max operating speed ..... 100 kt (186 km/h; 115 mph)
Cruising speed: at 75% power ..... 85 kt (157 km/h; 98 mph)
econ ..... 65 kt (120 km/h; 75 mph)
Max rate of climb at S/L ..... 540 m (1,771 ft)/min
Hovering ceiling: IGE ..... 2,320 m (7,620 ft)
OGE ..... 1,800 m (5,905 ft)
Service ceiling ..... 5,150 m (16,900 ft)
Range: at 75% power ..... 172 n miles (320 km; 198 miles)
at econ speed ..... 189 n miles (350 km; 217 miles)
g limits ..... +0.5/+2.5

AEROPRAKT

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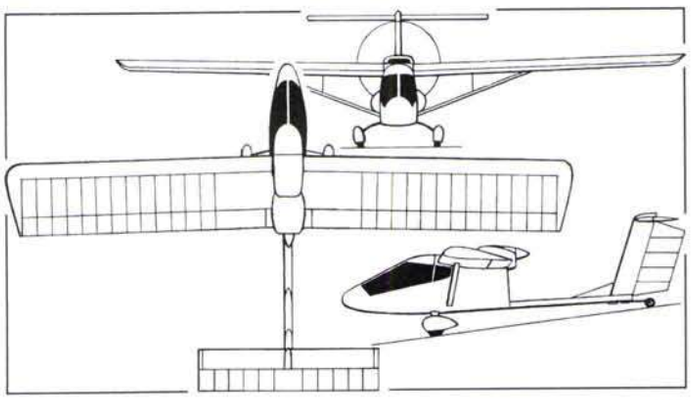
SALES MANAGER: Shawn Okun

Aeroprakt was formed in Kiev in 1986, after Yuri Yakovlev, who had designed the T-8 lightplane for the Aeropract organisation of Samara, Russia, was invited to work at Antonov ASTC. Yakovlev then produced the A-20 Chervonets and joined with fellow engineer Oleg Litovchenko in an initially part-time venture. Established in present, commercial form in 1991. Retaining the 'k for Kiev' in its name, the company now employs only even-numbered designations for its aircraft, the latest to fly being the A-28. Company has agencies in Australia, Belgium, Canada, Denmark, Germany, Iran, Italy, Latvia, New Zealand, Poland, Russia, South Africa, Spain, Turkey, UAE, UK and USA.

Design and production personnel total 50; factory space 2,000 m² (21,525 sq ft), although some production subcontracted to Aviant and Antonov. Test and associated flying club airfield at Nalivaykovka. More than 100 Aeroprakt aircraft have been constructed and the A-20 continues in production.



Aeroprakt-20 general arrangement *(James Goulding)* 1158778

SA-20 Vista *(Paul Jackson)* 0525065

AEROPRAKT-20R912 SKY CRUISER

US marketing names: Vista Cruiser and Varlet

TYPE: Tandem-seat ultralight/kitbuilt.

PROGRAMME: Design started September 1990; Aeroprakt-20 powered by 37.0 kW (49.6 hp) Rotax 503; construction of prototype began November 1990; first flight 5 August 1991; construction of first production aircraft started September 1991, first flown 15 August 1993; prototype appeared abroad for first time in Hodkovice, Czech Republic, at European Microlight Championship, August 1993, gaining ninth place; fourth production A-20 won third place at World Microlight Championship, Poznan, Poland, August 1994; seventh production A-20 gained second place at EMC '95, Little Rissington, UK; initial production aircraft was placed first at EMC, Hungary, 2002.

Increased engine power provided by flat-four Rotax 912 produced A20-R912, alternatively designated Aeroprakt-20M. Construction of prototype Sky Cruiser began February 1997; first flight 11 May 1997. Gained second place in 1st World Air Games, Turkey, September 1997; second place in 1998 World Microlight Cup, Hungary; and third place, 2nd World Air Games, Spain.

CURRENT VERSIONS: **Vista Cruiser:** Baseline version. *As described.*

CUSTOMERS: First customer delivery of A-20 in August 1993; exports to Czech Republic, Germany, Hungary, Jordan, Poland, Russia, Singapore and United Arab Emirates; last-

Spectrum Aircraft SA-20 Vista Cruiser 1151715

mentioned acquired seven for Umm-al Qaiwain Flying Club. Total of 47 A-20s of all types produced by early 2006, including 13 of A-20R912 version.

COSTS: Quick-build kit (40 hours) including engine, propeller and instruments (2004): Vista Cruiser, USD48,500; Super Cruiser USD51,000; Varlet USD57,800 (2005).

DESIGN FEATURES: High-wing, T-tail configuration, optimised for rapid disassembly for transport by trailer. Tail surfaces mounted on aluminium tube which detaches at joint with the nacelle.

Unswept wing on A-20; P-IIIa-15 wing section, thickness/chord ratio 15 per cent; chamfered tips; dihedral 1° 30'; incidence at roots 3° 30', twist 3°.

A-20R912 has increased power, shorter wing and tailplane spans, engine cowling, constant-speed propeller, fully balanced control surfaces, smaller wheels and more streamlined wing struts and landing gear. Sweepback 1° 30'.

FLYING CONTROLS: Manual. Single-piece, rod-operated flaperons extend full length of wing trailing-edge; no tabs. Single-piece, horn-balanced elevator with protruding, in-flight adjustable tab. Full-height rudder with no tab.

STRUCTURE: Riveted aluminium wing structure; leading-edge D box closed by I-section main spar; stamped wing ribs; bent sheet rear false spar; partially fabric covered. Control surfaces similar to wings. All-composites honeycomb sandwich fuselage pod.

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted spring cantilever mainwheel legs with wheel fairings. Steerable tailwheel.

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS flat-four driving a three-blade Ivoprop constant-speed propeller. Standard fuel capacity (US versions) 85 litres (22.5 US gallons; 18.7 Imp gallons). Optional capacity 128 litres (33.8 US gallons; 28.8 Imp gallons).

EQUIPMENT: Ballistic recovery parachute.

DIMENSIONS, EXTERNAL:

Wing span	10.17 m (33 ft 4½ in)
Length overall	6.72 m (22 ft 0½ in)
Height: cabin roof	1.68 m (5 ft 6¼ in)
propeller turning	2.33 m (7 ft 7¾ in)

DIMENSIONS, INTERNAL:

Cockpit max width	0.64 m (2 ft 1¼ in)

AREAS:

Wings, gross	14.00 m² (150.7 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	249 kg (550 lb)
Max T-O weight	455 kg (1,003 lb)

PERFORMANCE:

Max level speed	113 kt (210 km/h; 130 mph)
Cruising speed	100 kt (185 km/h; 115 mph)
Stalling speed, landing configuration	30 kt (55 km/h; 34 mph)
Max rate of climb at S/L	360 m (1,181 ft)/min
T-O run	61 m (200 ft)
Landing run	77 m (250 ft)
Range	608 n miles (1,126 km; 700 miles)
Endurance	12 h 0 min
g limits	+4/−2

AEROPRAKT-22

French marketing name: Vision
Russian name: Sharik (Balloon)
UK marketing name: Foxbat
US marketing name: Valor

TYPE: Side-by-side ultralight/kitbuilt.

PROGRAMME: Design started February 1990, construction of prototype began September 1994; first flight 21 October 1996; certified to German BFU-95; production began in early 1999 with c/n 003. Approved for kit assembly in UK.

CURRENT VERSIONS: **Aeroprakt-22 Sharik:** Original version, with 59.6 kW (70.9 hp) Rotax 912 UL engine and fuselage fuel tank.

Following versions have uprated engine.

Foxbat: UK version, marketed from 2000 by Small Light Aeroplane Company Ltd and, later, Dragon Aviation (www.foxbat.co.uk). Prototype, G-FBAT (16th airframe) first flown after kit assembly in UK 12 August 2000. BCARS certification in early 2002; by 2006, 20 had been built under auspices of PFA.

Valor: US version. Standard with Rotax 912 UL engine; option of Rotax 912 ULS and 9.44 m (30 ft 11¾ in) wing span. One only by 2006.

Vision: Marketed in France and Belgium by Aerotrophy of Montagu.

Description applies to Valor.

CUSTOMERS: More than 146 A-22s built by early 2006 and delivered to Australia, France, Georgia, Germany, Ireland, Italy, Latvia, Luxembourg, Mexico, New Zealand, Poland, Russia, South Africa, UAE, UK and USA.

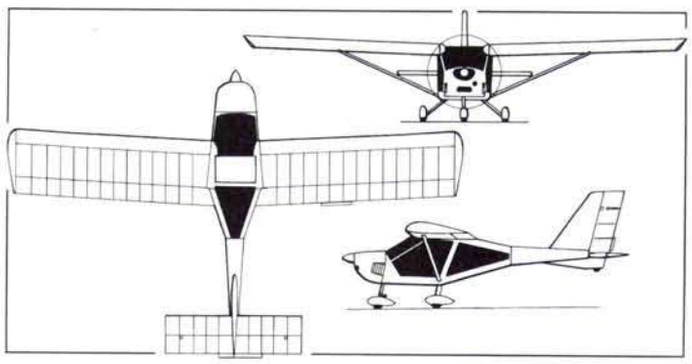
COSTS: UK kit cost GBP32,500 including Rotax 912 ULS engine and Newton propeller, builder's assistance, basic instruments and tax (2006). US cost USD58,469 plus tax and shipping, flyaway with Rotax 912 ULS (2006).

DESIGN FEATURES: Constant-chord wings and horizontal tail surfaces. Wings swept forward 2° 30'; P-IIIa-15 wing section, thickness/chord ratio 15 per cent; chamfered tips; dihedral 1° 30'; incidence at root 4°; twist 2° 30'.

FLYING CONTROLS: Manual, by pushrods and cables. Full-span slotted flaperons with trim tab to starboard; single-piece elevator with tab; and sweptback rudder with ground-adjustable tab.

STRUCTURE: Riveted aluminium wing structure; leading-edge D box closed by I-section main spar; stamped wing ribs; bent sheet rear false spar; Ceconite covering on wings (except metal leading-edge), rudder and elevator. Fin and tailplane similar to wings. Anodised aluminium fuselage with profiled sheet and fluted skin, stamped bulkheads, steel and aluminium tubing. Extensive glazing. Glass fibre engine cowling, wheel spats, wing fillets and fintip.

Sole Aeroprakt SA-22 Valor on US civil aircraft register *(Paul Jackson)* 1159070



Aeroprakt-22 ultralight *(James Goulding)* 1158779

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring steel mainwheel legs with wheel fairings. Hydraulic mainwheel brakes. Steerable nosewheel; small tailwheel protects ventral strake from nose-high landings.

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS or 59.6 kW (79.9 hp) Rotax 912 UL flat-four driving a KievProp three-blade ground-adjustable pitch propeller or (Foxbat) Newton two-blade. Fuel tank in each wingroot; combined capacity 90 litres (23.8 US gallons; 19.8 Imp gallons). Optional capacity 135 litres (35.6 US gallons; 29.7 Imp gallons).

ACCOMMODATION: Two persons, side by side. Large upward-hinged window/door on each side.

EQUIPMENT: Ballistic parachute.

Note that data vary slightly between German, UK and US variants.

DIMENSIONS, EXTERNAL:

Wing span	10.10 m (33 ft 1¾ in)
Length overall	6.30 m (20 ft 8 in)
Height overall	2.40 m (7 ft 10½ in)
Tailplane span	3.00 m (9 ft 10 in)
Propeller diameter	1.68 m (5 ft 6 ¼ in)

DIMENSIONS, INTERNAL:

Cabin: Length	1.60 m (5 ft 3 in)
Max width	1.30 m (4 ft 3¼ in)
Height	1.10 m (3 ft 7¼ in)

AREAS:

Wings, gross	13.70 m² (147.5 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, equipped	260 kg (573 lb)
Max T-O weight	450 kg (992 lb)

PERFORMANCE (Rotax 912 UL):

Max level speed	92 kt (170 km/h; 106 mph)
Cruising speed	86 kt (160 km/h; 99 mph)
Stalling speed	30 kt (55 km/h; 35 mph)
Max rate of climb at S/L	300 m (984 ft)/min
T-O and landing run	90 m (295 ft)
Range with max fuel	594 n miles (1,100 km; 683 miles)
g limits	+4/−2

AEROPRAKT-24

US marketing name: Viking

TYPE: Three-seat amphibian kitbuilt.

PROGRAMME: Design began September 2000; first flight 25 October 2001.

CURRENT VERSIONS: **Viking:** *As described*

Twin Viking: Twin-engined version; programme currently suspended. Two Rotax 582s, each 47.8 kW (64.1 hp); empty weight 431 kg (950 lb); MTOW 726 kg (1,600 lb); max level speed 87 kt (161 km/h; 100 mph); T-O run 138 m (450 ft); stalling speed 33 kt (62 km/h; 38 mph).

CUSTOMERS: Nine sold by early 2006. US availability to special order only. Fifth aircraft received Canadian registration (C-FGDY) in December 2005; MTOW of this aircraft officially 793 kg (1,750 lb).

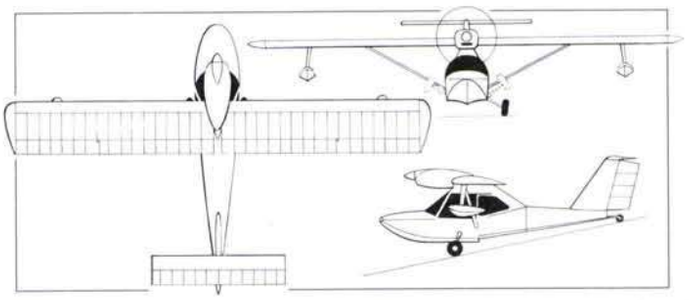
COSTS: USD84,995, complete, quick-build, plus tax (2006). Basic kit USD39,000, plus tax (2004).

DESIGN FEATURES: Braced high-wing monoplane, capable of meeting JAR-VLA certification criteria, which not yet pursued. Several detail changes from version promoted in late 1990s, but not built, including weight in Experimental category; single bracing strut and jury strut each side; flying-boat hull with single step; sweptback vertical tail with unswept horizontal surfaces at tip.

Wing section P-IIIa-15; no dihedral; incidence 4° 30' at mean aerodynamic chord; twist −3°.

FLYING CONTROLS: Conventional and manual.Mass-balanced ailerons and elevator; ailerons and flaps separate, and both slotted; flap deflections 10, 20 and 30°. Actuation by pushrods, except cable-operated rudder and elevator trim tab.

Aeroprakt-24 three-seat amphibian 1158853



Aeroprakt-24 kitbuilt amphibian *(James Goulding)* 0558328

STRUCTURE: Generally as for A-20 and A-22. Hull and integral fin of glass fibre and epoxy resin sandwich with foam core, reinforced by internal bulkheads and beams forming three separate, watertight compartments. Engine and metal wing, with fabric covering, both attached to central, metal box-pylon supported by two stainless steel bracing struts within the cabin. Composites floats constructed integrally with pylons. Metal tailplane with fabric covering.

LANDING GEAR: Tailwheel type, with retractable, but externally stowed, Matco 6.00-6 mainwheels with disc brakes. Faired tailwheel doubles as water rudder. Cantilever spring steel mainwheel legs attached to hull bulkhead. Initial manual retraction replaced by electric motor from 2004. Stabilising float under each outer wing.

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS or 84.5 kW (113.3 hp) Rotax 914 flat four projecting from wing centre-section. Fuel capacity 87 litres (23.0 US gallons; 19.1 Imp gallons) in tank behind cabin. Optionally, to provide additional baggage capacity, fuselage tank replaced by two wing tanks, combined capacity 90 litres (23.8 US gallons; 19.8 Imp gallons).

ACCOMMODATION: Two seats forward; removable seat at rear of cabin. Sliding door each side openable in flight. Luggage stowage in forward watertight compartment; accessed via door in upper surface.

DIMENSIONS, EXTERNAL:

Wing span	11.12 m (36 ft 5¾ in)
Wing chord, constant	1.40 m (4 ft 7 in)
Wing aspect ratio	8.0
Length overall	7.29 m (23 ft 11 in)
Height: top of engine cowlings	2.45 m (8 ft 0½ in)
propeller turning	3.19 m (10 ft 5½ in)
Tailplane span	3.60 m (11 ft 9¾ in)
Tailplane chord, constant	0.80 m (2 ft 7½ in)
Wheelbase	4.62 m (15 ft 2 in)
Wheel track	1.60 m (5 ft 3 in)
Propeller diameter	1.70 m (5 ft 7 in)
Cabin doors (each): Height	0.63 m (2 ft 0¾ in)
Width	1.00 m (3 ft 3¼ in)

DIMENSIONS, INTERNAL:

Cabin: Length	2.20 m (7 ft 2½ in)
Max width	1.10 m (3 ft 7¼ in)
Max height	1.20 m (3 ft 11¼ in)
Forward baggage hold: Length	0.90 m (2 ft 11½ in)
Max width	1.05 m (3 ft 5¼ in)
Max height	0.75 m (2 ft 5½ in)
Volume	0.15 m³ (5.3 cu ft)

AREAS:

Wings, gross	15.50 m² (166.8 sq ft)
Ailerons (total)	1.78 m² (19.16 sq ft)
Trailing edge flaps (total)	2.44 m² (26.26 sq ft)
Fin	1.05 m² (11.30 sq ft)
Rudder	0.72 m² (7.75 sq ft)
Tailplane	2.88 m² (31.00 sq ft)
Elevator, incl tab	1.44 m² (15.50 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	440 kg (970 lb)
Max T-O weight	750 kg (1,653 lb)
Max wing loading	50.0 kg/m² (10.24 lb/sq ft)
Max power loading:	
Rotax 912	10.20 kg/kW (16.76 lb/hp)
Rotax 914	8.88 kg/kW (14.59 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	97 kt (180 km/h; 112 mph)
Max level speed	89 kt (165 km/h; 103 mph)
Stalling speed: flaps up	46 kt (85 km/h; 52 mph)
flaps down	38 kt (70 km/h; 43 mph)
Max rate of climb at S/L	240 m (787 ft)/min
Service ceiling	3,500 m (11,480 ft)
T-O and landing run: land	150 m (492 ft)
water	200 m (660 ft)
Range with max fuel	432 n miles (800 km; 497 miles)
Endurance	4 h 30 min
g limits	+4/−2

AEROPRAKT-26

US marketing name: Twin Vista

TYPE: Tandem-seat ultralight twin/kitbuilt.

PROGRAMME: Development of A-20 with two engines; commissioned by Gulf Aviation Technologies; prototype construction began March 1996; first flight 18 November 1997. Initially marketed in US as Vulcan.

CURRENT VERSIONS: **SA-26 Twin Vista:** Lower-powered variant; Rotax 503 engines. Marketed in US by Spectrum Aircraft.

Twin Vista SS: With Rotax 582 engines.

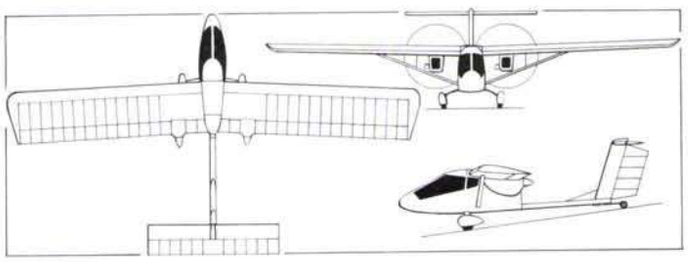
Vulcan: Aeroprakt-36; *described separately*.

CUSTOMERS: Total 16 sold by 2006 to customers in Guatemala, Panama, UAE and USA. No recent manufacture known.

COSTS: Vista SS USD59,999; including engines, propellers, basic digital instruments, paint and fabric (2006).

Description of A-20 applies generally, except as below.

Aeroprakt-26 Twin Vista 1159009



Aeroprakt-26 twin-engined ultralight *(James Goulding)* 0051502

DESIGN FEATURES: Introduces twin-engine safety margins to A-20 design; able to take off on one engine. Sweepback increased to 3°; tailfin height and rudder chord both increased.

POWER PLANT: Two 47.8 kW (64.1 hp) Rotax 582 UL two-cylinder two-stroke engines, each driving a three-blade, ground-adjustable pitch Ivoprop propeller. Alternatively, two 38.3 kW (51.6 hp) Rotax 462 or 34.0 kW (45.6 hp) Rotax 503 twin-piston engines. Fuel capacity 90 litres (23.8 US gallons; 19.8 Imp gallons) standard; 180 litres (47.5 US gallons; 39.6 Imp gallons) optional in Twin Vista SS.

SYSTEMS: Electrical system with 12 V DC, 14 Ah battery for electric starter.

DIMENSIONS, EXTERNAL:

Wing span	11.34 m (37 ft 2½ in)
Length: fuselage	5.75 m (18 ft 10½ in)
overall	6.72 m (22 ft 0½ in)
Height overall	1.90 m (6 ft 2¾ in)
Propeller diameter	1.70 m (5 ft 7 in)

DIMENSIONS, INTERNAL:

Cabin: Length	2.20 m (7 ft 2½ in)
Max width	0.64 m (2 ft 1¼ in)
Max height	1.20 m (3 ft 11¼ in)

AREAS:

Wings, gross	15.70 m² (169.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: Twin Vista	300 kg (660 lb)
Twin Vista SS	318 kg (701 lb)
Max T-O weight	550 kg (1,212 lb)[1]

[1] *or local ultralight limit*

PERFORMANCE (Twin Vista SS):

Max level speed	97 kt (180 km/h; 112 mph)
Normal cruising speed	96 kt (177 km/h; 110 mph)
Stalling speed, landing configuration	30 kt (55 km/h; 34 mph)
Max rate of climb at S/L	549 m (1,800 ft)/min
T-O run	31 m (100 ft)
Landing run	107 m (350 ft)
Range with normal fuel	173 n miles (321 km; 200 miles)
Endurance	6 h 0 min
g limits	+4/−2

AEROPRAKT-30

TYPE: Tandem-seat ultralight.

PROGRAMME: No details officially released, but a photograph has been circulated of (apparently) second prototype LA-3002 showing close similarity to A-20, except for a three-blade scimitar propeller.

Aeroprakt-30 registered LA-3002 1158851

AEROPRAKT-36

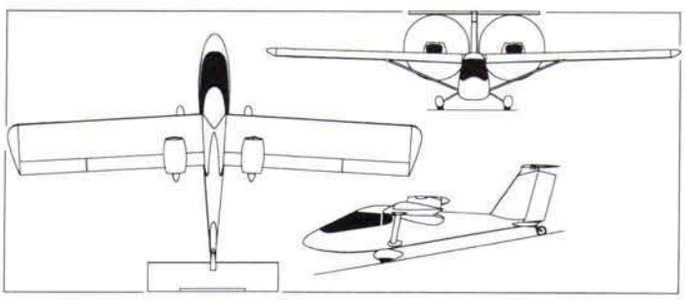
US marketing name: Vulcan

TYPE: Tandem-seat twin/kitbuilt.

PROGRAMME: Commissioned by Spectrum Aircraft of US in February 2002; design began September 2002; cockpit mockup approved December 2002; assembly of prototype began May 2003; first flight, at Nalivaykovka, 19 September 2004. Kit-deliveries began immediately. Promoted at AirVenture, Oshkosh, July 2003. Development of Aeroprakt-26 Vulcan.

CUSTOMERS: Two orders from UAE, of which one delivered by 2006.

Prototype Aeroprakt-36 Vulcan 1159010



Aeroprakt-36 Vulcan *(Paul Jackson)* 0580702

COSTS: USD118,000, plus tax (2006).

DESIGN FEATURES: Generally as for A-26, but with two close-centreline-thrust engines. Wing section P-IIIa-15; dihedral 1° 30'; incidence 2° 30' at mean aerodynamic chord; twist 3°; sweptback 3°.

FLYING CONTROLS: Manual, mass-balanced ailerons, rudder and all-moving tailplane with integral, electric anti-balance/trim tab. Flaps; deflections 10, 20, 30 and 40°. Actuation by pushrods, except cables for mid-portion of tailpane linkage.

STRUCTURE: Single-spar, strut-braced wing of aluminium alloy with steel fittings; composites wingtip and leading-edge, latter forming fuel tank; aluminium alloy bracing struts with composites end fairings. Forward and centre fuselage of glass fibre and foam sandwich monocoque, reinforced by bulkheads and beams, with frames and stringers, plus integral fin and rudder, both of aluminium. Single-spar, all-moving tailplane of aluminium, except composites mass-balance fairing. All control surfaces aluminium-skinned.

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted, spring cantilever mainwheel legs with speed fairings and Matco 6.00-6 wheels with disc brakes. Steerable tailwheel; 3.00-4.

POWER PLANT: Two 73.5 kW (98.6 hp) Rotax 912 ULS flat-four piston engines driving two-blade, pusher propellers. Fuel tanks in inboard wing leading edges, combined capacity 120 litres (31.7 US gallons; 26.4 Imp gallons).

ACCOMMODATION: Two in tandem. Starboard-hinged canopy replaceable by stub windscreen for open-cockpit flying. Rear baggage compartment with 56 cm (1 ft 6 in) square external door, port.

DIMENSIONS, EXTERNAL:

Wing span	11.395 m (37 ft 4½ in)
Wing chord, constant	1.40 m (4 ft 7 in)
Wing aspect ratio	8.4
Length: fuselage	7.10 m (23 ft 3½ in)
overall	7.34 m (24 ft 1 in)
Height overall	2.30 m (7 ft 6½ in)
Tailplane span	3.60 m (11 ft 9¾ in)
Propeller diameter	1.80 m (5 ft 10¾ in)

DIMENSIONS, INTERNAL:

Cockpit: Length	2.15 m (7 ft 0¾ in)
Max width	0.70 m (2 ft 3½ in)
Max height	1.10 m (3 ft 7¼ in)

AREAS:

Wings, gross	15.40 m² (165.8 sq ft)
Ailerons (total)	1.54 m² (16.58 sq ft)
Flaps (total)	2.72 m² (29.28 sq ft)
Fin	0.97 m² (10.44 sq ft)
Rudder	0.73 m² (7.86 sq ft)
Tailplane	2.88 m² (31.00 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	450 kg (992 lb)
Max T-O weight	750 kg (1,653 lb)
Wing loading	47.8 kg/m² (9.79 lb/sq ft)
Power loading	5.10 kg/kW (8.38 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	156 kt (290 km/h; 180 mph)
Max level speed	140 kt (260 km/h; 162 mph)
Cruising speed at 75% power	119 kt (220 km/h; 137 mph)
Econ cruising speed	97 kt (180 km/h; 112 mph)
Stalling speed: flaps up	46 kt (85 km/h; 53 mph)
flaps down	37 kt (67 km/h; 42 mph)
Max rate of climb at S/L	660 m (2,165 ft)/min
Rate of climb at S/L, OEI	240 m (787 ft)/min
Service ceiling	8,535 m (28,000 ft)
Service ceiling, OEI	4,500 m (14,760 ft)
T-O run	120 m (395 ft)
T-O to 15 m (50 ft)	200 m (660 ft)
Landing from 15 m (50 ft)	300 m (985 ft)
Landing run	150 m (495 ft)
Range, 30 min reserves	513 n miles (950 km; 590 miles)
Endurance	6 h
g limits	+4.4/−1.76

ANTONOV

NATSIONAL'NAYA KORPORATSIA SAMOLET-ZDANI ANTONOVA (ANTONOV NATIONAL AIRCRAFT-BUILDING CORPORATION)

GENERAL DIRECTOR: Anatoly Myalitsa

On 14 July 2005, Ukrainian parliament approved plans for creation of 'National Amalgamation Antonov' which to encompass Antonov design bureau; formerly separate aircraft building plants at Kiev and Kharkov; and No 410 Civil Aviation Depot at Kiev. New grouping to employ 20,000 workers and be augmented at later stage by UkrNIIAT (state scientific research institute for aviation technologies).

By mid-2006, Antonov Corporation was controlling central revenues, although existing contracts were still being fulfilled by individual companies, and few steps taken towards formulation of unified strategy and funding plan.

AVIATSIONNY NAUCHNO-TEKHNICHESKY KOMPLEKS imeni O K ANTONOVA (Aviation Scientific-Technical Complex named for O K Antonov)

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e-mail: info@antonov.com
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Antonov An-32s being completed for Libya from stock airframes held by Aviant 1158190

GENERAL DESIGNER: Dmytro S Kiva
FIRST DUPTY GENERAL DESIGNER: Volodymir Shmiryov
EXECUTIVE DIRECTOR, ANTONOV AIRLINES: Konstantin F Lushakov
HEAD OF MARKETING AND SALES: Alexander Kiva
PUBLIC RELATIONS OFFICER: Andrey Sovenko

Antonov OKB was founded by a decree of 31 May 1946, existing initially at Novosibirsk as OKB 153, under Oleg Konstantinovich Antonov, who died 4 April 1984, aged 78. Initial design was SKh-1, better known as An-2; design bureau re-established at Kiev in mid-1952. More than 22,000 aircraft of over 100 types and versions of Antonov design have been built; more than 1,500 have been exported, to 72 countries. Other production includes trolley-buses, trams and racing bicycles.

Antonov continues to be engaged in designing and building new aircraft prototypes as well as modifications of earlier designs; and the provision of operational and product support and engineering work on extending the service life of exisiting aircraft. It also provides service such as basic and conversion training for flight and maintenance crews; and international air charter transportation, particularly of outsize cargoes. On-site training of personnel is available. Antonov also participates in international co-operation in the field of aircraft and equipment design and manufacture as well as the development of land vehicles.

Current projects include the An-148 twin-turbofan airliner and An-70 military transport. On 29 October 2004 agreement reached with PZL of Poland on joint development of **An-128** variant of An-28 which to be marketed as replacement for M28 Skytruck.

Antonov received Aviation Register approval on 30 December 1992 to develop civil aircraft. It also operates its own cargo airline with a fleet of one An-225, seven An-124s, one An-22, three An-12s, and one each An-26 and An-74. Company parents the Medium Transport Aircraft International Consortium created by Russia and Ukraine in February 1996 and formally established on 18 May 1999.

By November 2003, Antonov-designed aircraft held 477 international records, including 124 gained by the An-225 in a single sortie on 1 September 2001.

Flight test airfield is Gostomel; works airfield at Svyatoshino in Kiev suburbs. Established freight division in 1989, this becoming Antonov Airlines with fleet of seven An-124s, single An-225 and six other Antonov types available for commercial leasing.

AVIANT, KIEVSKY GOSUDARSTVENNY AVIATSIONNY ZAVOD (Aviant, Kiev State Aviation Plant)

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The Kiev Aviation Plant has effectively terminated work on the Antonov An-32 twin-turboprop transport and An-124 heavy transport, the 19th and last Kiev-built An-124 having flown on 6 October 2003. However, it built two prototypes of the An-70 four-propfan transport and shares in production with Aviacor at Samara. The two firms will also manufacture the Tupolev Tu-334 twin-turbofan transport of which initial Aviant aircraft first flew

21 November 2003. Budgetary financing for two An-70s received December 2005. Overhauls An-24/26, An-32 and An-124 aircraft. Offers An-3 turboprop conversion of Antonov An-2 as parallel to Polyot conversion in Russia. By early 2006 had orders for seven An-148s, of which first batch of five then in hand, including two for Kazakhstan. Non-aviation activities include manufacture of trolley-buses, pressure chambers and customer goods. Recently contributed to manufacture of prototype Aviaimpex Yanhol helicopter prototype and is involved in manufacture of Aeros flex-wing trikes.

Aviant previously built 3,320 An-2s (1947–59), An-8s (1956–59), 1,028 An-24s (1959–78), 1,402 An-26s (1969–85), 123 An-30s (1973–79), 361 An-32s and 18 An-124s. Will participate in planned continuation of An-124 production. An-32 remains available to order, using stock of 15 uncompleted fuselages. Two An-32Ps for Libya delivered January 2006, together with further two second-hand examples for same customer from Antonov bureau, increasing production to 363. Five An-32s reportedly under construction for UAE in 2006. Further interest from Mexico, Sri Lanka and Turkey yet to have firm results.

KHARKOVSKOYE GOSUDARSTVENNOYE AVIATSIONNOYE PROIZVODSTVENNOYE PREDPRIYATIE (Kharkov State Aviation Production Enterprise)

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Established in 1926 as GAZ 135, Kharkov State Aircraft Manufacturing Company (KSAMC) has built military, passenger and freight aircraft, including the K-5, KhAI-1, K-7, Su-2, MiG-15UTI, Tu-104, Tu-124, Tu-134 and An-72/72P, plus Tu-141 UAV. Export of its products began in 1964. ISO 9002 was gained in 1998.

Current production is centred on the 52-seat Antonov An-140-100 twin-turboprop and Antonov An-74 in various versions, including the An-74TK-300, with underslung engine. Flew An-74T-200A subvariant on 24 December 2004, this being first of five for Egypt, plus two An-74TK-200S 'flying hospitals' for Syria. Also produces centre wing section for Antonov An-148 production by Aviant.

Kharkov consortium also provides support services, including maintenance, flying training, technical training, spare parts provision, ground equipment, test equipment and turnkey maintenance facilities.

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Established in 1948, GAZ 410 (Westernised as ARP 410) is licensed to overhaul, maintain and modify the full range of Antonov-designed aircraft, as well as their engines and systems.

ANTONOV An-38

TYPE: Twin-turboprop transport.

PROGRAMME: Requirement for 25–30 seat development of An-28 emerged during 1989 sales tour of India. Development of all-new An-38 approved by Soviet Ministry of Aviation, late 1990. Details announced, and model displayed, at 1991 Paris Air Show; initial batch of six built, not by Antonov, but at production factory, NAPO, Novosibirsk, Russia: one prototype (01001; first flight 23 June 1994, with TPE331 engines), four trials aircraft and one (01002) for static testing at Kiev; certification to AP-25 granted 22 April 1997. In December 1995, Antonov and NAPO formed joint venture company, Siberian Antonov Aircraft, to produce, market and provide after-sales service for the An-38. Indian demonstration tour undertaken in July and August 1997, followed by appearance at Aero India in December 1998 and February 2001.

Production at NAPO was suspended between 2000 and 2003, but in March 2003 an agreement was signed by the plant, Moscow Leasing Company and Volgograd-SpetzAvia for resumption with a batch of five. In January 2006, NAPO in discussions with VulcanAir of Italy, latter offering to finance EASA certification in return for appointment as completion centre for estimated 60 An-38s required in Europe.

CURRENT VERSIONS: **An-38-100:** With Honeywell TPE331 engines. First and second (01003; exhibited Moscow 1997) flying aircraft to this standard. Trials of international navigation avionics completed March 2000.

An-38-110: Reduced avionics fit in comparison with –100.

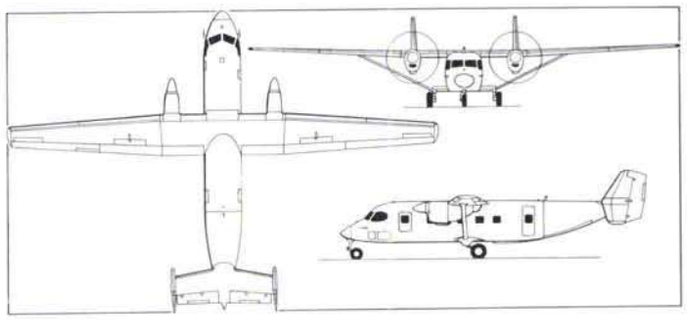
An-38-120: Enhanced avionics fit in comparison with –100; equipment includes VOR/DME, Opal-B voice recorder and SPPZ-2000 ground proximity warner. At least RA-41900 and 41902 to this standard.

An-38-200: With Omsk MKB 'Mars' TVD-20-03 engines. Third and fourth prototypes were planned to this standard when engine development complete; however, minor problems with Aerosila AV-36M propeller delayed programme, but maiden flight achieved (at NAPO) 11 December 2001. Equipment standard as for An-38-120, but with addition of TCAS-2000 traffic collision avoidance system. State Tests were completed on 28 November 2002. Subsequent report indicated "no significant advantages" over TPE331 version.

An-38D: Proposed military version for parachutist dropping, medical evacuation and general light transport.

An-38K: Convertible version of An-38-100; large upward-hinging side door at rear on port side; able to carry four LD-3 (KMP-500) or five LD-3K containers (= *konteinernyi*); cargo handling equipment removable for conversion to 30-passenger transport.

Versions with RKBM TVD-1500 engines said to be under construction in 2000, but none had emerged by mid-2002. All versions can be equipped for aerial photography (An-38F: *fotografiya*), survey (An-38GF *geofizicheskiy*), forest patrol (An-38D: *desantnyi*), VIP transport, ambulance (An-38S: *sanitarnyi*; six stretchers, nine seated, with attendant) and fishery/ice patrol duties (An-38LR: *ledovoi razvedki*). An assault transport, also designated An-38D, capable of carrying 22 paratroops, 26 troops or 3 tonnes of cargo, was revealed to be in the design stage in August 2001; –100 or –200 engine options will be available.



Antonov An-38-100 27-seat transport *(Mike Keep)* 0051508

CUSTOMERS: Eight Srs 100s produced by mid-2000: two prototypes (one at Antonov; one at NAPO), one static test airframe and five with airlines (Vostok, three; Alrosa, two); by mid-2004, no further production had been undertaken, and, in fact, only four production aircraft positively identified. Further four reported under construction in 2005 for delivery from October that year, including one for Khromaton of Moscow for remote earth sensing. Two Vostok aircraft to Malaysia during 2001 for lease by Layang Layang Aerospace for tourist flights, cargo transport and aerial photography.

First three (subsequently increased to eight) An-38-100s ordered for Vostok Airlines and received by mid-1995 for one year of intensive trials before passenger certification. Second firm customer is Chukotavia (10; although initial batch is two); letters of intent from Petropavlovsk-Kamchatsky, Merninsky, Novosibirsky, Ulyanovsky and Nikolaevsk-na-Amur. In 1999–2000, second prototype was being operated by NAPO-Aviatrans, the airline of the NAPO aircraft factory; this also to Layang Layang by 2003. By July 2003, Layang Layang was discussing order for six An-38s subsequent to type's certification in Malaya. In 1998, Siberia Airlines was considering purchase of two. Alrosa-Avia of Zhukovsky has ordered five for diamond mining support, of which first in service by early 2000; second followed in July 2000. Indian Air Force interest expressed in initial six to 10; estimated market for 40 with Indian regional airlines (2001), of which 20 covered by letters of intent. Interest in -200 from Vietnam Airlines, which in 2001 signed lease for NAPO's own -120; this still in Vietnam in 2004 with a second Vostok aircraft. On conclusion of lease, two Vietnamese aircraft transferred to Hangard Airlines of Mongolia in mid-2005. First customer for Srs 200 was expected to have been Kemerovo Airlines, which required two for delivery in late 2003.

ANTONOV An-38 KNOWN PRODUCTION

Registration	Remarks
3810001	Prototype
3810002	Static test airframe
3810003	Second prototype
RA-41900	NAPO-Aviatrans; Layang Layang 2003; Vietnam Air Services 2004-05; Hangard Airlines 2005
RA-41901	Vostok; Layang Layang 2002; Vostok 2004-05; Hangard Airlines 2005
RA-41902	Vostok; Vietnam Air Services 2004
RA-41903	Vostok; Layang Layang as 9M-LLB

Notes: 3810003 and RA-41900 may be the same aircraft. An-38-200 prototype reported as RA-41910.

COSTS: An-38-100 basic price USD4 million (2000); An-38-200 USD3.5 million (2003).

DESIGN FEATURES: Developed from PZL Mielec (Antonov) An-28 to replace An-24s, Let L 410s and Yak-40s. New high-efficiency engines; lengthened passenger cabin; optional weather radar and automatic flight control system; improved sound and vibration insulation; reduced external noise; wheel or ski landing gear; rear cargo door and cargo handling system; able to operate from unpaved runways; operating temperatures from –45 to +45°C, including 'hot-and-high' conditions. Service life 30,000 hours. Maintenance (including overhaul) requirement 4 man-hours/flying hour.

FLYING CONTROLS: Conventional and manual. Single-slotted mass and aerodynamically balanced ailerons (port aileron has trim tab), designed to droop with large, hydraulically actuated, two-segment double-slotted flaps; electrically actuated trim tabs in each elevator have manual back-up; twin rudders each with electrically actuated trim tab; automatic leading-edge slats over full span of wing outboard of engines; slab-type spoiler forward of each aileron and each outer flap segment at 75 per cent chord.

LANDING GEAR: Tricycle type; fixed. Mainwheels 610×320-330; nosewheel 600×320-254.

POWER PLANT: Two Honeywell TPE331-14GR-801E turboprops, each 1,118 kW (1,500 shp), driving Hartzell HC-B5MA five-blade propellers rotating at 1,522 rpm; or two Omsk MKB 'Mars' TVD-20 turboprops, each 1,029 kW (1,380 shp), driving Aerosila AV-36M quiet, constant-speed reversible-pitch propellers rotating at 1,827 rpm.

ACCOMMODATION: Two crew side by side on flight deck; passenger cabin equipped normally with 26 seats, basically three-abreast, with centre aisle; 27 seats at 75 cm (29½ in) pitch optional; ambulance version for six stretchers, eight seated casualties and medical attendant, executive versions with eight to 10 seats and forest surveillance/paradrop version for 26 smoke-jumpers or trainee paratroops (reduced to 22 with full kit) available; seats and baggage compartment can be folded quickly against cabin wall to provide clear space for 2,500 kg (5,510 lb) of freight. Maximum practical cargo dimensions in combi variant are 1.40 m (4 ft 7 in) height and 1.05 m (3 ft 5¼ in) width with seats removed or 0.95 m (3 ft 1½ in) with seats stowed against walls. Door with airstairs on port side, with service door opposite; emergency exit each side. Optional cargo door under upswept rear fuselage slides forward under cabin for direct loading/unloading of freight.

AVIONICS: Russian or Western equipment; latter comprises Bendix/King Silver Crown range; former listed below.

Comms: SO-72 transponder.

Radar: A813Ts weather radar.

Flight: BSFK-1 navigation system; VEM-72PB-3A altimeter and A-037 radar altimeter; twin US-450K airspeed indicators; SAU-28 AFCS; M3 GPS; VMD-94 DME; SPPZ-200 GPWS; TCAS-2000 TCAS; and KURS-93M autoland.

EQUIPMENT: Hand-operated travelling overhead winch in cabin; capacity 500 kg (1,102 lb).

Antonov An-38-120 of Vietnam Air Services 1158191

DIMENSIONS, EXTERNAL:

Wing span	22.065 m (72 ft 4¾ in)
Length overall	15.67 m (51 ft 5 in)
Height overall	5.05 m (16 ft 6¾ in)
Span over tailfins	5.14 m (16 ft 10½ in)
Wheel track	3.515 m (11 ft 6½ in)
Wheelbase	6.345 m (20 ft 9¾ in)
Distance between propeller centres	5.58 m (18 ft 3¾ in)
Propeller diameter: Hartzell	2.85 m (9 ft 4 in)
AV-36	2.65 m (8 ft 8¼ in)
Cargo ramp:	
Length	2.40 m (7 ft 10½ in)
Width: at floor	1.40 m (4 ft 7 in)
at rear	1.00 m (3 ft 3¼ in)
Passenger door: Width	0.70 m (2 ft 3½ in)
Height	1.55 m (5 ft 1 in)

DIMENSIONS, INTERNAL:

Cargo hold: Length, excl ramp	7.83 m (25 ft 8¼ in)
Width: max	1.74 m (5 ft 8½ in)
at floor	1.55 m (5 ft 1 in)
Max height	1.70 m (5 ft 7 in)
Volume, incl ramp	24.7 m³ (872 cu ft)

WEIGHTS AND LOADINGS (A: An-38-100, B: An-38-200, K: An-38K):

Weight empty: A	5,735 kg (12,643 lb)
Max payload: A, B	2,500 kg (5,510 lb)
K	3,200 kg (7,055 lb)
Max fuel: A	2,210 kg (4,872 lb)
Max T-O weight: A	9,500 kg (20,943 lb)
B	9,930 kg (21,891 lb)

PERFORMANCE (estimated, with TPE331 engines):

Max level speed	219 kt (405 km/h; 252 mph)
Nominal cruising speed:	
A, B	205 kt (380 km/h; 236 mph)
Nominal max cruising altitude: A, B	4,200 m (13,780 ft)
T-O run: A	350 m (1,150 ft)
K	480 m (1,575 ft)
Landing run: A	270 m (885 ft)
K	440 m (1,445 ft)
Balanced field length: A	895 m (2,940 ft)
B	1,050 m (3,445 ft)
Range at FL100, no reserves:	
with max payload: A	513 n miles (950 km; 590 miles)
B	540 n miles (1,000 km; 621 miles)
with max fuel (1,650 kg; 3,638 lb payload):	
A	944 n miles (1,750 km; 1,087 miles)
B	961 n miles (1,780 km; 1,106 miles)

ANTONOV An-70

TYPE: Medium transport/multirole.

PROGRAMME:

DEVELOPMENT MILESTONES

Design began	1986
Announced	20 Dec 88
Official go-ahead	24 Jun 93
Rolled out	20 Jan 94
First flight	16 Dec 94
Production go-ahead	12 Oct 00

Development began 1986 to replace some An-12s remaining in air force service from 2002–2003; initial all-metal, 5.0 m (16 ft 5 in) fuselage diameter design featured four D-236 turboprops and tail gunner's position, and was in competition with Yakovlev design (then known as Yak-44). Significant redesign began in 1986, upon appointment of Pyotr Balabuyev as designer, resulting in postponement of planned 1986 first flight.

Announced by *Izvestia* 20 December 1988; at 1991 Paris Air Show Antonov OKB reported prototype being assembled at Kiev; funding by Russian (80 per cent) and Ukrainian governments under agreement of 24 June 1993; preliminary details released and model displayed at Moscow Aero Engine and Industry Show April 1992.

Prototype rolled out at Antonov's Kiev plant on 20 January 1994; first flight (01-01) 16 December 1994 (was also delivery flight to Gostomel test airfield); this aircraft lost during fourth sortie following in-flight collision with chase An-72 on 10 February 1995. Second prototype produced by upgrading of static test airframe (for which replacement under construction in 2000); rolled out 24 December 1996; first flight (01-02/UR-NTK) 24 April 1997; international debut at Moscow Air Show, August 1997; handed over to Russian Air Forces' test centre at Akhtubinsk, August 1998. Had flown 380 of planned 780-sortie test programme by January 2001; high AoA trials mid-2000; first stage of State testing completed October 2000, confirming safety in all flight regimes. Crash-landed and fuselage broken into two parts immediately after take-off from Omsk on 27 January 2001 following double engine failure. Airframe transferred to Polet aircraft plant and repaired at cost of USD3 million; reflown 5 June 2001; certification rescheduled to first quarter of 2002; appeared at MAKS '01, Moscow, August 2001. By June 2004, stated to require further 100 sorties to complete testing, which target set for end of 2005. Trials delayed because of "deficiencies in D-27 engine"; Russian Air Forces' C-in-C stated in December 2004 that these now "eliminated" and testing to resume.

Bilateral agreement between Russia and Ukraine revised 18 May 1999, and underlined decision taken to order first 10 (and 50 engines) before planned production at Aviant plant, Kiev, from 1999 and Aviacor plant, Samara, from 2000; each plant building initial batch of five, which then intended to enter service by 2003. Russian production specification issued 4 December 1999; Russian government decree of 4 October 2000 covers purchase of 164 An-70s, but, at same time, Samara regional government announced that local manufacturers were withdrawing from An-70 project. In late 2003, power-plant manufacturing partner, Salyut of Moscow, proposed a revised compressor design for D-27 engine which would address Russian military concern over efficiency and reliability. Other sources reported simultaneously that these issues already solved in Ukraine. Ukrainian government resolution guaranteeing An-70 purchase passed 12 October 2000; total of 65 to be obtained by 2018. First five for Ukraine ordered from Aviant on 2 April 2001. However, in September 2001, Polyot was allocated Russian An-70 final assembly, augmented by Novosibirsk's NAPO and Voronezh's VASO. Aviacor no longer involved. Russian share of series production is 72 per cent; Ukraine 28 per cent. Assembly of first Polet-built An-70 formally began on 10 October 2002. Polet (Russian) and Aviant plants signed agreement in June 2004 for joint manufacture of An-70 in Ukraine using Russian-built components.

By September 2002, An-70 had flown 550 hours in 440 sorties towards anticipated late 2003 completion of State Tests, but unofficial reports were by that time citing alleged discovery of 382 deficiencies, of which 95 rated essential for pre-delivery rectification. These included engine reliability, the prototype having suffered 52 in-flight shutdowns during its 440 sorties. Russian Air Forces' disinclination to fund An-70 was being discussed in November 2002, and C-in-C voiced outright rejection of purchase at January 2003 press conference, claiming An-70 unsuitable for its intended task of replacing An-12, and pledging support for rival Tupolev Tu-330. Joint (Russo-Ukrainian) acceptance testing was frozen on 25 February 2003; resumed following signature of agreement by Cs-in-C of Russian and Ukrainian air forces, 16 June 2004. By April 2003 however, it was reported unofficially that Air Forces' support had been resumed, but with proviso of rewritten TTZ (tactical and technical specification) detailing changes to avionics and equipment and extending development period. Optimism short-lived, and despite support from some political quarters, An-70 funding was removed from 2004 budget at military request.

Faced with shortfall in Russian financial support, Ukrainian government considered unilateral financial support in 2003 national budget, allowing production launch, but decided against the proposal in November 2002, although continued flight testing did receive official funds. Trials at Feodosia test centre included February 2003 air-drop within 18 seconds of four pallets totalling 34.5 tonnes; operations planned from airstrips with bearing strength of between 6 and 9 kgf/cm² (85 to 128 lbf/sq in). Short field trials at Feodosia between 18 July and 4 August 2003.

Ukrainian parliament decision of February 2004 to complete An-70 development and production in two-stage programme between 2004 and 2022 assigns some Hr1 billion up to 2006 for development (Hr130 million; USD25 million), production investment (Hr450 million; USD85 million) and two production aircraft (Hr430 million; USD80 million). Initial expenditure in 2004 was Hr243 million (USD46 million). Phase 2, from 2007 to 2022, not yet costed; these two received funding in December 2005 to permit manufacturing launch by Aviant production plant.

In late 2005/early 2006, Russian and Ukranian media reported numerous statements and counter-statements concerning Russian Air Forces' intentions towards An-70, it appearing that senior military commanders considered purchase unnecessary. Stage 'B' of State Tests begun April 2006 after An-70 demonstrated improved gas dynamic stability of modified engines during four test sorties.

Medium Transport Aircraft International Consortium (MTA) formed February 1996 to co-ordinate development, certification, sales and after-service, comprising four Ukrainian and six Russian companies: ANTK Antonov (designer and component manufacturer), ZMKB Progress (engine designer), Aviant (airframe manufacturer) and Motor Sich (engine manufacturer) from Ukraine; Aviapribor (flight control system manufacturer), Elektroavtomatika (avionics), Leninets (airborne monitoring and diagnostic system) and Aerosila (propfan) from Russia. Refer to 'Structure'. Following inconclusive discussions with Russia over international promotion, Ukraine unilaterally announced Poland as partner for Western sales of An-70 in November 2003. Was also hoping to obtain Chinese order. MTA consortium reported in late 2004 to be in process of liquidation.

CURRENT VERSIONS: **An-70:** Military STOL transport; proposed production version. Stated to have double the payload of Lockheed Martin C-130J, with similar STOL and rough-field performance, yet only 40 kt (74 km/h; 46 mph) slower than the Boeing C-17A Globemaster III, which carries 15 per cent more payload.

Detailed description applies to baseline An-70.

An-70-100: Civilian transport. Reported in 2005 to have received expressions of interest from UAE and Ukranian air transport companies. Aviant predicts break-even at 20; unit cost USD50 million. Production could begin in 2008. Noise compliance certificate issued to An-70 on 22 December 2005 confirming Level 3, Appendix C, ICAO Part 36.

An-77: Proposed military STOL transport for export customers; as An-70-100 but with cockpit for two or three crew. Runway length of 1,900 m (6,235 ft) required with 35,000 kg (77,161 lb) payload for 2,051 n mile (3,800 km; 2,361 mile) range.

Antonov An-70 tactical transport *(Yefim Gordon)*

1158636

An-70T: Commercial transport, generally as An-70, with improved runway capability but no requirement for STOL. Two or three crew. To carry 35,000 kg (77,161 lb) payload 2,051 n miles (3,800 km; 2,361 miles) from 1,900 m (6,235 ft) runway, or 20,000 kg (44,092 lb) for 2,915 n miles (5,400 km; 3,555 miles) from 1,300 m (4,265 ft) runway.

An-170: Heavy transport derivative carrying 45,000–50,000 kg (99,210-110,230 lb) of cargo.

CUSTOMERS: Requirements originally expressed by Russian Air Forces for up to 500 and by Ukrainian Air Force for 100. This modified by 1999 to 164 for Russia and 65 for Ukraine, with envisaged in-service date of 2002. German requirement potentially for 75 aircraft. By mid-1999 potential civil operators had signed documents of intent for some 100 further aircraft. Chinese interest reported in 2000. Czech Republic reportedly finalising a contract for three in 2002, delivery to be from Omsk at one per year, beginning 2005. Not achieved, but Antonov statement of 2006 noted unequivocal Czech "order" for three.

COSTS: Military version USD60 million (2002), but estimated in 2003 that this could be reduced to "under USD40 million". Civil An-70T to cost 20 to 30 per cent less than military variant. Total of USD3,500 million reportedly spent on development by late 2002, of which Russian defence ministry then owed Antonov USD49 million; further USD86 million (of which USD61 million due from Russia) required to complete development and flight testing. Engines cost USD75 million up to 2002, and further USD30 million allegedly required to address recorded malfunctions during testing. Establishment of Russian assembly line at Polyot plant (Omsk) estimated to cost Rb3bn (2004).

DESIGN FEATURES: First aircraft to fly powered only by propfans. Slightly larger than projected European FLA transport, much smaller than US Boeing C-17A; conventional high-wing configuration, with wings and tail surfaces slightly sweptback; supercritical wing section; anhedral from roots; loading ramp/doors under upswept rear fuselage with adjustable sill height and built-in cargo handling system; horizontal tail surfaces on rear fuselage; propfans mounted conventionally on wing leading-edge; propeller wash doubles wing lift during take-off and landing. Multiple-section control surfaces provide redundancy in event of battle damage or physical obstruction. Claimed features include independent operational capability at non-equipped airfields for 30 days. Design life 15,000 cycles and 45,000 flying hours in 25 years. Operable 3,500 hours per year, with eight to 10 man-hours of maintenance per flying hour. Cost-effective with only 200 flying hours per month.

FLYING CONTROLS: Prototypes have fly-by-wire system with four digital and six analogue channels; primary controls are quadruplex; back-up by unique fly-by-hydraulics system, in which pilot or autopilot inputs are relayed (via conventional 'mini-wheels') to actuators by commands in hydraulic control channels, unaffected by electromagnetic interference. Production aircraft will have a four-channel, all-digital primary FCS, rather than the hybrid digital/analogue system of the prototypes. Secondary FCS controls two independent flap systems, leading-edge slats and blown flaps. Three-section double-winged rudder. Double-slotted trailing-edge blown Fowler flaps in two sections on each wing; forward element maximum deflection 60°; intermediate settings 5, 10, 15, 20, 25, 30, 35, 40 and 50°. Three-section spoilers forward of each outer flap. Leading-edge has flaps inboard; slats centre and outboard. Two-section, double-hinged elevators forward section maximum deflections +28/–20°, rear section +50/–40°, to enhance low-speed authority; horizontal stabilisers are fitted with automatic leading-edge slats.

STRUCTURE: Approximately 28 per cent of airframe, by weight, made of Organit composites, including complete tail unit, ailerons and flaps. Fuselage stringer/skin joints are spot-welded and hot-bonded, manually.

Single source for all major components. Russian assembly by Polyot, which also to build cargo hold; NAPO producing the centre section; VASO, the wing. Aviant at Kiev to assemble Ukrainian aircraft and build flight deck, empennage and engine nacelles.

LANDING GEAR: Twin-wheel nose unit; each main unit has three pairs of wheels in tandem, retracting into large fairing on side of cabin; can operate from CBR6 unpaved surfaces. All tyres 1,120×450. Steel-steel brakes. Nosewheel turning angle ±55° for taxying; nosewheel turning radius 19.6 m (64¼ ft); wingtip turning radius 34.8 m (114¼ ft); required taxiway width for 180° turn 38.4 m (126 ft).

POWER PLANT: Four ZMKB Progress/Ivchenko D-27 propfans, each 10,290 kW (13,800 shp) built consortium including Motor-Sich and Russia's Salyut. Aerosyla Stupino SV-27 contrarotating propellers, each with eight composites blades in front and six at rear. Reversible-pitch blades of scimitar form, with electric anti-icing.

ACCOMMODATION: Three flight crew (two pilots and flight engineer or 'tactical pilot') plus loadmaster; navigation station on captain's left is optionally operated by fourth member of flight crew; provision for converting cockpit for two-crew operation, with co-pilot operating flight engineer's station; seats in forward fuselage for two cargo attendants; freight loaded via rear ramp using four built-in, powered hoists (each of 3 tonne capacity) reaching out 6.6 m (22 ft) from aircraft. Hoists can be combined for heavier loads. Freight can be carried on PA-5.6 rigid pallets, PA-3, PA-4 and PA-6.8 flexible pallets, in UAK-2.5, UAK-5 and UAK-10 containers; unpackaged freight, wheeled and tracked vehicles, food and perishables can be carried; seats for 300 troops, or 206 stretchers, can be installed using optional, prefabricated (10 section) upper deck or optional, easily removable seven-section upper deck in cargo hold; vehicles, freight and paratroops can be airdropped; maximum single airdrop item weight 20,000 kg (44,092 lb); crew door at front of cabin on port side; two upper deck doors each side, front and rear; cargo hold pressurised and air conditioned.

SYSTEMS: Aircraft systems automated to simplify operation and decrease probability of crew errors. Electronpribor engine control system; Leninets monitoring and information system.

AVIONICS: Integrated by Aviapribor, Leninets and Elektroavtomatika. Flight data, navigation and radio-navigation systems to ARINC 700 requirements; digital multiplex data interface equivalent to Western MIL-STD-1553B.

Comms: Integrated system by Gorkiski.

Flight: Ring laser INS; SKI-77 HUD; flight management system; designed for operation in adverse weather and for landing in ICAO Cat. II and IIIa conditions. BASK-70 onboard diagnostic system collects data from subsystems, registering and analysing about 8,000 parameters.

Instrumentation: Ten-screen EFIS by Elektroavtomatika comprises six main screens, each 200 × 200 mm (7¾ × 7¾ in), facing pilots and two each at navigation and flight engineer's stations, plus smaller secondary LCD screens and roof-mounted HUDs for pilot and co-pilot on production aircraft.

EQUIPMENT: Four electric hoists in hold.

DIMENSIONS, EXTERNAL:

Wing span	**44.06 m (144 ft 6¾ in)**
Length overall	**40.73 m (133 ft 7½ in)**
Fuselage diameter	**5.60 m (18 ft 4½ in)**
Height overall	**16.38 m (53 ft 9 in)**
Wheel track (bogie centres)	**5.21 m (17 ft 1 in)**
Wheelbase: front mainwheels	**12.48 m (40 ft 11¼ in)**
centre mainwheels	**13.98 m (45 ft 10½ in)**
rear mainwheels	15.48 m (50 ft 9½ in)
Propeller diameter	4.50 m (14 ft 9 in)
Propeller ground clearance (outer)	3.00 m (9 ft 10 in)
Rear-loading aperture: Height	4.10 m (13 ft 5½ in)
Width	4.00 m (13 ft 1½ in)

DIMENSIONS, INTERNAL:

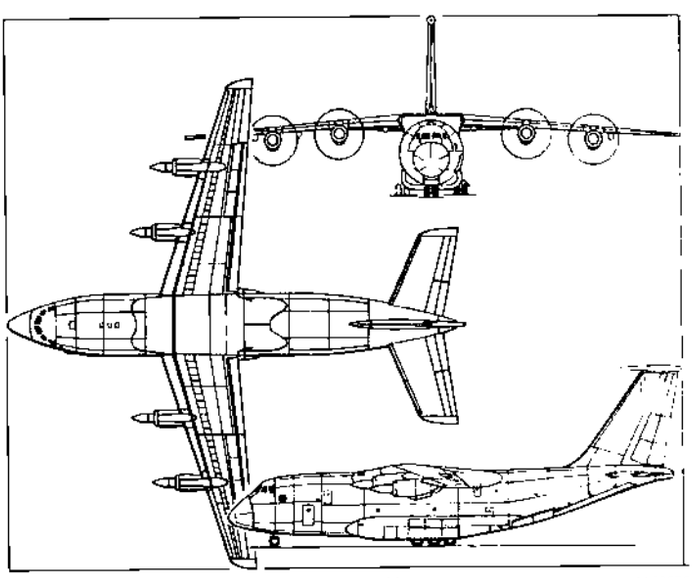
Cargo hold:	
Floor length: excl ramp	**18.60 m (61 ft 0¼ in)**
incl loadable ramp	**21.90 m (71 ft 10¼ in)**
Max width	4.80 m (15 ft 9 in)
Max width at floor	4.00 m (13 ft 1½ in)
Height: max	4.40 m (14 ft 5¼ in)
min	4.10 m (13 ft 5½ in)
Floor area, incl ramp	**89.0 m² (958 sq ft)**
Volume: pressurised	**400.0 m³ (14,126 cu ft)**
total	**425.0 m³ (15,008 cu ft)**

WEIGHTS AND LOADINGS:

Weight empty	74,000 kg (163,140 lb)
Normal payload (incl 5,000 kg; 11,025 lb on ramp)	35,000 kg (77,161 lb)
Normal payload from unpaved runway	30,000 kg (66,138 lb)
Payload: max	47,000 kg (103,615 lb)
restricted runway option	35,000 kg (77,161 lb)
700 m runway option	20,000 kg (44,092 lb)
Max T-O weight	145,000 kg (319,675 lb)
Max power loading	3.52 kg/kW (5.79 lb/shp)

PERFORMANCE (estimated):

Cruising speed: long range	**405 kt (750 km/h; 466 mph)**
max short range	**432 kt (800 km/h; 497 mph)**
Min control speed (demonstrated)	**53 kt (98 km/h; 61 mph)**
Nominal cruising height	**9,100-11,000 m (29,860–36,080 ft)**
Runway length required:	
conventional T-O	1,550–1,800 m (5,085–5,905 ft)
short T-O	700 m (2,300 ft)
Range (runway length A: 1,800 m; 5,905 ft, B: 700 m; 2,300 ft):	
with 47 tonnes: A	1,619 n miles (3,000 km; 1,864 miles)
B	not an option
with 35 tonnes: A	2,699 n miles (5,000 km; 3,106 miles)
B	not an option
with 30 tonnes: A	3,239 n miles (6,000 km; 3,728 miles)
B	647 n miles (1,200 km; 745 miles)
with 20 tonnes: A	3,563 n miles (6,600 km; 4,101 miles)
B	1,619 n miles (3,000 km; 1,864 miles)
with max fuel: all options	4,319 n miles (8,000 km; 4,971 miles)



Antonov An-70 tactical transport *(James Goulding)* 1158575

ANTONOV An-72 and An-74

NATO reporting name: Coaler

TYPE: Twin-jet freighter.

PROGRAMME: Originated as military transport based on stillborn An-60 64–73 seat civil airliner designed to meet 1967 specification. Revised design, following issue of military requirement in 1968, included relocation of engines above wings. Prototype An-72, built at Kiev, flew (SSSR-19774) 31 August 1977, followed by five (one static test, one fatigue test, three flying) preproduction aircraft, 1979–81. Manufacture transferred to Kharkov, Ukraine, where first production An-72 flew 22 December 1985.

An-74 also produced at Kharkov from December 1986. An-74 announced February 1984, meeting requirement for operation in Arctic and Antarctic conditions. An-72P maritime patrol version demonstrated 1992. Production of An-74 also started by Polyot Industrial Association at Omsk, Russia, in 1993 (assisted by Progress at Arsenyev); first Polyot aircraft (RA-74050) was flown 25 December 1993. Development by Antonov of various new versions of An-74 started 1995.

CURRENT VERSIONS: **An-72A: ('Coaler-C')** STOL transport for military use. Compared with An-72 ('Coaler-A') prototypes, wing span increased by 6.00 m (19 ft 8¼ in), fuselage length by 1.50 m (4 ft 11 in), fuel load by 2,500 kg (5,512 lb). An-72 prototype 003/SSSR-19795 converted to An-74 and first flew (SSSR-780334) 29 September 1983. Additionally, on production version, tail unit and engine air intake de-icing improved over An-72 prototype; Buran radar in enlarged radome; advanced navigation aids, including inertial navigation system; provision for wheel/ski landing gear.

An-72P: Maritime patrol version; delivered to Ukraine during 1990s.

An-72-100: Civilianised An-72, certified 1997; upgraded avionics.

An-74: Designation refers, generally, to all civilian versions (as under), although initially intended for Polar research, ice floe reconnaissance and transport. Airframe identical with An-72 except for two blister windows at rear of flight deck and front of cabin on port side. Proving trials 1983–89. First preproduction An-74 (SSSR-58642) first flew at Kharkov on 26 June 1986; further five development aircraft built by 1989. Maiden flight of production

Antonov An-74TK-200 company demonstrator *(Paul Jackson)*

1158194

An-74 (c/n 0706) December 1989; features include new APU, Buran-74 radar in larger radome and improved navigation aids. Type certificate awarded August 1991; initially operated by Yakutsk division of Aeroflot.

An-74-200: Freight version with D-36 Series 3A engines of unchanged rating; increased payload and maximum T-O weight. Able to carry four UAK-2.5 containers. Crew of four/five.

An-74T-200A: ('Coaler-B') Transport (*transportnyi*) version with longer hold; payload 10,000 kg (22,045 lb); roller conveyors in floor. Improved navigation aids and digital ('semi-glass') flight deck with B-RNAV, RNP-5 and RNP-1, compatible with ICAO air traffic requirements up to 2015; two flight crew. Range with maximum payload up to 728 n miles (1,350 km; 838 miles), with 3,500 kg (7,716 lb) payload 2,159 n miles (4,000 km; 2,485 miles). MTOW increased to 36,500 kg (80,468 lb). First flight 28 April 2005; due for delivery to Egypt in late 2005.

An-74TK-200: ('Coaler-B') Convertible transport/passenger aircraft (*transportnyi konvertiruyemnyi*) with twin seats for 52 passengers that fold against cabin walls, and with baggage racks, buffet/galley and lavatory. Certified by Interstate Aviation Committee. Alternative all-cargo or all-passenger or combi layouts. Typical combi options include 12 passengers plus 6,000 kg (13,228 lb) of freight and 20 plus 4,500 kg (9,921 lb). Built-in loading equipment. Crew of two. Range with 10,000 kg (22,045 lb) payload, 1 hour reserve, 459 n miles (850 km; 528 miles).

An-74TK-200A: As TK-200, but with improved navigation aids and digital flight deck ensuring compliance with all ICAO requirements up to 2015. First flight (UR-CES) 24 December 2004. Deliveries to Egypt begun September 2005.

An-74TK-200S: 'Flying hospital' version of -200A. Two ordered by Syria for operation as civil aircraft by KS Avia.

An-74TK-100/200 Salon: Business transport for 10 to 16 passengers, with increased cabin comfort. Equipment includes telephone, fax, video, bar, refrigerator, galley and separate rest area. Optional compartment for car at rear. Power plant and weights as basic An-74. Crew of four/five. **An-74D** is similar.

An-74T-100: ('Coaler-B') As An-74T-200, with flight engineer and navigator stations (crew of four).

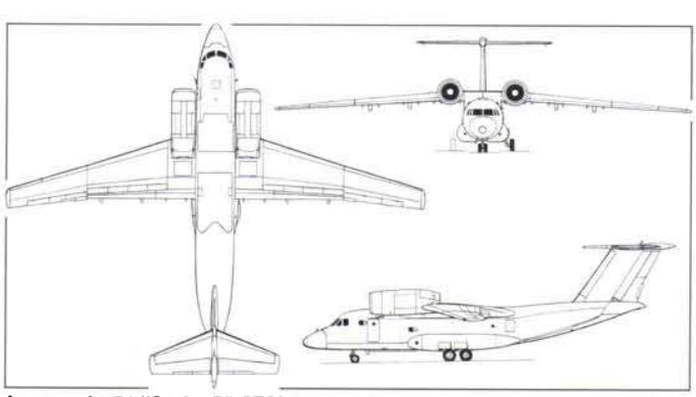
An-74TK-100: As An-74TK-200, with navigator and flight engineer stations (crew of four). Russian type certificate issued 4 August 1995.

An-74TK-100C: One VIP/medical evacuation aircraft (RA-74005) delivered to Gazprom on 26 February 2002. Air Ambulance Technology (Austrian) equipment. Designation remains '-100C' in both Cyrillic and Roman alphabets.

An-74TK-300: *Described separately.*

CUSTOMERS: More than 160 An-72/74s (including 96 military) built before An-74 production additionally established at Omsk; 20 in Russian Air Forces; four in Peruvian Air Force; 26 in Ukrainian Air Force; others in Estonia, Kazakhstan, Latvia, and Moldova. Total "nearly 200" in service by 2005, with over 1 million hours flown, including 16,000 by fleet leader.

Order placed by Iran in 1997 for 12 An-74TKs for Presidential Guard; other recent deliveries to Laotian government, Ukraine Border Guard (one An-72P in 2002), MChS Rossii, Vitair and Gazpromavia. By end of 2003, operators included nine with 68 An-72s and eight with 62 An-74s. Two An-74TK-200s built at Kharkov in 1999–2000; about 180 built by 2003. Indian interest being pursued in 2000; Omsk received order for one for MChS Rossii and one of required three for Russian Federal Security Service, to have been delivered in 2003; by late 2003, Omsk had delivered total of only five aircraft since 1993 and had further two in various stages of completeness. Kharkov received orders from Egyptian and Libyan governments in July 2004 for three An-74TK-200As, all for Egypt, of which first (SU-BPM) handed over 16 September 2005; and An-74TK-200 and VIP version for Libya. Egyptian order increased to nine. Sudan ordered five An-74s of various types on 25 December 2005; deliveries to begin March 2007 and continue at two-month intervals.



Antonov An-74 ('Coaler-B') STOL transport (two ZMKB Progress/Ivchenko D-36 turbofans) *(Dennis Punnett)*

0507543

COSTS: USD9 million (Omsk, 2000).

DESIGN FEATURES: Primary role as STOL replacement for turboprop An-26, with emphasis on freight carrying. High-wing, T-tail configuration, with upswept rear fuselage for freight access. Ejection of exhaust efflux over upper wing surface and down over large multislotted flaps gives considerable increase in lift; high-set engines avoid foreign object ingestion; special ramp/door as An-26; low-pressure tyres and multiwheel landing gear for operation from unprepared strips, ice or snow; sweptback fin and rudder.

Wing leading-edge sweepback 17°; anhedral approximately 10° on outer wings; normal T-O flap setting 25 to 30°, maximum deflection 60°.

FLYING CONTROLS: Conventional and manual. Two tabs in port aileron, one starboard; double-hinged rudder, with tab in lower portion of two-section aft panel; during normal flight only lower rear rudder segment is used; both rear segments used in low-speed flight; forward segment is actuated automatically to offset thrust asymmetry; horn-balanced and mechanically actuated, aerodynamically balanced elevators, each with two tabs; hydraulically actuated full-span wing leading-edge flaps outboard of nacelles; trailing-edge flaps double-slotted in exhaust efflux, triple-slotted between nacelles and outer wings; four-section spoilers forward of triple-slotted flaps; two outer sections on each side raised before landing, remainder opened automatically on touchdown by sensors actuated by weight on main landing gear; inverted leading-edge slat on tailplane linked to wing flaps.

STRUCTURE: All-metal; multispar wings mounted above fuselage; wing skin, spoilers and flaps mainly of aluminium, but flaps covered with titanium aft of engine nacelles; circular semi-monocoque fuselage, with rear ramp/door; tapered fairing forward of T tail fin/tailplane junction, blending into ogival rear fairing.

LANDING GEAR: Hydraulically retractable tricycle type, primarily of titanium. Rearward-retracting steerable twin-wheel nose unit. Each main unit comprises two trailing-arm legs in tandem, each with a single wheel, retracting inward through 90° so that wheels lie horizontally in bottom of fairings, outside fuselage pressure cell. Oleo-pneumatic shock-absorber in each unit. Low-pressure tyres, size 720×310 on nosewheels, 1,050×400 on mainwheels. Hydraulic disc brakes. Telescopic strut hinges downward, from rear of each side fairing, to support fuselage during direct loading of hold with ramp/door under fuselage.

POWER PLANT: Two ZMKB Progress/Ivchenko D-36 high-bypass ratio turbofans (Srs 2A in An-74; Srs 3A in An-74-200, T-100/200 and TK-100/200), each 63.74 kN (14,330 lb st). Integral fuel tanks between spars of outer wings. Thrust reversers standard.

ACCOMMODATION: An-72 has folding seats along sidewalls and removable central seats for 68 troops. Can carry 57 parachutists, and has provision for 24 stretcher patients. An-74's pilot and co-pilot/navigator side by side on flight deck, as in basic An-72, plus flight engineer, with provision for fourth person. Heated windscreen with two wipers. Bulged observation windows on port side for navigator and hydrologist. Flight deck and cabin pressurised and air conditioned. Main cabin designed primarily for freight, including four UAK-2.5 containers or four PAV-2.5 pallets each weighing 2,500 kg (5,511 lb). Provision for wardrobe and galley. Movable bulkhead between passenger and freight compartments, with provision for 1,500 kg (3,307 lb) of freight in rear compartment. Reinforced, movable bulkhead in combi versions protects passengers from shifting cargo in the event of sudden deceleration. Main crew and passenger door at front of cabin on port side. Emergency exit and servicing door at rear of cabin on starboard side.

Downward-hinged and forward-sliding rear ramp/door for loading trucks and tracked vehicles, and for direct loading of hold from trucks. It is openable in flight, enabling freight loads of up to 7,500 kg (16,535 lb), with a maximum of 2,500 kg (5,511 lb) per individual item, to be airdropped by parachute extraction system. In normal freight role, 1,000 kg (2,204 lb) of payload can be placed on ramp. Maximum size of containers up to 1.90 × 2.44 × 1.46 m (6 ft 3 in × 8 ft × 4 ft 9½ in), pallets up to 1.90 × 2.42 × 1.46 m (6 ft 3 in × 7 ft 11 in × 4 ft 9½ in). Main crew and passenger door at front of cabin on port side. Emergency exit and servicing door at rear of cabin on starboard side.

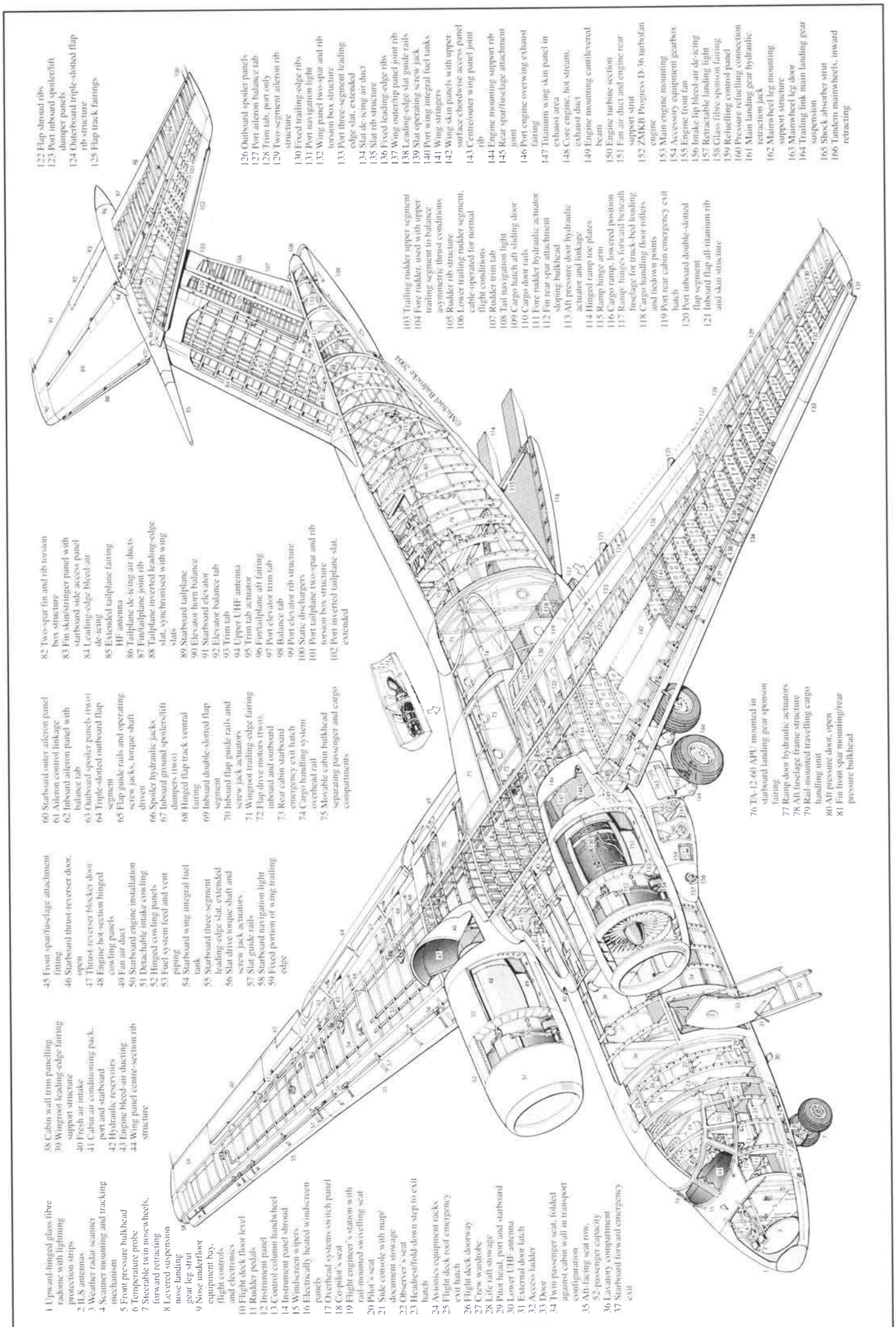
SYSTEMS: Air conditioning system with independent temperature control in flight deck and main cabin areas; used to refrigerate main cabin when perishable goods carried. Maximum cabin pressure differential 0.49 bar (7.1 lb/sq in). Hydraulic system for landing gear, flaps and ramp. Electrical system powers auxiliary systems, flight deck equipment, lighting and mobile hoist. Thermal de-icing system for leading-edges of wings and tail unit (including tailplane slat), engine air intakes and cockpit windows. Provision for TA-12 APU in starboard landing gear fairing. This can be used to heat cabin; under cold ambient conditions, servicing personnel can gain access to major electric, hydraulic and air conditioning components without stepping outside.

AVIONICS: *Comms:* HF com, VHF com/nav, 'Odd Rods' IFF standard.

Radar: Navigation/weather radar in nose.

Flight: ADF. Compatible with DME, Tacan, VOR, ILS and SP systems. Doppler-based automatic navigation system, linked to onboard computer, is preprogrammed before take-off on push-button panel to right of map display.

Instrumentation: Failure warning panels above windscreen display red lights for critical failures, yellow lights for non-critical failures, to minimise time spent on monitoring instruments and equipment.



Antonov An-74TK-100, cutaway drawing key *(Michael Badrocke)*

0581426

An-74 has enhanced avionics, including GPS, GPWS and TCAS 2000 in latest production. Five-screen 'glass cockpit' with twin HUDs under development by 2003.

EQUIPMENT: Removable mobile winch, capacity 2,500 kg (5,511 lb), assists loading. Cargo straps and nets stowed in lockers on each side of hold when not in use. Provision for roller conveyors in floor.

DIMENSIONS, EXTERNAL:

Wing span	31.89 m (104 ft 7½ in)
Wing aspect ratio	10.3
Length overall	28.07 m (92 ft 1¼ in)
Fuselage: Max diameter	3.10 m (10 ft 2 in)
Height overall	8.65 m (28 ft 4½ in)
Wheel track	4.09 m (13 ft 5 in)
Wheelbase	8.68 m (28 ft 5¾ in)
Min loading clearance beneath rear fuselage	2.80 m (9 ft 2¼ in)
Distance between engine centrelines	4.15 m (13 ft 7½ in)
Crew/passenger door: Height	1.65 m (5 ft 5 in)
Width	0.90 m (2 ft 11¼ in)
Rear-loading door: Length	7.10 m (23 ft 3½ in)
Width	2.40 m (7 ft 10½ in)
Height to sill	1.54 m (5 ft 0¾ in)

DIMENSIONS, INTERNAL:

Cabin: Length, An-74: excl ramp	10.50 m (34 ft 5¼ in)
incl ramp	14.30 m (46 ft 11 in)
Width: at floor level	2.15 m (7 ft 0½ in)
max	2.50 m (8 ft 2½ in)
Height	2.20 m (7 ft 2½ in)
Floor area: An-74T	22.5 m² (242 sq ft)
Ramp area	8.2 m² (88.3 sq ft)
Volume: An-74T (total)	73.3 m³ (2,589 cu ft)

AREAS:

Wings, gross	98.53 m² (1,060.6 sq ft)

WEIGHTS AND LOADINGS (A: An-72, C: An-74, D: An-74 Salon, E: An-74-200, F: An-74T-200 and An-74TK-200):

Weight empty: A	19,050 kg (42,000 lb)
F	21,820 kg (48,105 lb)
Max fuel: A, C, D, E, F	13,200 kg (29,100 lb)
Max payload: C, D	7,500 kg (16,535 lb)
A, E, F	10,000 kg (22,045 lb)
Max T-O weight:	
from 1,800 m (5,905 ft) runway:	
C	34,500 kg (76,060 lb)
from 600–800 m (1,970–2,630 ft) runway:	
A	31,200 kg (68,784 lb)
C	34,800 kg (76,720 lb)
D, E, F	36,500 kg (80,468 lb)
Max landing weight: C, D, E, F	33,000 kg (72,750 lb)

PERFORMANCE (An-72, A: at T-O weight of 31,200 kg; 68,784 lb, B: at T-O weight of 27,500 kg; 60,625 lb on 1,000 m; 3,280 ft unprepared runway, C, D, E, F, An-74 series as above):

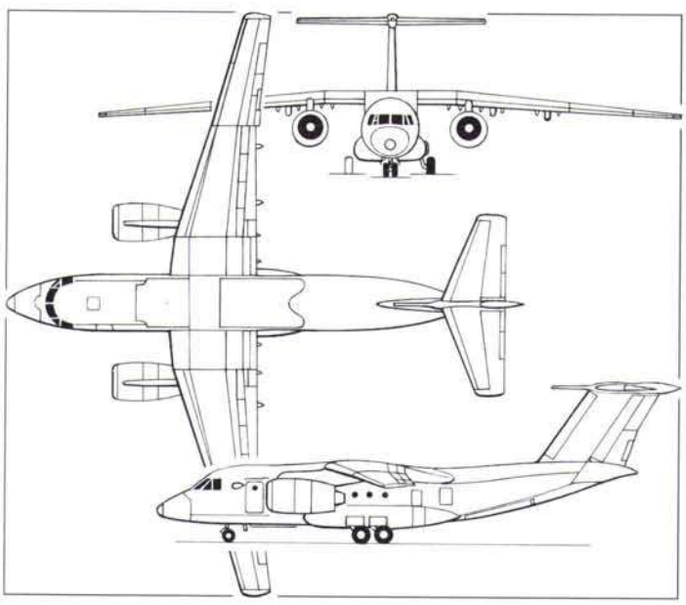
Max level speed at 10,000 m (32,810 ft):	
A	380 kt (705 km/h; 438 mph)
Max level speed at 10,100 m (33,135 ft):	
C, D, E, F	377 kt (700 km/h; 434 mph)
Cruising speed at 10,000 m (32,810 ft):	
A, B	297–324 kt (550–600 km/h; 342–373 mph)
Approach speed: A	97 kt (180 km/h; 112 mph)
Service ceiling: A	10,700 m (35,100 ft)
B	11,800 m (38,720 ft)
F	10,100 m (33,140 ft)
Service ceiling, OEI: A	5,100 m (16,740 ft)
B	6,800 m (22,300 ft)
T-O run: A	930 m (3,055 ft)
B	620 m (2,035 ft)
T-O to 10.7 m (35 ft): A	1,170 m (3,840 ft)
B	830 m (2,725 ft)
Landing run: A	465 m (1,525 ft)
B	420 m (1,380 ft)
Max length of runway required:	
C, D	1,200–1,800 m (3,940–5,905 ft)
E, F	1,400–2,150 m (4,595–7,055 ft)
Range, 45 min reserves:	
A with max payload	430 n miles (800 km; 497 miles)
A with 7,500 kg (16,535 lb) payload	1,080 n miles (2,000 km; 1,240 miles)
A with max fuel	2,590 n miles (4,800 km; 2,980 miles)
B with 5,000 kg (11,020 lb) payload	430 n miles (800 km; 497 miles)
B with max fuel	1,760 n miles (3,250 km; 2,020 miles)
F with 10,000 kg (22,046 lb) payload	809 n miles (1,500 km; 932 miles)
F with 5,000 kg (11,023 lb) payload	1,943 n miles (3,600 km; 2,236 miles)
Range, 1 hour reserves:	
C, F with 7,500 kg (16,535 lb) payload	944 n miles (1,750 km; 1,087 miles)
E with 7,500 kg (16,535 lb) payload	1,160 n miles (2,150 km; 1,336 miles)
C, E with 5,000 kg (11,020 lb) payload	1,511 n miles (2,800 km; 1,739 miles)
F with 5,000 kg (11,020 lb) payload	1,403 n miles (2,600 km; 1,615 miles)
C with max fuel and 800 kg (1,763 lb) payload	2,375 n miles (4,400 km; 2,734 miles)
D with max fuel and 16 passengers	2,429 n miles (4,500 km; 2,796 miles)
E with max fuel and 2,500 kg (5,511 lb) payload	2,294 n miles (4,250 km; 2,640 miles)
F with max fuel and 5,000 kg (11,020 lb) payload	2,321 n miles (4,300 km; 2,671 miles)
Endurance: F	6 h 50 min

ANTONOV An-74-300

TYPE: Twin-jet freighter.

PROGRAMME: First variant, An-74TK-300, announced mid-1998. Prototype An-74TK-300 modified by KhGAPP from An-74 c/n 1910; work began December 1999; first official flight (UR-74300) 20 April 2001; international debut at Paris Salon, June 2001; certification trials completed July 2002 after 219 sorties; AP-25 certificate approved 9 September 2002.

Antonov An-74-300 used by Ukrainian government *(KhGAPP)* 1158195



Antonov An-74T-300 STOL transport *(James Goulding)* 1158196

CURRENT VERSIONS: An-74 derivative in which podded, underslung engines, incorporating thrust-reversers, replace the normal An-72/74 installation.

An-74TK-300: Baseline transport for 52 passengers. *As described.*

An-74MP-300: Proposal announced 2002. Maritime patrol version of An-74TK-300; also capable of carrying 22 paratroops, or 44 soldiers or 16 stretchers. Provision for GSh-23L gun, rockets and 100 kg bombs.

An-74TK-300D: Executive transport for 30 passengers.

CUSTOMERS: Initial order for two from Ukraina airline for operation on behalf of government in VIP role. These comprise prototype, subsequently registered UR-LDK (Leonid Danilovich Kuchma) and second aircraft, UR-YVA (Yushchenko, Viktor Andreyevich). MoU for 25 from Aeroflot, signed June 2002; Chinese interest in two aircraft reported late 2002. Neither pursued to contract stage but home orders anticipated from UkrTransLeasing. In 2006, two An-74TK-300s on assembly line earmarked for Libya and Laos.

COSTS: USD12 million to USD14 million (2003).

DESIGN FEATURES: Revised engine installation decreases T-O run, despite loss of Coanda effect; new power plants reduce maintenance requirements and fuel consumption (up to 29 per cent); new position simplifies access.

Cabin enlarged by repositioning of partitions; integral airstairs; upgraded air conditioning; improved instrumentation.

POWER PLANT: Two 63.7 kN (14,330 lb st) Progress D-36-4A turbofans.

AVIONICS: *Comms:* SO-72M transponder, Arlekin-DA HF radio, twin Orlan-85ST VHF, Lainer-MVL PA system, Opal-B CVR, twin Cospas ELT. Optional Arlekin-DA HF radio.

Radar: Buran-74T weather radar.

Flight: NVS-74TM Malva navigation system, SAU-74–03 autopilot, EGPWS, twin SH-3301 GPS, twin A-037 radar altimeters, twin KURS-93M VOR/ILS, twin SD-75 DME, Veer-M Shoran, twin ARK-22 ADF and TCAS 2000. Optional SAU-104/74 digital autopilot.

Instrumentation: 'Glass cockpit' FMS optional.

Generally as for An-74, except that below.

DIMENSIONS, EXTERNAL:

Tailplane span	10.00 m (32 ft 9¾ in)
Wheel track (tread centre)	4.07 m (13 ft 4¼ in)
Wheelbase (mean)	8.08 m (26 ft 6 in)
Distance between engine centrelines	8.90 m (29 ft 2½ in)

DIMENSIONS, INTERNAL (VIP version):

Cabin: Length	10.49 m (34 ft 5 in)
Width	2.20 m (7 ft 2½ in)
Height	2.50 m (8 ft 2½ in)
Volume	54.0 m³ (1,907 cu ft)

AREAS:

Wings, gross	98.62 m² (1,061.5 sq ft)

WEIGHTS AND LOADINGS:

Max	10,000 kg (22,045 lb)
Max fuel weight	13,210 kg (29,123 lb)
Max T-O weight	36,500 kg (80,468 lb)
Max landing weight	33,000 kg (72,752 lb)

PERFORMANCE:

Max level speed	378 kt (700 km/h; 435 mph)
Max cruising speed	313 kt (580 km/h; 360 mph)
Service ceiling	10,100 m (33,140 ft)
Balanced field length	2,050 m (6,725 ft)
Range: with nine passengers and 2,300 kg (5,070 lb) cargo	1,781 n miles (3,300 km; 2,050 miles)
with eight passengers	2,375 n miles (4,400 km; 2,734 miles)
ferry	2,807 n miles (5,200 km; 3,231 miles)

ANTONOV An-128

TYPE: Regional jet airliner; twin-turboprop airliner.

PROGRAMME: Revealed October 2004, when joint development agreement reached with PZL of Poland. No further announcements by mid-2006.

DESIGN FEATURES: T-tail, high-wing transport with either turboprop or turbofan engine on each wing and accommodation for 21 passengers. Reportedly requested by Libya.

ANTONOV An-140

TYPE: Twin-turboprop airliner.

PROGRAMME: Announced at Paris in June 1993 as An-24 replacement; preliminary design finalised April 1994; two prototypes with TV3-117 engines and static test airframe constructed at Kiev; rolled out 6 June 1997; first flight (UR-NTO) at Kiev-Svyatoshino (landing at Gostomel flight test centre, as base for certification trials) 17 September 1997; second airframe (0102) for static tests; second flying prototype (UR-NTP) rolled out 11 December 1997 and flew 26 December. Third (0104; first production), due to fly at Kharkov, early 1999, and undertake electromagnetic compatibility and climatic tests but maiden sortie delayed until 11 October 1999; this aircraft (UR-PWO) flew 41 sorties towards certification.

Certification programme of 940 hours began August 1998 and completed in early 2000; included cold trials at Arkhangelsk (by UR-NTO between 29 March and 1 May 1999, and by UR-NTP in Yakutia for 10 days in January 2000) and hot-and-high trials in Uzbekistan and Kyrgystan (by UR-NTP, concluding 3 September 1999). Following first series of flight testing, tailplanes of prototypes modified to obviate propwash-induced vibration, gaining 15° dihedral and shortened elevator horn balance. An-140's 1,000th hour flown (by UR-NTP) on 12 January 2000. Trials concluded on 26 March 2000 after 1,286 hours in 1,138 sorties. Certification in Russia (AP-25) and Ukraine was achieved on 25 April 2000 coincident with that of TV3-117VMA-SBM1 engine and AV-140 propeller. Meets FAR Pt 25 airworthiness, Pt 34 emissions and Pt 36 noise requirements.

Series production began 1999 at KhGAPP, Kharkov (where wings for prototypes were built) and at Aviacor, Samara, Russian Federation.

Aviacor production intended to be 10 in 2000 (first in July) and to reach 30 per year by 2001, but reduced to combined total of eight in 2000–01; five under assembly at Aviacor by May 2000, but first (confusingly, RA-14001) not rolled out until 25 December 2003, being one of two ordered in 2003 by Samara Airlines; first flight delayed until 2 August 2005 and aircraft repainted as RA-41250 of Yakutia for display at Moscow Salon later in same month.

KhGAPP deliveries began with UR-14001 to Odessa Airlines on 4 March 2002. This made type's Western debut at Farnborough in July 2002. Six production aircraft supplied by KhGAPP before change to An-140-100, first of which delivered on 26 April 2004.

Production share agreement of 1998 assigns empennage to Antonov; engine nacelles, wing and associated control surfaces to KhGAPP; landing gear to Aviagregat at Samara and Youzhmash at Dniepropetrovsk; and fuselage to Aviacor (incorporating Avio Interiors fittings from Italy).

Agreement signed December 1995 for assembly by HESA at rate of 12 a year from 1999, progressing to local parts manufacture, in new plant at Esfahan, Iran, with Ukrainian assistance; first two kits shipped from KhGAPP to Iran by late 2000; initial aircraft first flown 7 February 2001. Iranian type certificate issued 14 April 2003. Total 10 kits delivered by early 2005, by which time two were flying.

In first four years of commercial operation (to 2006), An-140s flew 21,367 hours in 12,667 sorties.

CURRENT VERSIONS: **An-140:** Initial six production aircraft only; replaced in 2004 by -100.

An-140T: Proposed 6 tonne freighter with large door, port side, rear. Convertible **An-140TK** will be similar, but with 5 tonne payload and up to 50 passengers.

An-140VIP: Executive version; range 2,159 n miles (4,000 km; 2,485 miles). Prototype converted by InterAMI of Kharkov from former Odessa Airlines aircraft and shown at Kish, Iran, January 2005.

An-140-100: Improved version; advanced engine nacelle design, increased tankage and wing span increased by 1.00 m (3 ft 3¼ in) giving 21,500 kg (47,399 lb) MTOW and further 162 n miles (300 km; 186 miles) of range. Standard version from 2004. (Series 100 originally proposed in 1997 as 68-seat version with 3.80 m; 12 ft 5½ in fuselage stretch.) *As described.*

An-142: Under development for 2001 first flight; forward-retracting rear loading ramp similar to An-26. No further reports.

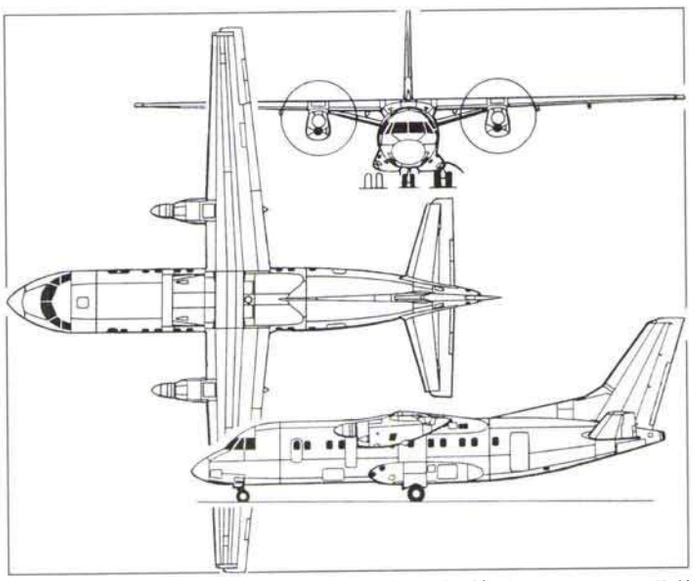
Ir.An-140: Licence-built by HESA in Iran.

An-140 Military: Patrol, surveillance, photographic and similar variants proposed for military operators.

CUSTOMERS: Air Ukraine letter of intent for up to 40 by 2010 signed 17 September 1997 (first flight); initial four firm conversions made June 1999 (for manufacture at Kharkov), specifying deliveries from 2000; however, initial recipient from Ukrainian production was Ikar Airlines, with five on order from January 2000 contract, first being UR-PWO, delivered in 2001, following testing at Antonov; this soon disposed of, however, and no more supplied to Ikar. Initial permanent operator, Odessa Airlines, ordered five from Kharkov production, of which first (UR-14001, the former UR-PWO) entered revenue-earning service on 29 March 2002, having been handed over to Ukrtransleasing on 4 March.

Kharkov only recorded as having delivered one (4K-AZ49 to Azerbaijan Airlines on 29 March) in 2005; third Azerbaijani aircraft completed, but not delivered by early 2006, following crash of first machine. One supplied by Samara in 2005 and two due in 2006 (all to Yakutia); none reported from Iran in 2005. Refer to table for further customers.

Launch order for Ir.An-140 was 20 for Iran Asseman Airlines; Iran Air also will be operator; Iranian licence initially for 80 aircraft, but interest reported, late 1998, in building further 160.



Antonov An-140-100 short-range transport *(James Goulding)* 1158198

COSTS: USD9.8 million (2006).

DESIGN FEATURES: Light transport, designed to be capable of autonomous operation from airfields with unprepared runways at all altitudes and in all weathers, providing airline-standard comfort. International certification and various engine options to maximise sales prospects. Conventional high-wing monoplane; tapered wing with unswept leading-edge; sweptback fin and tailplane, latter with 15° dihedral; engines mounted underwing. Maintenance target of 6.5 mmh/fh. Service life 50,000 landings/50,000 hours/25 years.

FLYING CONTROLS: Conventional and manual. Control surfaces all horn balanced; ailerons with servo tab in each (plus trim tab starboard); elevator with two-section trim/servo tab each side; rudder with large single tab. Two-section flaps in each wing; auto spoiler ahead of each outboard flap section.

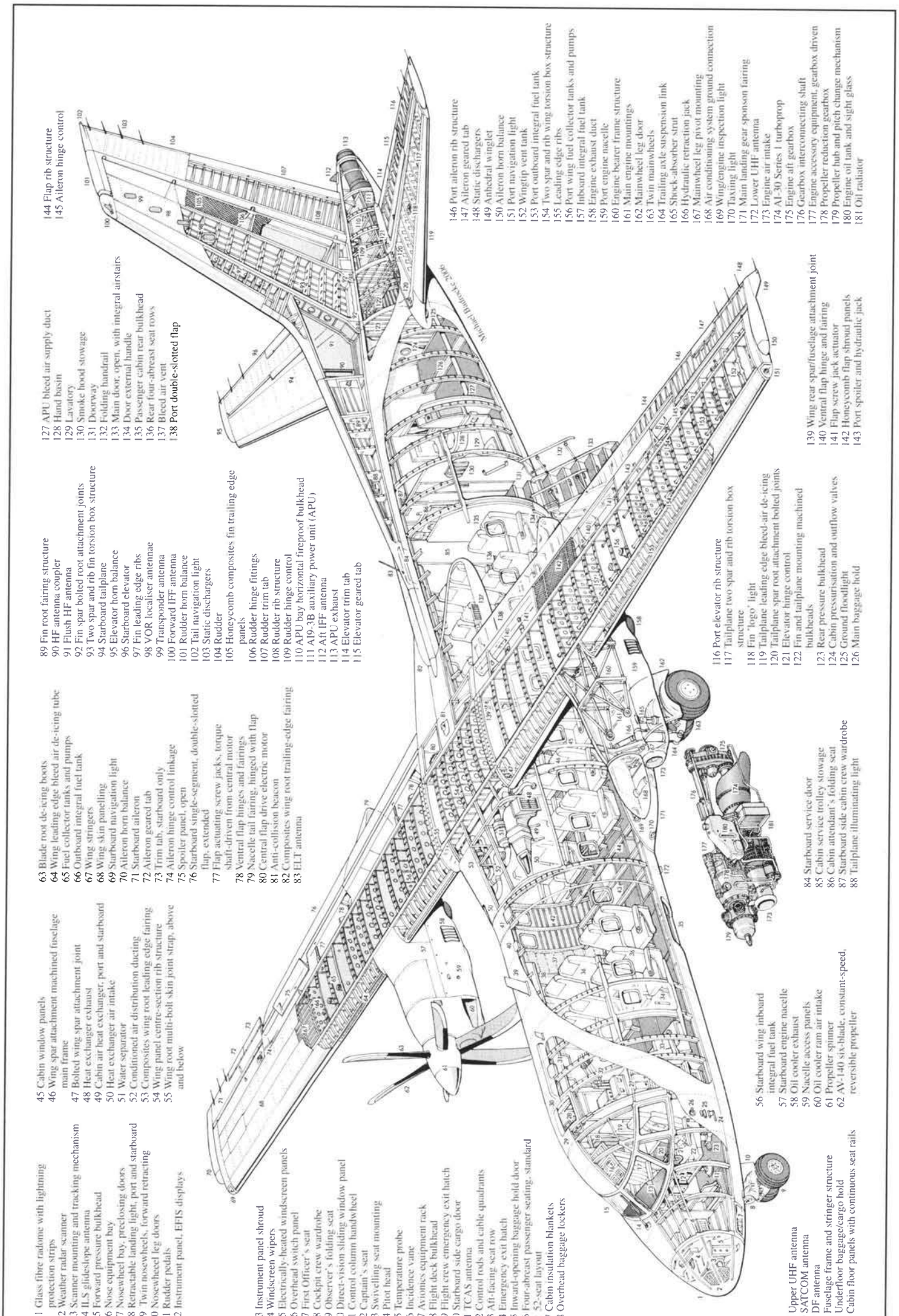
STRUCTURE: Largely of aluminium, with some titanium.

LANDING GEAR: Retractable tricycle type by Pivdennyi; twin Rubin wheels on each unit; steerable nosewheels retract forward, mainwheels into fairings each side of lower fuselage. Mainwheels KT-231, tyre size 810×320-330; nosewheels KN-44, tyre size 600×220-254. Rubin braking system on mainwheels. Able to operate from gravel or unpaved fields.

POWER PLANT: Two 1,839 kW (2,466 shp) Ivchenko TV3-117VMA-SBM1 (built at Zaporozhye, Ukraine, by Motor-Sich), driving AV-140 feathering and reversible propellers. FED fuel-management system; Star engine control system.

ACCOMMODATION: Flight crew of two, plus cabin attendant; basic seating for 52 passengers, four-abreast with centre aisle, at 78 cm (31 in) pitch, or 48 at 81 cm (32 in) pitch. Main passenger door with airstairs, at rear of cabin on port side, with service door (also emergeny exit Type I) opposite; Type III emergency exit port side at front of cabin; cargo door (and Type I exit) starboard side, front. Coat stowage, galley and lavatory at rear of cabin. Baggage/freight compartment at rear of cabin, plus forward underfloor baggage hold, with door on port side. Cargo door on starboard side, forward part of cabin floor reinforced, and

Kharkov-built Antonov An-140 operated by Ukrainian government *(Yefim Gordon)* 1158205



Antonov An-140 Series 100, cutaway drawing key *(Michael Badrocke)*

1151684

ANTONOV An-140 CUSTOMERS

Airline	Order	Remarks
Kharkov production		
Aeromost	3	First aircraft UR-14002 delivered 3 Aug 02
Air Ukraine	(4)	None received
Azerbeijan Airlines	4	First aircraft 4K-AZ48 delivered 27 Nov 04; revenue service 3 Dec 04
Ikar Airlines	(5)	First production aircraft used briefly from December 2001; none further
Il'ich-Avia	2	First aircraft UR-14007 delivered 26 Apr 04
Motor Sich	1	UR-14005 delivered 23 May 03
Odessa Airlines	5	First aircraft UR-14001 handed over (to Uktransleasing) 4 Mar 02; revenue service 29 Mar 02
TOJ-Airlines	1	Ordered 27 Oct 04
Volga Dnepr	(5)	Letter of intent Oct 02
Samara production		
Aeroflot	(50)	Letter of intent, mid-1999; PW127 engines
Air Libya	(5)	Ordered Jun 03
Buryatia Airlines	(2)	Ordered Dec 02
Ilyushin Finance	(25)	Ordered 17 Jul 06 by Samara local government
Samara Airlines	(15)	See Ilyushin Finance
Sibaviatrans	(3)	Ordered Dec 02
Yakutia	(3)	One An-140; two An-140-100s; five options

Notes: Iranian production not included

detachable equipment provided, enabling 1,650 to 3,650 kg (3,638 to 8,046 lb) of bulk cargo and 36 to 20 passengers to be carried with forward rows of seats removed. Overhead baggage lockers. Accommodation ventilated and pressurised.

SYSTEMS: Motor-Sich AI-9-3B 16 kW APU in tailcone. FED hydraulic system; Nauka air conditioning. Kommunar anti-icing and air conditioning control systems. Auxilec generators; Eros oxygen system.

Avionika SAU 28-02 analogue flight control system. Digital ICVSP-140-01 ADS optional.

AVIONICS: *Comms:* Arlekin-D-A HF/ radio, twin Orlan-85ST VHF, AVSA-MVL PA system, Opal-B CVR, R-855A1 emergency VHF/UHF, SO-72M transponder, Satori ELT96 ELT. Muza-A entertainment system.

Radar: Buran A-140 weather radar

Flight: ARK-25 ADF, Veer-M Shoran, Kurs-93M VOR/ILS, RMI-3 RMI, SN-3301 GPS, VND-94 VOR, A037 D1 radio altimeter, TCAS-94 and SSPZ-2000 GPWS.

DIMENSIONS, EXTERNAL:

Wing span: An-140	24.505 m (80 ft 4¾ in)
An-140-100	25.505 m (83 ft 8¼ in)
Length overall	22.605 m (74 ft 2 in)
Height overall	8.225 m (26 ft 11¾ in)
Wheel track (c/l shock-absorbers)	3.18 m (10 ft 5¼ in)
Wheelbase	8.125 m (26 ft 7¾ in)
Propeller diameter	3.72 m (12 ft 2½ in)
Distance between propeller centres	8.20 m (26 ft 10¾ in)
Main cabin door: Height	1.68 m (5 ft 6¼ in)
Width	0.915 m (3 ft 0 in)
Emergency exit: Height	1.19 m (3 ft 10¾ in)
Width	0.51 m (1 ft 8 in)
Service door: Height	1.29 m (4 ft 2¾ in)
Width	0.62 m (2 ft 0½ in)
Cargo door: Height	1.29 m (4 ft 2¾ in)
Width	0.985 m (3 ft 2¾ in)
Underfloor baggage hold door:	
Height	0.93 m (3 ft 0½ in)
Width	1.10 m (3 ft 7¼ in)

DIMENSIONS, INTERNAL:

Cabin: Length:	
excl flight deck, galley/lavatory area	10.50 m (34 ft 5½ in)
incl galley/lavatory and baggage	14.62 m (47 ft 11½ in)
Max width	2.60 m (8 ft 6¼ in)
Max height	1.90 m (6 ft 2¾ in)
Volume: total	65.5 m³ (2,313 cu ft)
Aft baggage compartment: Volume	6.1 m³ (215 cu ft)
Underfloor baggage hold: Length	3.98 m (13 ft 0¾ in)
Max width	1.45 m (4 ft 9 in)
Max height	0.545 m (1 ft 9¾ in)
Volume	3.0 m³ (106 cu ft)
Overhead baggage lockers:	
Volume (total)	2.4 m³ (85 cu ft)

WEIGHTS AND LOADINGS (An-140-100):

Operating weight empty	13,200 kg (29,101 lb)
Baggage capacity	1,840 kg (4,057 lb)
Max payload	6,000 kg (13,227 lb)
Max fuel weight	4,680 kg (10,318 lb)
Max T-O weight	21,500 kg (47,399 lb)
Max power loading	5.85 kg/kW (9.61 lb/shp)

PERFORMANCE (An-140-100):

Max cruising speed	290 kt (537 km/h; 334 mph)
Econ cruising speed	248 kt (460 km/h; 286 mph)
Landing speed	109 kt (202 km/h; 125 mph)
Nominal cruising altitude	FL200
Max certified altutude	7,620 m (25,000 ft)
T-O run	880 m (2,890 ft)
Landing run	530 m (1,740 ft)
Range, no reserves:	
with 6,000 kg (13,227 lb) payload	928 n miles (1,720 km; 1,068 miles)
with 52 passengers	1,495 n miles (2,770 km; 1,721 miles)
with 42 passengers	1,835 n miles (3,400 km; 2,112 miles)
ferry	2,176 n miles (4,030 km; 2,504 miles)

ANTONOV An-148

TYPE: Regional jet airliner.

PROGRAMME: In September 2001, Antonov revealed that it was working on the design of an 80-seat, twin-jet (Progress D-36-5AF), 1,349 n mile (2,500 km; 1,553 mile) range airliner. Configuration is similar to the An-74T-300; stretched and shrunk versions are also planned.

Model of Antonov An-148T military rear-loading freighter *(Paul Jackson)*

1159094

Series manufacture originally planned to be by KhGAPP at Kharkov and VASO at Vorenezh, Russia. Antonov and UUAP signed agreement for licensed production in February 2002, but this not taken further. Ukrainian participants include Motor Sich and ZhEDB Progress. By September 2004, envisaged that Aviant would be sole source, employing subassemblies from KhGAPP (centre fuselage) and VASO (empennage). Antonov and VASO signed production licence on 25 November 2005 and VASO deliveries to Ukraine began in early 2006.

The first of three (two flying; one static) Antonov-built prototypes was under construction at Kharkov by early 2002; fuselage removed from jigs 28 February 2003; unofficially rolled out 25 September 2004; formal presentation 15 October 2004; first flight (UR-NTA), from Svyatoshino to Antonov test base at Gostomel 17 December 2004; second prototype (UR-NTB), with airline interior, flew 19 April 2005; total 117 sorties by mid-June 2005 (both aircraft); Winter trials in Yakutia, January 2006. Static test airframe (0103) employed by Antonov; certification due in late 2006.

CURRENT VERSIONS: **An-148-100B:** Baseline version; 70 to 80 passengers; range up to 2,159 n miles (4,000 km; 2,485 miles). KrasAir aircraft equipped for eight first- and 60 economy passengers.

An-148-100A: Short-haul version; 75 passengers; range 1,187 n miles (2,200 km; 1,367 miles).

An-148-100E: Long haul, 75-seat version; range 2,753 n miles (5,100 km; 3,169 miles).

An-148-100E1: Long-haul version; 55 passengers in three-class cabin over 3,779 n miles (7,000 km; 4,349 miles); additional fuel tanks in baggage hold.

An-148-100E2: Executive transport; between 10 and 30 passengers; range 4,697 n miles (8,700 km; 5,405 miles). Baggage hold fuel. Second An-148 prototype acquired by KrasAir in 2006 as An-148VIP with 18 seats.

An-148-C1: Small parcels transport; total payload 10,500 kg (23,149 lb), loaded by conveyor belt via two side doors and underfloor baggage hatch.

An-148-C2: Palletised cargo transport, including LD1, LD2, LD3, LD3-46, LD3-46W, LD4, LD8 and AED containers. Maximum pallet size 2.24 × 3.18 m (88 × 125 in). Cargo door 3.40 m (11 ft 1¾ in) wide and 1.92 m (6 ft 4 in) high, port, rear; reinforced floor with roller track.

An-148T: Rear loading ramp freighter.

An-148-200: Stretched version for 100 passengers. Available as **200A** with range up to 1,619 n miles (3,000 km; 1,864 miles) and **200B** with 2,429 n mile (4,500 km; 2,796 mile) range. Fuselage plugs of 3.03 m (9 ft 11¼ in) ahead of wings and 2.20 m (7 ft 2½ in) aft.

CUSTOMERS: Volga-Dnepr letter of intent for three signed October 2002. Aeroflot lease agreement for 30 An-74s will be transferred to An-148. Aerosvit letter of intent for 10, 2004.

First firm order, May 2005, from KrasAir for 10, of which five for delivery in 2006; however, by mid-2006 Antonov naming SCAT of Kazakhstan as recipient of first seven production aircraft in 2006-07. Pulkovo Airlines to acquire 18 (replacing requirement for Tupolev Tu-334s), beginning with three in 2006. Initial aircraft for these two customers included in first production batch of 14 An-148s funded by Ilyushin-Finance from VASO plant in January 2005.

COSTS: GBP12.7 million (2005).

DESIGN FEATURES: Generally as for Antonov An-74, but FBW control system. Wing developed by KhGAPP. Intended parameters include 99.4 per cent dispatch reliability; 300 h/month utilisation; and 1.3 mmh/fh. Engine change in 2 hours. AP/FAR/EASA Pt 25 certification; ICAO IV noise/environmental impact.

POWER PLANT: Two progress (ZMKB) D436-148 turbofans, each of 65.6 kN (14,740 lb st). Provision for alternative engines. Fuel capacity approx 15,100 litres (3,989 US gallons; 3,322 Imp gallons) in all versions.

ACCOMMODATION: Flight deck crew of two, plus jump-seat. Seating in cabin as per variant. Passenger door, front, port; service doors, forward, starboard and rear port. Front and rear underfloor baggage holds, each with door, starboard. Cabin baggage compartment, rear, with door, starboard. Crew wardrobe, passenger wardrobe and lavatory forward; galley and lavatory rear, ahead of baggage compartment.

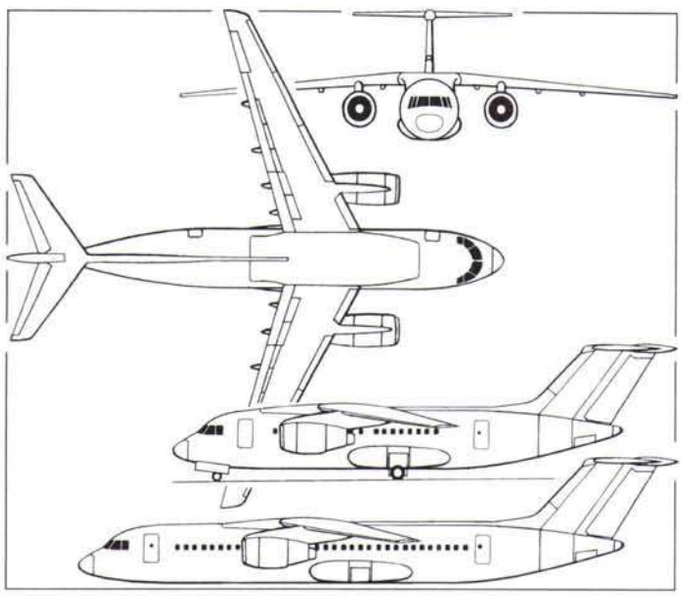
EQUIPMENT: ZMKB Progress AI-450MS APU.

AVIONICS: Two-crew cockpit with five-screen display by Aviapribor, Honeywell or Rockwell Collins equipment.

DIMENSIONS, EXTERNAL (An-148 100 and -200):

Antonov An-148 second prototype *(Yefim Gordon)*

1158248



General arrangement of the Antonov An-148-100 with additional side view of An-148-200 *(James Goulding)*

1162246

Wing span ..... 28.91 m (94 ft 10¼ in)
Length overall: 100 ..... 29.13 m (95 ft 6¾ in)
200 ..... 34.36 m (112 ft 8¾ in)
Height overall: 100 ..... 8.20 m (26 ft 10¾ in)
200 ..... 8.60 m (28 ft 2½ in)
Baggage door, underfloor (forward, stbd):
Height ..... 1.00 m (3 ft 3¼ in)
Width ..... 1.50 m (4 ft 11 in)
Baggage door, underfloor (rear, stbd):
Height ..... 1.00 m (3 ft 3¼ in)
Width ..... 1.00 m (3 ft 3¼ in)
Baggage door, cabin (rear, stbd):
Height ..... 1.00 m (3 ft 3¼ in)
Width ..... 0.75 m (2 ft 5½ in)
DIMENSIONS, INTERNAL:
Cabin: Height: max ..... 2.00 m (6 ft 6¾ in)
under baggage lockers ..... 1.40 m (4 ft 7 in)
Baggage hold: Height: max (centre) ..... 0.74 m (2 ft 5¼ in)
min (sides) ..... 0.44 m (1 ft 5¼ in)
Width: max (base) ..... 2.11 m (6 ft 11 in)
min (top) ..... 1.86 m (6 ft 1¼ in)
Volume: forward ..... 7.5 m³ (152 cu ft)
rear ..... 4.3 m³ (152 cu ft)
WEIGHTS AND LOADINGS (An-148-100 and -200):
Max payload ..... 9,000 kg (19,842 lb)
Max fuel weight ..... 12,100 kg (26,676 lb)
Max T-O weight:
100A ..... 37,130 kg (81,857 lb)
100B ..... 39,900 kg (87,964 lb)
100E, E1, E2 ..... 43,050 kg (94,908 lb)
PERFORMANCE (estimated):
Cruising speed: max ..... 470 kt (870 km/h; 541 mph)
econ ..... 443 kt (820 km/h; 510 mph)
Cruising altitude ..... 11,600 m (38,060 ft)
Required runway length: 100 ..... 2,300 m (7,545 ft)
200 ..... 2,100 m (6,890 ft)
Range: with max payload ..... 1,906 n miles (3,530 km; 2,193 miles)
with max fuel ..... 3,552 n miles (6,580 km; 4,088 miles)

ANTONOV An-148 REPORTED ORDERS

Notes: It has proved impossible to differentiate between claimed orders, actual orders, options, commitments and 'wish lists', even when reported by supposedly authoritative sources. Those marked * obtained on lease-purchase via Ilyushin Finance.

Airline	Version	Qty	Remarks
Aeroflot		30	Planned lease
Aerosvit		10	"Guaranteed" in magazine claim, 2005
Berkut			"Signed agreement" (Antonov)
Cubana*	-100B	3	Order Moscow Air Show 2005
Donbassaero		5	"Guaranteed" in magazine claim, 2005
KrasAir*	-100B	10	"Signed agreement" (Antonov)
	-100B	5	Option
	-VIP	1	Second prototype purchased in 2006; joint use with IFK-Jets
Polet*	-100B	15	Signed Moscow Air Show 2005
	An-148T	5	Signed Moscow Air Show 2005
Pulkovo*	-100B	8	"Signed agreement" (Antonov)
	-100B	10	Option
SCAT	-100	7	Launch operator
Ukrainian?		3	"Guaranteed" in magazine claim, 2005
Volga-Dnepr	-100B	3	Intention; Moscow 2005
	-100C	3	Intention; Moscow 2005
	An-148T	2	Intention; Moscow 2005
Yuzhnye		6	"Guaranteed" in magazine claim, 2005

Total: In early 2006, Antonov reported 41 aircraft covered by "signed delivery agreements" with Berkut, KrasAir, Pulkovo and Skat, omitting to mention Polet and Cubana orders announced earlier.

IKAR

FIRMA AEROKLUB 'IKAR' ('IKAR' AERO CLUB FIRM)

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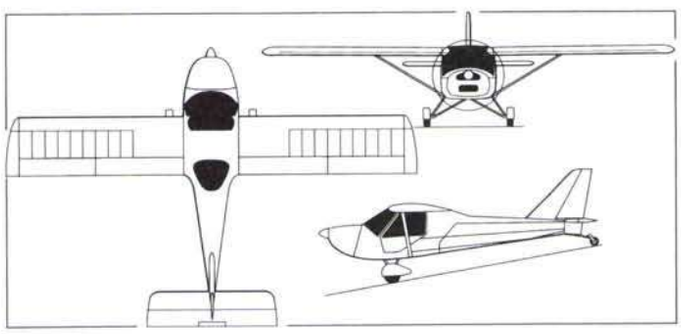
'Ikar' Aero Club was founded in 1995 to develop, build and provide engineering and maintenance support for light aircraft. In addition to the Ai-10, it has built the Ai-9 Lis of similar configuration; and Aist pod-and-boom ultralight. Projects include the Zhuravlik powered hang-glider; four-seat Ai-20 Dedal; Ai-30 Chirok four-seat amphibian; Ai-40 Leleka agricultural sprayer; tandem-seat Ai-50 Skvorets; Ai-60 (also known as Ai-240) four-seat light twin; and Ai-70 agricultural sprayer.

IKAR Ai-10 IKAR

TYPE: Side-by-side ultralight.
PROGRAMME: First flown in 1999. Gained French ultralight approval in October 2002. No recent reports, but marketing proceeding in France, Spain and elsewhere during 2006.

Ikar Ai-10 side-by-side ultralight of a Russian private owner *(Yefim Gordon)*
1044948



Ikar Ai-10 general arrangement *(Paul Jackson)*
1159116

COSTS: USD35,000 to USD39,000, according to equipment (2001).
DESIGN FEATURES: High-mounted, constant-chord, strut-braced wing. Sweptback fin and mid-mounted tailplane.
FLYING CONTROLS: Conventional and manual. Flaps.
STRUCTURE: Metal airframe. Fabric-covered wing.
LANDING GEAR: Tailwheel type; fixed.
POWER PLANT: One Rotax flat-four driving a Petrenko P-912-170 three-blade, wooden propeller: 59.6 kW (79.9 hp) Rotax 912 UL; 73.5 kW (98.6 hp) 912 ULS; or 84.6 kW (113.4 hp) 914. Fuel capacity 88 litres (23.2 US gallons; 19.4 Imp gallons).
DIMENSIONS, EXTERNAL:

Wing span	9.06 m (29 ft 8¾ in)
Length overall	6.21 m (20 ft 4½ in)
Height overall	1.70 m (5 ft 7 in)
AREAS:	
Wings, gross	11.74 m² (126.4 sq ft)
WEIGHTS AND LOADINGS:	
Weight empty	284 kg (626 lb)
Max T-O weight: Rotax 912 ULS	510 kg (1,124 lb)
Rotax 912 UL	450 kg (992 lb)
PERFORMANCE (Rotax 912 ULS):	
Cruising speed	97 kt (180 km/h; 112 mph)
Stalling speed	27 kt (50 km/h; 32 mph)
Max rate of climb at S/L	360 m (1,181 ft)/min
T-O run	80 m (265 ft)
Landing run	60 m (200 ft)
Range with max fuel	540 n miles (1,000 km; 621 miles)
g limits	+6/−3

IKAR Ai-70

TYPE: Agricultural sprayer.
PROGRAMME: Under development by 2005. No report of progress in subsequent year.
DESIGN FEATURES: Tandem-seat, high-wing, tailwheel design based on Ai-10. Typical working rate of 300 to 530 litres (80 to 140 US gallons; 67 to 117 Imp gallons) per flying hour.
POWER PLANT: One 103 kW (138 hp) LOM M332 four-cylinder, in-line piston engine.
EQUIPMENT: Chemical tank and spraybars.
DIMENSIONS, EXTERNAL:

Wing span	12.00 m (39 ft 4½ in)
Length overall	7.00 m (22 ft 11½ in)
Height overall	2.75 m (9 ft 0¼ in)
AREAS:	
Wings, gross	18.50 m² (199.1 sq ft)
WEIGHTS AND LOADINGS:	
Weight empty	320 kg (705 lb)
Max T-O weight	750 kg (1,653 lb)
PERFORMANCE:	
Normal cruising speed	70 kt (130 km/h; 81 mph)
Stalling speed	38 kt (70 km/h; 44 mph)
Max rate of climb at S/L	210 m (689 ft)/min
Service ceiling	3,500 m (11,480 ft)
T-O run	100 m (330 ft)
Landing run	70 m (230 ft)
Range with max fuel	216 n miles (400 km; 248 miles)
g limits	+4/−2

LILIENTAL'

LILIENTAL' ZAO (LILIENTHAL JSC)

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e-mail: lilienthal@xai.kharkov.ua
Web: xai.kharkov.ua/~lilienthal
PRESIDENT: Anatoly Borodin
PRODUCTION DIRECTOR: Yury Komarovsky
SALES MANAGER: Alexey Voloshin

The company (which adopts the German spelling of aviation pioneer Otto Lilienthal for marketing in the West) and its predecessors have built 15 types of aircraft, from hang-gliders (first flight 4 September 1975) to twins. Lilienthal was formed by Anatoly Borodin and Valentin Loskov out of the hang-glider club associated with the KhGAPP aircraft plant, transforming into an ultralight club in 1976 and establishing a design bureau within Kharkov factory in 1987.

Lilienthal was established as a firm in 1991, manufacturing the Kh-37 (X-37) Chibis hang-glider and moving two years later to the Kh-32 (X-32) Bekas. By 2003, more than 100 of each had been built, production continuing at a rate of 10 per year. All current types have a Russian type certificate. Manufacture is conducted in close association with related companies Otto Ltd and Gustav Ltd. Lilienthal is also a service centre for Rotax engines and licensed for flying instruction.

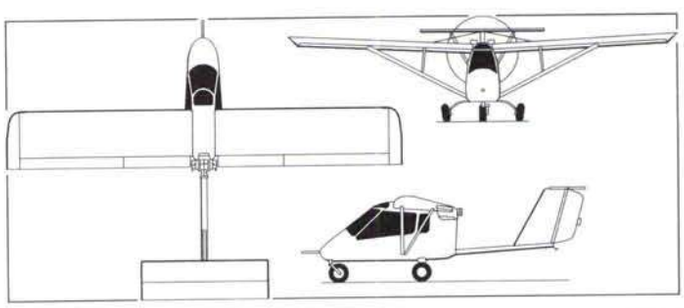
It will be noted that the Kh-designations of the Kharkov-designed aircraft of Lilienthal retain the Cyrillic 'X' for Western trading.

LILIENTHAL X-32 BEKAS

English name: Snipe
TYPE: Tandem-seat ultralight.
PROGRAMME: First flown March 1993; certified in Ukraine in 1995. Available in A (Arctica Skiplane), AT (sportplane), UT (Uchebno-Trenirovochnyy trainer), CX (Roman 'SKh') (agricultural) and H (Hydro floatplane) versions. Under a 2003 agreement with Jordan Aerospace Industries, is assembled and marketed in the Middle East as JAI RumBird X-32.

REMZ-Avia of Ryazan, Russia, (www.remz-avia.ru) markets the aircraft as the **Sintal**, in **S-2**, **S-2UT** and **S-2SKh** variants; cockpit glazing has rounded corners. The Sintal was shown at the Moscow Salon in August 2005, although there has been no evidence of recent production in Ukraine.

REMZ-Avia S-2 Sintal variant of X-32 marketed in Russia with revised door and windscreen shape *(Yefim Gordon)*
1129593



Lilienthal X-32 Bekas *(Paul Jackson)*
0576137

CUSTOMERS: Over 100 built by 2004.
COSTS: X-32AT USD15,510 for airframe, or USD22,300 with Rotax, USD33,800 with Rotax 912 and USD34,790 with Rotax 912S, plus tax (2004).
DESIGN FEATURES: Pod-and-boom pusher monophone, with constant-chord high wing braced by V struts and intermediate struts. T-tail with single bracing strut each side.
Wing section NACA 4412.
FLYING CONTROLS: Conventional and manual. Slotted flaps.
LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring cantilever mainwheel legs. Trailing-link, castoring nosewheel. Mainwheel brakes.
POWER PLANT: Suitable for engines between 60 hp and 100 hp; typically 48.0 kW (64.4 hp) Rotax 582 UL, 59.6 kW (79.9 hp) Rotax 912 or 73.5 kW (98.6 hp) Rotax 912S. VPSh-2 Donchak (or similar) variable-pitch propeller. Normal fuel capacity 40 litres (10.6 US gallons; 8.8 Imp gallons) in fuselage tank; optional additional 50 litres (13.2 US gallons; 11.0 Imp gallons) in wing tanks of Rotax 912-engined versions; total 90 litres (23.8 US gallons; 19.8 Imp gallons) max optional capacity.
EQUIPMENT: Optional spray bars and 120 litre (31.7 US gallon; 26.4 Imp gallon) ventral tank on X-32CX; alternative internal tank mounted on second seat.
DIMENSIONS, EXTERNAL:

Wing span	9.00 m (29 ft 6¼ in)
Length overall	6.25 m (20 ft 6 in)
AREAS:	
Wings, gross	12.33 m² (132.7 sq ft)
WEIGHTS AND LOADINGS:	
Chemical load (X-32SKh)	120 kg (265 lb)
Max T-O weight: Rotax 582	450 kg (992 lb)
Rotax 912	550 kg (1,212 lb)
PERFORMANCE:	
Max level speed: Rotax 582	85 kt (158 km/h; 98 mph)
Rotax 912	94 kt (175 km/h; 109 mph)
Cruising speed: Rotax 582	67 kt (125 km/h; 78 mph)

Stalling speed, power off, flaps down:	
Rotax 582	31 kt (57 km/h; 36 mph)
Rotax 912	37 kt (67 km/h; 42 mph)
Max rate of climb at S/L	240 m (787 ft)/min
T-O run	50 m (165 ft)
Landing run	30 m (100 ft)
Endurance: normal fuel	3 h 20 min
max fuel	7 h 30 min
g limits: Rotax 582	+4.4/−2.2
Rotax 912	+3.8/−1.9

LILIENTHAL X-34 BEKAS

English name: Snipe

TYPE: Three-seat lightplane.

PROGRAMME: Development of X-32. Briefly marketed in Middle East by Jordan Aerospace Industries as GulfBird X-34, but discontinued by 2006. Options include Spasatel (Rescuer) medical evacuation version.

United Kingdom

ATG

ADVANCED TECHNOLOGIES GROUP

Renamed SkyCat.

AVIATION ENTERPRISES

AVIATION ENTERPRISES LTD

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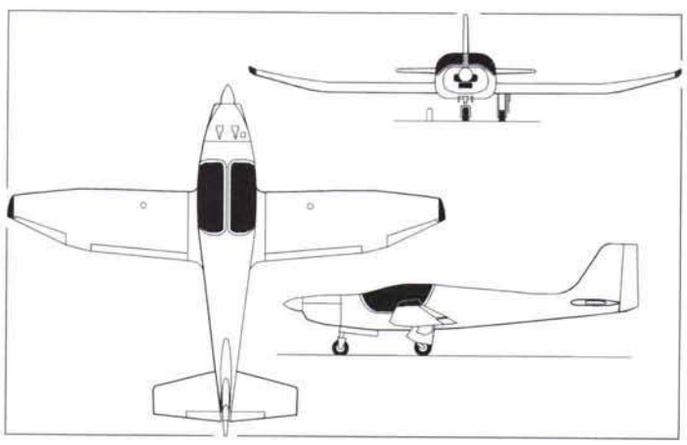
MANAGING DIRECTOR: Angus M Fleming

Previously trading as AMF Aviation Enterprises, the company built 40 production examples of the Chevvron 2-32 side-by-side seat ultralight between 1987 and 1998, then turning its attention to development of the Magnum, which was nearing certification in 2006. Aviation Enterprises is a CAA-approved organisation specialising in design, development and manufacturing for the aerospace industry, its other products including airship gondolas, composites propellers, tidal turbine blades, wind tunnel fan blades, camera booms and motorcar trailers.



Aviation Enterprises Magnum *(Paul Jackson)* 1158131

AVIATION ENTERPRISES MAGNUM

TYPE: Two-seat lightplane; side-by-side kitbuilt.

PROGRAMME: Preliminary design began 1990; complete by 1992, when one-third scale model tested in Bristol University wind tunnel; configuration refined by Steve Fiddes at Bristol, 1994; load analysis by Duncan Gibson. Funding assistance by UK Department of Trade and Industry 'Smart Awards' from 1993, including GBP116,133 in 2000 to complete prototype.

First flight at Membury on 5 June 2003; initially operated under 'B' Conditions as G-61-2; reregistered G-CDBC in August 2004; certification programme nearing completion by mid-2006, when exhibited at Aero Expo, High Wycombe, UK.

Plans for kit version and for assembly at local centres had been abandoned by mid-2006; available only as flyaway aircraft from Membury. Certified as VLA.

CUSTOMERS: Orders taken from mid-2006 onwards.

COSTS: GBP115,000 flyaway, including radio, GPS and standard instruments.

DESIGN FEATURES: Intended for initial marketing to JAR-VLA as two-seater, but engineered from the outset for ease of upgrading to four-seat FAR Pt 23 and equivalents. Low-drag design; believed first to achieve 3.88 km/h/kW (1.56 kt/hp) at continuous cruising power.

Mid/low-wing configuration; marked anhedral on tapered outer wing panels; low tailplane and sweptback fin. L/D ratio 21. Roomy cockpit with semi-reclining seats. Wings removable for storage; requires two persons to (dis)assemble.

Laminar flow wing section.

FLYING CONTROLS: Manual. Ailerons, rudder and all-moving tailplane with anti-balance tab. Aileron and tailplane actuation by pushrods; rudder by cables. Fowler flaps; max deflection 30°; +12° reflex setting of rearmost one-third for low-drag cruising; electrical actuation by torsion drive through control gearbox and rack-and-pinion drive.

STRUCTURE: Prototype constructed from epoxy composites, post-cured in heated moulds; extensive use of carbon fibre and PVC sandwich panels in wings; fuselage of glass fibre outer skin and sandwich core; wings of glass/carbon sandwich skins, with carbon-capped I-beam main spar and rear flap spar; and sailplane-type spar extensions and spherical wing shear pins. Production version has fuselage entirely of carbon fibre and wings similar, except for ribs and spar webs. Rollover protection beam for cockpit.

LANDING GEAR: Tricycle type; retractable. Composites trailing-link main legs; steerable nosewheel. Mainwheels retract inward; nosewheel rearward. Polymer shock-absorbers on mainwheels; oleo-pneumatic on nosewheel leg. Electro-hydraulic gear actuation with free-fall emergency deployment. TOST wheels with hydraulic brakes. Mainwheels 6.00-5; nosewheel 5.00-5.

POWER PLANT: One 84.6 kW (113.4 hp) Rotax 914F liquid-cooled, turbocharged flat-four driving an MT-Propeller MTV-7-A/17C-112 three-blade, constant-speed (electric) propeller. Fuel in two wing tanks; combined capacity 200 litres (52.8 US gallons; 44.0 Imp gallons). Fuel system optimised for mogas.

ACCOMMODATION: Two persons in semi-reclining seats, side by side beneath individual, left and right forward-hinged Plexiglas transparencies framed in carbon fibre. Instrument panel is integral with canopy. Large baggage shelf to rear of seats. Accommodation heated and ventilated.

AVIONICS: *Comms:* Bendix/King KY 96A transceiver, KY 76A transponder.

Instrumentation: AvMap GPS display.

DIMENSIONS, EXTERNAL:

Wing span	9.70 m (31 ft 10 in)
Wing aspect ratio	7.8
Length overall	7.49 m (24 ft 7 in)
Height overall	2.50 m (8 ft 2½ in)

Aviation Enterprises Magnum prototype at its first public air show: Aero Expo, High Wycombe, June 2006 *(Paul Jackson)* 1158130

Wheelbase ..... 1.74 m (5 ft 8½ in)
Wheel track ..... 1.65 m (5 ft 5 in)
Propeller diameter ..... 1.70 m (5 ft 7 in)
DIMENSIONS, INTERNAL:
Cockpit max width ..... 1.22 m (4 ft 0 in)
AREAS:
Wings, gross ..... 11.88 m² (127.9 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 500 kg (1,102 lb)
Max baggage weight ..... 50 kg (110 lb)
Max T-O weight ..... 750 kg (1,653 lb)
Max wing loading ..... 63.0 kg/m² (12.91 lb/sq ft)
Max power loading ..... 8.87 kg/kW (14.58 lb/hp)
PERFORMANCE:
Never-exceed speed (VNE) ..... 180 kt (333 km/h; 207 mph)
Cruising speed at 75% power ..... 137 kt (254 km/h; 158 mph)
Econ cruising speed at 38% power ..... 115 kt (213 km/h; 132 mph)
Stalling speed: clean ..... 48 kt (89 km/h; 56 mph)
flaps and gear down ..... 40 kt (75 km/h; 46 mph)
Max rate of climb at S/L ..... 289 m (950 ft)/min
T-O run ..... 300 m (985 ft)
T-O to 15 m (50 ft) ..... 450 m (1,480 ft)
Landing from 15 m (50 ft) ..... 350 m (1,150 ft)
Landing run ..... 250 m (820 ft)
Service ceiling ..... 4,875 m (16,000 ft)
Range: at 75% power ..... 1,370 n miles (2,537 km; 1,576 miles)
at 38% power ..... 2,200 n miles (4,074 km; 2,531 miles)

BAE

BAE SYSTEMS PLC

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CEO: Mike Turner
MARKETING DIRECTOR: Mike Rouse
DIRECTOR, CORPORATE COMMUNICATIONS: Hugh Colver

BAE Systems was established on 30 November 1999, upon the merger of British Aerospace (BAe) and the Marconi Electronic Systems business, then part of GEC-Marconi.

Sales in 2005 totalled GBP15.4 billion; order book at 31 December 2005 was GBP59.8 billion (including joint ventures). Employees in 2006 totalled 90,000 located in UK, USA, Sweden, Saudi Arabia, France, Italy, Germany, Australia and Canada.

Design and manufacturing of new aircraft (including UAVs) is undertaken by Air Systems Group.

Air Systems Group

MANAGING DIRECTOR: Nigel Whitehead

Group formed January 2002 to manage BAE Systems' activities in Hawk, Nimrod, Eurofighter Typhoon and Lockheed Martin F-35 JSF programmes. Personnel total 10,500. Nimrod structural upgrades are undertaken at the Woodford plant. New Business team involved with development of UAVs and RAF's Future Offensive Air System studies.

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BAE SYSTEMS HAWK 50, 60 and 100 SERIES

RAF/FAA designations: Hawk T. Mks 1 and 1A; Hawk Mk 128
US Navy designation: T-45A and T-45C Goshawk
Canadian Forces designation: CT-155

TYPE: Advanced jet trainer/light attack jet.

PROGRAMME: HS P1182 Hawk first flew 21 August 1974; first-generation Hawk no longer produced; current manufacture is of advanced 100 Series; single-seat 200 Series also out of production. Hawk design leadership transferred from Kingston to Brough 1988, and final assembly and flight test from Dunsfold to Warton 1989; Warton assembly line officially opened 24 October 1991; Brough subsequently assumed responsibility for final assembly, although first flights still at Warton.

Hawk 50 Series main exports made December 1980 to October 1985; largely supplanted by 60 Series until final aircraft in 1997; Hawk 100 enhanced ground attack export version announced mid-1982; first flight of 100 Series aerodynamic prototype (G-HAWK/ZA101 converted as Mk 100 demonstrator) 21 October 1987; trials of wingtip Sidewinder rails started at Warton in April 1990.

RAF ceremonially flew its 1,000,000th Hawk hour 5 July 2006.

CURRENT VERSIONS: **Hawk T. Mk 1**: Two-seater for RAF advanced flying and weapon training; 23.1 kN (5,200 lb st) Adour 151-01 (-02 in Red Arrows aircraft) non-afterburning turbofan; two dry underwing hardpoints; underbelly 30 mm gun pack; three-position flaps; simple weapon sight in some aircraft of No. 4 FTS.

Hawk T. Mk 1A: Contract January 1983 to wire 89 Hawks (including Red Arrows) for AIM-9L Sidewinder on each inboard wing pylon and optional activation of previously unused outer wing hardpoints; last conversion redelivered 30 May 1986.

RAF Hawk re-wing programme began 1989; initial 85 wings completed by BAe in 1993; delivery of second batch of 59 began November 1993 and completed in 1995. Rebuild programme by BAe for 80 RAF Hawks authorised 27 December 1998 to replace centre and rear fuselage by Mk 65 standard structures, extending service life to 2010; work undertaken at DARA St Athan and BAE Systems at Brough; first aircraft, XX348, redelivered 11 April 2000; last was XX242, delivered to Red Arrows on 27 August 2003. Aircraft comprised 11 Mk 1s, 62 Mk 1As and seven Mk 1Ws, retaining original designations. (Sole external indication of this upgrade is displacement of rear strobe light from centreline.) Avionics upgrade plans being formulated in Staff Requirement (Air) 449; primary aim is 'glass cockpit'. In 2006, UK MoD fleet included 132 Hawks.

In total, life extensions increased RAF Hawk lives from 6,000 to 10,200 hours and fatigue index from 100 to 150.

Hawk T. Mk 1W: Following re-winging, 24 RAF Hawk T. Mk 1s gained the ability to carry stores on two underwing pylons, although not the centreline gun pod. The alternative designation **T. Mk 1FTS** is also used for this modification.

Hawk 50 Series: Initial export version with 23.1 kN (5,200 lb st) Adour 851 turbofan.

T-45 Goshawk: US Navy version; built by Boeing. *Described separately.*

Hawk 60 Series: Development of 50 Series with 25.4 kN (5,700 lb st) Adour 861 turbofan; leading-edge devices and four-position flaps to improve lift capability.

Hawk 100 Series: Enhanced ground attack development of 60 Series, announced mid-1982, to exploit Hawk's stores carrying capability; two-seater, with perhaps pilot only on combat missions; 26.0 kN (5,845 lb st) Adour Mk 871 turbofan; new combat wing incorporating fixed leading-edge droop for increased lift and manoeuvrability from M0.3 to M0.7; full-width flap vanes; manually selected combat flaps; detail changes to wing dressing; structural provision for wingtip missile pylons; MIL-STD-1553B databus; advanced Smiths Industries HUDWAC and new air data sensor package with optional laser

Production Denel/BAE Systems Hawk Mk 120 of SAAF *(Jane's/Patrick Allen)*
1196330

First BAE Systems Hawk Mk 129 handed over to Bahrain *(Jane's/Patrick Allen)*
1183713

ranging and FLIR in extended nose; improved weapons management system allowing preselection in flight and display of weapon status; manual or automatic weapon release; passive radar warning; HOTAS controls; full-colour multipurpose CRT display in each cockpit; provision for ECM pod.

Demonstrator ZA101. Production prototype Mk 102D (ZJ100) flown 29 February 1992. Early orders from Abu Dhabi (placed 1989), Indonesia (signed June 1993), Malaysia (signed 10 December 1990) and Oman (signed 30 July 1990). FLIR, laser ranger and Sky Guardian RWR in Omani aircraft.

Selected by Australia in November 1996 as next-generation lead-in fighter trainer; order signed 24 June 1997 for 33 aircraft; Australian Hawk Mk 127s have new, advanced instrumentation resembling that of the F-18 Hornet and including an integrated Smiths system of three 127 mm (5 in) square colour screens in each cockpit, HUD, upgraded mission computer, engine life computer and stores management system.

Hawk LIFT: Variant of Series 100 as lead-in fighter trainer (LIFT). Features include 'combat wing', Adour Mk 871 or Mk 951 engine, new three MFD 'glass cockpit' with NVG compatibility, MIL-STD-1553B digital databus, revised mission planning system/data transfer unit, INS/GPS, OBOGS, APU, HUMS, new HUD and HOTAS controls. Provision for FLIR and aerial refuelling. Initial customer is South Africa (Mk 120); first SAAF Hawk (and sole aircraft assembled in UK) first flew (ZJ970, later SAAF 250) 2 October 2003; delivered to South Africa inside Antonov An-22 17 October 2003. First assembled by Denel at Johannesburg made initial flight (251) 13 January 2005.

Offered to RAF (**Mk 128**) to meet MFTS (military flying training system) requirement for some 31 to enter service in 2007 as lead-in to Eurofighter Typhoon, having open-architecture avionics and Adour Mk 951 engines. Maximum weapon load 3,000 kg (6,614 lb); basic mass empty 4,480 kg (9,877 lb). On 30 July 2003, BAE announced formal RAF commitment to potential £800 million contract for 20 Mk 128s, and 24 options; design and development contract, worth £159 million, signed 22 December 2004, covering only two development aircraft. First flight (ZK010) 27 July 2005; second aircraft (ZK011) flew 6 March 2006. Contract for 26 aircraft (not including earlier two) signed 19 October 2006, although 35 RAF serial numbers reserved in December 2004. Ascent consortium (Lockheed Martin and VT Group) named preferred bidder on 30 November 2006 for 25-year contract valued at GBP600 million (not including cost of aircraft); service entry target then April 2007 for ground training and full service provision by 2012.

Hawk 200 Series: single-seat multirole version. *Described separately.*

Hawk 100HNDA: Hawk New Development Aircraft; based on Mk 127. Prototype, and testbed for Adour Mk 951 turbofan, first flew (ZJ951) at Warton 5 August 2002 (initially with interim standard engine). To Bredasdorp, South Africa, for further trials associated with SAAF Hawk Mk 120; first flew with Mk 951 engine in May 2003.

CUSTOMERS: Refer to table. BAE delivered 20 Hawks in 1996 and 22 in 1997; none in 1998; deliveries resumed in 1999 with 10 to Indonesia before supply of remaining six was suspended by UK government embargo of 11 September 1999; deliveries re-authorised in early 2000, but without certain US-sourced components. Deliveries in 2000 totalled 16 (eight Australian and eight Canadian), not including Australian assembly. In 2001, UK production line delivered 13 (three to Australia and 10 to Canada); 2002 production comprised two to Canada and one company trials aircraft; 2003 production totalled one for South Africa. Two for Canada in 2004. One for RAF and two for Bahrain in 2005.

First Australian Hawk (A27-01) flew (in UK, temporarily as ZJ632) on 16 December 1999. First Australian-assembled aircraft flew (A27-010) on 12 May 2000; final Australian production delivery 8 August 2001; last UK-built aircraft delivered 5 October 2001.

BAE, Bombardier and partners T-6A Harvard II and Hawk Mk 115 as equipment of Canadian-based NATO Flying Training in Canada (NFTC) programme; contract agreed 17 November 1997 and formally issued on 12 May 1998 for 18, plus eight options, two of latter being taken up in 1999; further two stated to be required in early 2000, after Singapore joined programme; order total increased to 22 by early 2002. First aircraft, 155201, arrived in Canada 4 July 2000; officially received 6 July; instructor training began 12 July 2000. First flight of 22nd Hawk on 29 June 2004.

Hawk LIFT selected for purchase by South Africa, as announced 18 November 1998; order for 12, plus 12 options, announced 15 September 1999 and signed 3 December 1999; these first Hawks with Adour Mk 951 engines. First two handed over to SAAF 24 May 2006; formal acceptance of first 10 (and formation of 85 CFS) 19 October 2006.

Bahrain announced selection of Hawk on 22 July 2002; contract signed 28 January 2003; Mk 129 based on Mk 127, but with Adour Mk 951 engine; six aircraft, plus six options; part of training programme also including Slingsby Firefly piston lightplanes. First flew on 26 August 2005, temporarily as ZK106; last aircraft flew 24 October 2006. Initial acceptance (in UK) 30 June 2006; public handover at Farnborough, 17 July 2006; departed UK 13 October 2006.

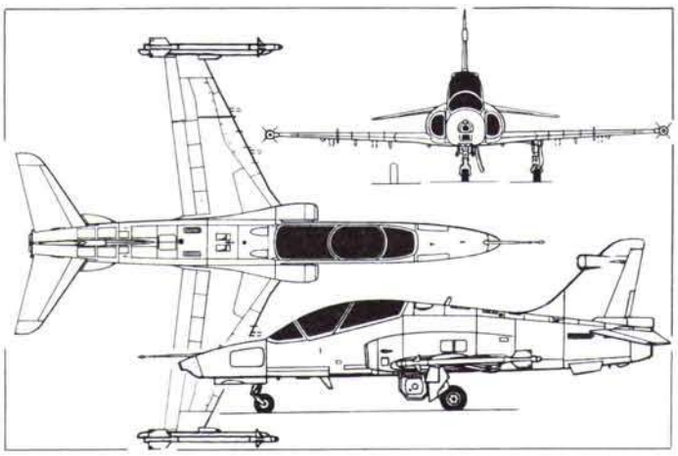
India requested quotation in September 1999 for 92 Hawks, later amended to 66, of which eight kits and 42 complete aircraft to be assembled by HAL at Bangalore; Anglo-Indian political reaffirmation of purchase plans on 12 December 2000; purchase agreement announced 3 September 2003 for 24 UK-built Hawks (temporarily ZK121 onwards) and 42 assembled in India; designation Mk 132. ZK121 first flew at Warton 13 December 2006. Avionics tested in company demonstrator ZJ100, 2006. Indian Navy expressed interest in 16 Hawks in mid-2006.

COSTS: South African purchase of 24 Hawk LIFTs estimated at R4.7 billion (1998). Canadian contract for 20 valued at GBP400 million (1999). Hawk centre/rear fuselage replacement for 80 RAF aircraft valued at GBP100+ million (2000). RAF Mk 128 purchase GBP160 million for design, development and production of initial two (2004) plus 26, costing GBP450 million, in 2006.

DESIGN FEATURES: Fully aerobatic two-seat advanced jet trainer, adaptable for ground attack and air defence; design capable of other optional roles, with wing improvements on developed Series to enhance combat efficiency. Low wing and mid-mounted, anhedral, sweptback tailplane; air intake on each side of fuselage, forward of wing leading-edge; single non-afterburning engine; elevated rear cockpit to enhance forward view; two strakes below rear fuselage; smurfs (refer Hawk 200 entry) on 100 Series; optional underwing hardpoints; wingtip AAM rails (100 Series).

Wing thickness/chord ratio 10.9 per cent at root, 9 per cent at tip; dihedral 2°; sweepback 26° on leading-edge, 21° 30' at quarter-chord.

First BAE Systems Hawk Mk 128 destined for RAF *(Paul Jackson)* 1158857



BAE Systems Hawk 100 with wingtip Sidewinders *(Dennis Punnett)* 1158774

FLYING CONTROLS: Conventional and assisted. Ailerons and one-piece all-moving tailplane actuated hydraulically by tandem actuators; rudder manually actuated, with electric trim tab. Hydraulically actuated double-slotted flaps, outboard 300 mm (12 in) of flap vanes normally deleted; small fence on each wing leading-edge; 100 and 200 Series use special 'combat wing' with full-width flap vanes (refer Hawk 200 entry); large airbrake under rear fuselage, aft of wings. Hydraulic yaw damper on 100 Series rudder.

STRUCTURE: Aluminium alloy; one-piece wing, with machined torsion box of two main spars, auxiliary spar, ribs and skins with integral stringers; most of box forms integral fuel tank; honeycomb-filled ailerons; composites wing fences; frames and stringers fuselage. Wing attached to fuselage by six bolts.

LANDING GEAR: Wide-track, hydraulically retractable tricycle type, with single wheel on each unit. AP Precision Hydraulics oleos and jacks. Main units retract inward into wing, ahead of front spar; castoring (optionally power-steered) nosewheel retracts forward. Dunlop mainwheels, brakes and tyres size 6.50–10 (14 ply) tubeless, pressure 9.86 bar (143 lb/sq in). (Hawk Srs 60 and 100 mainwheel pressure 17.23 bar; 250 lb/sq in at 9,100 kg; 20,061 lb T-O weight.) Nosewheel and tyre size 16×4.4 (8 ply) tubeless, pressure 8.27 bar (120 lb/sq in). Tail bumper fairing under rear fuselage, anti-skid wheel brakes. Tail braking parachute, diameter 2.64 m (8 ft 8 in), on Mks 52/53 and all 60 and 100 Series aircraft.

POWER PLANT: One Rolls-Royce Turbomeca Adour non-afterburning turbofan, as described under Current Versions. Adour Mk 861A for Switzerland assembled locally by Sulzer Brothers. Adour Mk 951, available for new-build Hawks rated at 28.9 kN (6,500 lb st) and has doubled TBO of 4,000 hours. Engine starting by Microturbo integral gas-turbine starter. Fuel in one fuselage bag tank of 832 litres (220 US gallons; 183 Imp gallons) capacity and integral wing tank of 823 litres (217 US gallons; 181 Imp gallons); total fuel capacity 1,655 litres (437 US gallons; 364 Imp gallons). Pressure refuelling point near front of port engine air intake trunk; gravity point on top of fuselage. Provision for carrying one 455 or 591 litre (120 or 156 US gallon; 100 or 130 Imp gallon) drop tank on each inboard underwing pylon, according to Series. All new Hawks since Mk 120 have provision for centreline external fuel tank and refuelling probe.

ACCOMMODATION: Crew of two in tandem under one-piece, fully transparent, acrylic canopy, opening sideways to starboard. Fixed front windscreen able to withstand a 0.9 kg (2 lb) bird at 454 kt (841 km/h; 523 mph). Improved front windscreen fitted retrospectively to RAF Hawks, able to withstand a 1 kg (2.2 lb) bird at 528 kt (978 km/h; 607 mph); this installed on all current export aircraft. Separate internal screen in front of rear cockpit. Rear seat elevated. Martin-Baker Mk 10LH zero/zero rocket-assisted ejection seats, with MDC (miniature detonating cord) system to break canopy before seats eject. MDC can also be operated from outside the cockpit for ground rescue. Dual controls standard. Entire accommodation pressurised, heated and air conditioned.

SYSTEMS: BAE Systems cockpit air conditioning and pressurisation systems, using engine bleed air. Two hydraulic systems; flow rate: System 1, 36.4 litres (9.6 US gallons; 8.0 Imp gallons)/min; System 2, 22.7 litres (6.0 US gallons; 5.0 Imp gallons)/min. Systems pressure 207 bar (3,000 lb/sq in). System 1 for actuation of control jacks, flaps, airbrake, landing gear and anti-skid wheel brakes. Compressed nitrogen accumulators provide emergency power for flaps and landing gear at pressure of 2.75 to 5.50 bar (40 to 80 lb/sq in). System 2 dedicated to powering flying controls. Hydraulic accumulator for emergency operation of wheel brakes. Pop-up Hamilton Sundstrand ram air turbine in upper rear fuselage is an option to provide emergency hydraulic power for flying controls in event of engine or No. 2 pump failure. No pneumatic system.

DC electrical power from single 12 kW 30 V DC brushless generator, with two 3 kVA 115/26 V 400 Hz three-phase inverters to provide AC power and two batteries for up to 20 minutes of standby power. Gaseous oxygen system for crew; optional Hamilton Sundstrand (HS Marston) OBOGS first installed in Australian Hawk Mk 127s from 2000 and is standard on all subsequent aircraft.

AVIONICS: *Comms:* Mk 1/Srs 50 includes Sylvania UHF and VHF; Cossor 2720 Mk 10A IFF in Finnish aircraft; Srs 60 has Rockwell Collins UHF and VHF, Magnavox UHF and Raytheon 2720 IFF; Srs 100 has Rockwell Collins AN/ARC-182 U/VHF, Magnavox AN/ARC-164 UHF and Raytheon 4720 IFF. Australian Mk 127 has twin Rockwell Collins AN/ARC-210 UHF/VHF and Raytheon 4720 IFF.

Flight: Mk 1/Srs 50 with Raytheon CAT 7000 Tacan, Cossor ILS having CILS.75/76 localiser/glideslope receiver and marker receiver; Rockwell Collins VOR/ILS and ADF, Rockwell Collins Tacan, Smiths-Newmark 6000-05 AHRS and Smiths radar altimeter in Srs 60; Srs 100 has BAE Systems INS300 inertial platform, Rockwell Collins AN/ARC-118 Tacan, Rockwell Collins VIR-31A VOR/ILS and Smiths 0103-KTX-1 radar altimeter, all integrated via dual redundant MIL-STD-1553B databus. Optional Skyforce Skymap II GPS-driven moving map in some RAF Hawks.

Instrumentation: Smiths-Newmark compass, BAE Systems gyros and inverter, two Honeywell RAI-4 4 in (100 mm) remote attitude indicators and magnetic detector system in Mk 1/Srs 50; Smiths 1500 Series HUDWAC in Srs 100; BAE Systems F.195 weapon sight in approximately 90 RAF aircraft; BAE ISIS 195 sight in Srs 50 and Srs 60, except Saab RGS2 in Finnish Mk 51.

Mission: BAE Systems camera and recorder in F.195-equipped RAF aircraft (requirement announced December 1997 to re-equip 41 with video recorders by late 1999); Vinten camera and recorder in Srs 50 and Srs 60. Srs 100 has Smiths 3000 Series colour MFD, GEC data transfer system and Vinten colour video recording system; plus BAE Systems Type 105H laser range-finder; optional FLIR.

BAE SYSTEMS HAWK CUSTOMERS

Customer	Qty	Mark	First aircraft	Deliveries	Squadrons
Abu Dhabi	16	63	1001	Oct 1984 — May 1985	
	18	102[11]	1051	Apr 1993 — Mar 1994	Khalif bin Zayed Air College
	4	63C	1017	Feb 1995 — Mar 1995	
Australia	33[9]	127	A27-01	Apr 2000 — Oct 2001	76, 79
Bahrain	6	129	ZK106	Oct 2006 —	
Canada	22	115/CT-155	155201	Jul 2000-2004	419
Dubai	8	61	501	Mar 1983 — Sep 1983	III Shaheen
	1	61	509	Jun 1988	III Shaheen
Finland	50	51	HW301	Dec 1980 — Oct 1985	3/11, 3/21, 3/31,
	7	51A	HW351	Nov 1993 — Sep 1994	Koulutuslentolaivue, 2/Tukilentolaivue
India	24[1]	132	A3480	2007	
	42[16]	132			
Indonesia	20	53	LL-5301	Sep 1980 — Mar 1984	103
	8	109	TT-1201	May 1996 — Mar 1997	1, 12
	16	209	TT-1205	Feb 1996 — Mar 1997	12
	16	209	TT-0217	Apr 1999 —	1
Kenya	12	52	1001	Apr 1980 — May 1982	(Laikipia AB)
Korea, South	20	67	67–496	Sep 1992 — Aug 1993	216
Kuwait	12	64	140	Nov 1985 — Sep 1986	12
Malaysia	10	108[9]	M40-01	Jan 1994 — Sep 1995	3 FTC (15 Sqdn)
	18	208[11]	M40-21	Aug 1994 — May 1995	6, 9, 3 FTC (15 Sqdn)
Oman	4	103[11]	101	Dec 1993 — Jan 1994	6
	12	203[9]	121	Dec 1994 — May 1995	6
Saudi Arabia	30	65	2110	Aug 1987 — Oct 1988	21, 37
	20	65A	7901	Mar 1997 — Dec 1997	79
South Africa	12	120/LIFT[9]	250[1]	May 2006 —	85 CFS
Switzerland	20[4]	66	U-1251	Nov 1989 — Nov 1991	Nil. Withdrawn from service 2002
UK	176	T. Mk 1	XX154	Nov 1976 — Feb 1982	4 FTS (19 & 208 Sqdns), Red Arrows, 100 Sqdn, FSATO, QinetiQ
	30[17]	128	ZK010	2008	
USA	211[5]	T-45A/C	162787	Apr 1988 —	VT-7, VT-21, VT-22
Zimbabwe	8	60	600	Jul 1982 — Oct 1982	2
	5	60A	608	Jun 1992 — Sep 1992	2
Demonstrator	3	60/102D/102NDA	G-HAWK		—
	3	200/200/200RDA	ZG200		.
Total	**897**				

[1] Built at Brough, Hamble and Samlesbury, assembled at Warton or Brough and first flown at Warton; unless stated otherwise, remainder built at Kingston, assembled at Dunsfold (290) and Bitteswell (1)
[2] Laser nose
[3] 46 assembled by Valmet in Finland
[4] 19 assembled by F + W in Switzerland
[5] Production by Boeing in USA (see International section)
[6] Two first flown at Warton
[7] Wingtip Sidewinders
[8] 89 converted to T. Mk 1A
[9] 13 converted to 63A; two to 63B
[10] Removable refuelling probe
[11] Radar warning receiver
[12] First 12 assembled at Warton; remainder by BAe Australia at Williamtown, assisted by Hunter Aerospace, Hawker de Havilland and Qantas
[13] One first flown at Warton
[14] Five repurchased by BAE Systems in 1999
[15] Plus 12 options; all except first aircraft assembled in South Africa
[16] Assembled by HAL in India
[17] Two demonstrators and 28 production, although 35 serial numbers initially assigned

Self-defence: (Series 100 only) Racal Prophet RWR in Mk 102s of Abu Dhabi; BAE Systems Sky Guardian in Indonesian, Malaysian and Omani aircraft, and retrofitted to Abu Dhabi's Mk 63s; optional chaff/flare dispenser at base of fin.

ARMAMENT: Underfuselage centreline-mounted 30 mm BAE Systems Aden Mk 4 cannon with 120 rounds (VKT 12.7 mm machine gun beneath Finnish aircraft), and two or four hardpoints under wing, according to Series. Provision for pylon in place of ventral gun pack. In RAF training roles, normal maximum external load is about 680 kg (1,500 lb), but the uprated Hawk 60 and 100 Series are cleared for an external load of 3,000 kg (6,614 lb), or 500 kg (1,102 lb) at 8 *g*. Typical weapon loadings on 60 Series include 30 mm or 12.7 mm centreline gun pod and four packs each containing eighteen 68 mm rockets; centreline reconnaissance pod and four packs each containing twelve 81 mm rockets; five 1,000 lb free-fall or retarded bombs; four launchers each containing four 100 mm rockets; nine 250 lb or 250 kg bombs; thirty-six 80 lb runway denial or tactical attack bombs; five 600 lb cluster bombs; four Sidewinder or two Magic air-to-air missiles; or four CBLS 100/200 carriers, each containing four practice bombs and four rockets. Vinten reconnaissance pod available for centre pylon. Similar options on 100 Series, plus wingtip air-to-air missiles. Mk 102s of Abu Dhabi/UAEAF can carry (but not designate for) two Alenia Marconi PGM-500 ASMs.

DIMENSIONS, EXTERNAL:

Wing span: Mk 1, Srs 50, Srs 60 ..... 9.39 m (30 ft 9¾ in)
Srs 100 ..... 9.08 m (29 ft 9½ in)
Srs 100 with Sidewinders ..... 9.94 m (32 ft 7⅜ in)
Wing chord: at root ..... 2.65 m (8 ft 8¼ in)
at tip ..... 0.90 m (2 ft 11½ in)
Wing aspect ratio: Mk 1, Srs 50, Srs 60 ..... 5.3
Srs 100 ..... 4.9
Length: fuselage (incl jetpipe):
Mk 1, Srs 50, Mks 60-66 ..... 10.775 m (35 ft 4¼ in)
Mk 67 ..... 11.375 m (37 ft 3¼ in)
Srs 100 ..... 11.40 m (37 ft 4¼ in)
fuselage and pitot:
Mk 1, Srs 50, Mks 60-66 ..... 11.455 m (37 ft 7 in)
Mk 67, Srs 100 (non combat) ..... 12.035 m (39 ft 5¾ in)
Srs 100 (incl chaff/flare dispenser) ..... 12.095 m (39 ft 8 in)
overall:
Mk 1, Srs 50, Mks 60-66 ..... 11.845 m (38 ft 10¼ in)
Mk 67, Srs 100 ..... 12.425 m (40 ft 9¼ in)
Nose to pitot tip:
Mk 1, Srs 50, Mks 60-66 ..... 0.68 m (2 ft 2¾ in)
Mk 67 ..... 0.66 m (2 ft 2 in)
Srs 100 ..... 0.635 m (2 ft 1 in)
Tailplane overhang ..... 0.39 m (1 ft 3½ in)
Height overall ..... 3.98 m (13 ft 0¾ in)
Tailplane span ..... 4.39 m (14 ft 4¾ in)
Wheel track ..... 3.47 m (11 ft 5 in)
Wheelbase ..... 4.50 m (14 ft 9 in)

AREAS:

Wings, gross ..... 16.69 m² (179.6 sq ft)
Ailerons (total):
Mk 1, 50 and 60 Series ..... 1.05 m² (11.30 sq ft)
100 Series ..... 0.97 m² (10.44 sq ft)
Trailing-edge flaps (total) ..... 2.50 m² (26.91 sq ft)
Airbrake ..... 0.53 m² (5.70 sq ft)
Fin: Mk 1, 50 and 60 Series ..... 2.51 m² (27.02 sq ft)
100 Series ..... 2.61 m² (28.10 sq ft)
Rudder, incl tab ..... 0.58 m² (6.24 sq ft)
Tailplane ..... 4.33 m² (46.61 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: 60 Series ..... 4,012 kg (8,845 lb)
100 Series ..... 4,400 kg (9,700 lb)
Max weapon load (60, 100 Series) ..... 3,000 kg (6,614 lb)
Max usable fuel weight:
internal ..... 1,277 kg (2,815 lb)
external ..... 930 kg (2,050 lb)

For details of the latest updates to ***Jane's All the World's Aircraft*** online and to discover the additional information available exclusively to online subscribers please visit
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Specially decorated Hawk T. Mk 1s of No. 4 FTS, RAF *(Jamie Hunter)* 1181803

Max T-O weight: T. Mk 1 ..... 5,700 kg (12,566 lb)
50 Series ..... 7,350 kg (16,200 lb)
60, 100 Series ..... 9,100 kg (20,061 lb)
Max landing weight: T. Mk 1 ..... 4,649 kg (10,250 lb)
60 Series ..... 7,650 kg (16,865 lb)
Max wing loading: T. Mk 1 ..... 341.5 kg/m² (69.97 lb/sq ft)
50 Series ..... 440.4 kg/m² (90.20 lb/sq ft)
60, 100 Series ..... 545.4 kg/m² (111.70 lb/sq ft)
Max power loading: T. Mk 1 ..... 246 kg/kN (2.42 lb/lb st)
50 Series ..... 318 kg/kN (3.12 lb/lb st)
60 Series ..... 359 kg/kN (3.52 lb/lb st)
100 Series ..... 350 kg/kN (3.43 lb/lb st)

PERFORMANCE:

Never-exceed speed (VNE), clean:
at S/L ..... M0.87 (575 kt; 1,065 km/h; 661 mph EAS)
at and above 5,180 m (17,000 ft) ..... M1.2 (575 kt; 1,065 km/h; 661 mph EAS)
Max level speed at S/L:
50 Series ..... 535 kt (990 km/h; 615 mph)
60 Series ..... 545 kt (1,010 km/h; 627 mph)
100 Series ..... 540 kt (1,001 km/h; 622 mph)
Max level flight Mach No. 0.88
Stalling speed, flaps down ..... 96 kt (177 km/h; 110 mph)
Max rate of climb at S/L ..... 3,600 m (11,800 ft)/min
Time to 9,150 m (30,000 ft), clean: 60 Series ..... 6 min 54 s
100 Series ..... 7 min 30 s
Service ceiling: 60 Series ..... 14,020 m (46,000 ft)
100 Series ..... 13,565 m (44,500 ft)
T-O run (clean): 60 Series ..... 710 m (2,330 ft)
100 Series ..... 640 m (2,100 ft)
Landing run (10% fuel load): 60 Series ..... 550 m (1,800 ft)
100 Series ..... 605 m (1,980 ft)
Combat radius, Aden gun pod and two Sidewinder AAMs:
with four 500 lb bombs and two 130 Imp gallon tanks ..... 345 n miles (638 km; 397 miles)
with four 1,000 lb bombs ..... 125 n miles (231 km; 143 miles)
Ferry range:
60 Series, with two 591 litre (156 US gallon; 130 Imp gallon) drop tanks ..... 1,575 n miles (2,917 km; 1,812 miles)
100 Series, as above ..... 1,360 n miles (2,519 km; 1,565 miles)
Endurance, 100 n miles (185 km; 115 miles) from base:
60 Series ..... approx 2 h 42 min
100 Series ..... approx 2 h 6 min
g limits: full internal fuel, all ..... +8/−4
100 series, 60% fuel load:
1,360 kg (3,000 lb) external load ..... +8/−4
2,721 kg (6,000 lb) external load ..... +6/−3

BAE SYSTEMS NIMROD MRA. Mk 4

TYPE: Maritime reconnaissance four-jet.

PROGRAMME: Original Hawker Siddeley HS 801 Nimrod first flew 23 May 1967 as adaptation of de Havilland D.H.106 Comet airliner. Total of two prototypes (converted Comet fuselages; now withdrawn), 46 Nimrod MR. Mk 1s and three Nimrod R. Mk 1 elint/sigint aircraft built for the RAF. Of these, 35 converted to MR. Mk 2 from 1979 onwards and 11 became Nimrod AEW. Mk 3s, but failed to enter service and were scrapped. MR. Mk 2 fleet of Nos. 42(R), 120, 201 and 206 Squadrons at Kinloss in 1996 totalled 28 (including three

BAE Systems Nimrod MRA. Mk 4 ZJ517 making the type's first public appearance over Farnborough on 18 July 2006 *(Jane's/Patrick Allen)* 1183752

in long-term storage), plus one under conversion to R. Mk 1, four scrapped or used for ground instruction and two lost in accidents. Force reduced to three squadrons on disbandment of No. 206 on 1 April 2005; fleet reduced to 16 Mk 2s in early 2006; last to have been replaced by Mk 4s by 2011, although Nimrod fleet may be moved from current base at Kinloss in 2013. Two original R. Mk 1s remain with No. 51 Squadron at Waddington, augmented by one conversion.

Following RAF issue of Staff Requirement (Air) 420 for a Nimrod replacement, Dassault Atlantique 3, two versions of Lockheed Martin P-3 Orion (new production from manufacturer or refurbished P-3A/Bs from Loral) and upgraded Nimrod offered as potential solutions. UK official announcement on 25 July 1996 nominated last-mentioned proposal under commercial designation (since abandoned) Nimrod 2000. Although based on existing aircraft, the upgrade involves extensive (80 per cent) reconstruction of the airframe, plus incorporation of many new components, including engines, wings, landing gear and general systems, as well as new flight deck and detection systems. Contract MAR21a/100 awarded January 1997. Initial three development batch (DB) aircraft are conversions of stored Mk 2s, on which work began in early 1997; first delivery originally scheduled to RAF in 2001, followed by IOC in April 2003 on delivery of seventh aircraft; by early 1999, these dates had slipped 23 months due, in part, to excessive weight of new wing. New schedule called for first flight in June 2002; service deliveries in August 2004; IOC in March 2005; and final delivery in December 2008. Critical design review for air vehicle conducted late 1999 and finalised in early 2000, completing weapon system design. However, due to further slippage, prototype was given media debut on 16 August 2002 in expectation of maiden flight before year-end; delivery then stated to be late 2004.

By October 2002, first flight had been rescheduled for second half of 2003 due to discovery of "minor issues during airframe stress testing", although in-service date of March 2005 stated to be unchanged. BAE Systems and MoD announced change to Nimrod contract on 19 February 2003, this including halt to structural work on fourth and subsequent aircraft until risk reduction exercise completed on first three. This formalised by agreement signed 23 February 2004. Price data for completion of 12 aircraft submitted to MoD on 13 July 2005; contract award (and first public appearance; Farnborough flypast) 18 July 2006; first delivery 2009; first squadron forms 2010; final delivery 2012.

Ground testing and verification of engineering plans undertaken at Warton on Nimrod MR. Mk 1 prototype XV147. FR Aviation at Hurn, Bournemouth, selected for airframe refitting and upgrading as subcontractor to BAE, flying 'green' aircraft to Warton for mission avionics installation; first three (DB) aircraft (XV247/PA1, XV234/PA2 and XV242/PA3, for modification in that order) dismantled at RAF Kinloss and flown to Hurn by Antonov An-124 14 to 16 February 1997; redelivery to Warton originally due late 1999, January and February 2000. Fourth conversion subject, XV251/PA4, to Hurn under own power, 2 November 1998.

Programme revised in early November 1999, when FR Aviation contract cancelled and airframe work transferred to BAE at Woodford. PA1 completed at Hurn; PA2, PA3 and PA4 airfreighted to Woodford in An-124 in November/December 1999 for completion. Fifth subject, XV258/PA5, delivered directly ex-RAF to Woodford on 8 November 1999; further two (XZ284 and XV233) followed in 2000 and one (a former ground instructional airframe, XV253) in October 2001. Wing for initial aircraft delivered from Chadderton to Woodford in September 2000; second aircraft similarly fitted in December 2000.

Short Brothers and various BAE plants supply airframe components and subassemblies. Ground training systems supplied by Thomson TSL.

Static test wing mounted on Nimrod AEW. Mk 3 fuselage for 1,000 hour trial, beginning 2004.

CURRENT VERSIONS (SPECIFIC): **PA1/ZJ516**: First flight 26 August 2004; landed at Warton. Aerodynamic, avionics and engine trials.

PA2/ZJ518: First flight 15 December 2004; landed at Warton. Full mission system; avionics and mission systems tests; weapon carriage and release trials. First with grey colour scheme, May 2005; Sigonella, Sicily, for environmental testing; Eglin AFB, Florida, 26 September 2006, for six weeks in McKinley climatic laboratory.

PA3/ZJ517: First flight 29 August 2005; landed at Warton. Mission systems testbed. Production standard, but additional flight test instrumentation fitted.

By July 2006, combined test flight totals were 125 sorties and 320 hours.

CUSTOMERS: Royal Air Force order was originally 21. In deference to comprehensiveness of rebuild, aircraft issued with new serial numbers ZJ514 to ZJ534. However, in March 2002 it was announced that the contract had been reduced to 18. Defence review of July 2004 reduced in-service fleet requirement to 12 aircraft, including three prototypes. Formal announcement of contract award made at Farnborough on 18 July 2006.

COSTS: Ordered as GBP2 billion programme, including training system and initial logistic support, of which 75 per cent of work being placed with UK companies. Boeing TCCS mission system avionics contract valued at USD639 million (1996). Programme cost increased to GBP2.4 billion by March 1999, equivalent to 0.5 per cent above inflation. In mid-2000, BAE agreed to pay GBP46 million penalty because of 23-month programme slippage. BAE profits suffered GBP300 million charge in 2000 to offset expected Nimrod contract losses. Programme cost stated in 2002 to be GBP2.98 billion. Further GBP500 million charged to BAE accounts for 2002. By March 2005, GBP2.2 billion had been spent; 2006 contract valued at under GBP1 billion; eventual cost estimated (2006) GBP3.8 billion.

DESIGN FEATURES: World's first jet-powered, land-based maritime patrol and ASW aircraft on original 1969 servicE-entry; remains sole four-jet in this role. Optimised for anti-submarine warfare (ASW), anti-surface unit warfare (ASUW), search and rescue (SAR), maritime reconnaissance and provision of aid to civil authorities, including fisheries protection and operations against terrorism, drug smuggling and blockade running. Combines fast transit to operational area with low wing loading (and, hence, manoeuvrability) when on station. Can cruise on two or three engines to extend endurance. No special ground equipment required for off-base deployments.

Mid-mounted wing, with two engines in each root; wingtip ESM pods; two hardpoints under each wing. Dihedral tailplane with auxiliary fins at onE-third span to counter aerodynamic effects of electro-optical turret rotation; fin has large fillet and electrical equipment/decoy housing pod at tip. MAD tailboom. 'Double bubble' fuselage cross-section, with weapons bay below; latter restructured for Mk 4 and now in two, separated parts. Wing sweepback 20° at quarter-chord.

Operational life of 150,000 hours with annual A Check and six-yearly C Check. Designed for first-line mean active repair time of 29.5 minutes for light rectification and 180 minutes for heavy rectification; 4.2 mmh/fh first- and second-line preventative maintenance; 60 minutes post-flight maintenance, including 30 minute refuelling. Reliability contract specifies 480 faults per 1,000 flying hours. Engine change time 3 hours; power plant reliability targets per 1,000 hours are 0.1 unscheduled removal, two fail-to-start and 0.03 in-flight shut-down.

FLYING CONTROLS: Conventional and powered. Aileron and elevator systems have release units, used to disconnect the two halves of the control circuits in the event of a jam, thus enabling control of the unjammed half of the control circuit to be retained. Secondary flight controls consist of flaps and air brakes. Flaps comprise inner and outer flap surface on each wing. Two airbrake surfaces per wing; one upper and one lower

STRUCTURE: Conventional construction including fuselage and unpressurised pannier which includes weapons bay and nose radome. Pannier segments are free to move, so that structural loads are not transmitted to pressure cell. Fuselage and empennage have frames, ribs and stringers that support skin panels made of light alloy; cantilever wing has machined skins and stringers, with machined spars and tank walls. Centre fuselage designed at Prestwick and built at Brough; lower and front fuselages designed at Farnborough and built at Brough; rear fuselage designed by Dassault in France and built at Brough. Fuselage pressure hull and rear retained from original airframes, but with new bulkheads and protective treatment

Wings have a new-design machined centre-section, built at Chadderton, that contains No. 1 fuel tank. Stub wing contains the four engines, and carries the hardpoints for weapon pylons. Stub wing also mounts main landing gear that is housed in a compartment outboard of the engines; retractable door and leg-mounted fairing seals the compartment. Outer wing (originally to have been retained, but now new-built, as requested by RAF, at Prestwick from Filton design) has both integral and pod fuel tanks and supports conventional ailerons, flaps and airbrakes. Wingtip pylons and winglets house electronic surveillance measures (ESM) and radar warning equipment.

Empennage has fixed tailplanes with aerodynamic finlets and elevators, plus rudder and fin that includes a dorsal fin and a fin-top fairing. Tailplane, elevators, rudder designed at Prestwick and Farnborough and built at Prestwick and by FR Aviation.

Fuselage pressurised from Frame 1 to Frame 54; unpressurised rear fuselage houses two environmental control system conditioning packs, flying control rods and levers. A boom contains a magnetic anomaly detector (MAD) head. Below the fuselage is a ventral fin with a bump-stop.

Unpressurised radome, forward of the nose landing-gear bay, houses radar scanner. Radome is part of a pannier which provides a bay for the carriage of various stores and equipment. Pannier comprises skin panels, skirt panels, bulkheads and four bomb doors. Rear fairing houses a towed radar decoy.

LANDING GEAR: Tricycle type; retractable. Four-wheel tandem main bogie units, tyre size 36×10.00-18 PR24; twin nosewheels, tyre size 30×9.00-15 PR14. Nose gear retracts rearwards; main gear outwards. When retracted, all landing gear doors are closed; when extended, main doors close and nose door stays open

Multiplate, carbon heat pack brakes. Brake pedals apply normal braking with anti-skid protection. Rotation of the parking brake selector on the centre console applies the parking brake.

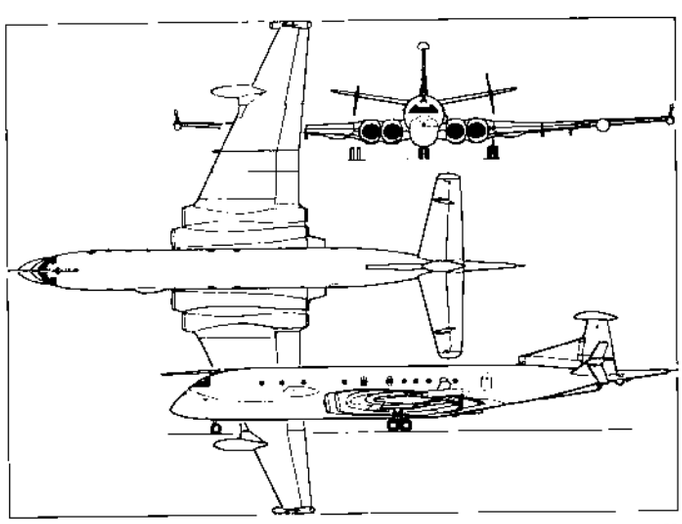
LCN "less than 75" at MTOW.

POWER PLANT: Four Rolls-Royce/BMW BR700-710 Mk 101 (BR710B3-40) high-ratio bypass, two-spool, FADEC-controlled turbofan engines in pairs, two in each wingroot, each rated at 68.9 kN (15,500 lb st). Engines alternatively can be started by ground accumulator trolley or by air from another running engine.

Fuel contained in 13 tanks in wings and fuselage and supplied to engines from one feed tank in fuselage and one in each wing. Remaining tanks transfer fuel into these feed tanks. Management by USMS computers 1 and 2, and only minimal interaction is required from aircrew. However, for certain malfunctions and for refuel, defuel, fuel dump and fuel transfer, controls are provided on the flight deck overhead panel.

All tanks are usually refuelled under pressure; Nos. 2, 3 and 4 can be gravity-filled using overwing caps. Tanks are No. 1 in wing centre-section; Nos. 2L and 2R, wings inboard; Nos. 3L and 3R, wings middle; Nos. 4L and 4R, wings outer; Nos 4AL and 4AR, wing leading-edge pods; No 5, fuselage, underfloor, within pressure shell, forward of wing leading edge; No 6, fuselage, underfloor, within pressure shell, aft of wing trailing-edge; Nos. 7L and 7R (different capacities), wingroots, adjacent to No. 6. Total capacity 60,923 litres (16,095 US gallons; 13,400 Imp gallons). Usable capacities as in adjacent table.

Tank	Kg	lb	litres	US gal	Imp gal
1	8,968	19,771	11,168	2,950	2,457
2L	8,118	17,897	10,110	2,671	2,224
2R	8,118	17,897	10,110	2,671	2,224
3L	3,572	7,875	4,448	1,175	978
3R	3,572	7,875	4,448	1,175	978
4L	3,473	7,657	4,325	1,143	951
4R	3,473	7,657	4,325	1,143	951
4AL	1,497	3,300	1,864	492	410
4AR	1,497	3,300	1,864	492	410
5	2,580	5,688	3,213	849	707
6	2,620	5,776	3,263	862	718
7L	1,133	2,498	1,411	373	310
7R	300	661	374	99	82
Usable	**48,921**	**107,852**	**60,923**	**16,095**	**13,400**
U/U	512	1,129	638	169	140
Total	**49,433**	**108,981**	**61,561**	**16,264**	**13,540**



BAE Systems Nimrod MRA. Mk 4 *(Paul Jackson)* 1158775

ACCOMMODATION: Crew areas, front and rear, are flight deck, lavatory/forward vestibule, mission area, optional additional workstation, galley/dinette, ordnance area (containing sonobuoy racking and dispensers), rear vestibule and aft stowage area. Integral airstairs

Two-crew flight deck with supernumerary crew seat which can be located between flight crew or at worktable on starboard side. Accommodation in mission area of cabin for seven-person tactical team (Tacco 1, Tacco 2, Radar, Communications, ESM, Acoustics 1 and Acoustics 2). Lookout/photography station on port side opening blister window; ESM operator station has an observer's blister window on starboard side.

Additional nine seats for support personnel or replacement crew; four in galley/dinette; four in the ordnance area; and one in central cabin, where an optional additional workstation can be fitted.

Galley, lavatory, general lighting and cabin trim is to modern airliner standards of appearance and fire safety and is supplied by Aim Aviation. Galley fitted with oven, water boiler, refrigerator, large sink and International Water Guard NPS-A3 potable water treatment unit. All seating, by Martin-Baker, to 16 *g* crashworthy standard.

SYSTEMS: Four 200 V, 40 kVA, three-phase, 400 Hz integrated-drive generators, one on each engine supply electrical power Power can also be provided from a single 200 V, 90 kVA, three-phase, 400 Hz APU generator (only while on ground) or an external power unit via a ground power socket. Each integrated-drive generator is connected to its own busbar, all of which can all be interconnected under the control of the utilities system management system (USMS). Use of a single phase of the three-phase 200 V supply provides 115 V AC power. One DC-powered 500 VA static inverter provides AC output for emergency use.

Ram air turbine (RAT), scabbed to fuselage side, ahead of port wingroot, is deployed automatically in the event of loss of all four integrated-drive generators and provides AC power solely to drive 'yellow' hydraulic system AC pump

Environmental control system (ECS) uses air supplied by the four engines or, during ground operation, the APU Engine bleed air is pre-conditioned by four engine bleed air conditioning packs before being distributed around the aircraft. Four conditioning packs (two in the tail and one in each wing) further condition the bleed air for use in maintaining a favourable environment for the aircrew. System is controlled by a combination of USMS and hardwired circuits ECS provides a supply of cooling air to avionics installed in the racks and workstations.

Cabin air is drawn through equipment in 'Essential' racks using cooling fans. Equipment in 'Mission' racks is cooled in a similar fashion while on the ground; supplied with cooling air from the conditioning packs while in flight. ECS also provides a source of bleed air for airframe anti-icing, the Normalair-Garrett onboard oxygen generation system (OBOGS) and engine starting. On the ground, an external source of low pressure cooling air can be used to condition the cabin.

Cabin and flight deck pressurised to a pre-defined schedule by the cabin pressure control system. Pressurisation is maintained using the cabin and flight deck conditioning air Control system and a dual-channel, digital cabin pressure controller, provides monitoring

Fire, smoke and overheat protection system provides detection, indication and suppression of fire in the engines and the APU; for detection and indication of smoke in avionic racks and galley area; and for detection and indication of fire in bomb bay.

GTCP 331-200[N] APU mounted in fireproof compartment in starboard wingroot. Unit consists of twin-stage centrifugal compressor section and a triple-stage axial turbine section, all on a common shaft Provides electrical power, and bleed air for starting engines or air conditioning on ground. Not cleared for airborne operation. Digital electronic control unit (ECU) monitors and controls all aspects of APU operation.

Each flight control system has spring feel, providing increasing force proportional to inceptor displacement. In addition, elevator system has Q-feel which provides increasing force proportional to airspeed, and rudder system has limiter which progressively restricts rudder travel with increasing airspeed. Inner flaps driven by hydraulic power drive unit via shafts, gearboxes and ballscrew actuators; outer flap connected to the inner flap by a link Flaps are normally powered by 'blue' hydraulic system, using Dowty actuators, with 'green' system as back-up. Airbrakes are driven by hydraulic actuators and powered by 'green' hydraulic system.

Automatic flight control system (AFCS) provides eight main functions to improve stability and provide guidance and/or automatic control: (1) Control in the directional (yaw) plane; rudder control surface controlled with two independently operated ganged-output yaw dampers. (2) Automatic control of longitudinal (pitch) stability; by movement of elevator control surfaces with separate pitch trim. (3) Assisted control in lateral (roll) plane; controlled by movement of ailerons (4) Steering guidance on flight director to enable manual control in the pitch and roll planes to achieve required flight path. (5) Three-dimensional guidance and/or control of aircraft position, using external radio navigation aids and flight management system. (6) Automatic control of engine thrust to control speed and vertical path, and NI synchronisation to reduce noise and vibration interference from engines. (7) Display of AFCS operation, alerts and mode/status indications on flight deck display system. (8) Guidance for take-off and go-around, and approach for Category I (Cat I) operation. Stall warning system.

Oxygen system for crew and passengers. USMS controls operation, but oxygen can be manually selected. OBOGS is main source of breathing oxygen, supported by 1,400 litre (49.4 cu ft) bacK-up oxygen supply (BOS) cylinders. Oxygen also available in portable oxygen sets, for crew movement about the cabin and for emergencies.

Hydraulic system has two main subsystems; emergency and an auxiliary. Main subsystems are designated 'blue' and 'green'; auxiliary as 'yellow'. No.3 and No.4 engines drive pumps for blue system, this also having AC and DC electrical pumps.

Blue system provides power for ailerons, elevators, rudder and alternative power to landing gear; normal hydraulic power to bomb bay doors and flaps, and hydraulic power to bomb bay door secondary actuators; normal hydraulic power to wheel brakes and for operation of parking brake. Blue system supplies hydraulic power to power transfer unit (PTU) motor Blue subsystem is powered by a DC pump and provides power to lower the landing gear and operate wheel brakes in the event of a failure of both blue and green systems.

Green system powered by EDPs on Nos.1 and 2 engines and also by PTU pump. Supplies hydraulic power to ailerons, elevators and rudder, power to operate airbrakes, nosewheel steering and landing gear; plus alternative power to bomb bay doors, flaps and brakes, if blue hydraulic system fails.

Yellow hydraulic system has an AC electric pump and supplies aileron, rudder and elevator systems in the event of both blue and green hydraulic systems failing. Yellow pump can also have power provided by the RAT in the event of total engine loss.

Powered flying control units (PFCUs) operate all primary flight control surfaces. Aileron system uses two simplex PFCUs per control surface; elevator and rudder systems each have a tandem PFCU per control surface. Hydraulic power from the blue and green hydraulic system is normally used for the PFCUs. Yellow hydraulic power is used as emergency back-up for the primary flying controls only.

Ice and rain protection system provides anti-icing for airframe and engine intakes and heating for windscreens, air data probes, pressure heads and water drain masts Windscreen wash wipe system clears rain and other contaminants.

Utilities systems management system (USMS) integrated digital system, providing control, monitoring, test functions and health status for all general systems and also interfaces with aircraft conditioning monitoring system (ACMS); engine management unit (EMU); navigation and flight management system (NAV/FMS); radio navigation aids; and warnings and acquisition computer (WAC)

AVIONICS: Airframe incorporates 6 million lines of software code; 90 antennas and sensors; and over 1,000 mission avionic line-replaceable items. Extensive use of off-the-shelf items.

Comms: Five V/UHF radios incorporating Have Quick II secure speech facility; two UHF radios. Thales IFF Mode S transponder. Radio communications system (RCS) controls all internal and external; includes intercom system (ICS). RCS has two radio management units (RMU) on flight deck that control two identical V/UHF systems ICS controls all internal and external distribution of audio signals between the crew members; integrates navigation tones, warning tones and internal voice communications to flight deck and to applicable cabin workstations; provides interface between the crew members and V/UHF radio systems.

Radar: Thales Searchwater 2000MR radar integrated into the TCSS (tactical control and sensor system). Radar gives target classification using both range profiling and synthetic image processing techniques, with following modes: maritime reconnaissance; air to air; weather; swath SAR; spotlight SAR; ISAR; SAR; RN I-band Transponder; and D-band IFF interrogator.

Principal elements comprise: (1) Two-axis scanner in nose, incorporating IFF dipole aerials for interrogator operation (2) Transmitter (3) Radar frequency and control unit (RFCU) directing high power I-band radar pulses to the scanner. (4) Receiver exiter (RxEx) unit to generate timing pulses for the system and also (at low level power) I-band radio frequency radar frequency radar pulses to be transmitted by the radar. (5) Signal processor (SP) to process digitised radar (and transponder) returns; or SAR and ISAR modes. SP undertakes motion compensation and image processing. (6) Data processor (DP), receiving command and control information from TCS via MIL-STD 1553 interface; mode setup commands are then distributed to all system units; DP provides all display data to the TCSS for presentation on the radar operator's PPI display. (7) IFF interrogator. (8) IFF crypto unit, enabling cryptographic codes to be loaded into IFF. (9) INS/GPS providing radar with time, position, heading and aircraft attitude (latter enabling scanner to be stabilised against aircraft attitude changes); additionally for SAR and ISAR modes, INS/GPS unit provides high-speed motion compensation data to enable aircraft motion to be determined. (10) Radar video recorder providing recording and playback of I/PAL video, using Hi-8mm videotape cassettes.

Flight: Navigation controlled through the flight management system (FMS), interfacing with AFCS, FDDS and the aircraft sensor systems. FMS has two multifunction control and display units (MCDU) controlling tuning of the radio navigation systems. Triple air data system. BAE Systems ILS/VOR/MLS, Rockwell Collins ADF, DME, Rockwell Collins Tacan, twin Litton LN-1006 laser INS with embedded GPS, Thales radar altimeters, embedded Aviation Specialities EGWPS, Rockwell Collins TCAS II.

Instrumentation: Flight deck display system (FDDS) has seven Thales display units (based on those of Airbus A330/A340) and shows flight reference data, aircraft system condition and crew alerting information. Independent instrument system has 11 stand-alone instruments (SAI), of which five provide back-up flight reference data.

Mission: Tactical command and sensor system (TCSS), integrated by Boeing, provides command and control of mission system and mission sensors, conforming to MIL-STD-1760; and capability for mission operators to manage tactical situation, control sensor, navigation, communication and defensive aids subsystems and to command stores deployment on seven identical, Boeing-supplied consoles. It uploads pre-flight message (PFM) data to all mission avionics subsystems and performs in-flight mission data recording. Additionally commands and co-ordinates built-in test (BIT) facilities on all subsystems and on TCS computing equipment itself.

Northrop Grumman Nighthunter electro-optical surveillance and detection system (EOSDS) has retractable turret, with deployment unit and sliding doors, in a compartment to the rear of the nose landing gear. Turret contains two thermal imaging and two TV cameras, each sensor having option of narrow and wide fields of view. Turret controlled automatically, or from No. 2 tactical console.

Ultra Electronics CAMBS VI active search sonobuoy system. Acoustics system comprises antennas; receiver subsystem; acoustics processor subsystem (APSS); and acoustics recorder (AR). Five antennas dedicated to acoustics system; primary receive antenna, used to receive sonobuoy radio frequency (RF) data, and four-blade array antenna, which can also receive the sonobuoy RF data, but is primarily to collect the RF data in a suitable form to allow calculation of sonobuoy positions.

Receiver subsystem consists of the RF distribution box (RFD) and two receivers. Provides routing and switching of antenna signals to receivers; low-noise amplification, preservation of phase integrity of signals from four-blade array; and frequency translation of search and rescue (SAR) signals. Two receivers simultaneously receive the RF emissions of NATO standard sonobuoys; one performs sonobuoy positioning calculations and this will also locate a signal on one of two SAR frequencies or one SAR training frequency.

Computing Devices Canada/Ultra Electronics UYS-503/AQS-970 acoustics processor subsystem (APSS) consists of four acoustic data processors (ADPs) and one acoustics control unit (ACU), which is self-contained processor responsible for overall APSS control, human/machine interface and external interfacing. ACU contains main control processor and several external interfaces; ADP is acoustic sonobuoy processor that provides the entire APSS sonobuoy signal processing functions and also provides the functions for an embedded tactical sonobuoy simulator. Acoustic recorder for high-density digital recording of sonobuoy data.

Internal racks for normal 180 sonobuoys; maximum 360. Four Normalair-Garrett rotary launchers in rear fuselage, each holding 10 Size A buoys; two single-barrel launchers for high level (pressurised) fuselage release.

Elta EL/L-8300UK ESM provides all-round coverage, ±35° in vertical plane, with rotating antenna beneath fuselage. CAE ASQ-504(V) AIMS MAD in tailcone, transferred from Mk 2 Nimrod, although now integrated with AQS-970 processor.

Ultra Link 11 and Rockwell Collins Link 16 (JTIDS), MBDA SHF/satcom, Raytheon UHF/satcom; teletype modem.

Self-defence: Defensive aids subsystem (DASS) formulates response strategy; initiates and controls countermeasures; monitors and reports DASS activities; centralises PFM loading for all DASS equipment; provides situational awareness to aircrew; determines weapon system characteristics, advisories, system/subsystem status, and audio tones; includes automatic and operator control modes; provides selectable PFMs, response assets mode control; integrates subsystem control and information in defensive system manager; provides countermeasure response(s) to threat(s) response strategy; co-ordinates RF jamming, chaff/flare, and/or evasive manoeuvres, either individually or in unison.

DASS primary equipment comprises Lockheed Martin ALR-56M C/D-band and E- to K-band RWR; Lockheed Martin/Sanders AAR-57 missile approach warner; Lockheed Martin/Thales Vicon 78 chaff/flare dispensers (eight chaff, four flare); Lockheed Martin/Racal/Raytheon ALE-50(V) active, towed RF radar jammer. Interoperability of onboard radiators and receivers provided by modified Lockheed Martin/Lambda MX-18296/A systems manager.

ARMAMENT: Four pylons underwing, each with dedicated position for two AIM-9 Sidewinder or ASRAAM AAMs, in addition to primary weapon; plus fuselage weapon bay. Weapon

system controls carriage, release and jettison of the wing- and bomb bay-mounted stores, along with carriage, selection and release of sonobuoys. Control of weapon selection, setting and release by stores management system (SMS) and tactical command and sensor system (TCSS). Selection and release of sonobuoys is through TCSS, with SMS providing a safety interlock via the sono-inhibit/enable switch. Subsystems for stores management: carriage and release; sonobuoy release; and bomb bay door control and indication.

Typical loads could include six Harpoon or SLAM-ER ASMs (four beneath wings); 10 mines (four beneath wings); nine internal torpedoes; or five packs of three rescue containers; or five packs of three dinghies; or 12 survival containers; or single pod of 36 light series stores; each accompanied by optional underwing load of four anti-radiation missiles or AGM-65 Maverick ASMs.

DIMENSIONS, EXTERNAL:

Wing span	38.70 m (126 ft 11½ in)
Wing standard mean chord	6.10 m (20 ft 0¼ in)
Length: fuselage, incl MAD cone	38.63 m (126 ft 8¾ in)
refuelling probe to MAD cone	39.33 m (129 ft 0½ in)
overall, incl MAD static wick	40.08 m (131 ft 6 in)
Height overall	9.60 m (31 ft 6 in)
Tailplane span	14.51 m (47 ft 7¼ in)
Tailplane standard mean chord	2.74 m (9 ft 0 in)
Mainwheel track: c/l shock-absorbers	10.68 m (35 ft 0½ in)
between outer tyre rims	11.44 m (37 ft 6½ in)
Nosewheel track (tyre outer rims)	0.71 m (2 ft 4 in)
Wheelbase	14.24 m (46 ft 8½ in)

DIMENSIONS, INTERNAL:

Cabin (incl flight deck): Length	26.82 m (88 ft 0 in)
Max width	2.95 m (9 ft 8 in)
Max height	2.08 m (6 ft 10 in)
Volume	124.1 m³ (4,384 cu ft)

AREAS:

Wings, gross	235.80 m² (2,538.0 sq ft)
Ailerons (total)	5.63 m² (60.60 sq ft)
Tailplane	40.41 m² (435.00 sq ft)
Elevators, incl tabs	12.57 m² (135.30 sq ft)

WEIGHTS AND LOADINGS:

Basic weight empty	51,150 kg (112,765 lb)
Max fuel weight	48,920 kg (107,850 lb)
Max T-O weight	106,215 kg (234,165 lb)
Max zero-fuel weight	58,285 kg (128,500 lb)
Max wing loading	450.4 kg/m² (92.26 lb/sq ft)
Max power loading	385 kg/kN (3.78 lb/lb st)

PERFORMANCE:

Max operating Mach No. (MMO)	0.77
Service ceiling	12,800 m (42,000 ft)
Range with max internal fuel	more than 6,000 n miles (11,112 km; 6,904 miles)
Endurance, unrefuelled	more than 14 h
g limit	+3

BLA

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Aviation Group International, a privately owned company specialising in airliner maintenance and support, acquired two light aircraft programmes from FLS Aerospace, the Sprint (formerly Trago Mills/Orca SAH-1) and Optica. In 2005 was planning with business partner, Aerostar of Romania, to build both in kit form, with intended new names, Redwing and Dragonfly, respectively.

FLS Sprint (formerly Trago Mills SAH-1) which is proposed for re-launch by BLA as the Redwing *(Paul Jackson)* 1047832

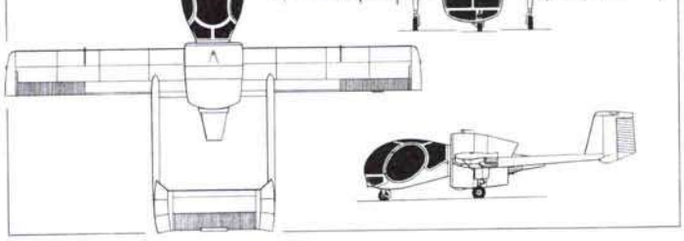
BLA DRAGONFLY (OPTICA)

TYPE: Multisensor surveillance lightplane.

PROGRAMME: Edgley OA7 Optica prototype (G-BGMW), designed by John Edgley, first flew 14 December 1979; initial production aircraft flew 4 August 1984; certified by UK CAA 12 February 1985; deliveries began to Air Foyle (two on order) 14 May 1985 and leased-out to Hampshire Constabulary same day (G-KATY); lost in flying accident 15 May. Edgley Aircraft into receivership October 1985, having built two prototypes (001 and 003) and two production aircraft (004 and 005). Currently exists as Edgley Aeronautics, producer of EA9 Optimist single-seat sailplane and EA10 two-seater.

Optica Industries formed December 1985 and took over Optica plant at Old Sarum; built 10 (c/ns 006 to 015), last of which had not flown when factory destroyed by arson on 16 January 1987, resulting in loss of nine complete aircraft. Company dissolved.

Brooklands Aircraft formed February 1987 to market EA7 under name of Optica Scout; company name changed to Brooklands Aerospace in April 1987. Specific surveillance version designated Scoutmaster, which was joint venture with ASTA of Australia. Brooklands built five Opticas (c/ns 016 to 020), last being initial Mk 301 (Series 300) version with 46 design changes, including IFR avionics, wing fences and upturned wingtips. Manufacture ended 23 March 1990 when Brooklands entered receivership.



BLA Dragonfly (Optica) observation platform *(Dennis Punnett)* 1047804

Programme acquired by FLS Aerospace (Lovaux Ltd) on 27 July 1990 and transferred to Hurn/Bournemouth Airport. Completed certification of Srs 300 in December 1991; assembled three inherited airframes (c/n 021 to 023); began new manufacture, but first two aircraft not completed (c/n 024 and 025). Programme offered for sale in May 1994, although Optica Srs 300 was certified by US FAA on 14 February 1995. Earlier versions retrospectively assigned Srs 100 and 200 by UK CAA.

Type Certificate acquired by Aviation Group International on behalf of subsidiary, British Light Aircraft. Agreement with Aerostar of Romania in April 2004 as risk-sharing partner for subassembly kits under provisional name of Dragonfly. Thrush Aircraft of Albany, Georgia, USA, considering becoming North American assembly centre. Relaunched version will have redesigned instrument panel and dual-bus electrical system with separate alternators.

CUSTOMERS: At least aircraft eight extant from earlier production, comprising four stored in UK (G-BPMF, G-BMPL, G-BOPO and G-BOPR); two owned by Martin Waterhouse of Narrabeen, NSW, Australia (VH-BMC and VH-OPI); and two in USA (N130DP William Bruggeman, North Oaks, Minnesota; N198DP Darrell Wallace, Hoodsville, Florida).

DESIGN FEATURES: Three-seat observation aircraft, suited particularly for pipeline and powerline inspection, photography, crime prevention and pursuit, fire patrol, game spotting, Customs and Excise duties, pollution control reconnaissance, narcotics control, disaster monitoring, survey, leisure and sightseeing, security escort, coastguard, search, accident control, police duties, film/TV and press reporting. 'Insect eye' cabin with outward view approximately 270° in vertical plane and 340° in horizontal plane, combining all-round field of view of a helicopter with lower operating costs of fixed-wing aircraft; ducted propulsor power plant unit, offering very low vibration levels and exceptional quietness, both within cabin and from ground; claimed fuel consumption 16-24 per cent of comparable light turbine helicopter, and 31 per cent of operating costs (fixed and direct for 500 hours per year); low wing loading, preset inboard flaps and low stalling speed facilitate continuos low speed flight; generous flap area provides good field performance; stressed to BCAR Section K (non-aerobatic category) and FAR Pt 23 (Normal category).

Wing section NASA GA(W)-1; thickness/chord ratio of 17 per cent; dihedral 3° on outer panels; incidence 0°.

FLYING CONTROLS: Conventional and manual. Bottom hinged, mass balanced slotted ailerons outboard of outer flaps, operated by pushrods; balanced rudders; elevators with inset trailing-edge trim tab. Fowler trailing-edge flaps (29 per cent of total wing chord) inboard and outboard of tailbooms; electrically actuated outboard flaps can be set at angles up to 50° for landing; inboard flaps set permanently at 10°, giving effect of slotted wing, for continuous low speed flying; no spoilers or airbrakes; twin inward canted fins; fixed incidence tailplane. Control surface movements: ailerons +22°/–12°; rudder ±25°; elevator +26° 30'/–19°.

STRUCTURE: Constant chord single-spar wings of 1.72 duralumin stressed skin construction; GFRP wingtips; aluminium alloy cabin with ICI Perspex windows (optionally tinted), attached to fan shroud and rest of airframe by six slators of steel tube and aluminium alloy shear web construction; steel tube and aluminium alloy nose beam supports cabin floor; horizontal window frame member just above floor level, together with nosewheel box, designed to withstand 9*g* impact; two movable 7.5 kg (16.5 lb) ballast weights may be positioned on nose beam; landing lamp and taxi/standby landing lamp mounted in nose beam; aluminium alloy stressed skin tubular twin tailbooms; limited GFRP in non-load-bearing areas of tail unit, including fin/tailplane fillets; two movable 9 kg (20 lb) ballast weights may be psitioned in fins. Propulsor pod attached to fan shroud with four Lord rubber mountings, and supported by four stators of steel channel and aluminium alloy shear web construction, with steel tube engine bearers. Some fairings of GFRP.

LANDING GEAR: Tricycle type; fixed. Wing-mounted cantilever main legs with compressed rubber shock absorbers. Steerable nosewheel offset to port; shock absorption by bungee rubber. Tyre sizes 6.00-6 (main) and 5.00-5 (nose). Pressures 2.90 bar (42 lb/sq in) main; 3.72 bar (54 lb/sq in) nose. Hydraulic disc brakes on mainwheels. Parking brake. Nosewheel mudguard of GFRP.

POWER PLANT: Ducted propulsor unit, with engine and fan forming a power pod separate from the main shroud. Five-blade Hoffmann HO-E315/122EZ fixed-pitch fan, driven clockwise (viewed from rear) by a 194 kW (260 hp) Textron Lycoming IO-540-4A5D flat-six engine, mounted in a duct downstream of the fan. Fuel tank of 128 litres (33.8 US gallons; 28.0 Imp gallons) capacity in each wing leading-edge, immediately outboard of tailbooms and forward of wing spar. Tanks are of full wing section, but are designed not to be stressed by wing bending and torsion. Total usable fuel capacity 250 litres (66.0 US gallons; 55.0 Imp gallons); 6 litres (1.6 US gallons; 1.3 Imp gallons) unusable. Refuelling point in upper surface of each wing. Oil capacity 7.6 litres (2.0 US gallons; 1.7 Imp gallons).

ACCOMMODATION: Cabin designed to accommodate up to three persons side by side on fore and aft adjustable seats with either single- or two-pilot operation (left hand and centre seats). Dual controls standard. Baggage space aft of seats. Single elliptical door on each side, hinged at front and opening forward. Can be flown with doors removed. Cabin heated, by hot air from engine, and ventilated. Janitrol combustion heater optional.

SYSTEMS: Hydraulics for mainwheel brakes only. Electrical system (24V) includes engine driven alternator and storage battery for engine starting and actuation of flaps.

FLS Optica Scoutmaster from original production *(Paul Jackson)*

1047831

AVIONICS: Standard nav/com avionics by Bendix/King (Silver Crown). Alternative avionics optional.

EQUIPMENT: Special equipment tested successfully includes FLIR, Barr & Stroud thermal imager and an air-to-ground video relay. Other equipment such as BAE Systems TICM II, searchlights and loudspeakers, were assessed.

DIMENSIONS, EXTERNAL:

Wing span	12.00 m (39 ft 4 in)
Wing chord: basic, constant	1.32 m (4 ft 4 in)
over 10° fixed flaps	1.45 m (4 ft 9 in)
Wing aspect ratio	9.09
Length overall	8.15 m (26 ft 9 in)
Height over fan shroud (excl aerial)	1.98 m (6 ft 6 in)
Diameter of fan shroud	1.68 m (5 ft 6 in)
Diameter of fan	1.21 m (3 ft 11¾ in)
Shroud ground clearance	0.25 m (10 in)
Height over tailplane	2.31 m (7 ft 7 in)
Tail unit span:	
c/l of tailbooms	3.40 m (11 ft 2 in)
intersection fin chord	2.60 m (8 ft 6½ in)
Wheel track	3.40 m (11 ft 2 in)
Wheelbase	2.73 m (9 ft 0 in)
Doors (each): Long axis	1.35 m (4 ft 5 in)
Short axis	1.96 m (3 ft 1¾ in)
Height to sill	0.51 m (1 ft 8 in)

DIMENSIONS, INTERNAL:

Cabin: Length	2.44 m (8 ft 0 in)
Max width (to door Perspex)	1.68 m (5 ft 6 in)
Max height	1.35 m (4 ft 5 in)
Floor area	0.72 m² (7.75 sq ft)

AREAS:

Wings, gross	15.84 m² (170.5 sq ft)
Ailerons (total)	1.55 m² (16.68 sq ft)
Trailing-edge flaps:	
inboard (total)	0.61 m² (6.57 sq ft)
outboard (total)	1.59 m² (17.12 sq ft)
Fins (total)	1.98 m² (21.31 sq ft)
Rudders (total)	1.10 m² (11.84 sq ft)
Tailplane	1.62 m² (17.44 sq ft)
Elevator, incl tab	1.26 m² (13.56 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, equipped	948 kg (2,090 lb)
Max baggage weight	30 kg (66 lb)
Max passenger weight	227 kg (500 lb)
Max combined cabin load	231 kg (510 lb)
Max T-O and landing weight	1,315 kg (2,900 lb)
Max zero-fuel weight	1,240 kg (2,734 lb)
Max wing loading	83.0 kg/m² (17.0 lb/sq ft)
Max power loading	6.78 kg/kW (11.2 lb/hp)

PERFORMANCE (at max T-O weight, forward limit CG):

Never-exceed speed (V_{NE})	140 kt (259 km/h; 161 mph)
Max level speed	115 kt (213 km/h; 132 mph)
Cruising speed:	
50% power	86 kt (159 km/h; 99 mph)
70% power	103 kt (191 km/h; 119 mph)
Loiter speed (40% power)	70 kt (130 km/h; 81 mph)
Stalling speed, outboard flaps up	58 kt (108 km/h; 67 mph)
Max rate of climb at S/L	247 m (810 ft)/min
Service ceiling	4,275 m (14,000 ft)
Max certified altitude	3,960 m (13,000 ft)
T-O run	331 m (1,084 ft)
T-O to 15 m (50 ft)	472 m (1,548 ft)
Landing from 15 m (50 ft)	555 m (1,820 ft)
Landing run	278 m (912 ft)
Range with max fuel (45 min reserves):	
at 70% power	334 n miles (619 km; 385 miles)
at 70 knots (130 km/h; 81 mph)	570 n miles (1,056 km; 656 miles)
Endurance (45 min reserves):	
at 70% power	3 h 40 min
at 70 kt (130 km/h; 81 mph)	8 h
g limits	+3.8/–1.5

BNG

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Pilatus Aircraft Ltd of Switzerland, which acquired Britten-Norman (Bembridge) Ltd 1979, sold the company on 21 July 1998 to investment group Litchfield Continental Ltd, at which time the original name Britten-Norman Ltd was re-adopted. Company sold almost immediately to Global Spill Management (environmental protection) which reformed as Biofarm (pharmaceutical manufacturer) in Romania; Agreement to purchase Romaero, long-term maker of Islander airframes, made January 1999, but not concluded. Proposed capital injection by UAE-based HSDP, early 2000, also failed to take place.

On 3 April 2000 Britten-Norman was placed in receivership; sale announced 26 April to Alawi Zawawi of Oman, and new company formed as B-N Group Ltd (BNG). Order backlog at that time stood at nearly GBP12 million.

Since April 2000, Britten-Norman has undergone a major restructuring, including formation of two wholly-owned subsidiaries: Fly BN Ltd in 2002 and Britten-Norman Aircraft Ltd in 2004. Britten-Norman has also expanded into aerospace composites, logistics, human resources and training, and now supports a wide range of products and services in the aerospace sector. Company has been producing the BN2 series of Islander, Trislander and Defender for a period spanning five decades. Customers include short-haul regional airlines and military and government agencies; company has produced in excess of 1,250 aircraft. BN2 series currently in daily use with some 500 companies and organizations in over 120 countries.

Britten-Norman Aircraft Ltd (BNA) has wide-ranging capabilities which extend from subcontract component manufacture through to integration of sophisticated sensor suites to other third-party aeroplanes and helicopters. Company is also a defence contractor specialising in the integration, installation, test and trials of mission equipment. BNA is backed by approvals from the UK CAA, EASA (21/145) and the UK MoD and is also accredited under AS9100.

As sole manufacturer-approved providers of Britten-Norman's world-wide customer support, Fly BN Ltd (FBN) offers maintenance support for BN2 and other aircraft types. From its UK base, FBN maintains large inventories of aircraft spares which it distributes globally through a network of strategic partners and BN Logistics. FBN is independently backed by approvals from EASA.

BN Resources Ltd completes the service by providing type-rated training for pilots, mission operators, avionics technicians and engineers.

On 28 January 2002, B-N Group signed a 15-year agreement with Bembridge Airfield Ltd under which BNG will manage and develop Bembridge Airfield, thus securing the site for the manufacture and development of the Islander and Defender range. Three Defenders supplied to UK Army Air Corps in 2004.

In August 2002, BNG signed a contract with Romaero for production of 24 Islander airframes over a two-year period, with the option for Defenders to replace some of the contracted Islanders.

BNG BN2B ISLANDER

TYPE: Light utility twin-prop transport.

PROGRAMME: Prototype (G-ATCT) first flight 13 June 1965 with two 157 kW (210 hp) Rolls-Royce Continental IO-360-B engines and 13.72 m (45 ft) span wings; subsequently re-engined with Textron Lycoming O-540s and flown 17 December 1965; wing span also increased by 1.22 m (4 ft) to initial production standard; production prototype BN2 (G-ATWU) flown 20 August 1966; domestic C of A received 10 August 1967; FAA type certificate 19 December 1967; Romanian manufacture (see Romaero entry) began 1969. In July 2002, further 24 Islanders ordered by BNG from Romaero with option to include two three-engined Trislanders. Contract included completion of three Islanders in advanced state of manufacture when former B-N company entered receivership. First of these flew 2 September 2002 and delivered to UK on 5 September as BN2B-20.

CURRENT VERSIONS: **BN2 Islander:** Initial piston-engined production model (23 delivered).

BN2A Islander: Piston version built from 1 June 1969 until 1989 (see *Jane's Aircraft Upgrades*). Deliveries totalled 890.

BNG BN2 Islander *(Paul Jackson)* 1159149

BN2B Islander: Standard piston-engined version since 1979; higher maximum landing weight; improved interior design; available with two engine choices and optional wingtip fuel tanks as **BN2B-26** with O-540s and **BN2B-20** with IO-540s (BN2B-27 and -21 no longer available). Features include range of passenger seats and covers, more robust door locks, improved door seals and stainless steel sills, redesigned fresh air system to improve ventilation in hot and humid climates, smaller diameter propellers to reduce cabin noise, and redesigned flight deck and instrument panel.

B-N, in conjunction with Hartzell Propeller Inc, has been testing a three-blade scimitar-shaped propeller developed as part of the NASA-sponsored AGATE/GAP programme, using a BN-2B operated by the North East Police Air Support Unit. The aim of the test programme is to minimise the aircraft's noise footprint through enhanced propeller aerofoil efficiency and reduced tip speeds.

In early 2003 BNG was evaluating aero diesel engines, including the 261 kW (350 hp) SMA, for possible installation on future production Islanders, and for retrofit to existing Islanders and Trislanders.

Detailed description applies to BN2B version.

Series of modification kits available as standard or option for new production aircraft and can be fitted retrospectively to existing aircraft.

BN2B Defender: Military version. Design features as detailed under Turbine Islander and Defender entry. Customers include Indian Navy (six recently converted to turbine power), Belgian Army, Botswana Defence Forces and Jamaican Defence Force.

BN2C Islander: Proposed upgrade with 224 kW 300 hp piston engines; Hartzell scimitar-blade propellers; fuel tanks in wingtips; all-glass cockpit; window for third seating row; and enlarged cargo door. Under study in early 2004.

BN2T Turbine Islander: *Described separately.*

BN2T-4R Defender: *Described in 1997–98 and earlier editions.*

BN2T-4S Defender 4000: *Described separately.*

BN2A Mk III Trislander: *Described separately.*

CUSTOMERS: Total of 1,161 twin-engined Islanders and Turbine Islanders built by early 2006, including three (but not fourth, unflown) BN2T-4R MSSA. These assembled in UK (416 including two at Eastleigh), Belgium (179), Philippines (44) and Romania (522). At least 166 of these are current BN2B version. First to fly post-April 2000 purchase of company was G-BWNG exhibited at Farnborough Air Show, July 2000 having flown on 10 July 2000 and arrived at Bembridge on 19 July. First delivery under new ownership was a BN2B-26 delivered on 10 November 2000 to Aer Arann of Galway, Ireland, followed by another Islander delivered to Ryuku Air Commuter of Japan on 12 November 2000. One delivered in 2004 to FLN of Germany and others to Pakistan and private owners. BNG has also refurbished second-hand aircraft for new owners..

COSTS: Direct operating cost (2004): BN2B-26 USD241.85 per hour (900-1,000 hours annual utilisation; 0.90 mmh/fh).

DESIGN FEATURES: Robust STOL light transport, suitable for operation from semi-prepared airstrips. High, unswept, constant-chord wings and tailplane; sweptback fin with small fillet; upswept rear fuselage. Three-blade propellers available on BN2B-20 and BN2B-26 giving quieter noise signature.

NACA 23012 wing section; no dihedral; incidence 2°; no sweepback.

FLYING CONTROLS: Conventional and manual. Actuation by pushrods and cables. Slotted ailerons, with starboard ground-adjustable tab; mass-balanced elevator; trim tabs in rudder and elevator; single-slotted flaps operated electrically; fixed incidence tailplane. Dual controls standard.

STRUCTURE: L72 aluminium-clad aluminium alloys; two-spar wing torsion box in one piece; flared-up wingtips; integral fuel tanks in wingtips optional; four-longeron fuselage of pressed frames and stringers; two-spar tail unit with pressed ribs.

LANDING GEAR: Non-retractable tricycle type, with twin wheels on each main unit and single steerable nosewheel. Cantilever main legs mounted aft of rear spar. All three legs fitted with oleo-pneumatic shock-absorbers. All five wheels and tyres size 16×7-7, supplied by Goodyear. Tyre pressure: main 2.41 bar (35 lb/sq in); nose 2.00 bar (29 lb/sq in). Foot-operated air-cooled Cleveland hydraulic brakes on main units. Parking brake. Wheel/ski gear available optionally. Minimum ground turning radius 9.45 m (31 ft 0 in).

POWER PLANT: Two Textron Lycoming flat-six engines, each driving a Hartzell HC-C2YK-2B or -2C two-blade constant-speed feathering metal propeller; optional three-blade Hartzell HC-C3YR-2UF/FC8468-8R. Propeller synchronisers optional. Standard power plant (BN2B-26) 194 kW (260 hp) O-540-E4C5, but 224 kW (300 hp) IO-540-K1B5 fitted at customer's option (BN2B-20).

Integral fuel tank between spars in each wing, outboard of engine. Total fuel capacity (standard) 518 litres (137 US gallons; 114 Imp gallons). Usable fuel 492 litres (130 US gallons; 108 Imp gallons). With optional fuel tanks in wingtips, total capacity is increased to 814 litres (215 US gallons; 179 Imp gallons). Additional pylon-mounted underwing auxiliary tanks, each of 227 litres (60.0 US gallons; 50.0 Imp gallons) capacity, available optionally. Refuelling point in upper surface of wing above each internal tank. Total oil capacity 22.75 litres (6.0 US gallons; 5.0 Imp gallons).

ACCOMMODATION: Up to 10 persons, including pilot, on side-by-side front seats and four bench seats. No aisle. Seat backs fold forward. Access to all seats via three forward-opening doors, forward of wing and at rear of cabin on port side and forward of wing on starboard side. Baggage compartment at rear of cabin, with port-side loading door in standard versions. Exit in emergency by removing door windows. Special executive layouts available.

Can be operated as freighter, carrying more than a ton of cargo; in this configuration passenger seats can be stored in rear baggage bay. In ambulance role, up to three stretchers and two attendants can be accommodated. Other layouts possible, including photographic and geophysical survey, parachutist transport or trainer (with accommodation for up to eight parachutists and dispatcher), firefighting, environmental protection and crop-spraying.

SYSTEMS: Janaero cabin heater standard. 45,000 BTU Janitrol combustion unit, with circulating fan, provides hot air for distribution at floor level outlets and at windscreen demisting slots. Fresh air, boosted by propeller slipstream, is ducted to each seating position for on-ground ventilation. Electrical DC power, for instruments, lighting and radio, from two engine-driven 24 V 70 A self-rectifying alternators and a controller to main busbar and circuit breaker assembly. Emergency busbar is supplied by a 24 V 25 Ah heavy-duty lead-acid battery in the event of a twin alternator failure. Ground power receptacle provided. Optional electric de-icing of propellers and windscreen, and pneumatic de-icing of wing and tail unit leading-edges. Oxygen system available optionally for all versions.

AVIONICS: *Comms:* Dual VHF nav/com with ILS; transponder; intercom, including second headset, and passenger address system, all standard. Optional ELT, HF/MF radios.

Radar: Optional weather radar in nose.

Flight: ADF, MKR, VOR, DME standard. Optional autopilot, EGPWS, TCAS and B-RNAV.

Instrumentation: IFR standard.

DIMENSIONS, EXTERNAL:

Wing span	14.94 m (49 ft 0 in)
Wing chord, constant	2.03 m (6 ft 8 in)
Wing aspect ratio	7.4
Length overall	10.86 m (35 ft 7¾ in)
Fuselage: Max width	1.21 m (3 ft 11½ in)
Max depth	1.46 m (4 ft 9¾ in)
Height overall	4.18 m (13 ft 8¾ in)
Tailplane span	4.67 m (15 ft 4 in)
Wheel track (c/l of shock-absorbers)	3.61 m (11 ft 10 in)
Wheelbase	3.99 m (13 ft 1¼ in)
Propeller diameter	1.98 m (6 ft 6 in)
Cabin door (front, port): Height	1.10 m (3 ft 7½ in)
Width: top	0.64 m (2 ft 1¼ in)
Height to sill	0.59 m (1 ft 11¼ in)
Cabin door (front, starboard): Height	1.10 m (3 ft 7½ in)
Max width	0.86 m (2 ft 10 in)
Height to sill	0.57 m (1 ft 10½ in)
Cabin door (rear, port): Height	1.09 m (3 ft 7 in)
Width: top	0.635 m (2 ft 1 in)
bottom	1.19 m (3 ft 11 in)
Height to sill	0.52 m (1 ft 8½ in)
Baggage door (rear, port): Height	0.69 m (2 ft 3 in)

DIMENSIONS, INTERNAL:

Passenger cabin, aft of pilot's seat: Length	3.05 m (10 ft 0 in)
Max width	1.09 m (3 ft 7 in)
Max height	1.27 m (4 ft 2 in)
Floor area	2.97 m² (32.0 sq ft)
Volume	3.7 m³ (130 cu ft)
Baggage space aft of passenger cabin	1.4 m³ (49 cu ft)
Freight capacity:	
aft of pilot's seat, incl rear cabin baggage space	4.7 m³ (166 cu ft)
with four bench seats folded into rear cabin baggage space	3.7 m³ (130 cu ft)

AREAS:

Wings, gross	30.19 m² (325.0 sq ft)
Ailerons (total)	2.38 m² (25.60 sq ft)
Flaps (total)	3.62 m² (39.00 sq ft)
Fin	3.41 m² (36.64 sq ft)
Rudder, incl tab	1.60 m² (17.20 sq ft)
Tailplane	6.78 m² (73.00 sq ft)
Elevator, incl tabs	3.08 m² (33.16 sq ft)

WEIGHTS AND LOADINGS (A: 194 kW; 260 hp engines, B: 224 kW; 300 hp engines):

Weight empty, equipped (without avionics): A	1,866 kg (4,114 lb)
B	1,925 kg (4,244 lb)
Max disposable load: A	1,128 kg (2,486 lb)
B	1,068 kg (2,356 lb)
Payload: with max standard fuel: A	774 kg (1,706 lb)
B	715 kg (1,576 lb)
with max optional fuel: A	497 kg (1,196 lb)
B	484 kg (1,066 lb)
Max fuel weight: standard: A, B	354 kg (780 lb)
with optional tanks in wingtips: A, B	585 kg (1,290 lb)
Max T-O and landing weight: A, B	2,993 kg (6,600 lb)
Max zero-fuel weight (BCAR): A, B	2,855 kg (6,300 lb)
Max floor loading, without cargo panels: A, B	586 kg/m² (120 lb/sq ft)
Max wing loading: A, B	99.2 kg/m² (20.31 lb/sq ft)
Max power loading: A	7.73 kg/kW (12.69 lb/hp)
B	6.70 kg/kW (11.00 lb/hp)

PERFORMANCE (A and B as above):

Never-exceed speed (VNE): A, B	183 kt (339 km/h; 211 mph) IAS
Max level speed at S/L: A	148 kt (274 km/h; 170 mph)
B	151 kt (280 km/h; 173 mph)
Max cruising speed at 75% power at FL70: A	139 kt (257 km/h; 160 mph)
B	142 kt (264 km/h; 164 mph)
Cruising speed at 67% power at FL90: A	134 kt (248 km/h; 154 mph)
B	137 kt (254 km/h; 158 mph)
Cruising speed at 59% power at FL120:	
A	130 kt (241 km/h; 150 mph)
B	132 kt (245 km/h; 152 mph)
Stalling speed: flaps up: A, B	50 kt (92 km/h; 57 mph) IAS
flaps down: A, B	40 kt (74 km/h; 46 mph) IAS
Max rate of climb at S/L: A	262 m (860 ft)/min
B	344 m (1,130 ft)/min
Rate of climb at S/L, OEI: A	44 m (145 ft)/min
B	60 m (198 ft)/min
Absolute ceiling: A	4,145 m (13,600 ft)
B	6,005 m (19,700 ft)
Service ceiling: A	3,445 m (11,300 ft)
B	5,240 m (17,200 ft)
Service ceiling, OEI: A	1,525 m (5,000 ft)
B	1,980 m (6,500 ft)
T-O run at S/L, zero wind, hard runway: A	278 m (915 ft)
B	215 m (705 ft)
T-O run at 1,525 m (5,000 ft): A	396 m (1,300 ft)
B	372 m (1,225 ft)
T-O to 15 m (50 ft) at S/L, zero wind, hard runway: A	371 m (1,220 ft)
B	355 m (1,165 ft)

T-O to 15 m (50 ft) at 1,525 m (5,000 ft): A ..... 528 m (1,735 ft)
B ..... 496 m (1,630 ft)
Landing from 15 m (50 ft) at S/L, zero wind, hard runway: A, B ..... 299 m (980 ft)
Landing from 15 m (50 ft) at 1,525 m (5,000 ft): A, B ..... 357 m (1,170 ft)
Landing run at 1,525 m (5,000 ft): A, B ..... 171 m (560 ft)
Landing run at S/L, zero wind, hard runway: A, B ..... 140 m (460 ft)
Range, block-to-block, plus 10% plus 45 min reserves:
B, standard fuel: IFR ..... 503 n miles (931 km; 578 miles)
VFR ..... 639 n miles (1,183 km; 735 miles)
B, with optional tanks: IFR ..... 896 n miles (1,659 km; 1,031 miles)
VFR ..... 1,075 n miles (1,990 km; 1,237 miles)

BNG BN2T TURBINE ISLANDER and DEFENDER

UK Army Air Corps designation: Islander AL. Mk 1
Royal Air Force designation: Islander CC. Mk 2/2A

TYPE: Utility turboprop twin.

PROGRAMME: Turboprop Islander; first flight of prototype (G-BPBN) 2 August 1980 with two Allison (now Rolls-Royce) 250-B17Cs; British CAA certification received end of May 1981; first production aircraft delivered December 1981; FAR Pt 23 US type approval 15 July 1982; full icing clearance to FAR Pt 25 gained 23 July 1984.

CUSTOMERS: Total of some 69 produced by early 2006. Several intended BN2Ts completed as BN2Bs at Romanian factory before delivery to UK, while other BN2Bs upgraded to BN2T in UK before delivery to customers. For turbine (BN2T) version, customers include Moroccan Ministry of Fisheries, Pakistan Maritime Security Agency (three, including one in August 2004), Belgian Gendarmerie, Netherlands Police, Royal Air Force, UK Army Air Corps and Mauritius Coast Guard. EAS Aviation of Abu Dhabi received one in 2005; another under conversion in 2006.

COSTS: Direct operating cost (2003) GBP158.05 per hour (900+ hours annual utilisation; 0.90 mmh/fh).

DESIGN FEATURES: As for piston-engined version; turboprops enable use of available low-cost jet fuel; low operating noise level; available for same range of applications as Islander. Defender has four underwing hardpoints for standard NATO pylons to attach fuel tanks, weapons and other stores; number of additional airframe options, including sliding door on rear port side which can be opened in flight, are also offered. Concept of Defender is to provide a low-cost airframe which can be fitted with best available sensors to meet operational needs of customers.

Description of BN2B Islander applies also to BN2T and Defender, except as follows:

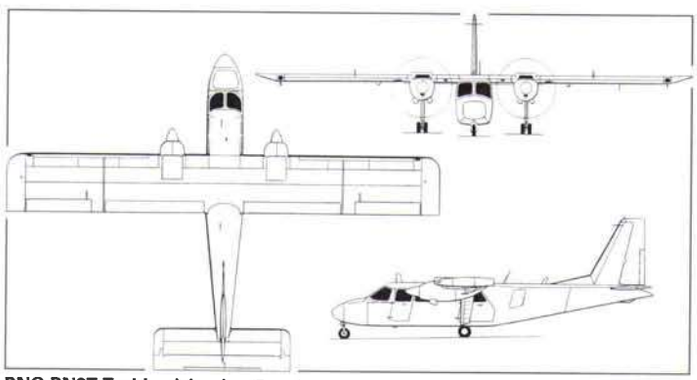
POWER PLANT: Two 313 kW (420 shp) Rolls-Royce 250-B17C turboprops, flat rated at 238.5 kW (320 shp), and each driving a Hartzell three-blade constant-speed fully feathering metal propeller. Usable fuel 814 litres (215 US gallons; 179 Imp gallons). Pylon-mounted underwing tanks, each of 227 litres (60.0 US gallons; 50.0 Imp gallons) capacity, are available optionally for special purposes. Total oil capacity 5.7 litres (1.5 US gallons; 1.25 Imp gallons).

ACCOMMODATION: Generally as for BN2B. In ambulance role can accommodate, in addition to pilot, a single stretcher, one medical attendant and five seated occupants; or two stretchers, one attendant and three passengers; or three stretchers, two attendants and one passenger. Other possible layouts include executive, photographic and geophysical survey; parachutist transport or trainer (with accommodation for up to eight parachutists and a dispatcher); and pest control or other agricultural spraying. Maritime Turbine Islander/Defender versions available for fishery protection, coast guard patrol, pollution survey, search and rescue, and similar applications. In-flight sliding parachute door optional.

AVIONICS: *Comms:* Optional maritime band and VHF transceivers.
Flight: VLF/Omega nav system; radar altimeter.
Self-defence : (Military versions) Since at least 1994 Army Air Corps Islander AL. Mk 1s have had provision for AN/ALQ-144 IR jammer under fuselage. Lockheed Martin IRCM suite tested on AAC Islander in early 1998.

EQUIPMENT: According to mission, can include fixed tailboom or towed bird magnetometer, spectrometer, or electromagnetic detection/analysis equipment (geophysical survey); one or two cameras, navigation sights and appropriate avionics (photographic survey); 189 litre (50.0 US gallon; 41.5 Imp gallon) Micronair underwing spraypods complete with pump and rotary atomiser (pest control/agricultural spraying versions); dinghies, survival equipment and special crew accommodation (maritime versions). Optimal installations for British Army Islanders include photographic surveillance package of door-mounted Zeiss 610 camera, vertical Zeiss Trilens 80 mm and either F126 vertical, RMK vertical or two KS-153 vertical cameras; Vinten F143 panoramic is also available.

DIMENSIONS, EXTERNAL: As for BN2B, except:
Length overall: standard nose ..... 10.86 m (35 ft 7¾ in)
weather radar nose ..... 11.07 m (36 ft 3¾ in)
Propeller diameter ..... 2.03 m (6 ft 8 in)



BNG BN2T Turbine Islander *(Dennis Punnett)* 0507236

WEIGHTS AND LOADINGS:
Weight empty, equipped ..... 1,832 kg (4,040 lb)
Payload with max fuel ..... 689 kg (1,520 lb)
Max T-O weight ..... 3,175 kg (7,000 lb)
Max landing weight ..... 3,084 kg (6,800 lb)
Max zero-fuel weight ..... 2,994 kg (6,600 lb)
Max wing loading ..... 105.2 kg/m² (21.54 lb/sq ft)
Max power loading ..... 5.33 kg/kW (8.75 lb/shp)

PERFORMANCE (standard Turbine Islander/Defender):
Max cruising speed: at FL100 ..... 170 kt (315 km/h; 196 mph)
at S/L ..... 154 kt (285 km/h; 177 mph)
Cruising speed at 72% power: at FL100 ..... 150 kt (278 km/h; 173 mph)
at FL50 ..... 143 kt (265 km/h; 165 mph)
Stalling speed, power off: flaps up ..... 52 kt (97 km/h; 60 mph) IAS
flaps down ..... 45 kt (84 km/h; 52 mph) IAS
Max rate of climb at S/L ..... 320 m (1,050 ft)/min
Rate of climb at S/L, OEI ..... 66 m (215 ft)/min
Service ceiling ..... 7,620 m (25,000 ft)
Absolute ceiling, OEI ..... over 3,050 m (10,000 ft)
T-O run ..... 255 m (840 ft)
T-O to 15 m (50 ft) ..... 381 m (1,250 ft)
Landing from 15 m (50 ft) ..... 339 m (1,110 ft)
Landing run ..... 228 m (750 ft)
Range (IFR) with max fuel, reserves for 45 min hold plus 10% ..... 590 n miles (1,093 km; 679 miles)
Range (VFR) with max fuel, no reserves ..... 728 n miles (1,348 km; 838 miles)

BNG BN2T-4S DEFENDER 4000

UK Army Air Corps designation: Defender AL. Mk 1

TYPE: Multisensor surveillance twin-turboprop.

PROGRAMME: Marketing experience with BN2T Defenders revealed that many military and government agencies expressed need for greater payload; announced 1994; prototype (G-SURV) made first flight 17 August 1994; public launch at Farnborough Air Show September 1994; CAA certification achieved 13 November 1995; CAA transport (passenger) certification 4 April 1996.

Britten-Norman and Orenda Recip Inc of Canada announced in September 1999 joint study to re-engine Defender with Orenda OE600 V-8 piston engines, resulting in improved performance and efficiency. Projected specification includes maximum T-O weight 4,241 kg (9,350 lb), maximum cruising speed 176 kt (326 km/h 202 mph) and maximum rate of climb 366 m (1,200 ft)/min. However, engine programme was abandoned.

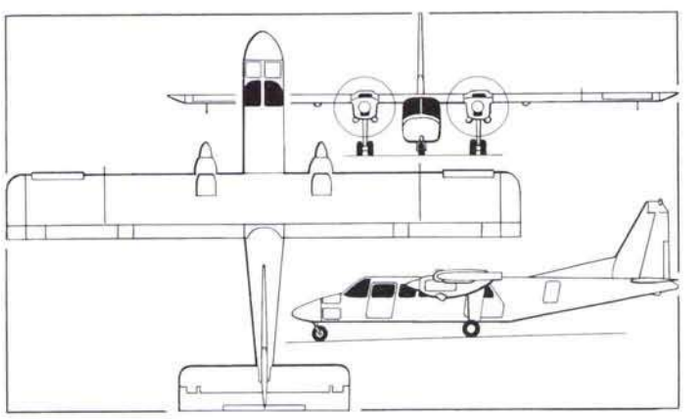
CURRENT VERSIONS: **BN2T-4S Defender 4000:** Standard version, *as described.*

National Defender: Derivative version of Defender 4000 optimised for homeland defence role; features include increased sensor payload of 1,587 kg (3,499 lb).

CUSTOMERS: Seven aircraft registered to manufacturer in April 1996. Irish Ministry of Justice took delivery of one on 14 August 1997; aircraft is operated by the Irish Air Corps at Baldonnel, Dublin, on behalf of the Garda Siochana (National Police), and is equipped with a comprehensive suite of law enforcement communications equipment, thermal imager and observers' removable consoles. Sabah Air of Malaysia took delivery of one in November 1997; primarily equipped for aerial photographic work, with quick-change facility to 12-passenger transport. Police Aviation Services UK took delivery of a single (ex-

BN2T Islander equipped as demonstrator for Selex ATOS airborne tactical and observation system which is being promoted for installation in Defender 4000 *(Paul Jackson)* 1159150

BNG Defender AL. Mk 1 of Army Air Corps 1158852



BNG BN2T-4S Defender 4000 *(James Goulding)* 1158783

demonstrator) example in November 1998, this later (2002) passed to Atlantic Air Transport, Coventry, for operation on behalf of the National Environmental Research council. Hampshire Police Authority took delivery of one (G-SJCH, named *Sir John Charles Hoddinott*) on 26 February 2001 for service with its Lee-on-Solent-based Air Support Unit, replacing a BN2B Islander. Greater Manchester Police ordered one (G-GMPB) on 15 January 2002, delivery of which was achieved on 2 July 2002. In March 2004, Army Air Corps purchased three (including prototype) for surveillance operations, first being delivered on 5 October 2004 and last on 29 April 2005; aircraft equip 651 Squadron, formed at RAF Odiham in April 2006, and operate regularly overseas, including Iraq. In mid-2006, two were at Basrah, Iraq, and one at Odiham.

COSTS: GBP2.5 million (2002). Direct operating cost USD220.90 per hour in 'surveillance' role (900-1,000 hours per year utilisation and 0.90 mmh/th).

DESIGN FEATURES: As for Islander, but with enlarged wing, based on that of Trislander, although retaining original control surfaces; compared with BN2T, has tailplane and elevator of increased span; modified fin with larger fillet; fuselage stretched by means of 0.76 m (2 ft 6 in) plug forward of wing to seat up to 16; more powerful engines for greater sortie time and payload capacity; fuselage and landing gear strengthened; flight deck windows deepened for enhanced field of view; redesigned nose and tail unit; rear-sliding door with blister window.

POWER PLANT: Two Rolls-Royce 250-B17F turboprops, each flat rated at 298 kW (400 shp) and driving a three-blade propeller. Internal fuel capacity 1,131 litres (299 US gallons; 249 Imp gallons).

ACCOMMODATION: Flight crew of two on airline-type seats; sliding seat rails permit seat and equipment positioning anywhere within fuselage. Space for two or more consoles and operators in tandem along one side of cabin. Up to 16 troops/passengers in tactical transport role. Certified to carry pilot and 11 passengers, subject to local airworthiness requirements.

SYSTEMS: Electrical system includes two 200 A engine-driven generators. Full de-icing.

AVIONICS: *Comms:* Full range of open or secure voice com radios from UHF, VHF, HF and VHF-FM.

Radar: Modified nose can accommodate 68.5 cm (27 in), 360° rotating antenna for maritime, simple search or weather radar (BAE Systems Seaspray 2000 in prototype Defender 4000).

Flight: Fully integrated autopilot, GPS nav system, integrated with Omega or INS.

Mission: Sensors can include thermal imagers and/or hand-held or podded video or film cameras. Prototype on debut fitted with Agema FLIR under fuselage on starboard side; alternatives could include BAE Systems Titan, L-3 Wescam MX, LEO or FSI Ultraforce. Appropriate radars could include BAE Systems Seaspray, Telephonics RDR 1500RDR1400C or Bendix/King ART2000/2100. Other equipment could include banner/target-towing provisions, and public address systems.

Selex Sensors and Airborne Systems intergrated mission sensor suite (IMSS) available from early 2006.

ARMAMENT: Two hardpoints under each wing, inboard pair stressed for loads of up to 340 kg (750 lb) and outboard pair for up to 159 kg (350 lb) each. Typical weapons include: inboard stations: reconnaissance pods, reconnaissance flares, CS gas canisters, light series canisters, gun pods, rockets, torpedoes, Sea Skua missiles, fuel tanks or flare/chaff dispensers; outboard stations: reconnaissance pods, land/sea rescue packs, marker/smoke bombs, light series canisters, gun pods or rockets.

DIMENSIONS, EXTERNAL: As for BN2B, except:

Wing span	16.15 m (53 ft 0 in)
Wing aspect ratio	8.0
Length overall	12.20 m (40 ft 0½ in)
Height overall	4.36 m (14 ft 3½ in)
Tailplane span	5.31 m (17 ft 5 in)
Wheelbase	4.76 m (15 ft 7½ in)

AREAS:

Wings, gross	32.61 m² (351.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, equipped	2,223 kg (4,900 lb)
Max usable internal fuel	908 kg (2,002 lb)
Payload with max fuel	724 kg (1,598 lb)
Max T-O and landing weight	3,855 kg (8,500 lb)
Max zero-fuel weight	3,765 kg (8,300 lb)
Max wing loading	109.6 kg/m² (22.45 lb/sq ft)
Max power loading	6.46 kg/kW (10.63 lb/shp)

PERFORMANCE:

Max cruising speed: at S/L	154 kt (285 km/h; 177 mph)
at FL100	176 kt (326 km/h; 202 mph)
Transit speed from base to patrol area	160 kt (296 km/h; 184 mph)
Cruising speed at 72% power:	
at FL50	149 kt (276 km/h; 171 mph)
at FL100	160 kt (296 km/h; 184 mph)
Stalling speed, power off:	
flaps up	53 kt (99 km/h; 61 mph) IAS
flaps down	47 kt (87 km/h; 54 mph) IAS
Max rate of climb at S/L	381 m (1,250 ft)/min
Rate of climb at S/L, OEI	61 m (200 ft)/min
Absolute ceiling	7,620 m (25,000 ft)
Absolute ceiling, OEI	3,660 m (12,000 ft)
T-O run	356 m (1,170 ft)
T-O to 15 m (50 ft)	565 m (1,855 ft)
Landing from 15 m (50 ft)	589 m (1,935 ft)
Landing run	308 m (1,015 ft)
Max range on internal fuel:	
with IFR reserves	861 n miles (1,594 km; 990 miles)
with VFR reserves	1,006 n miles (1,863 km; 1,157 miles)
Max endurance on internal fuel	8 h 30 min

BNG DEFENDER 4000 PRODUCTION

C/N	Reg/serial	Date	Operator
4005	G-SURV	17 Aug 94	(Pilatus) Britten-Norman
		19 Oct 98	Police Aviation Services
		02	Atlantic Air Transport
	ZG995	26 Mar 04	Army Air Corps assigned
		5 Oct 04	Army Air Corps delivered
4006	G-SJCH	26 Feb 01	Hampshire Police
4007	(G-BWPM)		not yet completed (reserved as BN2T-4R)
4008	255	15 Aug 97	Garda Siochana (IAC)
4009	9M-TPS	23 Nov 97	Sabah Air
4010	ZG996	26 Mar 04	Army Air Corps assigned
		23 Dec 04	Army Air Corps delivered
4011	G-GMPB	2 Jul 02	Greater Manchester Police
4012	ZG997	26 Mar 04	Army Air Corps assigned
		29 Apr 05	Army Air Corps delivered
4013	(G-BWPW)		not yet completed
4014	(G-BWPX)		not yet completed

Notes: c/n 4001-04 are BN2T-4R; two conversions and two new-build, the last-mentioned completed, but not flown. Built at Bembridge (4005 to 4010) and in Romania (4011 onwards).

CAMERON

CAMERON BALLOONS LTD

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SALES DIRECTORS: Nick Purvis
Jim Howard
MARKETING DIRECTOR: Alan Noble
TECHNICAL DIRECTOR: Tom Sage
OPERATIONS AND PRODUCTION DIRECTORS: Lindsay Sadler
David McGibbon
PUBLIC RELATIONS: Hannah Cameron

Cameron Balloons, formed in 1970 and now part of the Cameron Holdings Group, holds CAA, FAA, French CNT, German Musterzulassungsschein, Canadian, Russian and ANO approved type certificates for its hot-air balloons. It is the world's largest manufacturer of conventional and special-shape balloons and, by early 2005, had produced 5,522 from its main factory in Bristol, of which 376 (built or on order) were special shapes. A sister company in Dexter, Michigan, USA, had produced more than 1,200 by 2002.

Details of Cameron's conventional-shape balloon range are currently available on the company website.

Cameron also designs and produces hot-air airships, being the first company to develop a craft of this type. Current production hot-air airships are predominantly the DP-80, DP-90, AS 105, the slightly more streamlined AS 105GD and the AS-120. Production of these totalled 71 by March 2006, comprising three D-38 type, 25 DP type, 10 D-50 type, 20 D-96 type and 13 AS type, in addition to six earlier DG type helium airships.

EUROPA

EUROPA AIRCRAFT 2004 LTD

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SALES DIRECTOR: John Wheeler
LOGISTICS DIRECTOR: Roger C Bull
COMMERCIAL DIRECTOR: Karen H Ward
TECHNICAL MANAGER: Andrew J Draper

Europa Aircraft company founder Ivan Shaw previously built three Rutan canards before designing Europa for European environment, including operating from grass strips. Don Dykins, formerly British Aerospace Chief Aerodynamicist, defined aerodynamics; Barry Mellers (Chief Designer of Slingsby Aviation Ltd) made structural calculations. In October 2001, company was bought from US parent Liberty Aerospace (which see) by its management and renamed Europa Management (International). Europa was UK distributor for US-built Liberty XL-2.

Europa sales passed the 1,000 mark in late 2003, but on 6 July 2004 Europa Management was placed in receivership with debts of GBP1.3 million. It re-formed on 6 September 2004 as Europa Aircraft (2004), owned by its directors and initially concentrating on support of existing Europa fliers and constructors. By 2005, shipments had restarted of kit aircraft.

EUROPA EUROPA

TYPE: Side-by-side lightplane/motor glider kitbuilt.

PROGRAMME: Design started January 1990; prototype (G-YURO) made first flight 12 September 1992. PFA certification achieved May 1993; produced mainly in kit form under PFA auspices, but two assembled by Europa Aviation in 1994 and further three followed by 1996; first customer-built aircraft (G-OPJK) flown 14 October 1995.

Company announced sale of "1,000th" kit on 24 November 2003, but total represented orders and commitments and believed not yet achieved; in 2004, introduced new ready-to-install cockpit module, said to save at least 200 hours of build time.

CURRENT VERSIONS: **Europa Classic:** Standard aircraft; has options of several types of engine, and monowheel, tailwheel or tricycle landing gear. Superseded by XS.

Europa XS: Improved version introduced June 1997. Features include higher aspect ratio premoulded wings; larger ailerons; enlarged cabin providing additional legroom and seat width; Rotax 912 UL, 912 ULS or turbocharged Rotax 914 UL engine in **Turbo XS**, with new cowlings giving improved cooling, lower drag, increased propeller clearance and better field of view from cockpit; non-steerable tailwheel permitting full rudder deflection during take-off and landing; and supplementary tank holding 35 litres (9.1 US gallons; 7.6 Imp gallons) of usable fuel. Maximum take-off weight increased by 32 kg (70 lb), making it possible to fit a child's seat in the baggage area; maximum speed 174 kt (322 km/h; 200 mph); maximum range more than 869 n miles (1,609 km; 1,000 miles). Prototype (G-EUXS) first flown 21 March 1997; public debut at EAA Convention at Oshkosh July 1997. Trial installation undertaken in 1999 on G-WWWG with 89 kW (120 hp) Wilksch Airmotive WAM 120 three-cylinder Diesel.

PFA approval June 2005 for Hi-Top version, at least three of which (G-OSJN, first flight 7 March 2005; G-TOPK, 29 May 2005; and N284A, 4 June 2005) completed and flown by that time. Otherwise known as Mod 52, this allows up to 5 cm (2 in) extra headroom through incorporation of extension strip along fuselage side and increased size of engine firewall.

Europa motor glider: Alternative long-span glider wings, interchangeable in quoted 5 minutes with standard wings, and featuring trailing-edge airbrakes, maximum extension 60°, inboard of the ailerons, but no flaps; public debut, installed on demonstrator G-ODTI, at PFA International Rally at Cranfield, July 1997; first flight in this configuration on 20 November 1998; production-standard wing, which made public debut at PFA International Rally, July 2000, has winglets and extended span of 14.40 m (47 ft 3 in).

CUSTOMERS: More than 850 kits sold by mid-2006 to customers in 38 countries, of which more than 350 then flown.

COSTS: Airframe kits (XS monowheel) GBP20,795, (XS tri-gear) GBP21,295, (XS motor glider monowheel) GBP32,795, (XS motor glider tri-gear) GBP33,295; engine packages (Rotax 912 UL) GBP8,100, (Rotax 912 ULS) GBP8,940, (Rotax 914 UL) GBP13,345. Motor glider wing retrofit for XS, GBP20,000; accelerated build cockpit module GBP1,875 extra. (All prices 2006).

DESIGN FEATURES: Objectives included low-cost, economical cruise at IAS up to 120 kt (222 km/h; 138 mph) over 500 n miles (926 km; 575 miles), grass field capability, and ability to rig and de-rig quickly for storage in a trailer similar to a shorter version of glider trailer. Rig/de-rig by six pip-pins, two for tail, two for each wing. Quoted kit building time without cockpit module option is 700 hours. Designed to JAR-VLA, stressed for maximum in-flight normal g of 4.3; proof factor of 2.25 used in design instead of the more usual 1.5, because of extensive use of composites materials in primary structure.

Low/mid-wing layout; moderately tapered wings and tailplane; large, sweptback fin and short fuselage.

Aerofoil is laminar flow Dykins design with 12 per cent thickness/chord ratio and 2° 30' washout at tips. Modified Dykins section (15 per cent t/c ratio) on motor glider wings. Wing dihedral 3° (2° 30' on motor glider); no tail dihedral.

Speed Kit introduced in 1999 features outrigger mechanism and wheel fairings and flap hinge fairings for monowheel versions; and wheel, landing gear leg and flap hinge fairings for tricycle version resulting in 9 to 10 kt (17 to 18 km/h; 10 to 11 mph) speed increase for Europa XS.

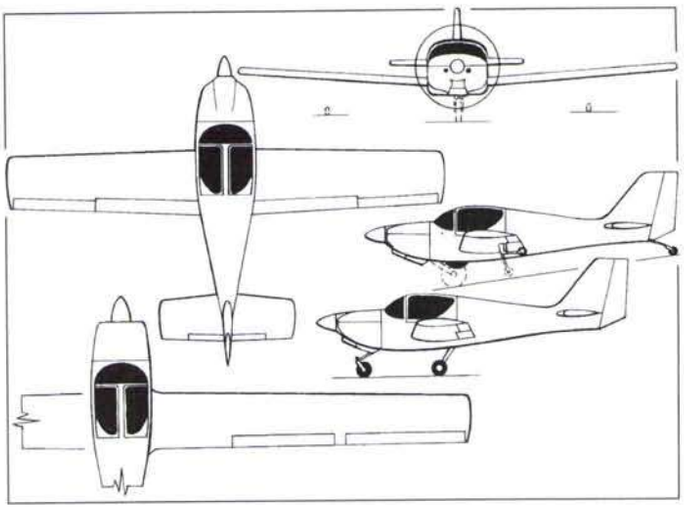
FLYING CONTROLS: Manual. Conventional ailerons and rudder; all-moving tailplane for pitch control with tab geared for balance, under pilot control for trim. Ground-adjustable tabs in ailerons and rudder. Two control columns, one centrally mounted at each seat; two pairs of rudder pedals. Central console between seats has throttle, combined flap and landing gear levers. Pitch trim switch next to throttle. Slotted flaps with settings of 0° and 27°, electrically actuated on tricycle landing gear version.

STRUCTURE: General construction of GFRP.

LANDING GEAR: Monowheel version has large, single, semi-retractable mainwheel, with brake, and steerable tailwheel; outriggers at about half-span mounted on nylon stalks which retract with flaps. Mainwheel uses standard 6 in hub, as in many light aircraft; and an 8.00–6 Tundra tyre. Tricycle landing gear version has fuselage-mounted, fixed, spring steel cantilever legs, castoring nosewheel, and toe brakes on port side rudder pedals; or finger brakes on central tunnel to starboard side of throttle lever. Mainwheel tyre size 5.00-5, nosewheel 4.00–5. Tailwheel landing gear kit offered by Aero Developments of Kemble, UK.

POWER PLANT: One 59.6 kW (79.9 hp) Rotax 912 UL flat-four engine, directly driving a three-blade fixed-pitch Warp Drive propeller; propeller pitch is adjustable on ground to match operating environment (fine pitch for good take-off distances and rate of climb but higher noise and lower cruising speeds; reverse for coarse pitch); alternatively, one 73.5 kW

Europa tri-gear version, built by Brian J Tarmar *(Paul Jackson)* 1158859



Standard (monowheel) version of Europa, with additional side elevation of tricycle option and partial plan view of Europa Motor Glider
(James Goulding) 1158769

(98.6 hp) Rotax 912 ULS or one 84.6 kW (113.4 hp) turbocharged Rotax 914 UL, driving a three-blade variable-pitch NSI or Airmaster propeller. Alternative Subaru/NSI EA81 installation in 73 kW (98 hp) and 88 kW (118 hp) form first flown (G-NDOL) 18 November 1995. MWAE rotary (73 kW; 98 hp), BMW 1100RS (67.1 kW; 90 hp) and 89 kW (120 hp) Wilksch WAM 120 engine installations under development, the first-mentioned installed in UK prototype G-YURO and UK- and US-built tricycle gear demonstrators (G-KITS and N496TG); BMW engine began ground running trials in the third quarter of 1996, Jabiru 3300 offered from 1998.

Normal fuel capacity 68.2 litres (18.0 US gallons; 15.0 Imp gallons); optional 104.6 litres (27.6 US gallons; 23.0 Imp gallons).

ACCOMMODATION: Enclosed cabin seating two side by side under individual upward-opening canopies, hinged on centreline. Baggage compartment at rear of cabin.

SYSTEMS: Hydraulics: mainwheel brake. Electrical: 12 V 30 Ah battery; alternator fit appropriate to engine.

AVIONICS: Customer choice.

DIMENSIONS, EXTERNAL:

Wing span: XS	8.28 m (27 ft 2 in)
motor glider	14.40 m (47 ft 3 in)
Wing chord (XS): at root	1.27 m (4 ft 2 in)
at tip	1.00 m (3 ft 3½ in)
Wing aspect ratio: XS	7.2
motor glider	15.6
Width, wings removed	1.17 m (3 ft 10 in)
Length overall	5.84 m (19 ft 2 in)
Height overall: monowheel	1.32 m (4 ft 4 in)
tricycle	2.13 m (7 ft 0 in)
Tailplane span	2.44 m (8 ft 0 in)
Wheel track (tricycle)	1.83 m (6 ft 0 in)
Wheelbase (tricycle)	1.47 m (4 ft 9¾ in)
Propeller diameter	1.57 m (5 ft 2 in)
Propeller ground clearance: XS	0.39 m (1 ft 3½ in)

DIMENSIONS, INTERNAL:

Cabin: Length: XS	1.83 m (6 ft 0 in)
Max width	1.12 m (3 ft 8 in)
Max height	0.97 m (3 ft 2 in)
Baggage volume: XS	0.64 m³ (22.5 cu ft)

AREAS:

Wings, gross: XS	9.48 m² (102.0 sq ft)
motor glider	13.29 m² (143.0 sq ft)
Ailerons (total): XS	0.62 m² (6.650 sq ft)
Trailing-edge flaps (total)	1.37 m² (14.70 sq ft)
Fin	1.03 m² (11.10 sq ft)
Rudder	0.48 m² (5.20 sq ft)

WEIGHTS AND LOADINGS (standard aircraft unless otherwise stated):

Weight empty, equipped: XS monowheel	340 kg (750 lb)
XS tricycle	354 kg (780 lb)
motor glider	358 kg (790 lb)
Baggage capacity	36 kg (80 lb)
Max T-O and landing weight: XS and motor glider	621 kg (1,370 lb)[1]
Payload with full fuel	197 kg (435 lb)
Max wing loading: XS	65.6 kg/m² (13.43 lb/sq ft)
motor glider	46.8 kg/m² (9.58 lb/sq ft)
Max power loading:	
Rotax 912 ULS	8.46 kg/kW (13.89 lb/hp)
Rotax 914 UL	7.35 kg/kW (12.08 lb/hp)

[1] *657 kg (1,450 lb) permitted in USA only*

PERFORMANCE, POWERED (XS and motor glider with Rotax 912 ULS engine, unless otherwise stated):

Max cruising speed at 75% power:	
Rotax 912 ULS at FL80: monowheel	140 kt (259 km/h; 161 mph)
tricycle	135 kt (250 km/h; 155 mph)
motor glider	130 kt (241 km/h; 150 mph)
Rotax 914 UL at FL100: monowheel	174 kt (322 km/h; 200 mph)
tricycle	166 kt (307 km/h; 191 mph)
Rotax 914 UL at FL175	151 kt (280 km/h; 174 mph)
Econ cruising speed: motor glider	100 kt (185 km/h; 115 mph)
Stalling speed, power off: flaps up	50 kt (92 km/h; 57 mph)
flaps down	45 kt (83 km/h; 51 mph)
Max rate of climb at S/L: Rotax 912 ULS: XS	305 m (1,000 ft)/min
motor glider	335 m (1,100 ft)/min
Rotax 914 UL: XS and motor glider	396 m (1,300 ft)/min
T-O run: Rotax 912 ULS: XS	180 m (590 ft)
motor glider	183 m (600 ft)
Rotax 914 UL: XS and motor glider	153 m (500 ft)
Landing run: all	183 m (600 ft)
Range at econ cruising speed: standard fuel	732 n miles (1,355 km; 842 miles)
optional fuel	1,093 n miles (2,024 km; 1,257 miles)
g limits (all): design	+3.8/−1.9
ultimate: XS	+8.55/−4.27
motor glider	+10.87/−4.27

PERFORMANCE, UNPOWERED (motor glider):

Best glide ratio at 53 kt (98 km/h; 61 mph) IAS	27
Min rate of sink at 47 kt (87 km/h; 52 mph)	1.02 m (3.33 ft)/s

Europa monowheel G-EORJ, built by Philip George *(Paul Jackson)* 1158860

FACL

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Former Farnborough-Aircraft.com (FAC) applied for insolvency protection in first half of 2002; this rejected, but 51 per cent of shareholders voted on 8 July 2002 for restructuring under new company title FACL, as above, and continuation with development of the F1 business turboprop. Reported in late 2004 that major investor Geoffrey Galley had agreed to maintain financing project, enabling completion of prototype in US, where maiden flight achieved July 2006.

Aircraft became joint programme with Gulf Aircraft Maintenance Corporation (GAMCO) in November 2005, when MoU (renewed in late 2006) signed to create Gulf Aircraft Partnership (GAP) to produce aircraft as Kestrel JP100. Description now appears under that heading in International section of *All the World's Aircraft*.

FANWING

FANWING LTD

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FanWing Ltd was incorporated on 3 August 1999 to develop manned and unmanned rotary-wing aircraft of a particularly unorthodox concept. Preliminary designs for the ultralight version have received funding support from the UK government's London Development Agency. With this backing, discussions were being held in March 2006 towards finding major investment and partnership for a first manned prototype.

FANWING ULTRALIGHT

TYPE: Technology demonstrator.

PROGRAMME: Began with small-scale, unmanned model designed in Italy and flown September 1998; several more scale versions subsequently, gradually increasing lifting efficiency and glide ratio; these led to August 2002 development grant from UK Department of Trade and Industry for commercial surveillance UAV version which began flight testing September 2003. Winglets added November 2003 and re-flown at 17.5 kg (38.6 lb) gross weight including 8 kg (17.6 lb) of payload. Subsequent upscaling reached 21 kg (46.3 lb) gross with 12 kg (26.5 lb) payload by June 2004. Plans for 2006-07 included new collaboration on 200 kg (441 lb) UAV to permit heavier payloads including radar and, in a separate development, to optimise VTO capability.

Ultralight is first planned application of FanWing principle to a piloted version. Future applications foreseen include local transport, agricultural sprayer, patrol, ambulance, ground penetrating and surface surveillance, firefighting and other civil and military missions. Principle could also be applied to a medium-size passenger transport or freighter. First stages of final design process involve new simulation project at Imperial College, London. Partnership discussions in progress during early months of 2006.

DESIGN FEATURES: Conventional wing is replaced by a combination of multiblade, backward-rotating cylinders, driven by a centrally mounted engine, immediately ahead of a narrow chord wing. Fan effect of the cylinders draws in air and accelerates it over the trailing-edge, generating lift even when the aircraft is stationary.

Lifting efficiency and performance increase with size, and wind tunnel testing has indicated that a full-sized FanWing could lift up to 2 tons weight with only 74.6 kW (100 hp) of power. Rotor rpm less than 1,000, thus producing low noise. Wing said to be unable to stall; lift declines gradually with forward speed until static lift limit is reached. Narrow chord wing is affected less by turbulence than a conventional wing, enhancing gust resistance. No sharp air flow separation from wing trailing-edge at any stage of the flight envelope. Other attributes include stable low/slow flying speeds and low noise levels.

FLYING CONTROLS: Three fan sections per wing. Leading-edge flaps provide principal aerodynamic control of both lift and thrust; by increasing the blanking effect of these on one wing and reducing them on the other, aircraft will turn without yawing.

Following provisional details apply to the projected Ultralight.

POWER PLANT: Two 22.4 kW (30 hp) piston engines.

ACCOMMODATION: Pilot and one passenger.

DIMENSIONS, EXTERNAL:

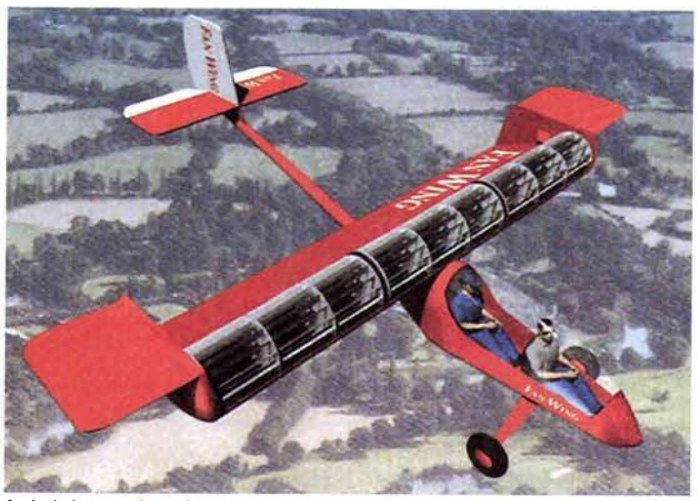
Wing span	10.00 m (32 ft 9¾ in)

WEIGHTS AND LOADINGS:

Weight empty	350 kg (772 lb)

PERFORMANCE (estimated):

Max level speed	55 kt (101 km/h; 63 mph)
Min level speed	20 kt (37 km/h; 23 mph)
Ceiling	6,000 m (19,680 ft)
Endurance	10 h



Artist's impression of FanWing Ultralight *(Jon Linney)* 1129497

LAYZELL

LAYZELL GYROPLANES LTD

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Web: www.layzellgyroplanes.com
DIRECTOR: Gary J Layzell

Mr Layzell formed his company in July 2002 to manufacture autogyro kits and accessories. The company is developing its own design of rotor blade, which will be available for fitment to other craft.

LAYZELL AV-18

TYPE: Single-seat autogyro ultralight kitbuilt.

PROGRAMME: AV-18 incrementally developed from Bensen B-8M Gyrocopter, which built under licence at Membury by Campbell Aircraft from 1960 until 1968, when rights withdrawn; Campbell then adopted version with 1,600 cc VW engine, developed privately by Peter Lovegrove, which first flew as Campbell Cricket in July 1969 and certified 14 November 1969. Following closure of original Campbell company, derivative design marketed since 1984 by Everett Engineering of Ipswich as kitbuilt Everett Gyroplane.

Having produced two further versions of Cricket for personal use, Mr Lovegrove was invited in 1996 by the Popular Flying Association to design Cricket Mk 4 as plans-built version, available from British Gyroplanes of Wallingford, incorporating Rotax engine and other improvements, fully meeting PFA safety requirements. This followed in 2000 by single Mk 5 with 'Cierva-sized' horizontal stabiliser. Mk 6 is plans-built successor to Mk 4.

Prototype AV-18, G-CBWN, built in May 2003 from Cricket Mk 6, incorporating several minor changes—again engineered by Mr Lovegrove—to facilitate mass-production of kits for home assembly. Permit to Fly granted 7 March 2005 following CAA flight testing. Partly enclosed AV-18B produced in 2006.

CURRENT VERSIONS: **AV-18A:** Open version; as prototype.

AV-18B: With protective nosecone.

COSTS: GBP5,800, less engine, rotors, nosecone and instruments (2006).

DESIGN FEATURES: Typical Bensen formula autogyro with two-blade Rotordyne rotor and optional pre-rotation mechanism; low-mounted horizontal stabiliser strut-braced to fin. Meets BCAR Section T standards.

FLYING CONTROLS: Manual. Horn-balanced rudder. Floor-mounted control column.

STRUCTURE: Aluminium alloy tube, plus square section keel; with composites empennage and optional nosecone.

LANDING GEAR: Tricycle type; fixed. Mainwheels mounted on horizontal tube metal Vs, each with damped arm anchored to main engine support. Steerable nosewheel. Auxiliary tailwheel.

POWER PLANT: One 48.0 kW (64.4 hp) Rotax 582 DCDI two-cylinder, liquid-cooled two-stroke driving a GSC Tech III three-blade, ground adjustable pitch wooden propeller. Air-cooled, 37.0 kW (49.6 hp) Rotax 503 option for AV-18B. Fuel tank behind and below seat, capacity 36.0 litres (9.6 US gallons; 8.0 Imp gallons).

DIMENSIONS, EXTERNAL:

Rotor diameter	6.71 m (22 ft 0 in)
Length of fuselage: AV-18A	3.20 m (10 ft 6 in)
AV-18B	3.73 m (12 ft 3 in)
Height overall	2.03 m (6 ft 8 in)
Wheel track	1.68 m (5 ft 6 in)

AREAS:

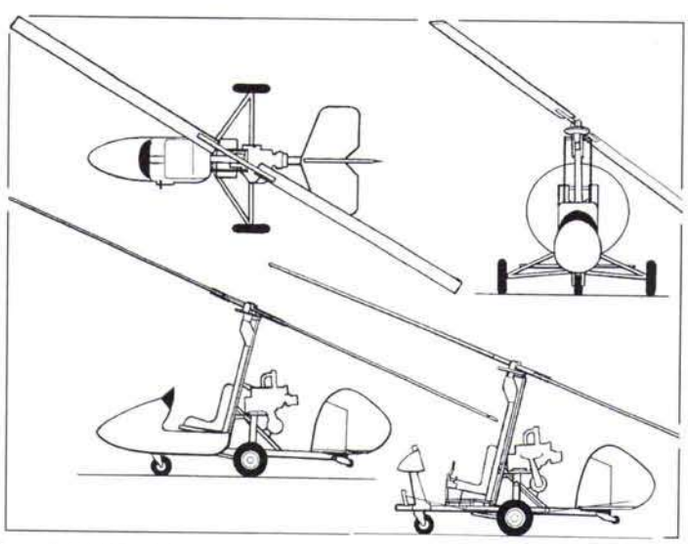
Rotor disc	35.31 m² (380.1 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	141 kg (310 lb)
Max T-O weight	294 kg (650 lb)

PERFORMANCE:

Max rate of climb at S/L	198 m (650 ft)/min



Layzell AV-18B, with additional side view of AV-18A open version *(Paul Jackson)* 1158258

Prototype Layzell AV-18A single-seat autogyro 1180241

MEDWAY

MEDWAY MICROLIGHTS

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DIRECTORS:
Chris Draper
Karen Draper

After two decades of building weight-shift microlights such as Av8r, EclipseR and HybredR with its own Raven Rogallo wing, UK's oldest approved microlight manufacturer added its first three-axis aircraft in 2006.

MEDWAY SLA100 EXECUTIVE

TYPE: Side-by-side ultralight.

PROGRAMME: Prototype (G-CCJJ) registered in August 2003 and made unannounced first flight about same time. Further two development/demonstrator aircraft flown early 2006 before public unveiling at International Microlight Exhibition, Popam, Hampshire, on 29-30 April 2006.

COSTS: GBP28,995 including tax with Rotax 912 UL; GBP1,000 extra for Rotax 912 ULS (2006).

DESIGN FEATURES: High, constant-chord wing braced to lower longerons by streamlined V-struts and auxiliary struts. Sweptback fin with full-height rudder; empennage mutually braced by wires.

FLYING CONTROLS: Conventional and manual. Flaps. Actuation by cables; electrically operated pushrods for flaps. Flight-adjustable tab on port elevator.

STRUCTURE: Bolted tubular aluminium with laced Dacron covering for all surfaces, except composites forward of windscreen.

LANDING GEAR: Tricycle type; fixed. Twin Vs (forward strut streamlined; aft tubular) hinged on centreline, plus oleo-damped tubular leg attached to lower longerons, each side. Forward-canted, steerable cantilever nosewheel leg. Mainwheels 3.50-6; nosewheel 5.50-6. Hydraulic brakes. Optional mainwheel fairings.

POWER PLANT: One liquid-cooled Rotax flat-four driving a three-blade, ground adjustable pitch propeller: 59.6 kW (79.9 hp) Rotax 912 UL; or 73.5 kW (98.6 hp) Rotax 912 ULS. Fuel behind seats: capacity 100 litres (26.4 US gallons; 22.0 Imp gallons) when flown solo; 20 litres (5.3 US gallons; 4.4 Imp gallons) with two crew.

DIMENSIONS, EXTERNAL:
Wing span ..... 9.69 m (31 ft 9½ in)
Length overall ..... 5.71 m (18 ft 9 in)
Height overall ..... 2.26 m (7 ft 5 in)
DIMENSIONS, INTERNAL:
Cabin max width ..... 1.19 m (3 ft 10¾ in)
WEIGHTS AND LOADINGS:
Max T-O weight ..... 450 kg (992 lb)
PERFORMANCE:
Never-exceed speed (VNE) ..... 107 kt (200 km/h; 124 mph)
Max level speed ..... 82 kt (153 km/h; 95 mph)
Cruising speed at 4,800 rpm ..... 70 kt (129 km/h; 80 mph)
Stalling speed, flaps down ..... 33 kt (60 km/h; 37 mph)
Max rate of climb at S/L ..... 259 m (850 ft)/min

Medway SLA100 Executive at the type's public announcement, Popham, 29 April 2006 *(Paul Jackson)* 0581615

NEWGEN

NEWGEN ROTORCRAFT LTD

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Web: www.flygyro.co.uk
DIRECTOR: Malcolm Reid
MANAGING DIRECTOR: Martin Deady

NewGen was established in November 2001, as a private company, by Martin Deady, former Chief Mechanical Systems Engineer at Westland Helicopters. Company's function is to design, certify and produce an autogyro which it terms a continuous autorotation light aircraft–very light gyroplane: CARLA VLG.

Prototype NewGen CARLA-VLG at its public debut in April 2006 1158274

NEWGEN CARLA

TYPE: Two-seat autogyro.

PROGRAMME: Promotional mockup, based on fuselage of G-WOLV (a standard Ikarus C42 FB100 aeroplane supplied by UK importers Aerosport Ltd of Wolverhampton), exhibited, at London Air Show, 21 to 23 April 2006 (and subsequently returned to aeroplane configuration). By mid-2006, CARLA concept had passed technical and marketing assessment by UK Department of Trade & Industry. Development continues.

DESIGN FEATURES: Intended to fill a market niche and offer improved operating envelope when compared with teetering, two-blade autogyros; this is combined with purchase and operating costs similar to those near the upper end of volume-production motorcars. Unique rotor design to provide safe flight in a wide range of conditions, notably gusts and unexpected manoeuvres; offers unstallable flight and handling characteristics with symmetric, non-coupled control, similar to aeroplane. Jump start and vertical landing.

Four-blade rotor designed by NewGen and with NACA 8-H12 aerofoil section, mounted on rotor mast attached to otherwise conventional C42 B fuselage.

FLYING CONTROLS: Manual. Include conventional rudder and elevators.

STRUCTURE: As Ikarus C42.

LANDING GEAR: As Ikarus C42.

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS flat-four driving a three-blade, nose-mounted propeller.
ACCOMMODATION: Two persons, side by side.
DIMENSIONS, EXTERNAL:
Rotor diameter ..... 8.00 m (26 ft 3 in)
Fuselage: Length ..... 7.00 m (22 ft 11½ in)
Max width ..... 1.40 m (4 ft 7 in)
WEIGHTS AND LOADINGS:
Disposable load ..... 250 kg (551 lb)
PERFORMANCE (estimated):
Max level speed ..... 100 kt (185 km/h; 115 mph)
Normal cruising speed ..... 80 kt (148 km/h; 92 mph)
Min cruising speed ..... 18 kt (34 km/h; 21 mph)
Range ..... 350 n miles (648 km; 402 miles)

REALITY

REALITY AIRCRAFT LTD

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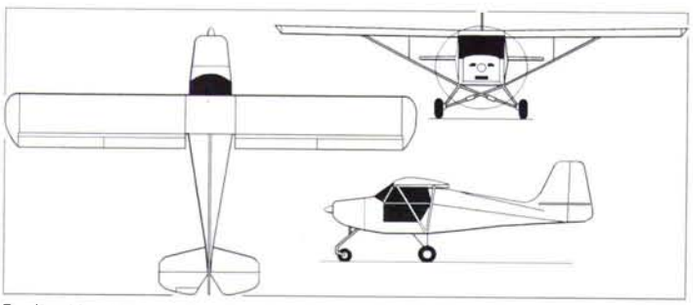
Web: www.realityaircraft.com
MANAGING DIRECTOR: Terry Francis
MARKETING DIRECTOR: Tom Lafferty
DIRECTOR: Kate Mather

Reality previously marketed the Easy Raider, for which it has world rights, except in the USA, but is now concerntrating on the new (2003) Escapade. By mid-2006, six Easy Raiders flying and further five under construction. US partner, Just Aircraft LLC, developed the Escapade for which it previously supplied components to the UK until indigenous sourcing was achieved in 2005. A related aircraft, the Just Summit, is marketed only in the USA.

Completions of Reality Easy Raiders continue, although kit manufacture has ended *(Paul Jackson)* 1159071

Reality (Just Plane) Escapade nosewheel version in UK ownership *(Paul Jackson)* 1159072



Reality (Just) Escapade side-by-side kitplane *(Paul Jackson)* 1128972

REALITY (JUST PLANE) ESCAPADE

TYPE: Side-by-side ultralight kitbuilt.
PROGRAMME: US prototype, built by Just Aircraft LLC of Caldwell, Iadho, first flew (N116JA, Rotax engine) 22 February 2003 and made its public debut at Sun 'n' Fun, Lakeland, Florida, 2 to 8 April 2003; UK prototype (G-ESCA, Jabiru engine) followed on 2 June 2003, with debut at PFA International Rally, Kemble, 11 to 13 July 2003. G-ESCA awarded UK Permit to Fly on 18 September 2003. Grand Champion lightplane at Sun 'n' Fun 2004. VLA version with 500 kg (1,102 lb) MTOW under construction in mid-2005.
CURRENT VERSIONS: **Escapade:** *As described.*
Highlander: Introduced 2004; 20 cm (8 in) taller, square-cornered fin; and additional 89 cm (2 ft 11 in) wing span and 1.18 m² (12.75 sq ft) area to maintain stalling speed. 'Bush plane' featuring enlarged, horn-balanced elevator, horn-balanced rudder and associated trim tab; vortex generators along full span of wing leading-edge upper surface; extended, strengthened landing gear with 8.50-6 tundra tyres and brakes; Rotax 912 ULS engine; and gull-wing, flight-openable doors. First aircraft, N8056A, built from 13th Escapade kit. Not being marketed in UK; suitable for US LSA or Experimental class. Weight empty 272 kg (600 lb); MTOW 598 kg (1,320 lb).
CUSTOMERS: By mid-2006, 11 flying and 15 more under construction in UK. Further 85 sold in US and elsewhere for total of some 110 kits (at least 14 Highlanders) delivered by early 2006.
COSTS: Kit, excluding engine and instruments: tailwheel version GBP18,500; nosewheel version plus USD950; Highlander USD21,500; all plus tax (2006).
DESIGN FEATURES: Baseline requirements included wide, dual control cockpit, nose- or tailwheel options, high commonality with Easy Raider, wide C of G range, 70 kt cruise and 35 kt, stall and wide range of alternative engines.
Fuselage similar to Skystar Kitfox Lite², but with slight stretch and several detail improvements, married to wing of Reality Easy Raider. Wing braced by V struts; Hoerner wingtips; wire-braced empennage. Conforms to BCAR Section S.
FLYING CONTROLS: Conventional and manual. Cable actuation. Flight-adjustable tab in port elevator. Flaps; maximum deflection 40°. Optional electric elevator trim.
STRUCTURE: Chromoloy 4130 steel tube fuselage with fabric covering and composites engine cowling and aluminium turtledeck. Wing as for Easy Raider, with aluminium trailing edges and glass fibre leading edges to flaps and ailerons.
LANDING GEAR: Fixed; tricycle or tailwheel type. Two faired-in side Vs attached to lower longerons, plus half-axles, each with bungee cord shock-absorber, attached to compression frame. Mainwheels typically 6.00–6; solid, steerable Matco tailwheel or castoring nosewheel. Optional hydraulic disc brakes. Version with steerable nosewheel is planned.
POWER PLANT: Options include 37.0 kW (49.6 hp) Rotax 503 driving a three-blade Powerfin composites propeller; 73.5 kW (98.6 hp) Rotax 912 ULS; 59.6 kW (79.9 hp) Rotax 912 UL with two-blade Powerfin propeller; and 59.7 kW (80 hp) Jabiru 2200 with two-blade Powerfin or Newton wood propeller; and 89 kW (120 hp) Jabiru 3300. Usable fuel capacity 72 litres (19.0 US gallons; 15.8 Imp gallons).

Just Plane Highlander US Experimental/LSA version *(Paul Jackson)* 1159073

DIMENSIONS, EXTERNAL:
- Wing span ... 8.69 m (28 ft 6 in)
- Width, wings folded ... 2.42 m (7 ft 11½ in)
- Length excl propeller ... 5.79 m (19 ft 0 in)
- Height overall: tailwheel ... 1.75 m (5 ft 9 in)
- nosewheel ... 2.18 m (7 ft 2 in)

DIMENSIONS, INTERNAL:
- Cockpit max width ... 1.12 m (3 ft 8 in)

AREAS:
- Wings, gross ... 10.03 m² (108.0 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty (Rotax 912) ... 255 kg (562 lb)
- Max T-O weight: in UK ... 450 kg (992 lb)
- in USA ... 558 kg (1,232 lb)

PERFORMANCE (Rotax 912 at US MTOW):
- Normal cruising speed ... 80 kt (148 km/h; 92 mph)
- Stalling speed, power off, flaps down ... 23 kt (43 km/h; 27 mph)
- Max rate of climb at S/L ... 268 m (880 ft)/min
- T-O and landing run ... 92 m (300 ft)
- g limits ... +4/−2

SKYCAT

SKYCAT GROUP

No 2 Hangar, Cardington Field, Shortstown, Bedford MK42 0TJ
Web: www.skycatgroup.com (reserved)
CEO: Egidio Di Lorenzo
TECHNICAL DIRECTOR: Roger Munk

ATG became the trading name, from June 2000, of Airship Technologies Services Ltd, which was created in February 1996 to revive the activities of the former Airship Industries company, responsible for the British-designed Skyship 500/600 series. On 26 July 2005, ATG went into administration under Part II of the Insolvency Act of 1986 to allow the company, which had received about GBP30 million in investment since 1996, time to refinance and restructure, possibly under new ownership. Purchase by a British-Italian consortium was duly announced on 1 June 2006, with ATG financially restructured under the new name SkyCat Group for a purchase price of GBP1 million plus a percentage of any profits made during the first eight years. It will be staffed by personnel from both countries: former ATG investors and management from the UK, plus aerospace management personnel (including the new CEO) from Finmeccanica and other Italian industry sources. Activity continues to be based at the former ATG facility in Cardington, UK.

Current work will continue to be directed towards new concepts in lighter-than-air design: SkyCat, a hybrid air vehicle, and StratSat, a stratospheric telecommunications platform. SkyCat has a fully amphibious design incorporating a sophisticated lifting body, ellipsoidal cross-section hull and a catamaran hover cushion landing system which equips it to land on a grass field, a swamp, sand, snow or open sea.

In March 2002, ATG had announced the first flight of its AT-10 airship, intended for advertising work, as a camera platform, and for surveillance and pilot training applications. The AT-10, SkyCat 20 and StratSat were all designed to be powered by ATG diesel engines ranging from 74.6 to 447 kW (100 to 600 hp). Of these, the 100 hp engine was ready for limited production in early 2004, the first series example completing its CAA acceptance test on 15 January. At that time the 600 hp engine had reached prototype completion and testing status. In late 2002, ATG announced receipt of a contract from Japanese engine maker IHI for a propulsion system for a low-altitude flight test airship, an initial stage in Japan's programme to develop an unmanned airship-based stratospheric telecommunications and surveillance system. This propulsion system had been delivered and tested by early 2004.

SKYCAT AT-10

TYPE: Helium non-rigid airship.

PROGRAMME: Prototype registered G-OATG in November 2001; made first flight 28 March 2002. Phase 2 flight testing completed by July 2003; C of A (Airship Special Category) awarded 4 March 2004; more than 125 hours accumulated by July 2005.

CUSTOMERS: First sale announced in May 2001, to Chinese operator for advertising and police surveillance duties in Shanghai area. This airship only partially completed by July 2005.

DESIGN FEATURES: Commercial airship with capability for advertising and camera platform use and for other applications such as pilot training. X configuration tailfins.

FLYING CONTROLS: Split-channel, optically signalled flight control system incorporating sidestick controllers, powered flight actuators and an Ada control system interface; provision for autopilot. Single ballonet centrally located over gondola for envelope pressure control.

STRUCTURE: Envelope of laminated translucent fabric with external catenary collar system supporting gondola. Provision for internal mercury illumination system.

LANDING GEAR: Non-retractable bicycle type, coil-sprung with oleo damping; twin wheels on each unit.

POWER PLANT: Two 74.6 kW (100 hp) (59.7 kW; 80 hp maximum continuous) A-Tech 100 horizontally opposed, two-stroke, direct injection Diesel engines with vectorable-thrust ducted propellers. Supercharged induction system.

ACCOMMODATION: One or two pilot stations with sidestick controls; four or five passenger seats on multiple tracks; large flight deck and passenger cabin transparencies; large passenger door on port side. Rear of gondola contains lavatory, ballonet air system, pneumatics, electrical services and cabin heater.

SYSTEMS: Low-pressure pneumatic system to power flight control actuators and provide low susceptibility to lightning strike and electromagnetic interference. Electrical power (28 V DC) from 6 kVA alternator.

DIMENSIONS, EXTERNAL:
- Length overall ... 41.40 m (135 ft 10 in)
- Max diameter ... 10.70 m (35 ft 1¼ in)
- Height overall ... 13.60 m (44 ft 7½ in)

DIMENSIONS, INTERNAL:
- Envelope volume ... 2,500 m³ (88,290 cu ft)
- Gondola: Length ... 4.40 m (14 ft 5¼ in)
- Max width ... 1.52 m (4 ft 11¾ in)
- Width at floor ... 0.83 m (2 ft 8¾ in)
- Min height ... 1.86 m (6 ft 1¼ in)

WEIGHTS AND LOADINGS:
- Max payload ... 740 kg (1,631 lb)

PERFORMANCE (design):
- Max level speed ... 60 kt (111 km/h; 69 mph)
- Cruising speed ... 50 kt (93 km/h; 58 mph)
- Pressure ceiling ... 2,745 m (9,000 ft)
- Max range at 30 kt (56 km/h; 35 mph) ... 1,020 n miles (1,889 km; 1,173 miles)
- Endurance at 30 kt (56 km/h; 35 mph) ... 34 h

SKYCAT SKYCAT

TYPE: Hybrid non-rigid air vehicle.

PROGRAMME: Launched 29 June 2000, with three versions announced; name derived from 'sky catamaran'; numerals in designations indicate payload capacity in tonnes. Preceded by SkyKitten I, a 12.2 m (40 ft) long proof-of-concept prototype; first flight (retrospectively allocated, but did not carry, UK 'B Conditions' registration G-86-01 which eventually applied instead to one-tenth scale StratSat prototype) 28 June 2000; more than 30 short flights, from land and water, by early 2001; bow thruster added. SkyKitten II (13.5 m; 44.3 ft long, envelope volume 145 m³; 5,120 cu ft) is one-seventh scale representation of SkyCat 20; 3.0 kW (4 hp) engines (being test-run in early 2004); retractable hover skirts (to be fitted after first flight); envelope shape identical to SkyCat 20. Shown statically at Paris, June 2001, registered G-86-02.

CURRENT VERSIONS: **SkyCat 20**: Initial operational version. Manufacture under way by mid-2000; not completed by July 2005. Maiden flight now reportedly targeted for late 2008.

SkyCat 220: Second, and larger, operational version (originally 200). Work started on payload module. Industrial partner IAR Brasov (which see under Romania) was due to begin deliveries of major subassemblies in 2001, but these not known to have taken place.

SkyCat 1000: Largest in current range. Subject in 2001 of US Army study contract to assess ultra-heavy-lift potential; completed study delivered to US Army in 2002.

CUSTOMERS: First SkyCat 20 ordered by World SkyCat Ltd of Wytham Abbey, Oxford, UK (tel: +44 1865 72 50 15).

Prototype AT-10 four/five-passenger airship

0589387

SLINGSBY

SLINGSBY AVIATION LIMITED

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Web: www.slingsby.co.uk
CHIEF DESIGNER: David Goddard
SALES DIRECTOR: Steven Boyd

Formerly a subsidiary of ML Holdings, Slingsby was sold to Cobham plc in 1997 and is a component of Chelton Group within that holding. Company specialises in application of composites materials; was previously manufacturer of sailplanes but then concentrated on development and low-rate production of T67 Firefly series of aerobatic training aircraft, for which new orders received in 2001–02 and delivered by February 2003. Slingsby Aviation has site area of 12,220 m² (131,535 sq ft) and workforce of about 130; also has own airfield with 750 m (2,460 ft) reinforced grass runway.

Other activities include design and manufacture of air cushion vehicles and design, development and manufacture of high-performance composites structures for marine and aerospace industries. Supplier to Lockheed Martin of C-130J cockpit interior trim panels in sculptured composites. Other production includes emergency detainment door systems, fast-jet helmets, airframe aerostructures and propeller spinners for Bombardier Dash 8 Q400.

Work for UK MoD includes technical support for RAF Air Cadet gliders and Firefly aircraft.

WARRIOR

WARRIOR (AERO-MARINE) LTD

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MANAGING DIRECTOR: James Labouchere

NORTH AMERICAN OFFICE (WARRIOR (AERO-MARINE INC):
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Tel/Fax: (+1 207) 885 99 20
e-mail: dverrill@centaurseaplane.com
VICE-PRESIDENT AND DIRECTOR: David C Verrill

Company created in 1995 to develop and market Centaur six-seat amphibian; US subsidiary formed in January 2000 to manufacture and promote aircraft in North American market. Funding acquired by March 2002 from private investors (more than USD3 million), Maine Technology Institute (USD500,000) and UK Department of Trade and Industry (GBP450,000/USD640,000). Fresh design and programme review completed in January 2005. Market estimates from independent US authority updated December 2005.

WARRIOR CENTAUR

TYPE: Six-seat amphibian.

PROGRAMME: First design studies 1992; Mk 1 hull design, and first flight by one-fifth scale model, in 1993; Mk 2 hull configuration developed and trialled 1995; dynamically refined (and still current) one-fifth model first flown 1996; cockpit mockup completed 1997; initial funding by Royal Aeronautical Society Handley Page award. Revealed at Farnborough Air Show, September 1998, when development and planning continuing. Funding for construction and testing of full-size prototype secured 1 September 2001. Prototype, manufactured by Warrior in association with Maine Composites Inc, began in December 2001 and was then expected to fly by end of 2003; however, by then postponed to fourth quarter 2004 (not achieved due to withdrawal of funding pledge). Design changes have included new contours on rear fuselage and outer wings, and deletion of wing bracing struts. Fuselage shipped to company's US facility in October 2003 for installation of systems and power plant. Specifications for military and coast guard search and rescue were proposed in March 2004. Certification to FAR 23 anticipated 24 months after first flight, pending finance or partners.

CUSTOMERS: Five orders by March 2002. Production target is 68 in first full year; 172 in second.

COSTS: Expected to be USD600,000 at 2006 prices and rates. Seat-mile cost estimated at 35 per cent less than comparable amphibians.

Following description applies to full-size aircraft:

DESIGN FEATURES: Concepts proven and refined using CATIA software. Objectives of design included low hydrodynamic drag and structural weight, use of composites materials, folding wing, comfortable operation in coastal wave conditions (0.9 to 1.2 m; 3 to 4 ft wave height), competitive seat-mile costs and payload-range performance, safety, saline impermeability and access to all areas frequented by boats.

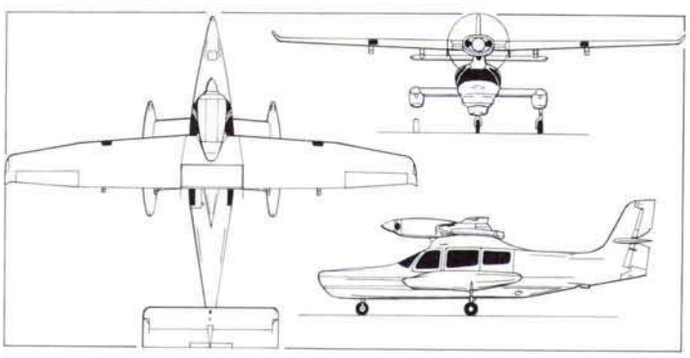
Slender boat hull without planing step improves rough-water ride and increases aerodynamic efficiency; parasol-mounted high-lift wing with centrally installed engine nacelle; stub-wing/sponsons with end-mounted floats; conventional tail surfaces. Main panels of wing fold back manually (optionally hydraulically) to within beamwidth of sponsons to permit docking in standard 12 m (40 ft) yacht berths.

FLYING CONTROLS: Conventional and manual. Electrohydraulically actuated, slotted trailing-edge flaps.

STRUCTURE: Composites construction (carbon and glass fibres). Top surfaces of stub-wings laminated with energy absorbent tread; door sills reinforced with stainless steel.

LANDING GEAR: Electrohydraulically retractable tricycle type in amphibian, nosewheel retracting rearward, mainwheels outward into sponson tip-floats. Landing gear can be omitted in 'pure' seaplane version, with corresponding increase in payload. Stern-mounted 7 kW (9 hp) water-jet for manoeuvring in marine environment.

Gull UAV, based on Centaur technology *(Jane's/Patrick Allen)* 1149548



General arrangement of the Warrior Centaur amphibian *(James Goulding)* 0526455

POWER PLANT: One 224 kW (300 hp) Textron Lycoming IO-540-C or 261 kW (350 hp) IO-540-J2B flat-six engine; three-blade, constant-speed, variable-pitch propeller. Further plans include 410 kW (550 shp) PT6A-powered turboprop version. One fuel tank in each sponson: see under Weights and Loadings for details.

ACCOMMODATION: Pilot and one passenger in cockpit; five passenger seats in flying-boat cabin, four in amphibian (forward-facing or club layout). Baggage compartment behind seats. Three doors on port side; two on starboard.

SYSTEMS: Electrically driven hydraulic actuation of wing folding (optional), landing gear (optional) and flaps. Electrical systems powered by 28 V DC alternator and 24 V lead-acid batteries. Air conditioning optional.

AVIONICS: Honeywell APEX 1000 standard; marine HF radio, two-axis autopilot and bow-mounted weather radar.

DIMENSIONS, EXTERNAL:

Wing span	13.65 m (44 ft 9½ in)
Width over sponsons	4.54 m (14 ft 10¾ in)
Length overall	11.15 m (36 ft 7 in)
Height overall, on land	3.78 m (12 ft 4¾ in)
Wheel track	4.09 m (13 ft 5 in)

DIMENSIONS, INTERNAL:

Cabin, excl cockpit: Length	3.81 m (12 ft 6 in)
Max internal load length	4.27 m (14 ft 0 in)
Max width	1.37 m (4 ft 6 in)
Max height	1.22 m (4 ft 0 in)
Volume	3.74 m³ (132 cu ft)
Baggage compartment volume	1.59 m³ (56 cu ft)

WEIGHTS AND LOADINGS (A: 300 hp, B: 350 hp engine):

Weight empty: A	1,207 kg (2,661 lb)
B	1,274 kg (2,809 lb)
Baggage capacity	90 kg (200 lb)
Fuel weight: max	354 kg (780 lb)
with max payload	68 kg (150 lb)
Payload: max:	
amphibian	641 kg (1,414 lb)
flying-boat	718 kg (1,583 lb)
with max fuel	264 kg (583 lb)
Max T-O weight from water: A	1,920 kg (4,232 lb)
B	2,100 kg (4,629 lb)

PERFORMANCE (estimated, A and B as above):

Cruising speed:	
at max cruise power at FL50, 75% MTOW: A	127 kt (235 km/h; 146 mph)
B	149 kt (276 km/h; 171 mph)
at recommended cruise power at S/L: A	119 kt (220 km/h; 137 mph)
Stalling speed, power off:	
flaps up: A	51 kt (95 km/h; 59 mph)
flaps down: A	46 kt (86 km/h; 53 mph)
B	48 kt (89 km/h; 56 mph)
Time to FL100: at max cruise power: A	13 min 24 s
B	11 min
T-O run: on water: A	173 m (569 ft)
T-O to 15 m (50 ft): on land: A	286 m (940 ft)
B	289 m (950 ft)
on water: A	362 m (1,190 ft)
B	365 m (1,200 ft)
Landing from 15 m (50 ft) at 1,700 kg (3,748 lb):	
on land: A	348 m (1,140 ft)
Range at max cruising speed, VFR reserves: with max payload:	
A	150 n miles (278 km; 172 miles)
with 545 kg (1,202 lb) (amphibian) or 615 kg (1,356 lb) payload (seaplane):	
A	552 n miles (1,022 km; 635 miles)
B	595 n miles (1,101 km; 684 miles)
with 340 kg (750 lb) payload:	
A and B	1,200 n miles (2,222 km; 1,380 miles)

United States

AAI

AMERICAN AUTOGYRO INC

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Web: www.americanautogyro.com

SALES OFFICE:
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Tel: (+1 801) 973 01 77
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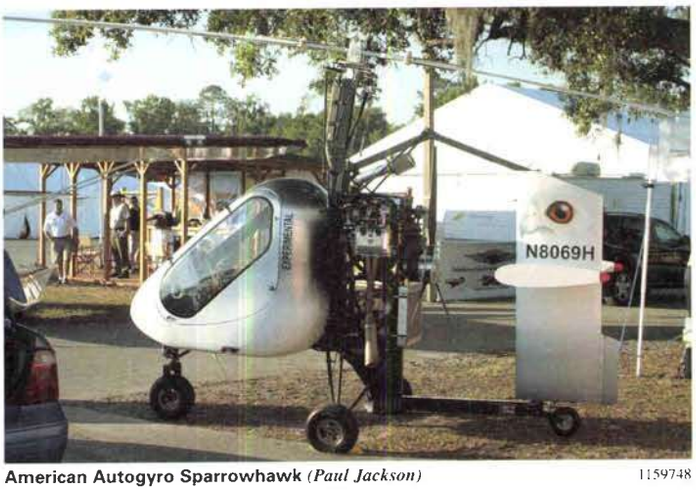
The company was formed in December 2002, as a division of Groen Brothers Aviation, designer and builder of larger autogyros, but was merged back into Groen Brothers Aviation on 1 November 2004. AAI's initial objective has been to develop stability augmentation and other safety features for existing autogyros; in February 2003, it began design of its own Sparrowhawk autogyro.



American Autogyro Sparrowhawk *(Paul Jackson)* 1159748

AMERICAN AUTOGYRO SPARROWHAWK

TYPE: Two-seat autogyro ultralight/kitbuilt.

PROGRAMME: Following incremental development on several testbeds, launched at AirVenture, Oshkosh, July 2003, when proof-of-concept vehicle N974J (flown February 2003) was displayed. Kit deliveries then scheduled to begin in late 2003, although stability augmentation kits for gyrocopters already flying were available from April 2003. Factory-complete aircraft also available; law enforcement/aerial patrol conversion (EJ22 engine) (N8069H) first flew in third quarter of 2003.

AAI-built production (N4132R) prototype first flown 25 February 2004. By April 2004, over 1,000 flight hours had been accumulated by the various prototypes; first customer-built kit first flown (in Russia) 23 September 2004.

CURRENT VERSIONS: **Sparrowhawk I:** Initial version, now superseded.

Sparrowhawk II: Current model, *as described*. Has wider cabin and simpler build process.

Sparrowhawk APV: Airborne patrol vehicle, designed for law enforcement, surveillance and patrol. As Sparrowhawk II; however doors, heating, navigation lights are standard.

CUSTOMERS: Total of 100 sales by January 2006. Dealers appointed in Australia, the Bahamas, Canada, Costa Rica, Ecuador, India, Philippines, South Africa and South Korea by September 2006.

COSTS: Sparrowhawk kit, USD39,500 (2006); Sparrowhawk APV USD62,384, assembled and typically equipped (2004). Operating cost USD20 per hour (2003).

DESIGN FEATURES: Development aircraft based on RAF 2000 pod, but modified substantially with large all-moving rudder and fixed cruciform horizontal stabiliser with endplates. Rudder/stabiliser intersection in line with propeller boss for optimum dynamic stability, assisted by rudder self-centring springs.

SparrowHawk is unconnected with Canadian RAF company.

FLYING CONTROLS: Dual control sticks for roll and cyclic rotor control; rudder pedals also used for ground steering, in conjunction with differential braking.

STRUCTURE: Aluminium frame with glass fibre pod and honeycomb composites empennage; aluminium keel and mast; tubular steel landing gear; bonded metal rotor blades; carbon composites propeller.

LANDING GEAR: Tricycle type with steerable nosewheel and safety tailwheel; fixed. Cable-operated brakes. All wheels 6.00-6.

POWER PLANT: One reconditioned 119 kW (160 hp) Subaru EJ25 flat-four (new engine in Sparrowhawk APV) driving a two-blade, fixed-pitch, carbon fibre pusher propeller and rotor prerotate drive; dual electronic ignition systems. Fuel capacity 95 litres (25.0 US gallons; 20.8 Imp gallons) of which 87 litres (23.0 US gallons; 19.2 Imp gallons) are usable. Oil capacity 3.3 litres (0.87 US gallons; 0.72 Imp gallons).

AVIONICS: Bendix/King or Micro-Air equipment to customer's choice.

Instrumentation: AMPtronics Skydat LCD instrument displays for all flight, rotor and engine functions.

DIMENSIONS, EXTERNAL:

Rotor diameter	9.14 m (30 ft 0 in)
Rotor blade chord	0.22 m (8½ in)
Fuselage: Length	3.73 m (12 ft 3 in)
Max width (over landing gear)	1.85 m (6 ft 1 in)
Height: overall	3.05 m (10 ft 0 in)
to top of fuselage	1.90 m (6 ft 3 in)
Wheel track	1.68 m (5 ft 6 in)
Wheelbase	1.46 m (4 ft 9½ in)
Doors (each side): Width	0.91 m (3 ft 0 in)
Height to sill	0.84 m (2 ft 9 in)

DIMENSIONS, INTERNAL:

Cabin: Length	1.60 m (5 ft 3 in)
Max height	1.35 m (4 ft 5 in)
Max width: to sills	1.13 m (3 ft 8½ in)
with doors	1.17 m (3 ft 10 in)

AREAS:

Rotor disc	65.64 m² (706.5 sq ft)
Vertical tail	1.07 m² (11.50 sq ft)
Horizontal tail	1.02 m² (11.00 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	386 kg (850 lb)
Max T-O weight	680 kg (1,500 lb)

PERFORMANCE:

Never-exceed speed (VNE)	86 kt (160 km/h; 100 mph)
Max cruising speed	65 kt (121 km/h; 75 mph)
Max rate of climb at S/L	198 m (650 ft)/min)
Service ceiling	3,050 m (10,000 ft)
T-O run	92–153 m (300–500 ft)
T-O to 15 m (50 ft)	305 m (1,000 ft)
Landing from 15 m (50 ft)	92 m (300 ft)
Range at 75% power	245 n miles (453 km; 281 miles)

ABC

AMERICAN BLIMP CORPORATION

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Web: www.lightships.com
MARKETING DIRECTOR: Toby Page

In 1995, ABC announced the design of a series of airships larger than the A-60, designated A-1-50 (marketing designation A-150). These, now also including the A-170, are a refinement of the earlier A-120 conceptual design with a new technology envelope. The civil version incorporates the ABC internal illumination system for advertising and is designated a Lightship; the non-illuminating surveillance version is designated SPECTOR. Lightship envelopes remain translucent for internal illumination, whereas SPECTOR envelopes are opaque. Each is offered in sizes designed to optimise costs with mission requirements. Other structural elements are identical.

The same envelope technology was introduced as an option for production on existing A-60+ Lightships from 1996 (first contract, for seven envelopes to be supplied by ILC Dover, announced 18 March 1996).

On 23 July 2002, ABC announced that it had acquired the Virgin Lightships interests in the former's affiliate The Lightship Group (TLG), following Virgin's decision to exit the commercial airship market. TLG is now a wholly owned ABC subsidiary, and operates ABC airships around the world.

Company recently stated that it is developing airship designs for medium-altitude (2,000 to 3,000 m; 6,560 to 9,840 ft) operation with military and commercial payloads for surveillance and communications relay. It has also, on behalf of the Jet Propulsion Laboratory, been studying the use of a helium airship as a possible vehicle for unmanned exploration of Titan, the largest of Saturn's moons. Named Aerover, the projected airship would be approximately 10 m (33 ft) long, 2.44 m (8 ft) in diameter and weigh about 100 kg (220 lb). No other details of these new designs had emerged by the fourth quarter of 2006.

In 1999, ABC increased its manufacturing area by 30 per cent with a 410 m² (4,400 sq ft) extension at Hillsboro, which now covers almost 2,325 m² (25,000 sq ft). At the same time, a 280 m² (3,000 sq ft) fabrication shop was being readied at the Tillamook flight test centre. By late 2004, ABC's combined fleet of 18 A-60+/A-1-50/A-170 airships had achieved a cumulative total of nearly 200,000 flight hours.

On 21 November 2000, ABC purchased the type certificate (originally issued on 17 November 1992) for the Colt GA 42 non-rigid helium airship. It is believed that three airships of this type were included in the transfer.

ABC LIGHTSHIP A-60+

TYPE: Helium non-rigid airship.

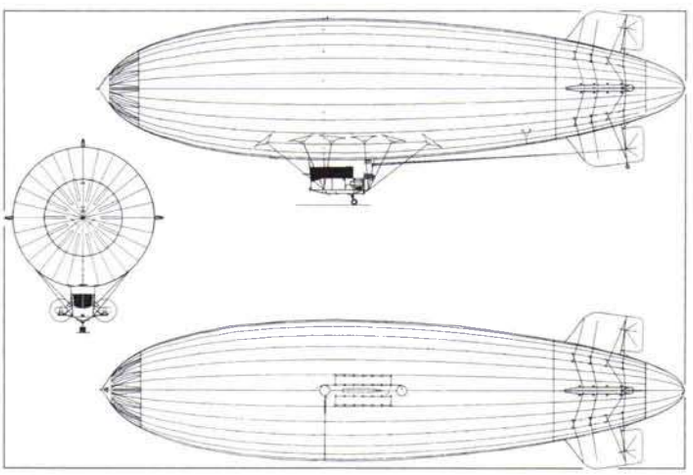
PROGRAMME: A-50 prototype N5132A registered 31 March 1988 and made first flight 9 April 1988; first flight of production A-60 June 1989; A-60 certified by FAA 18 May 1990 for day/night and VFR/IFR flight; first delivery (to Virgin Lightships Ltd) November 1990; A-60+ certified third quarter 1991 by FAA; APU upgrade certified by FAA, and FLIR Systems Inc gyrostabilised IR camera approved by FAA, in 1993; all A-60s converted to A-60+ in 1993. Certified also in Argentina, Australia, Brazil, Canada, Germany, Italy and

A-60+ PRODUCTION AND LOCATION
(at October 2006)

c/n[1]	Identity	Owner	Location
01	N2012P *Snoopy 1*	Icarus Aircraft Inc	US
03	N2017A/I-TIRE *Spirit of Europe* 1/G-TLEL	Lightship Europe	UK
04	N2022B/ZS-ODY/N460LG	Lightship Group	US
05[3]	N560VL *Skeeter*	Virgin Lightships	US
06	N660VL Van Heusen/PK-	Lightship Group	US
07	N760VL *Snoopy* 2/N760AB	Icarus Aircraft Inc	Out of service (US)
08	N860AB	Lightship Group	Out of service (Brazil)
09	N960AB	Beijing Orient	Out of service (US)
010	N3119W/VH-ZIC *Spirit of the South Pacific*/N610LG	Lightship Group	US
011	N11ZP	Lightship Group	Out of service (US)
012	N12ZP *Spirit of Europe 2*/JA12ZP	Virgin Lightships	Japan
014	N614LG/PT-MKJ *Spirit of the Americas*/N614LG	Lightship America	US
015[3]	N615LG	Lightship Group	US
016	N606LG/G-OLEL/China	Lightship Europe	UK
017	N607LG *Horizon*	Icarus Aircraft Inc	US
018	N618LG	Lightship Group	US
019-023	N619LG-N623LG[2]	ABC	US

[1] 02 and 013 not built
[2] Reservations only; not completed by late 2006
[3] Converted to A-60R

Lightship A-60+ advertising airship 0558597



ABC Lightship A-60+ *(Paul Jackson)* 0568971

South Africa; approved for operation in China, Japan and Turkey. Airship 05 reached 10,000 flight hours on 28 October 1999, and two others had achieved this total by February 2000. A Lightship Group two-man British crew in 016/N606LG set a new FAI Class BA absolute world speed record for gas airships on 19 January 2000, reaching 50.11 kt (92.80 km/h; 57.66 mph) over a 1 km course.

One A-60+ loaned by The Lightship Group was used in January 2000 for UK-based flight trials fitted with a DERA (now QinetiQ) Mineseeker ultra-wideband, ground-penetrating radar for detection of undersurface metal and plastics mines. Subsequently, after the addition of a Wescam 16DS-M dual-sensor (daylight TV and FLIR) payload, this airship conducted a six-week programme (4 October to 14 November 2000) from bases in Italy and Kosovo, surveying 30 sites in the latter locality for mines and other unexploded ordnance on behalf of the United Nations Mine Action Co-ordination Centre (UN MACC). As a result of the success of this operation, a Mineseeker Foundation was set up as a joint venture with DERA/QinetiQ which, in April 2001, announced plans to raise GBP10 million to purchase five similarly equipped airships. No such orders had been announced by November 2006.

CURRENT VERSIONS: **A-60:** Initial production version. All since converted to A-60+.

A-60+: Current version from 1991; larger envelope; payload increased by 181 kg (400 lb) compared with A-60; Lightsign message board option from 1992. Also offered in **SPECTOR 19** form (which see).

Description applies to A-60+.

A-60R: Conversion of A-60+ with Rotax engines. Two by 2006 (registered as 'A60R').

CUSTOMERS: Total of 21 registered by 1998 (see table); of these 018 made its first flight 4 August 2000; none further by late 2006, thus 16 completed. 01 badly damaged by storm on 7 September 2001 and may not have been repairable.

DESIGN FEATURES: Conventional-shape envelope; cruciform tail surfaces; gondola suspended by 12 catenary cables each attached to external patches, eliminating need for internal cables, gastight fittings and bellow sleeves. Can be inflated without a net by attaching ballasted gondola before adding helium; gondola can be removed from inflated Lightship without a net by ballasting catenary cables.

FLYING CONTROLS: Single internal ballonet; rudder or elevator on each of four tailfins; primary flight controls for left-hand front seat only.

STRUCTURE: Outer envelope skin of Dacron/Mylar with separate urethane film inner gastight bladder and single ballonet. All structural attachments to sewn outer bag, such as nose mooring, fin base and guy wires, car catenary and handling lines, made with webbing reinforcements sewn directly to envelope.

LANDING GEAR: Single twin-wheel unit beneath gondola; small tailwheel at base of lower vertical fin. Operating area diameter required: 229 m (750 ft).

POWER PLANT: Twin 59.7 kW (80 hp) Limbach L 2000 engines, pusher-mounted to enhance propulsive efficiency and reduce noise. Standard capacity of rear-mounted fuel tank is 280 litres (74.0 US gallons; 61.6 Imp gallons); can be refuelled in the field without mooring.

ACCOMMODATION: Two single seats and rear bench seat in gondola (pilot plus three adult passengers or two adults and two small children.) Ground crew of 13.

SYSTEMS: 28 V 70 A electrical system with two 28 V 35 A alternators. APU capable of delivering 2.5 kW at 110 V certified December 1993 and now standard. Used mainly to power internal illumination lights, but can also be used for other airborne equipment.

EQUIPMENT: Two 1 kW bulbs for internal illumination system. Certified for gyrostabilised TV or IR camera mount, complete with microwave downlink for live broadcast; can be operated simultaneously with APU.

DIMENSIONS, EXTERNAL:

Overall: Length	39.01 m (128 ft 0 in)
Width	10.97 m (36 ft 0 in)
Height	13.41 m (44 ft 0 in)
Envelope: Length	39.01 m (128 ft 0 in)
Max diameter	10.01 m (32 ft 10 in)
Fineness ratio	3.9
Advertising banner areas:	
Each side: Length	27.43 m (90 ft 0 in)
Max depth	6.10 m (20 ft 0 in)
Underside, forward:	
Length	6.10 m (20 ft 0 in)
Width	7.62 m (25 ft 0 in)
Gondola: Length	3.96 m (13 ft 0 in)
Width	1.52 m (5 ft 0 in)
Height (incl landing gear)	2.90 m (9 ft 6 in)
Propeller diameter	1.52 m (5 ft 0 in)

DIMENSIONS, INTERNAL:

Envelope volume	1,926 m³ (68,000 cu ft)
Gondola: Cabin length	2.68 m (8 ft 9½ in)
Cabin height	1.93 m (6 ft 4 in)

AREAS:

Tailfins (four, total)	42.74 m² (460.0 sq ft)

WEIGHTS AND LOADINGS:

Total weight empty	1,393 kg (3,070 lb)
Max buoyancy	1,814 kg (4,000 lb)
Max dynamic lift	113 kg (250 lb)
Max useful lift, ISA at 660 m (2,000 ft)	680 kg (1,500 lb)
Max gross weight	1,993 kg (4,394 lb)

PERFORMANCE:

Max level speed	47 kt (88 km/h; 55 mph)
Cruising speed	28 kt (51 km/h; 32 mph)
Max rate of ascent	488 m (1,600 ft)/min
Service ceiling	2,225 m (7,300 ft)
Max rate of descent	396 m (1,300 ft)/min
Min T-O distance	112 m (366 ft)
Max range at 28 kt (51 km/h; 32 mph)	425 n miles (787 km; 489 miles)
Max endurance at 28 kt (51 km/h; 32 mph)	15 h

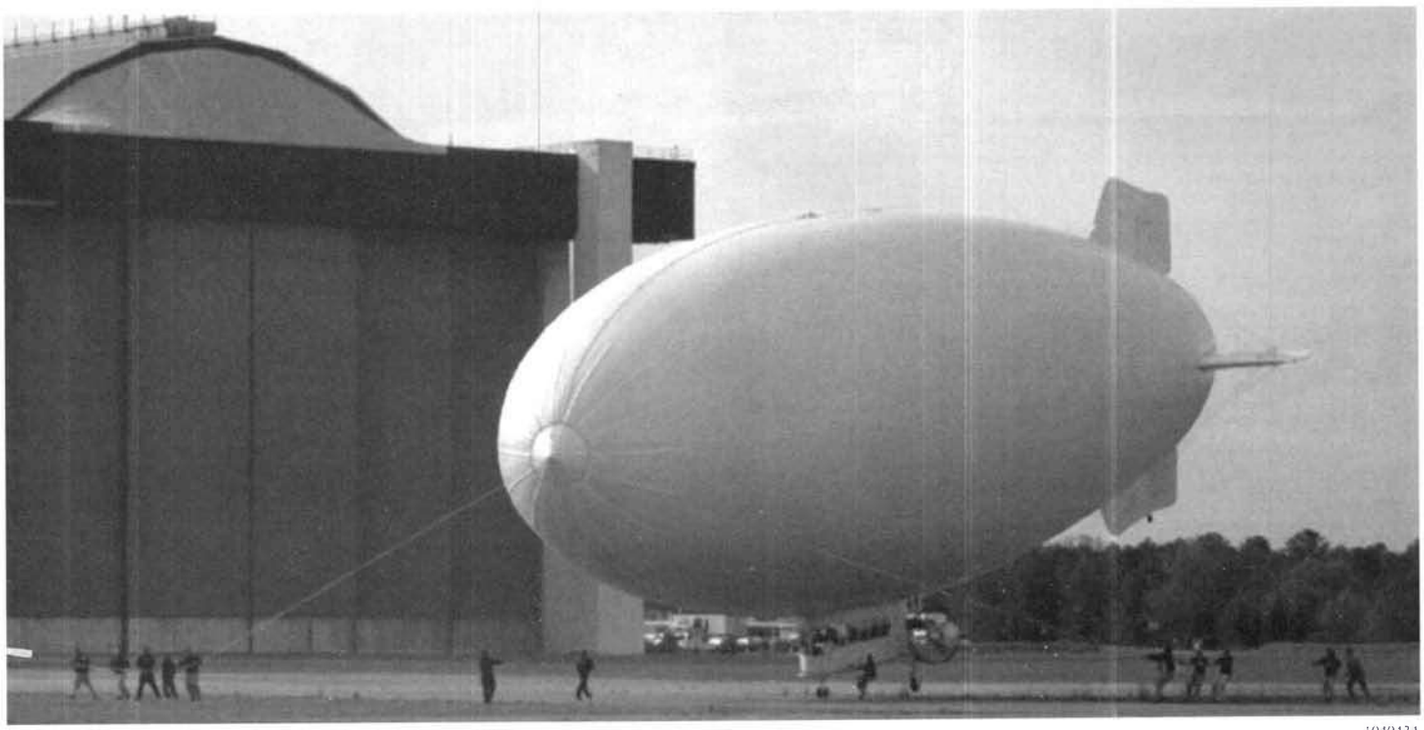
ABC LIGHTSHIP/SPECTOR SERIES

US Navy designation: MZ-3A

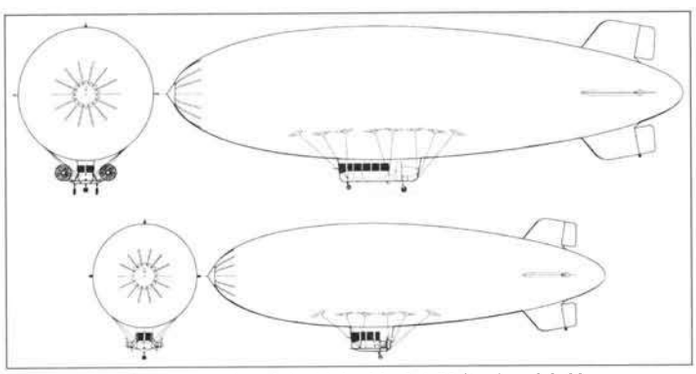
TYPE: Helium non-rigid airships.

PROGRAMME: Three envelope sizes offered for both civil and surveillance versions; SPECTOR name applies to surveillance versions. First to be built, a Lightship A-1-50 (N5132A, c/n 001), made its first flight on 8 January 1997. FAA type certificate issued 3 October 1997, at which time a total of 683 hours had been flown; 10,000-hour milestone passed in early 2004. Marketing designations are A-150 and A-170; designation on Type Certificate and registration documents of current version is A-1-50.

On 13/14 September 2004, an A-150 (N155LG) piloted by Carl Harbuck and Douglas McFadden established (subject to FAI confirmation) a new world class duration record of 24 hours 39 minutes 55 seconds, breaking six classes of endurance record for non-



ABC MZ-3A (A-1-70) being manoeuvred at Lakehurst *(US Navy)* 1040434



Comparative views, to scale, of the Lightship A-1-50 (top) and A-60+ *(Paul Jackson)* 0507571

pressurised gas airships of more than 3,000 m³ (105,950 cu ft) and exceeding the previous record by more than 10 hours. Some 125 litres (33.0 US gallons; 27.5 Imp gallons) of fuel - enough for more than three additional hours' flying - remained at the end of the flight.

CURRENT VERSIONS: **Lightship A-60+/SPECTOR 19:** See A-60+ entry.

Lightship A-1-50/SPECTOR 42: Initial production version; *as described*.

Lightship A-170/SPECTOR 48: First flight 13 May 2004 (N156LG). One completed and two others nearing completion by early November 2004. First example took part in late September and early October 2004, in a week-long joint ABC/ARINC demonstration on behalf of the Joint Land Attack Cruise Missile Defense Elevated Netted Sensor (JLENS) Project Office that included a 24-hour endurance flight over the Pentagon and support of a joint force protection mission. Equipment on board included Rapid Aerostat Initial Deployment System (RAIDS) surveillance cameras and sensors of the type used in support of troops in Afghanistan and Iraq. ARINC has proposed an unmanned version for a similar role.

MZ-3A: One A-170 acquired by US Navy under USD3.5 million contract from Office of Naval Research; operated from NAS Lakehurst, New Jersey (initial test sortie 2 May 2006) as research platform testing sensors and other equipment for use in manned aircraft and UAVs. Designation MZ-3A adopted 17 August 2006.

Lightship A-170 Video Lightsign: Version with 21.34 × 9.14 m (70 × 30 ft) LED screen on envelope, developed by High-Tech Electronic Displays Inc, to display full-colour live video at 128 × 240 pixel resolution. Video is captured by a FLIR Systems Ultramedia camera mounted on the A-170 and sent via a laptop PC to the 408 kg (900 lb), 3.8 cm (1½ in) thick screen. First example leased for 1 year in August 2006 to Australian company G M Holden, following receipt of FAA approval in April 2006. Manufacture of a second example was due to begin in August 2006.

CUSTOMERS: Seven A-1-50s and at least three A-170s completed by November 2006; see table.

COSTS: SPECTOR 42 approximately USD3.5 million (2002).

DESIGN FEATURES: As described for A-60+; larger gondola; also seat tracks for quick reconfiguration of cabin; water ballast trim system.

FLYING CONTROLS: Standard as for A-60+; dual controls and autopilot optional. Trimming with ballonet accomplished by transferring water to the nosecone tank from the main tank in the rear portion of the gondola. Certified for day/night, VFR/IFR, single-pilot operation.

STRUCTURE: Single-walled ILC Dover envelope with single (26 per cent of volume) ballonet; Tedlar outer film plus inner ripstop fabric/helium barrier film laminated material with heat-sealed seams. Envelopes translucent on Lightship versions, opaque for SPECTOR; those for SPECTOR series have carbon black in the material for ease of maintenance. Control surfaces and fins of fabric-covered aluminium; gondola of aluminium and fabric-covered steel tubing.

LANDING GEAR: Non-retractable tricycle type. Spring-damped main units each with single wheel and tyre; slightly raised nose unit with twin wheels/tyres; small tailwheel at base of lower vertical fin. Required operating area diameter: 305 m (1,000 ft).

POWER PLANT: *SPECTOR 42 and 48:* Two 134 kW (180 hp) Textron Lycoming IO-360-B1G6 flat-four engines, each driving an MTV-25-B-C five-blade constant-speed, reversible-pitch tractor propeller. Rear-mounted fuel tank, standard capacity 560 litres (148 US gallons; 123 Imp gallons). Airship can be refuelled in the field without mooring.

ACCOMMODATION: Single seats for pilot and co-pilot (optional) or passenger on flight deck; five single seats and a three-person bench seat in main cabin. Lavatory and galley optional. Door on port side, aft of pilot station; emergency exit opposite on starboard side. Ground crew of 10 to 12.

SYSTEMS: Electrical system is 28 V DC, with two 90 A alternators; additional 2.5 kW/110 V at 60 Hz available from removable APU.

AVIONICS: Primary suite from Bendix/King Silver Crown range, including:

Comms: KY 196 com, KT 76A transponder and KMA 24H audio panel.

Flight: KX 155 nav/com and Apollo 820 GPS receiver.

EQUIPMENT: Two 1 kW bulbs for internal illumination system. Gyrostabilised camera mount, as in A-60+. Gondola hardpoint provisions for external installation of a variety of sensor equipment. Standard seat tracks in main cabin facilitate sensor/electronics rack installations.

DIMENSIONS, EXTERNAL (A: A-1-50/SPECTOR 42, B: A-170/SPECTOR 48):

Overall: Length: A	50.29 m (165 ft 0 in)
B	53.64 m (176 ft 0 in)
Width: A, B	14.02 m (46 ft 0 in)
Height: A, B	16.76 m (55 ft 0 in)
Envelope: Length: A	49.38 m (162 ft 0 in)
B	52.73 m (173 ft 0 in)
Max diameter: A, B	13.11 m (43 ft 0 in)
Fineness ratio: A	3.8
B	4.0
Advertising banner areas:	
Each side: Length	35.97 m (118 ft 0 in)
Max depth	8.53 m (28 ft 0 in)
Underside, forward:	
Length	8.53 m (28 ft 0 in)
Width	9.75 m (32 ft 0 in)
Gondola: Length: A, B	8.08 m (26 ft 6 in)
Max width: A, B	6.25 m (20 ft 6 in)
Max height: A, B	3.35 m (11 ft 0 in)
Propeller diameter: A, B	1.68 m (5 ft 6 in)

DIMENSIONS, INTERNAL:

Envelope volume: A	4,248 m³ (150,000 cu ft)
B	4,814 m³ (170,000 cu ft)

A-1-50 PRODUCTION AND LOCATION
(at October 2004)

c/n	Identity	Owner	Location
101	N151AB	Lightship Group	US
102	N152LG/N151LG *Bud I*/PR-ANA	Lightship Group	Brazil
103	N153LG/TC-AVK	KOC Holdings	Out of service
104	N154ZP	(destroyed 22 May 2004)	
105	N155LG *Trumpasaurus*	Lightship Group	US
106	N156LG	Virgin Lightships	US
107	N157LG	US Navy	US

Ballonet volume: A ..... 1,104 m³ (39,000 cu ft)
B ..... 1,257 m³ (44,387 cu ft)
Gondola:
Cabin overall length:
A, B ..... 4.79 m (15 ft 8½ in)
Main cabin length: A, B ..... 4.27 m (14 ft 0 in)
Average cabin width: A, B ..... 1.52 m (5 ft 0 in)
Cabin height: A, B ..... 1.93 m (6 ft 4 in)
WEIGHTS AND LOADINGS:
Total weight empty: A ..... 2,860 kg (6,305 lb)
B ..... 2,897 kg (6,387 lb)
Max payload: A ..... 663 kg (1,461 lb)
B ..... 993 kg (2,189 lb)
Max buoyancy: A ..... 4,055 kg (8,939 lb)
B ..... 4,595 kg (10,131 lb)
Max dynamic lift: A, B ..... 340 kg (750 lb)
Max useful lift at 656 m (2,000 ft), ISA:
A ..... 1,633 kg (3,600 lb)
B ..... 2,253 kg (4,967 lb)
Max T-O weight: A ..... 4,394 kg (9,689 lb)
B ..... 4,981 kg (10,981 lb)
PERFORMANCE (B: estimated):
Max level speed: A ..... 52 kt (96 km/h; 59 mph)
B ..... 50 kt (92 km/h; 57 mph)
Cruising speed: A ..... 40 kt (74 km/h; 46 mph)
Max single-engine speed: A ..... 33 kt (61 km/h; 38 mph)
B ..... 31 kt (57 km/h; 35 mph)
Max rate of ascent: A, B ..... 488 m (1,600 ft)/min
Max rate of descent: A ..... 488 m (1,600 ft)
B ..... 427 m (1,400 ft)
Service ceiling: A, B ..... 3,050 m (10,000 ft)
Max rate of descent: A ..... 488 m (1,600 ft)/min
Max range at 35 kt (65 km/h; 40 mph):
A ..... 534 n miles (990 km; 615 miles)
B ..... 437 n miles (811 km; 503 miles)
Max endurance at 35 kt (65 km/h; 40 mph):
A, B ..... approx 15 h

ADAM

ADAM AIRCRAFT INDUSTRIES

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VICE-PRESIDENTS:
Richard Boone (Manufacturing and Test Engineering);
Matthew Kull (Operations);
Bill Mermelstein (Propulsion);
Dennis Olcott (Design Engineering);
Mike Smith (Finance);
Tom Wiesner (Flight Operations);
Rob Penrod (Manufacturing);
Joe Wilding (Advanced Development)
CHIEF FINANCIAL OFFICER: Chris Naro

Adam Aircraft Industries formed in 1998 and is building the A500 centreline-thrust twin-engine business aircraft at its 9,848 m² (106,000 sq ft) Englewood and the A700 twin-engined business jet derivative, in a 2,044 m² (22,000 sq ft) facility at Kemp Ogden Airport Gateway Centre, Utah. Additional 3,716 m² (40,000 sq ft) component fabrication plant is located in Pueblo, Colorado. By mid-2000 the workforce numbered 12 but had risen to 72 by October 2001 and 540 by April 2006.

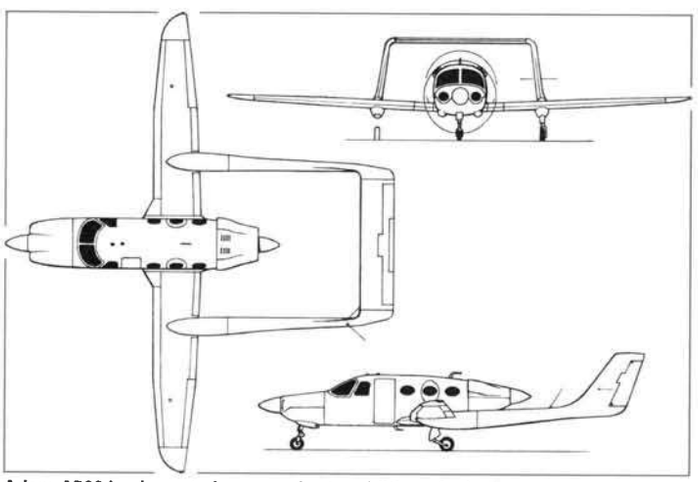
Having designed its own seats for the A500, Adam has begun an auxiliary business as a seat producer to the aerospace industry.

ADAM A500

TYPE: Business twin-prop.

PROGRAMME: Designed by Burt Rutan, with designation M-309 denoting his 309th aircraft design; development started September 1999; proof-of-concept aircraft (N309A), manufactured by Scaled Composites Inc, first flown at Mojave, California, 21 March 2000; formally rolled out 5 April 2000; total of 80 flight hours completed by the time of public debut at EAA AirVenture 2000 at Oshkosh in July 2000 and 155 hours by EAA AirVenture 2001; second aircraft, designated A500, and in proposed production configuration, first flew (N500AX) 11 July 2002 at Centennial Airport, Denver. First production fuselage, completed January 2002, used for promotional display; three conforming production aircraft participating in FAA FAR Pt 23 IFR certification, using FAA's Certification Process Improvement programme including flight into known icing; no carry-forward certification from M-309 trials, and this aircraft had been withdrawn from use by mid-2002. Second A500 prototype (N501AX, first with winglets,) flew 18 February 2003; third prototype (N502AX) flew 12 December 2003; FAA type inspection authorisation received, 30 September 2004; sixth airframe, first destined for customer, rolled out 10 October 2004, becoming N522EA, c/n 005 and delivered to a customer from Colorado Springs on 7 November 2005 during the NBAA Convention in Orlando, followed by delivery of the second customer aircraft, c/n 006, on 5 December 2005; and third, c/n 007, on 25 May 2006. Day VFR certification awarded by FAA on 11 May 2005. Night/IFR, pressurisation, altitude expansion and de-icing approvals achieved 28 September 2006.

CURRENT VERSIONS: **M-309**: Original proof-of-concept model, described in 2002–03 *Jane's*.



Adam A500 business twin-prop prior to addition of winglets *(Michael Badrocke)*

1159115

A500: Production version with changes to wing span, length, flying controls and door positioning; *as described.*

A family of aircraft, ultimately stretched to seat 19 passengers, is planned.

CUSTOMERS: Total 70 sold to private owners by October 2006, plus unspecified number within 276 A500/A700s sold to air taxi and managed/shared fleets.

COSTS: Unit cost USD1.2 million (2005). Direct operating cost USD274/h (2005).

DESIGN FEATURES: Twin-boom configuration with swept fins and high-set tailplane; unswept low wings have dihedral on outboard panels and small winglets. Tractor/pusher power plant simplifies handling with single engine failure.

FLYING CONTROLS: Conventional and manual. Flaperons of M-309 replaced by separate ailerons and Fowler flaps. Trim tab in each aileron (flight adjustable). Full-width elevator with tab and external mass balance. Twin rudders have no tabs. No flaps on proof-of-concept aircraft; production aircraft will have separate flaps.

STRUCTURE: Single-cure graphite carbon composite with no secondary bonds or fasteners. Proof-of-concept aircraft has three-spar main wing spar, but production aircraft will have a single-piece spar, with wing mounted lower than on POC aircraft to minimise spar carry-through in cabin. Wing attached by four bolts to fuselage.

LANDING GEAR: Retractable tricycle type, with single wheel on each unit; trailing link suspension on main units. All wheels retract rearwards; mainwheels 6.00–6, nosewheel 15×6.0–6. Hydraulic brakes.

POWER PLANT: Two 261 kW (350 hp) Teledyne Continental TSIO-550-E flat-six piston engines, with optional TCM/Aerosance FADEC, mounted in centreline thrust configuration and driving a three-blade Hartzell FC7663D-2R scimitar-bladed propeller at the front and a three-blade Hartzell FLC7663DF-2RX at rear. Fuel capacity 946 litres (250 US gallons; 208 Imp gallons) in outer wing tanks of which 871 litres (230 US gallons; 192 Imp gallons) are usable.

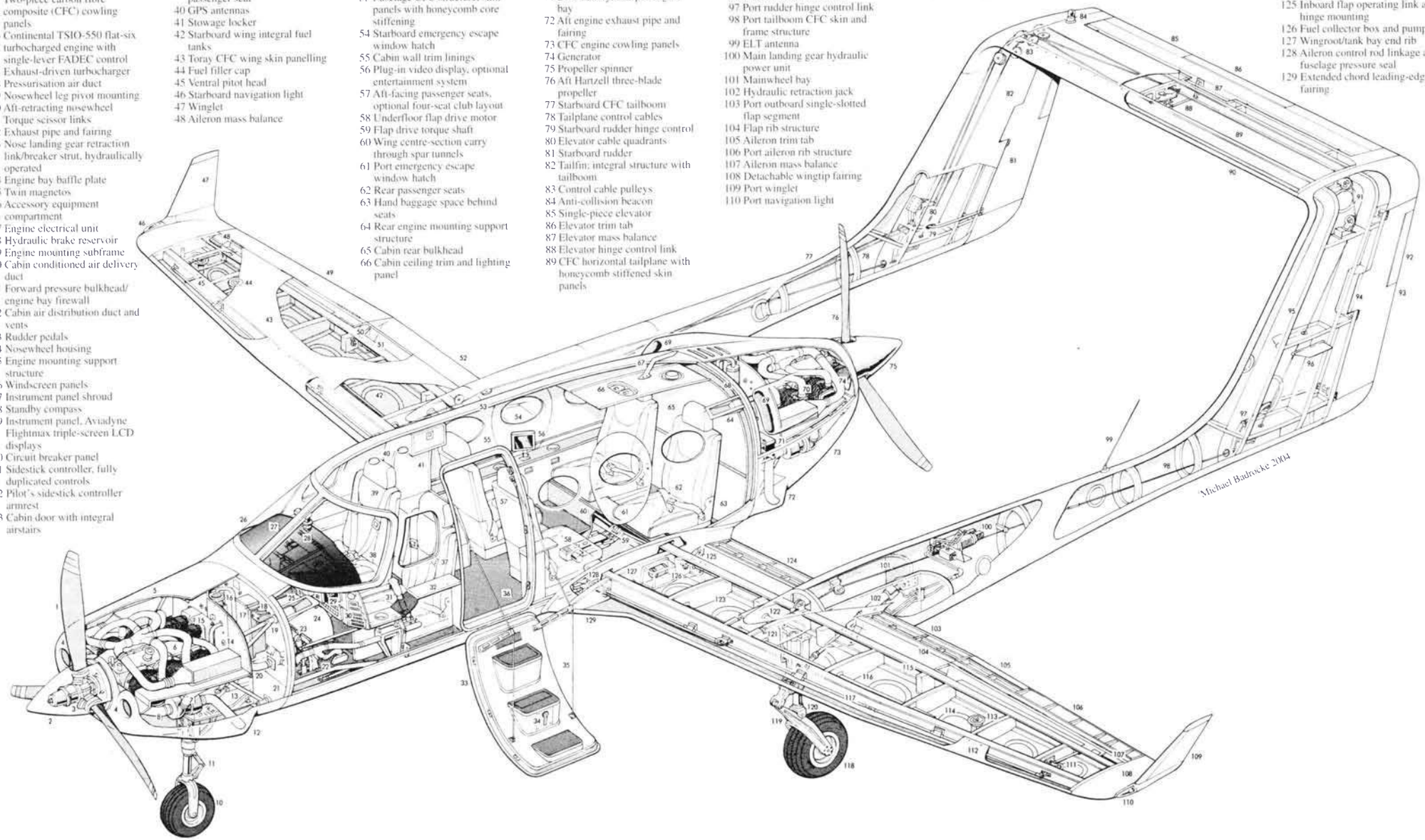
ACCOMMODATION: Pilot and five passengers in pressurised cabin on three pairs of leather seats. Door with integral airstair on port side, ahead of wing leading edge; emergency window on each side. Integrated ventral baggage pod optional.

Adam A500 company demonstrator *(Paul Jackson)*

1159166

Adam A500, cutaway drawing key

1 Hartzell three-blade 'scimitar' constant-speed propeller
2 Spinner
3 Propeller hub pitch change mechanism
4 Engine bay cooling air intakes
5 Two-piece carbon fibre composite (CFC) cowling panels
6 Continental TSIO-550 flat-six turbocharged engine with single-lever FADEC control
7 Exhaust-driven turbocharger
8 Pressurisation air duct
9 Nosewheel leg pivot mounting
10 Aft-retracting nosewheel
11 Torque scissor links
12 Exhaust pipe and fairing
13 Nose landing gear retraction link/breaker strut, hydraulically operated
14 Engine bay baffle plate
15 Twin magnetos
16 Accessory equipment compartment
17 Engine electrical unit
18 Hydraulic brake reservoir
19 Engine mounting subframe
20 Cabin conditioned air delivery duct
21 Forward pressure bulkhead/engine bay firewall
22 Cabin air distribution duct and vents
23 Rudder pedals
24 Nosewheel housing
25 Engine mounting support structure
26 Windscreen panels
27 Instrument panel shroud
28 Standby compass
29 Instrument panel, Aviadyne Flightmax triple-screen LCD displays
30 Circuit breaker panel
31 Sidestick controller, fully duplicated controls
32 Pilot's sidestick controller armrest
33 Cabin door with integral airstairs
34 Door internal latch
35 Door support cables/handgrips
36 Entry doorway
37 Pilot's seat
38 Safety harness
39 Second pilot or forward passenger seat
40 GPS antennas
41 Stowage locker
42 Starboard wing integral fuel tanks
43 Toray CFC wing skin panelling
44 Fuel filler cap
45 Ventral pitot head
46 Starboard navigation light
47 Winglet
48 Aileron mass balance
49 Starboard aileron
50 Flap operating link, torque shaft driven
51 Outboard ventral flap hinge
52 Starboard outboard flap segment
53 Fuselage CFC structure, skin panels with honeycomb core stiffening
54 Starboard emergency escape window hatch
55 Cabin wall trim linings
56 Plug-in video display, optional entertainment system
57 Aft-facing passenger seats, optional four-seat club layout
58 Underfloor flap drive motor
59 Flap drive torque shaft
60 Wing centre-section carry through spar tunnels
61 Port emergency escape window hatch
62 Rear passenger seats
63 Hand baggage space behind seats
64 Rear engine mounting support structure
65 Cabin rear bulkhead
66 Cabin ceiling trim and lighting panel
67 Upper VHF communications antenna
68 Engine bay firewall
69 Aft engine air intakes
70 Aft Continental TSIO-550 turbocharged engine
71 24 V battery, one per engine bay
72 Aft engine exhaust pipe and fairing
73 CFC engine cowling panels
74 Generator
75 Propeller spinner
76 Aft Hartzell three-blade propeller
77 Starboard CFC tailboom
78 Tailplane control cables
79 Starboard rudder hinge control
80 Elevator cable quadrants
81 Starboard rudder
82 Tailfin; integral structure with tailboom
83 Control cable pulleys
84 Anti-collision beacon
85 Single-piece elevator
86 Elevator trim tab
87 Elevator mass balance
88 Elevator hinge control link
89 CFC horizontal tailplane with honeycomb stiffened skin panels
90 Detachable leading-edge
91 Rudder interconnecting cable
92 Rudder trim tab
93 Port rudder
94 Rudder mass balance
95 Fin CFC spar and rib structure
96 VOR localiser antenna
97 Port rudder hinge control link
98 Port tailboom CFC skin and frame structure
99 ELT antenna
100 Main landing gear hydraulic power unit
101 Mainwheel bay
102 Hydraulic retraction jack
103 Port outboard single-slotted flap segment
104 Flap rib structure
105 Aileron trim tab
106 Port aileron rib structure
107 Aileron mass balance
108 Detachable wingtip fairing
109 Port winglet
110 Port navigation light
111 Aileron hinge control
112 Detachable leading-edge panel
113 Port wing fuel filler
114 Wing bottom skin panel with access hatches
115 Two-spar and rib all-CFC wing torsion box structure
116 Port wing outboard fuel tank
117 Leading-edge aileron control rod
118 Port mainwheel, aft retracting
119 Trailing link mainwheel suspension
120 Shock absorber strut
121 Main landing gear leg pivot mounting
122 Wing panel dry bay
123 Inboard fuel tank bay
124 Port inboard single-slotted flap segment
125 Inboard flap operating link and hinge mounting
126 Fuel collector box and pump
127 Wingroot/tank bay end rib
128 Aileron control rod linkage and fuselage pressure seal
129 Extended chord leading-edge fairing



Michael Badrocke 2004

0581425

Adam A500 interior 0589402

SYSTEMS: Pressurisation system maintains a 2,440 m (8,000 ft) cabin environment at 7,620 m (25,000 ft). Vapour-cycle air conditioning system. Optional TKS liquid de-icing system for wing and tailplane leading-edges; windscreen and propeller have electrically heated de-icing.

AVIONICS: *Comms:* Dual Garmin GNS 430 GPS/NAV/COM/ILS, Garmin GMA 340 audio panel and Garmin GTX 327 transponder, all standard; GTX 330 transponder, GDL 49 WX Datalink transceiver, and Aircell AST Iridium 3500 satcom with wireless handset, optional.

Radar: Weather radar in wing-mounted pod optional.

Flight: S-Tec System FiftyFive X autopilot standard; L-3 Comm WX-500 Stormscope and Skywatch, and Ryan 9900B BX TCAD, optional.

Instrumentation: Avidyne FlightMax Entegra system comprising two 26 cm (10.4 in) diagonal, high-resolution, sunlight-readable screens, one each for MFD and PFD functions, each incorporating ADAHRS, EADI and EHSI functions; dual Vision Microsystems VM1000 EMS.

DIMENSIONS, EXTERNAL:

Wing span	13.41 m (44 ft 0 in)
Wing aspect ratio	10.9
Length overall	11.18 m (36 ft 8 in)
Height overall	2.90 m (9 ft 6 in)
Wheel track	3.57 m (11 ft 8½ in)
Wheelbase	3.08 m (10 ft 1¼ in)
Propeller diameter	1.93 m (6 ft 4 in)

DIMENSIONS, INTERNAL:

Cabin: Length	4.15 m (13 ft 7¼ in)
Max width	1.37 m (4 ft 6 in)
Max height	1.29 m (4 ft 3 in)
Volume	7.4 m³ (262 cu ft)

AREAS:

Wings, gross	15.33 m² (165.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	2,341 kg (5,160 lb)
Max fuel weight	585 kg (1,290 lb)
Max T-O weight	3,175 kg (7,000 lb)
Max ramp weight	3,198 kg (7,050 lb)
Max wing loading	207.1 kg/m² (42.42 lb/sq ft)
Max power loading	6.09 kg/kW (10.00 lb/hp)

PERFORMANCE:

Max level speed at FL220	250 kt (463 km/h; 288 mph)
Cruising speed at 75% power at FL220	230 kt (426 km/h; 265 mph)
Econ cruising speed at 60% power at FL220	200 kt (370 km/h; 230 mph)
Stalling speed, flaps and landing gear down	75 kt (139 km/h; 87 mph)
Service ceiling	7,620 m (25,000 ft)
Service ceiling, OEI	4,877 m (16,000 ft)
Max rate of climb at S/L	417 m (1,368 ft)/min
Rate of climb at S/L, OEI	69 m (227 ft)/min
T-O run	630 m (2,068 ft)
T-O to 15 m (50 ft)	753 m (2,471 ft)
Landing run	554 m (1,818 ft)
Landing from 15 m (50 ft)	753 m (2,471 ft)
Range with max fuel, NBAA IFR reserves:	
at max cruising speed	1,050 n miles (1,944 km; 1,208 miles)
at econ cruising speed	1,150 n miles (2,129 km; 1,323 miles)

ADAM A700 ADAMJET

TYPE: Light business jet.

PROGRAMME: Announced on 21 October 2002; first flight of the proof of concept prototype (N700JJ, later N700AJ) 27 July 2003, followed by public debut at EAA AirVenture, Oshkosh, 29 July 2003. Fitted with ventral fuel tank in early 2005.

Construction of two additional test and certification aircraft began in 2005. No. 2 built from A500 c/n 009 as A700 c/n 002/N700LJ, first flown 6 February 2006. Second prototype differs from c/n 001 in having its engine mounts moved aft for turbine burst protection; larger baggage and maintenance access doors; revised window and emergency exit locations; revised lavatory location on port side of rear cabin, and a three-tube EFIS flight deck. Three static and fatigue test airframes also used in the test programme, scheduled to culminate in FAA certification to FAR/JAR 25 in fourth quarter of 2006. By late April 2006 the two flying prototypes had jointly logged more than 500 flight hours and the performance envelope had been expanded to 340 kt (630 km/h; 391 mph) and FL410.

CUSTOMERS: Total of 286 ordered by April 2006, including 75 for launch customer air taxi operator Pogo, 61 for private buyers, and 150 for undisclosed fractional ownership operator.

COSTS: USD2.25 million. Direct operating cost USD350 per hour (both 2006).

DESIGN FEATURES: Design draws on A500 using wings (but with thicker main spar), booms, tailplane, fins, cockpit and landing gear for some 65 per cent parts commonality. Engines pylon-mounted at rear of fuselage.

FLYING CONTROLS: Similar to A500. Twin tabs in elevator and on one rudder. Two-section flaps (inboard and outboard of boom) on each wing.

STRUCTURE: Monocoque fuselage of carbon fibre composites with honeycomb stiffening. Two-spar wing with integral fuel tank.

LANDING GEAR: Generally as A500; mainwheels 6.50–8; nosewheel 6.00–6.

POWER PLANT: Two Williams International FJ33-4A turbofans, each derated to 5.34 kN (1,200 lb st) from nominal 6.83 kN (1,536 lb st). Fuel capacity (production) 1,249 litres (330 US gallons; 275 Imp gallons) in wing and fuselage ventral tanks.

ACCOMMODATION: One or two pilots in cockpit, plus four passengers in club seating plus one to rear on starboard side in owner/operator configuration, or six passengers, all in forward-facing seating, in air taxi configuration, in cabin, separated by divider and refreshment centre. Integral airstair on port side ahead of wing leading edge, with emergency exits on both sides of fuselage at rear of cabin. Lavatory to rear of club seats on starboard side in owner/operator configuration. Baggage compartment in nose, forward of pressure bulkhead, accessible externally. Second baggage compartment at rear of cabin. Accommodation is pressurised and air conditioned.

SYSTEMS: As A500, but with de-icing protection for wing, horizontal tail, windscreen and engine inlets with known icing certification. Dual 200 Ah starter-generators; dual bus electrical system with separate bus for emergency operation. Pressurisation system, maximum pressure differential 0.57 bars (8.33 lb/sq in), maintains a sea level cabin environment to 3,780 m (12,400 ft) and a 2,440 m (8,000 ft) cabin altitude to 12,500 m (41,000 ft).

AVIONICS: Avidyne FlightMax Entegra II integrated avionics with three-tube EFIS comprising two PFDs and one MFD.

All data are provisional.

DIMENSIONS, EXTERNAL:

Wing span	13.41 m (44 ft 0 in)
Length overall	12.42 m (40 ft 9 in)
Height overall	2.92 m (9 ft 7 in)

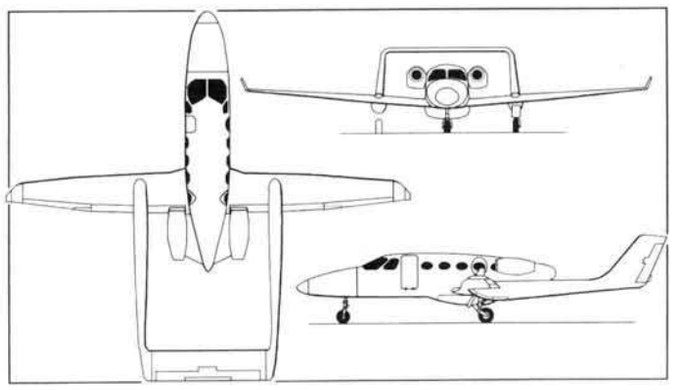
DIMENSIONS, INTERNAL:

Cabin (between pressure bulkheads):	
Length	4.88 m (16 ft 0 in)
Max width	1.37 m (4 ft 6 in)
Max height	1.31 m (4 ft 3½ in)
Volume	6.9 m³ (245 cu ft)
Baggage hold volume: front	0.85 m³ (30.0 cu ft)

WEIGHTS AND LOADINGS:

Basic operating weight	2,204 kg (4,860 lb)
Max fuel	1,003 kg (2,211 lb)
Max T-O weight	3,447 kg (7,600 lb)

Second Adam A700 more closely resembles production configuration *(Paul Jackson)* 1159169



Adam A700 AdamJet business jet *(Paul Jackson)* 1159122

Max landing weight ..... 3,356 kg (7,400 lb)
Max ramp weight ..... 3,470 kg (7,650 lb)
Max zero-fuel weight ..... 3,175 kg (7,000 lb)
Payload with max fuel ..... 329 kg (725 lb)
Fuel with max payload ..... 295 kg (650 lb)
Max power loading ..... 323 kg/kN (3.17 lb/lb st)

PERFORMANCE:

Max cruising speed at FL350 ..... 340 kt (630 km/h; 391 mph)
Service ceiling ..... 12,500 m (41,000 ft)
Service ceiling OEI ..... 9,140 m (30,000 ft)
Max rate of climb, OEI ..... 165 m (540 ft)/min
T-O run ..... 899 m (2,950 ft)
Range, 45 min reserves:
IFR ..... 1,100 n miles (2,037 km; 1,265 miles)
VFR ..... 1,400 n miles (2,592 km; 1,611 miles)

ADI

ADI

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PRESIDENT: Martin Hollmann
CHIEF AERODYNAMISIST: Rick McWilliams

This company produces kits for the Hollmann-designed Stallion; sells plans for the Hollmann HA-2M Sportster and Hollmann Bumble Bee gyrocopters (see 1992–93 *Jane's All the World's Aircraft*, Private Aircraft section); and is a major contributor to the Lancair series of kitbuilt aircraft (which see), as well as others including Seawind, Pulsar Sport 150, Prowler, Condor and Rans Courier. Also provides aircraft conceptual design and analysis. Covered plant area is 560 m² (6,025 sq ft) and full-time employees numbered two in 2005.

ADI SUPER STALLION

TYPE: Six-seat kitbuilt.
PROGRAMME: Construction of prototype began in 1990; first flew (N408S) July 1994.
CURRENT VERSIONS: **Super Stallion:** *As described.*
Turbine Stallion: One aircraft fitted with Walter M601 turboprop by Turbine Design of Deland, Florida.
CUSTOMERS: Seven production aircraft registered by mid-2006; 54 kits sold by July 2001 (latest data supplied) including one to New Zealand; five on US civil register by September 2006.
COSTS: USD98,225 (2006) excluding engine, instruments and avionics; estimated costs to first flight USD141,000-196,000 depending on engine choice.
DESIGN FEATURES: High-performance tourer for amateur construction. Designed to FAR Pt 23. Extensive use of composites. Employs Lancair IV wings and landing gear. Wing easily removed for storage and transportation. Winglets introduced from 2000. Quoted build time 1,500 hours.
Laminar flow, cantilever wing with 2° washout at tip. Wing section NACA 64-212 at tip, Jacosky RXM5-217 at root. Optional winglets.
FLYING CONTROLS: Conventional and manual. Flight-adjustable tab in port elevator; horn-balanced rudder with ground-adjustable tab. Fowler flaps droop to 30° and are 2.84 m (9 ft 4 in) long. Aileron length 1.78 m (5 ft 10 in).

Prototype ADI Super Stallion, following retrofit with winglets *(Paul Jackson)* 0110737

STRUCTURE: Prebuilt centre-fuselage area of welded 4130 steel tubing; remainder of airframe primarily of graphite/Nomex honeycomb core/epoxy.
LANDING GEAR: Tricycle type; retractable. Hydraulic power is provided by an electric motor. Cleveland 6.00–6 mainwheels and tyres; nosewheel 5.00×5. Hydraulic disc brakes.
POWER PLANT: Choice of either 224 kW (300 hp) Teledyne Continental IO-550-G or 261 kW (350 hp) turbocharged Teledyne Continental TSIO-550-B six-cylinder engine driving a McCauley or Hartzell three-blade constant-speed propeller. Fuel capacity 681 litres (180 US gallons; 150 Imp gallons) in two wing tanks. Other engine options include 268 kW (360 hp) Textron Lycoming TIO-540-AE2A, 560 kW (751 shp) Walter M 601E and reconditioned 410 kW (550 shp) PT6A-20.
ACCOMMODATION: Two pilots and up to four passengers in three pairs of seats. Two rear pairs can be swivelled to provide club seating arrangement. Alternatively, centre row of seats can be quickly removed for carriage of cargo. Large (two-part, horizontally split) door on port side. Removable 1.88 m (6 ft 2 in) × 0.91 m (3 ft 0 in) panel on starboard side for loading. Baggage shelf.
AVIONICS: To customer's specification.

DIMENSIONS, EXTERNAL:

Wing span without winglets ..... 10.67 m (35 ft 0 in)
Wing chord: at root ..... 1.52 m (5 ft 0 in)
at tip ..... 0.91 m (3 ft 0 in)
Wing aspect ratio 8.8
Length overall ..... 7.62 m (25 ft 0 in)
Max width of fuselage ..... 1.27 m (4 ft 2 in)
Height overall ..... 2.90 m (9 ft 6 in)
Tailplane span ..... 4.17 m (13 ft 8 in)
Tailplane chord: at root ..... 0.91 m (3 ft 0 in)
at tip ..... 0.56 m (1 ft 10 in)
Wheelbase ..... 2.34 m (7 ft 8 in)
Wheel track ..... 2.08 m (6 ft 10 in)

DIMENSIONS, INTERNAL:

Cabin: Length ..... 3.30 m (10 ft 10 in)
Max width ..... 1.24 m (4 ft 1 in)

AREAS:

Wings, gross ..... 13.00 m² (140.0 sq ft)
Vertical tail surfaces (total) ..... 1.78 m² (19.20 sq ft)
Tailplane ..... 3.07 m² (33.00 sq ft)

WEIGHTS AND LOADINGS:

Weight empty ..... 998 kg (2,200 lb)
Max payload ..... 499 kg (1,100 lb)
Max T-O weight ..... 1,724 kg (3,800 lb)
Max wing loading ..... 132.5 kg/m² (27.14 lb/sq ft)
Max power loading: 300 hp ..... 7.71 kg/kW (12.67 lb/hp)
350 hp ..... 6.61 kg/kW (10.86 lb/hp)

PERFORMANCE:

Max operating speed (VMO):
300 hp ..... 220 kt (407 km/h; 253 mph)
350 hp ..... 266 kt (493 km/h; 306 mph)
Max cruising speed at 2,500 rpm:
300 hp ..... 200 kt (370 km/h; 230 mph)
350 hp ..... 256 kt (474 km/h; 295 mph)
Stalling speed, power off, flaps down ..... 62 kt (115 km/h; 71 mph)
Max rate of climb at S/L: 300 hp ..... 488 m (1,600 ft)/min
350 hp ..... 792 m (2,600 ft)/min
Service ceiling ..... 9,750 m (32,000 ft)
T-O run ..... 549 m (1,800 ft)
Landing run ..... 213 m (700 ft)
Landing from 15 m (50 ft) ..... 366 m (1,200 ft)
Range at cruising speed, no reserves ..... 2,346 n miles (4,345 km; 2,700 miles)

ADVANCED AERO

ADVANCED AERO COMPANY

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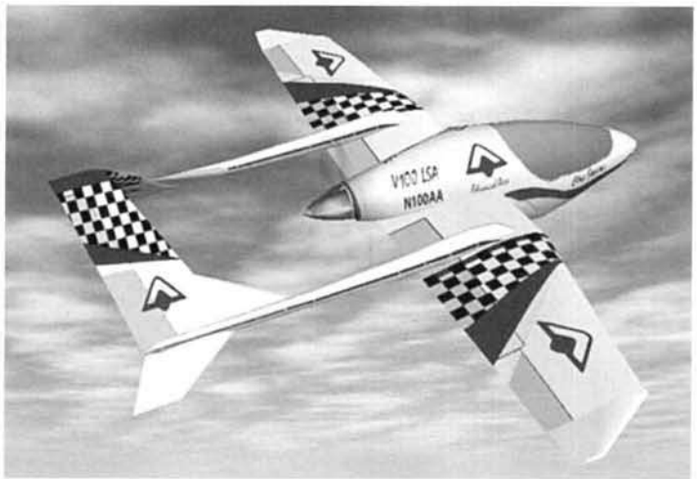
DIRECTORS: Darren A van Tassel (Engineering)
Chris Gagliano (Manufacturing)

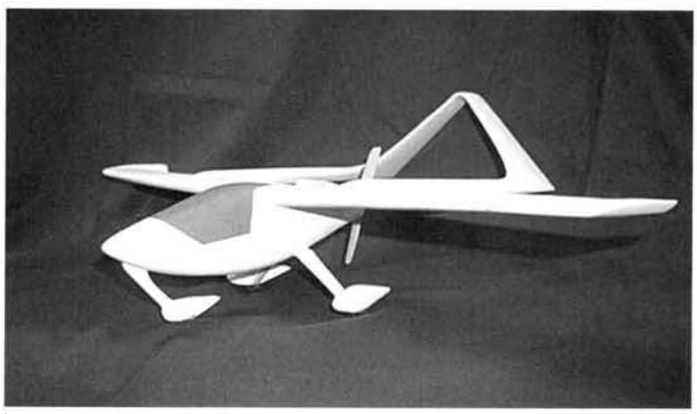
In 2004, Advanced Aero announced its search for financial backing to launch the first of a family of 'inverted V tail' aircraft which could include light transports, jets and UAVs. A technology demonstrator has flown. The company's plant covers 930 m² (10,000 sq ft).

ADVANCED AERO LSA-IVT

TYPE: Two-seat lightplane.
PROGRAMME: Announced 2004, following trials of one-fifth scale model. Financial backers being sought. Technology demonstrator, Advanced Aero Vortex, converted from Sadler Vampire c/n 26, made first flight (N101VX) 30 December 2005.
CURRENT VERSIONS: **LSA-IVT Sport Cruiser:** *As described.*



Advanced Aero LSA-IVT Sport Cruiser artist's impression 1159011



Impression of Advanced Aero LSA-IVT Sport Trainer 1159012

LSA-IVT Sport Aero: Available as baseline Aero with 59.6 kW (79.9 hp) Rotax 912; Aero SP with 73.5 kW (98.6 hp) Rotax 912S; or GA Trainer with Textron Lycoming O-235 of 85.7 kW (115 hp).

COSTS: Unit cost USD50,000 to USD60,000 (2007).

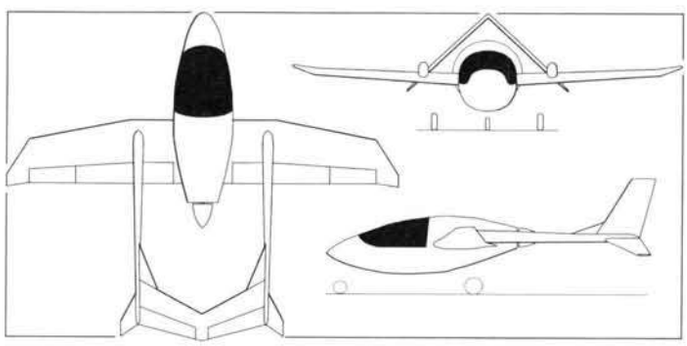
DESIGN FEATURES: Inverted V tail (IVT) designs to US Light Sport Aircraft certification category. Twin-boom, pusher propeller configuration with V-type tail surfaces joined on centreline. Advantages of IVT include increased safety (no propwash-induced yaw on take-off; less empennage blanking at high AoA on landing approach; reduced danger of human/vehicle propeller strike when on ground); stronger airframe (rigidity of empennage); improved performance (increased aspect ratio, thus reduced drag, of empennage); quietness (engine and propeller behind crew; reduced vibration) and reduced production costs (fewer parts). Single configuration allows for multiple power plant choices, including piston-tractor/pusher/tandem; turboprop pusher/tractor/twin; or turbofan single or twin.

Wing section NACA 64A417 (Mod); dihedral 3°; washout 4°.

FLYING CONTROLS: Manual. Ailerons and ruddervators. Flaps. All control surfaces balanced and actuated by pushrods.

STRUCTURE: Composites, semi-monocoque fuselage of carbon fibre and glass epoxy, with local Kevlar reinforcements. Wing has I-beam main spar with caps of S-Glass protrusions and metal, flush riveted, aluminium skin. Tailbooms and empennage of aluminium with glass epoxy streamline fairings. All metal parts epoxy-primed with final exterior polyurethane top coat.

Advanced Aero Vortex technology demonstrator *(R W Simpson)* 1159013



General arrangement of baseline Advanced Aero IVT *(Paul Jackson)* 1047708

LANDING GEAR: Tricycle type; fixed. Dual disc brakes; nosewheel steering suitable for grass operations.

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912S flat-four piston engine driving a three-blade, fixed pitch propeller. Fuel in two wing tanks, combined capacity 76 litres (20.0 US gallons; 16.7 Imp gallons).

ACCOMMODATION: Two persons, side by side.

EQUIPMENT: Ballistic parachute.

Data follow for baseline IVT two-seat version.

DIMENSIONS, EXTERNAL:

Wing span	8.32 m (27 ft 3½ in)
Length: fuselage	4.64 m (15 ft 2½ in)
to end of tailbooms	6.71 m (22 ft 0 in)
Max diameter of fuselage	1.24 m (4 ft 1 in)
Height overall	2.50 m (8 ft 2½ in)
Tailplane span (incl underfins)	3.44 m (11 ft 3½ in)
Wheel track	2.26 m (7 ft 5 in)
Wheelbase	2.83 m (9 ft 3½ in)
Propeller ground clearance on tail-scrape	0.25 m (10 in)
Distance between tailboom centres	2.74 m (9 ft 0 in)

AREAS:

Wings, gross	10.5 m² (113.0 sq ft)
Tailplane	2.80 m² (30.20 sq ft)

WEIGHTS AND LOADINGS:

Max T-O weight	598 kg (1,320 lb)
Max baggage weight	23 kg (50 lb)
Payload with max fuel	204 kg (450 lb)

PERFORMANCE:

Max level speed	120 kt (222 km/h; 138 mph)
Stalling speed, flaps down	38 kt (71 km/h; 44 mph)
Max rate of climb at S/L	396 m (1,300 ft)/min
Range at 75% power	470 n miles (870 km; 540 miles)

AERION

AERION CORPORATION

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CHIEF OPERATING OFFICER: Michael L Henderson
CHIEF ENGINEER James D Chase
DIRECTOR: Robert L Morse, Jr
PRINCIPAL SCIENTIST: Ilan M Kroo

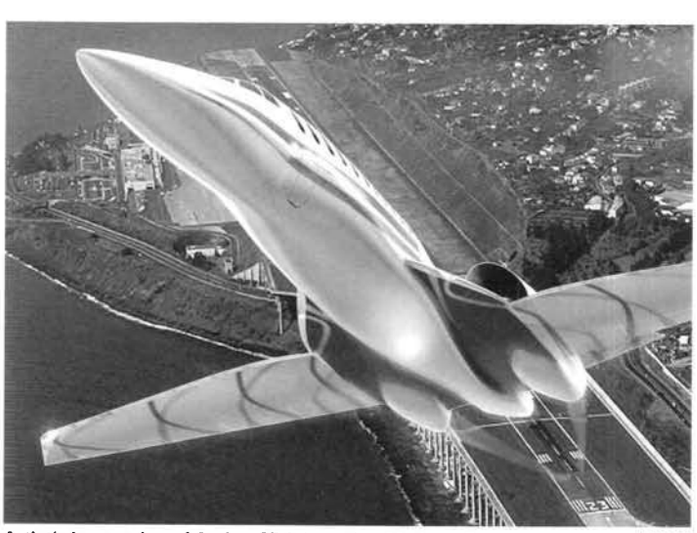
Aerion Corporation was established in 2002 to pursue development of supersonic aircraft incorporating natural laminar flow (NLF) technology. During 2006, Aerion was in discussions with several major aerospace firms and government agencies on three continents and anticipated finalising its choice of project partners during 2007.

AERION SBJ

TYPE: Supersonic business jet.

PROGRAMME: Initial studies (Design Cycle 1) between December 2003 and September 2004; announced at NBAA Convention in Las Vegas on 11 October 2004; detailed Design Cycle 2 begun September 2004 and included wind-tunnel tests and marketing survey; Design Cycle 2 – final element of Phase 1 – completed by September 2005, eliminating T-tail of earlier studies, among other improvements; expected five-year programme from launch (2007 or 2008) to certification.

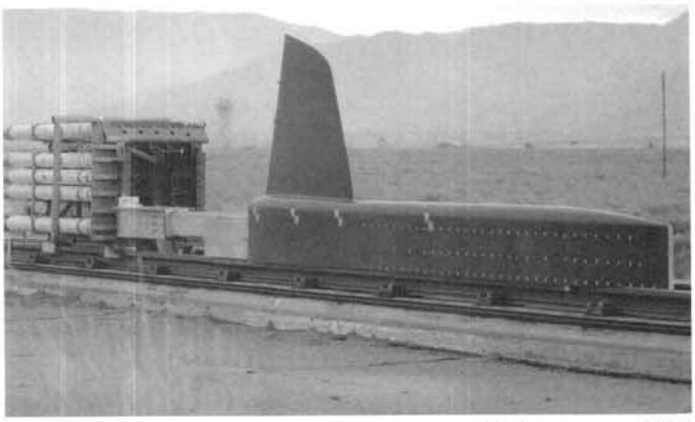
CUSTOMERS: Estimated market for 250 to 300 aircraft over 10-year period, 30 to 50 per cent of orders expected to come from fractional ownership operators.



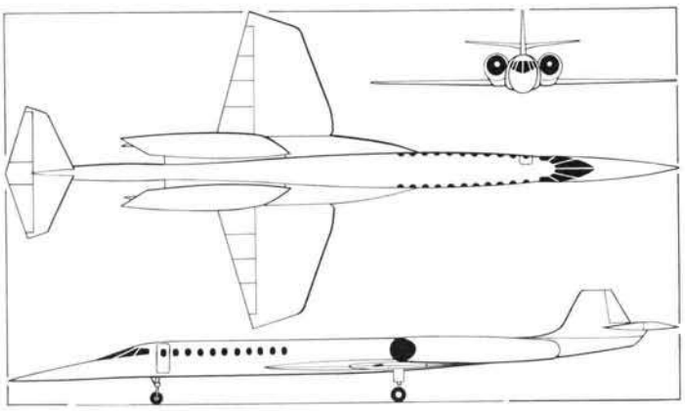
Artist's impression of Aerion SBJ departing Madeira/Funchal 1159697

COSTS: Target price USD80 million. Estimated direct operating cost USD8 per mile (both 2004).

DESIGN FEATURES: Low-risk design using mostly established technology and not dependent for market viability upon repeal of legislation prohibiting supersonic flight over land. Low



Rocket sled employed to test Aerion SBJ scale wing at Mach 1.55 1159698



Aerion SBJ general arrangement (*James Goulding*) 1151431

cruising speed of Mach 0.99, where required; 'boomless' cruise at Mach 1.1; max (unlimited) cruising speed Mach 1.6.

Fuselage has vertical oval cross-section in forward cabin, transitioning to oval in main cabin. Trapezoidal wing planform of natural laminar flow (NLF) section with rated wingtips; thickness 3% at root, 2% at tip. At supersonic cruise, achieves laminars flow over as much as 70 per cent of upper surface and up to whole lower surface. Cruciform tail with swept fin; area-ruled fuselage; engines pod-mounted on rear fuselage. Large trailing-edge flaps serve as flaperons for roll control (obviating spoilers) and are fitted with unique feature of secondary split flap at approximately half-chord to enhance low-speed capability and permit nose-down flight deck angle on landing approach; no leading-edge high-lift devices. Small notch in wing leading-edge at intersection with fuselage.

FLYING CONTROLS: Powered, electronically-signalled, hydraulically-actuated control surfaces. Flaps. Speedbrake.

STRUCTURE: Carbon fibre wings; high-strength aluminium alloy fuselage.

LANDING GEAR: Tricycle type; retractable. Two wheels in tandem on main units, twin wheels on nose unit. Ground turning radius less than 22.8 m (75 ft).

POWER PLANT: Two Pratt & Whitney JT8D-219 turbofans, each flat rated at 87.2 kN (19,600 lb st), with modified fan, upgraded compressor section and new exhaust mixer nozzle; low take-off thrust rating will enable the aircraft to meet Stage IV noise requirements. Thrust reverser. Fixed geometry scarfed air intakes. Fuel contained in wing and fuselage tanks.

ACCOMMODATION: Flat floor cabin with typical accommodation for 10 passengers, with two individual seats forward and two sets of club four seats aft; maximum 12 passengers; 11 cabin windows per side; galley at front and lavatory and baggage compartment at rear of cabin. Door forward, to rear of flight deck.

SYSTEMS: Stability augmentation system; pilot's commands are signalled to control surfaces electronically, but absence of AFCS and positive stability mean aircraft is not FBW in full sense. Tailplane size permits full control by pilot in the event of stability augmentation system failure. Cabin pressurisation system will have maximum pressure differential of 0.55 to 0.69 bar (8 to 10 lb/sq in).

DIMENSIONS, EXTERNAL:

Wing span	19.56 m (64 ft 2 in)
Wing aspect ratio	3.3
Length overall	41.30 m (135 ft 6 in)
Height overall	6.45 m (21 ft 2 in)

DIMENSIONS, INTERNAL:

Cabin (cockpit divider to aft pressure bulkhead):	
Length	9.14 m (30 ft 0 in)
Max width	1.98 m (6 ft 6 in)
Max height	1.83 m (6 ft 0 in)
Volume	27.75 m³ (980.0 cu ft)

AREAS:

Wings, gross	111.48 m² (1,200 sq ft)

WEIGHTS AND LOADINGS:

Basic operating weight	20,457 kg (45,100 lb)
Max fuel weight	20,593 kg (45,400 lb)
Max T-O weight	40,823 kg (90,000 lb)
Max wing loading	366.2 kg/m² (75.00 lb/sq ft)
Max power loading	255 kg/kN (2.50 lb/lb st)

PERFORMANCE (at max T-O weight, ISA, except where indicated):

Max cruising speed	M1.60
Long-range cruising speed	M1.50
No-boom cruising speed	more than M1.10
High subsonic cruising speed	M0.99
Long-range subsonic cruising speed	M0.95
Approach speed	120 kt (222 km/h; 138 mph)
Max operating altitude	15,545 m (51,000 ft)
T-O balanced field length	less than 1,829 m (6,000 ft)
Landing run, wet runway	less than 1,524 m (5,000 ft)
Range with NBAA IFR reserves, subsonic or supersonic	more than 4,000 n miles (7,408 km; 4,603 miles)

AEROCOMP

AEROCOMP

Aerocomp has changed name to Comp Air Inc.

AEROLITES

AEROLITES INC

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e-mail: admin@aerolites.com
Web: www.aerolites.com
PRESIDENT: Daniel J Rochè

AEROLITES AEROMASTER AG

TYPE: Agricultural sprayer ultralight.

PROGRAMME: Prototype (N17AG) first flown 1993.

CUSTOMERS: Total of 34 flying by mid-2005, including at least one in South Africa.

COSTS: Kit USD24,995 (2005).

DESIGN FEATURES: Strut-braced aluminium wing has ladder construction with internal diagonal bracing tested to +6/–4 *g*; aluminium ribs slot into pockets within fabric covering. Quoted build time 130 hours. Quoted spray coverage 61-81 ha (150-200 acres) per hour.

FLYING CONTROLS: Conventional and manual.

Aerolites Aeromaster agricultural ultralight 1158638

STRUCTURE: Fuselage of welded 4130 chromoly with fabric covering; aluminium wing ribs.

LANDING GEAR: Tailwheel type; fixed.

POWER PLANT: One 47.8 kW (64.1 hp) Rotax 582 two-cylinder engine driving Warp Drive carbon fibre three-blade propeller through C type 3:1 reduction gear. Fuel capacity 38 litres (10.0 US gallons; 8.3 Imp gallons).

EQUIPMENT: 12-nozzle SprayMiser CDA system fitted for agricultural operations; belly tank capacity 114 litres (30.0 US gallons; 25.0 Imp gallons). Optional ballistic parachute and electric starter.

DIMENSIONS, EXTERNAL:

Wing span	8.74 m (28 ft 8 in)
Length overall	5.64 m (18 ft 6 in)
Height overall	2.11 m (6 ft 11 in)

AREAS:

Wings, gross	13.54 m² (145.7 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	193 kg (425 lb)
Max T-O weight	453 kg (1,000 lb)

PERFORMANCE (with SprayMiser system fitted):

Never-exceed speed (VNE)	95 kt (177 km/h; 110 mph)
Normal cruising speed	65 kt (121 km/h; 75 mph)
Spray speed	56 kt (105 km/h; 65 mph)
Stalling speed	28 kt (52 km/h; 32 mph)
Max rate of climb at S/L	244 m (800 ft)/min
T-O run	153 m (500 ft)
Landing run	61 m (200 ft)
Range with max fuel	160 n miles (296 km; 184 miles)
Swath width	9–30 m (30–100 ft)
g limits	+6/–4

AEROLITES AEROSKIFF

TYPE: Two-seat amphibian ultralight kitbuilt.

CUSTOMERS: Nine flying by end-2005.

COSTS: Kit USD24,795 (2005).

DESIGN FEATURES: Pusher layout. Wings detach for storage. Quoted build time 190 hours.

FLYING CONTROLS: Conventional and manual. High-lift flaps.

STRUCTURE: Glass fibre fuselage and fabric-covered, strut-braced wings.

Aerolites Aeroskiff 0561756

LANDING GEAR: Tailwheel type; tailwheel also retracts for water landings. Drum brakes. Floats mounted on tubular outriggers at wing mid-point.
POWER PLANT: One 47.8 kW (64.1 hp) Rotax 582 water-cooled engine is standard; optionally, 55.0 kW (73.8 hp) Rotax 618. Fuel capacity 45 litres (12.0 US gallons; 10.0 Imp gallons).
SYSTEMS: Optional bilge pump and electric starter.
DIMENSIONS, EXTERNAL:
Wing span 9.04 m (29 ft 8 in)
Length overall 6.81 m (22 ft 4 in)
Height overall 2.13 m (7 ft 0 in)
DIMENSIONS, INTERNAL:
Cabin max width 1.12 m (3 ft 8 in)
AREAS:
Wings, gross 14.49 m² (156.0 sq ft)
WEIGHTS AND LOADINGS:
Weight empty 256 kg (565 lb)
Max T-O weight 510 kg (1,125 lb)
PERFORMANCE (Rotax 582):
Never-exceed speed (VNE) 82 kt (152 km/h; 95 mph)
Normal cruising speed 56 kt (105 km/h; 65 mph)
Stalling speed 33 kt (62 km/h; 38 mph)
Max rate of climb at S/L 183 m (600 ft)/min
Service ceiling 3,050 m (10,000 ft)
T-O run: water 168 m (550 ft)
land 122 m (400 ft)
Landing run: land 92 m (300 ft)
Range 140 n miles (259 km; 161 miles)

AEROLITES BEARCAT

TYPE: Single-seat ultralight kitbuilt.
CUSTOMERS: Total of 38 completed by early 2006.

Aerolites Bearcat promoted for LSA category 1158643

COSTS: Kit USD14,695, including engine and propeller (2004).
DESIGN FEATURES: Replica Corben Baby Ace (1930s vintage). Parasol wing is strut-braced and similar to AeroMaster, but struts are joined to fuselage at separate points rather than meeting at single point. Quoted build time 125 hours.
FLYING CONTROLS: Conventional and manual.
STRUCTURE: Fabric-covered 4130 chromoly fuselage and aluminium extruded-wing spar.
LANDING GEAR: Tailwheel type; fixed. Bungee shock absorption on main legs; optional hydraulic disc brakes.
POWER PLANT: One 31.0 kW (41.6 hp) Rotax 447 in-line two-cylinder piston engine, driving a two-blade propeller. Optionally, 37.0 kW (49.6 hp) Rotax 503 UL-2V. Fuel capacity 19 litres (5.0 US gallons; 4.2 Imp gallons).
DIMENSIONS, EXTERNAL:
Wing span 9.14 m (30 ft 0 in)
Length overall 5.33 m (17 ft 6 in)
Height overall 1.96 m (6 ft 5 in)
AREAS:
Wings, gross 13.94 m² (150.0 sq ft)
WEIGHTS AND LOADINGS:
Weight empty 125 kg (275 lb)
Max T-O weight 317 kg (700 lb)
PERFORMANCE:
Never-exceed speed (VNE) 95 kt (177 km/h; 110 mph)
Max operating speed 65 kt (121 km/h; 75 mph)
Normal cruising speed 59 kt (109 km/h; 68 mph)
Stalling speed 24 kt (44 km/h; 27 mph)
Max rate of climb at S/L 228 m (750 ft)/min
T-O and landing run 46 m (150 ft)
Range with max fuel 125 n miles (231 km; 143 miles)
g limits +6/−4

AEROS

WORLDWIDE AEROS CORPORATION

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Aeros was founded in 1987, and has since established itself as a leader in innovative lighter than air (LTA) technologies and manufacturing. Its product line includes a full spectrum of LTA vehicles, including the current Aeros 40D Sky Dragon FAA-certified airship, the partially buoyant Aeroscraft, and a range of tethered aerostat systems. Research and development has enabled Aeros successfully to develop innovative solutions for government and commercial programmes, including high-altitude and heavy-lift airships, and sensor platforms; its revenues are divided equally between government and civilian customers. Company headquarters, engineering and manufacturing are located in Los Angeles, California, with a work force of 50 comprising an engineering group and a technical production group, plus management and administrative personnel.

Aeros' newest airship, the 40D Sky Dragon, incorporates the latest technologies. Future focus is on production of the Aeroscraft, which encompasses capabilities (VTOL, low energy consumption and unprecedented cargo volumes, making it particularly well suited for low-density and perishable cargos as well as other missions) that entitle it to be classed as a new type of aircraft. During 2005-06, it has been advanced by demonstration of key technologies, and manufacture of the first ML 16 production series was beginning in the fourth quarter of 2006.

Aeros 40B flight deck 1196909

AEROS 40D SKY DRAGON

TYPE: Helium non-rigid airship.
PROGRAMME: Prototype; first flight (N818AC, c/n 16) 11 September 1998; exported to China (Thakral Media Corporation) in November 1998; operating in Hong Kong 1999. Three more (one for Argos Medien AG of Germany and two more for China) under construction in 1999–2001, of which c/n 17 (N819AC for China) destroyed in accident on 9 January 2001; c/n 18 (N820AC for Argos Medien) registered in January 2001, delivered in February 2002 but reverted to US registry in August 2003 and crashed in Portugal 12 June 2004.

FAA certification 21 June 2000; STC for external payload mounting awarded January 2001. Certified by LBA (Germany) January 2002; validation of type certificate by CAAC (China), July 2006.

Latest version (2006) is Aeros 40D: larger in size, volume and able to carry larger payloads than earlier versions; also incorporates new rapid deflation system, IFR capability, and camera system for envelope monitoring. Design driven by need to carry out surveillance missions requiring integration of IR cameras, radars and datalink systems.
CUSTOMERS: Six examples identified. N818AC (c/n 19) registered 20 March 2002; completed 2004 as surveillance platform (E-O/IR and other sensors) and delivered to Trinidad and Tobago Special Anti-Crime Unit following airworthiness certification 31 March; formally handed over on 20 October 2005, although first trial mission was flown on 16 July 2005. Systems testing for c/n 20 began 18 April 2005 and first metal cut for c/n 21 on 2 May 2005. First 40D due for delivery by end of 2006.
COSTS: Trinidad and Tobago USD32 million, plus USD8 million for surveillance equipment (2005).

Following details apply to Aeros 40D.

DESIGN FEATURES: X configuration tail unit, each with ruddervator. One ellipsoid ballonet forward and one aft (together, 26 per cent of total volume). Internal illumination by three 400 W lamps: one above gondola and one in each ballonet.
FLYING CONTROLS: Fly-by-wire electronically controlled, pneumatically actuated ruddervators, with manual back-up.
STRUCTURE: Envelope made up of 1,020 heat-sealed panels of a transparent, nylon-based, 7 ply polyurethane coated fabric; tailfins aluminium alloy with fabric covering. Aluminium alloy semi-monocoque gondola, with polycarbonate sheet transparencies.
LANDING GEAR: Two mainwheels, with shock-absorbers.
POWER PLANT: Two 93 kW (125 hp) Teledyne Continental IO-240 flat-four engines; MTV-7-D/LD170-12 variable- and reversible-pitch, three-blade wood/composites pusher propellers. Fuel capacity 287 litres (75.9 US gallons; 63.2 Imp gallons), of which 267 litres (70.5 US gallons; 58.7 Imp gallons) are usable.
ACCOMMODATION: Pilot and four passengers. Front two seats fully articulating and reclining; three bucket seats to rear. Full-depth windscreen; two doors, with upper and lower windows, in each side of gondola.

Aeros 40B Sky Dragon preparing for take-off 1196908

SYSTEMS: Pressure maintained by two air valves in each ballonet, each pneumatically actuated by an electric blower and having mechanical return springs. Two ballast compartments in gondola. Electrical system 28 V DC and 115 V AC. Nosecone mast mooring; ground handling crew of eight.

AVIONICS: Digital 'glass cockpit' package includes audio panel, voice annunciator, colour LEDs, GPS/com 2, nav/com 1 and transponder/encoder; readings displayed in both digital and analogue form.

DIMENSIONS, EXTERNAL:

Length overall	46.60 m (152 ft 10¾ in)
Envelope: Length	45.60 m (149 ft 7½ in)
Max diameter	10.60 m (34 ft 9½ in)
Fineness ratio	4.3
Height overall	13.35 m (43 ft 9½ in)
Banner (each side): Length	22.86 m (75 ft 0 in)
Height	7.92 m (26 ft 0 in)
Propeller diameter	1.70 m (5 ft 7 in)

DIMENSIONS, INTERNAL:

Envelope volume	2,773 m^3 (97,925 cu ft)
Ballonet volume (two, total)	549.2 m^3 (19,396 cu ft)
Gondola cabin: Length	1.96 m (6 ft 5 in)
Max width	1.57 m (5 ft 2 in)
Max height	1.73 m (5 ft 8 in)

AREAS:

Banner area (each side)	185.34 m^2 (1,995.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	1,891 kg (4,170 lb)
Useful load	978 kg (2,157 lb)

PERFORMANCE:

Max level speed	44 kt (82 km/h; 51 mph) IAS
Max rate of climb	610 m (2,000 ft)/min
Max rate of descent	610 m (2,000 ft)/min
Max certified altitude	2,135 m (7,000 ft)
Endurance: at 45% power	6 h 42 min
max	24 h

AEROS AEROSCRAFT

TYPE: Hybrid buoyant aircraft.

PROGRAMME: Development under way in 2006. Planned in four size configurations (see data below) to suit specific market segments. First of initial series (ML 16) targeted for roll-out in late 2008.

CUSTOMERS: Primary market interest foreseen as coming from resource-based exploration companies and luxury tour operators.

DESIGN FEATURES: New air vehicle concept combining positive effect of static lift provided by helium-filled internal gas cells with dynamic lift created by body shape. Positive buoyancy control system allows craft to achieve operating parameters said to make it well suited to many non-conventional types of mission. VTOL capability allows craft to circumvent traditional intermodal freight systems and operate autonomously without the aid of ground-based infrastructure.

FLYING CONTROLS: Aeros proprietary buoyancy control system.

STRUCTURE: Completely rigid body with rear-mounted propulsion units.

Following data all provisional:

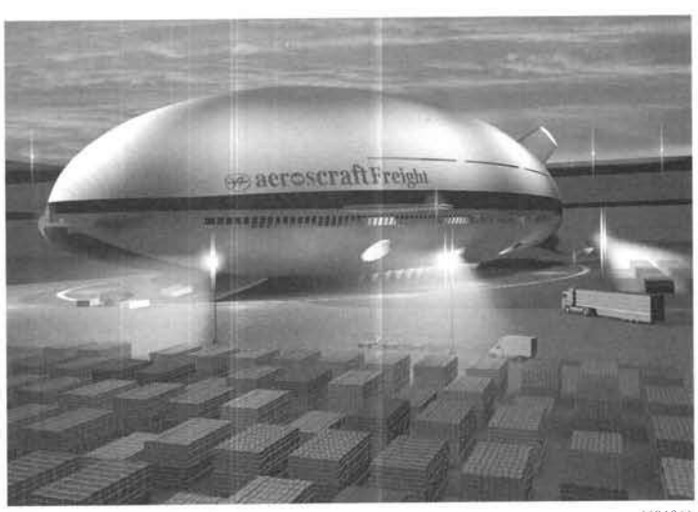
DIMENSIONS, EXTERNAL:

Length overall: ML 16	64.8 m (212.6 ft)
ML 60	123 m (403.5 ft)
ML 250	180 m (590.6 ft)
ML 500	238 m (780.8 ft)
Max width: ML 16	28.2 m (92.5 ft)
ML 60	42 m (137.8 ft)
ML 250	47 m (154.2 ft)
ML 500	66 m (216.5 ft)

DIMENSIONS, INTERNAL:

Total volume: ML 16	16,800 m^3 (593,300 cu ft)
ML 60	100,000 m^3 (3.53 million cu ft)
ML 250	450,000 m^3 (15.9 million cu ft)
ML 500	855,000 m^3 (30.2 million cu ft)

Typical Aeroscraft in passenger configuration 1196912



Aeroscraft in cargo configuration 1196911

WEIGHTS AND LOADINGS:

Payload: ML 16	6,000 kg (13,230 lb)
ML 60	60,000 kg (132,275 lb)
ML 250	250,000 kg (551,150 lb)
ML 500	500,000 kg (1,102,300 lb)

PERFORMANCE (estimated):

Max level speed: ML 16	110 kt (203 km/h; 126 mph)
ML 60, ML 250	120 kt (222 km/h; 138 mph)
ML 500	150 kt (277 km/h; 172 mph)
Operating altitude: ML 16	3,000 m (9,840 ft)
ML 60	3,200 m (10,500 ft)
ML 250, ML 500	3,500 m (11,480 ft)

AG CAT

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PRESIDENT: Frank D Kelley

Grumman G-164 Ag Cat radial-engined agricultural biplane first flew 22 May 1957 and certified 20 January 1959; produced under subcontract by Schweizer; rights passed to Gulfstream American upon its separation from Grumman, but planned transfer of manufacture to Savannah, Georgia, forestalled by Schweizer's outright purchase of programme in January 1981. Total of over 2,600 built, latterly only to specific order, before programme sold to Ag Cat Corporation of Malden, Missouri, in January 1996. Type Certificate again transferred on 22 February 2001 to current owner.

Allied Ag Cat supports the worldwide fleet of some 2,000 G-164 variants, some being G-164D, certified 26 March 1979 with Pratt & Whitney PT6A turboshaft, or similarly-powered Super B (certified 23 December 1985); services include remanufacture of existing airframes. Allied Ag Cat previously had plans to reintroduce new production aircraft from 2007 (12 in first year; 24 thereafter), principally Ag Cat Super-B Turbine with 507 kW (680 shp) or 559 kW (750 shp) PT6A-15AG/-34AG engines and 1,514 litre (400 US gallons; 333 Imp gallon) chemical hopper. Manufacture intended at Walnut Ridge Airport. However, in 2006, these plans were suspended indefinately.

AIR

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Formed to produce the Epic LT for the Experimental category, AIR moved into 8,360 m^2 (90,000 sq ft) accommodation at Bend, Oregon, on 1 June 2005. The company is also developing a jet version of the basic design (although with new wing) and will manufacture a certified Epic as the Dynasty at a new, 9,290 m^2 (100,000 sq ft) factory at Spring Bank Airport, Calgary, Canada, plans for which were announced on 5 September 2006. Employment at Bend was 127 in mid-2006.

AIR EPIC LT and DYNASTY

TYPE: Business turboprop.

PROGRAMME: Epic LT announced at AirVenture, Oshkosh, July 2003; first flight (N370JP) 17 July 2004. Initially available as Experimental category kitbuilt with Walter or PT6A engine with first components delivery of this version in first quarter of 2005. First customer completion was N89CL by Carlton Cadwell. First Dynasty (C-FJRQ) completed from 14th LT airframe; initial public display at NBAA Convention, Orlando, Florida, 17 October 2006. Canadian certification expected in 2008.

CURRENT VERSIONS: **Epic LT**: *As described.* Experimental category version; kitbuilt. Available as **Model 800** with Walter engine or **Model 1200** with P&W.

Dynasty: Certified version; available from early 2008.

Epic Jet: Twin-turbofan version produced in collaboration with TAM of Georgia. Described separately.

CUSTOMERS: More than 50 orders for LT by July 2005. Eight LTs flying by 19 December 2006, on which day N468TT (c/n 012) made initial sortie.

COSTS: Experimental category kit USD895,000 with Walter engine; USD1.16 million with PT6A. Certified Dynasty USD1.95 million (PT6A) (2006).

DESIGN FEATURES: "Full people; full fuel; full speed" capability intended. Designed for owner/operator requiring luxury motorcar standard of comfort; interior styled by Nissan Design Centre. Optional winglets.

FLYING CONTROLS: Conventional and manual. Flaps.

STRUCTURE: Generally of carbon fibre.

POWER PLANT: One turboprop: 560 kW (751 shp) Walter M 601 or 895 kW (1,200 shp) Pratt & Whitney Canada PT6A-67 according to version. Standard fuel capacity 1,136 litres (300 US gallons; 250 Imp gallons) gross, of which 1,091 litres (288 US gallons; 240 Imp gallons) usable; optional long-range tanks of unspecified volume.

AIR Epic LT flight deck 1040573

ACCOMMODATION: Six persons, including pilot(s); rear occupants in 'club four' configuration. Cabin pressurised. Cabin pressure differential 0.45 bar (6.5 lb/sq in).

DIMENSIONS, EXTERNAL:

Wing span	13.11 m (41 ft 2½ in)
Length overall	11.20 m (36 ft 9 in)
Height overall	3.81 m (12 ft 6 in)

AREAS:

Wings, gross	18.92 m^2 (203.6 sq ft)

DIMENSIONS, INTERNAL:

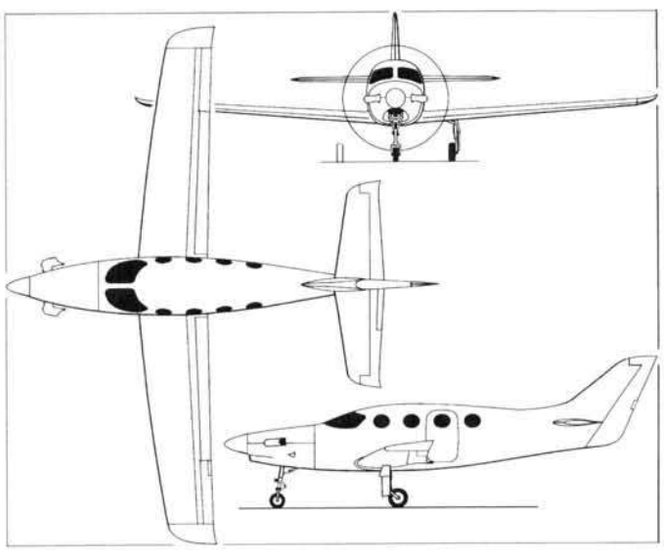
Cabin: Length	4.57 m (15 ft 0 in)
Max width	1.40 m (4 ft 7 in)
Max height	1.50 m (4 ft 11 in)

WEIGHTS AND LOADINGS:

Weight empty: LT	1,905 kg (4,200 lb)
Dynasty	1,814 kg (4,000 lb)
Payload: LT with max fuel	544 kg (1,200 lb)
Dynasty with standard fuel	603 kg (1,300 lb)

AIR Epic Dynasty development aircraft accompanied by kitbuilt Epic LT 1040572

Typical cabin of AIR Epic LT 1040574



AIR Epic LT business turboprop *(Paul Jackson)* 1158930

Max T-O weight: LT	3,324 kg (7,329 lb)
Dynasty	3,311 kg (7,300 lb)
Max wing loading: LT	175.8 kg/m² (36.00 lb/sq ft)
Dynasty	175.1 kg/m² (35.85 lb/sq ft)
Max power loading: LT (PT6A)	3.72 kg/kW (6.11 lb/shp)
Dynasty	3.70 kg/kW (6.08 lb/shp)
PERFORMANCE (estimated, PT6A engine):	
Cruising speed: max	350 kt (648 km/h; 403 mph) IAS
econ	289 kt (535 km/h; 333 mph) IAS
Time to FL280	11 min
Max certified altitude: LT	8,535 m (28,000 ft)
Dynasty	9,450 m (31,000 ft)
T-O to 15 m (50 ft), LT	488 m (1,600 ft)
Landing from 15 m (50 ft), LT	561 m (1,840 ft)
Range, 45 min reserves:	
LT at max cruising speed	1,369 n miles (2,535 km; 1,575 miles)
LT at econ cruising speed	1,608 n miles (2,978 km; 1,850 miles)
Dynasty at econ cruising speed and with long-range tanks	1,874 n miles (3,472 km; 2,157 miles)

AIR EPIC ELITE

TYPE: Private jet.

PROGRAMME: Announced (as Epic Jet) at the NBAA Convention in Las Vegas 20 October 2004; development is jointly with TAM-AIR of Tblisi, Georgia; fuselage mockup unveiled at EAA AirVenture, Oshkosh, 27 July 2005; first flight of prototype scheduled for October 2005 but delayed, in part by legal dispute with Farnborough Aircraft over rights to wing design. AIR elected to transfer development and production of aircraft to Canada, where prototype (C-GROL) registered in July 2006, coincident with announcement of name, Elite. Although structurally complete, C-GROL was unable to fly for legal reasons and did not make planned debut at Oshkosh in July 2006; in satisfaction of court ruling, new wing design was purchased from Germany and fitted to aircraft in latter part of 2006. Certification due in late 2008. Two production lines planned; AIR supplying aircraft to North American market; TAM to rest of world.

CUSTOMERS: By July 2005, six Epic LT customers had also purchased Epic Jets.

COSTS: USD2.35 million, certified (2006).

DESIGN FEATURES: Based on Epic LT turboprop with two podded, rear-mounted turbofan engines and T tail. Revised (2006) wing design has two-step sweep on outer panels.

STRUCTURE: Mostly carbon fibre composites with high fuselage and systems commonality with Epic LT.

LANDING GEAR: Tricycle type; retractable.

POWER PLANT: Two rear-mounted Williams FJ33-4 turbofan engines, rated at 8.45 to 8.00 kN (1,900 lb st). Max fuel capacity 1,211 litres (320 US gallons; 266.5 Imp gallons).

ACCOMMODATION: Six to eight seats in pressurised cabin. Payload with full fuel and 54 kg (120 lb) baggage is seven seats.

SYSTEMS: Pressurisation system, maximum differential 0.6 bar (8.5 lb/sq in).

AVIONICS: Garmin 1000 as core system.

DIMENSIONS, EXTERNAL:	
Wing span	13.41 m (44 ft 0 in)
Length overall	11.91 m (39 ft 11 in)
Height overall	3.78 m (12 ft 5 in)
DIMENSIONS, INTERNAL:	
Cabin: Length	5.18 m (17 ft 0 in)
Max width	1.48 m (4 ft 9 in)
Max height	1.52 m (5 ft 0 in)
WEIGHTS AND LOADINGS:	
Weight empty	1,814 kg (4,000 lb)
Payload with standard fuel	603 kg (1,330 lb)
Max T-O weight	3,492 kg (7,700 lb)
Max power loading	230 kg/kN (2.26 lb/lb st)
PERFORMANCE (estimated):	
Max cruising speed	412 kt (763 km/h; 474 mph)
Econ cruising speed	385 kt (713 km/h; 443 mph)
Certified ceiling	12,495 m (41,000 ft)
Time to FL410	17 min
Range with six passengers at econ cruising speed	1,400 n miles (2,592 km; 1,611 miles)

Artist's impression of Epic Elite very light jet 1040570

AIR COMMAND

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PRESIDENT: Harold Smith

Formed in 1985 and reorganised May 1992, Air Command produces kits of autogyros; with options, there are seven sub-versions of the Elite currently available; five of which are single-seat versions.

In 2003, Air Command had a 465 m² (5,000 sq ft) factory and seven employees.

AIR COMMAND COMMANDER ELITE

TYPE: Single-seat autogyro ultralight kitbuilt; two-seat autogyro ultralight kitbuilt.

PROGRAMME: Construction of tandem-seat F-30 began in late 1999; made first flight 1 March 2000; public debut at Sun 'n' Fun, April 2000. A side-by-side version of the F-30 has been introduced. Second-generation machines denoted by 'Elite' suffix.

CURRENT VERSIONS: **Commander 447:** Single-seat version, powered by 29.5 kW (39.6 hp) Rotax 447.

Commander 503: As Commander 447, but with 37.0 kW (49.6 hp) Rotax 503.

Commander Elite 3202: As Commander 447, but with 41.0 kW (55 hp) Hirth 3202.

Commander 582: As Commander 447, but with 47.8 kW (64.1 hp) Rotax 582.

Commander Elite 3203: As Commander 447, but with 48.5 kW (65 hp) Hirth 3203 and taller tail.

Elite F-30: Basic two-seat version, with Hirth F-30 engine.

Elite F-30ES: As F-30, but side-by-side seating.

Elite Subaru: As F-30, but with more powerful engine; under development during 2006.

CUSTOMERS: Over 1,000 kits sold in US by mid 2005.

COSTS: Commander 447 USD12,645, Commander 503 USD14,090, Commander 582 USD15,725, Commander Elite 3202 USD15,495, Commander Elite 3203 USD17,495; Elite F-30 USD22,475, Elite F-30ES USD21,792, all excluding engine (2006).

DESIGN FEATURES: Open cockpit autogyro with wide range of options to enable individual requirements to be met; many subassemblies preconstructed by factory. Quoted build time 100 hours.

STRUCTURE: Pre-drilled and anodised 6061-T6 tubular airframe; dual 2.5 5 × 5 cm (21 × 2 in) tubing used for mast. Optional glass fibre enclosure. F-30 has aluminium rudder and composites horizontal stabiliser and tailfins; Dragon Wings tip-weighted rotor blades.

LANDING GEAR: Fixed tricycle type with glass fibre speed fairings. Aluminium suspension system with Hager wheels and brakes on all wheels. Nosewheel is fully castoring with leg of 4130 steel tube and 6.00×6 Azusa tyres; 7.6 cm (3 in) tailwheel. Mainwheel hydraulic brakes.

POWER PLANT: One 82.0 kW (110 hp) Hirth F-30 driving a three- or four-blade graphite fibre Warp Drive propeller. Other options include the 29.5 kW (39.6 hp) Rotax 447, 37.0 kW (49.6 hp) Rotax 503 and 47.8 kW (64.1 hp) Rotax 582 for single-seat versions. Fuel capacity 37.9 litres (10.0 US gallons; 8.3 Imp gallons) in two seat tanks; optional 68.1 litre (18.0 US gallon; 15.0 Imp gallon) seat tank.

ACCOMMODATION: Pilot and passenger in tandem on Elite F-30; side by side on Elite F-30ES.

SYSTEMS: Basic engine instrumentation is provided with each kit. Options include hydraulic

Air Command Tandem Elite F-30 1158644

pre-rotator and clutch reduction drive on F-30; and pre-rotator, C Box upgrade and electric start on F-30ES. Optional New Horizons Components gyro recovery system rocket-powered ballistic parachute.

DIMENSIONS, EXTERNAL:

Rotor diameter: F-30	8.53 m (28 ft 0 in)
F-30ES	8.84 m (29 ft 0 in)
Rotor blade chord: F-30	0.19 m (7½ in)
Fuselage length: F-30	4.09 m (13 ft 5 in)
F-30ES	3.25 m (10 ft 8 in)
Height to top of rotor head: F-30	2.74 m (9 ft 0 in)
F-30ES	2.13 m (7 ft 0 in)
Width: F-30	1.88 m (6 ft 2 in)
F-30ES	1.70 m (5 ft 7 in)
Propeller diameter	1.73 m (5 ft 8 in)

AREAS:

Rotor disc: F-30	57.2 m² (616.0 sq ft)
F-30ES	61.4 m² (661.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: F-30	222 kg (490 lb)
F-30ES	141 kg (310 lb)
Max payload: both	191 kg (420 lb)
Max T-O weight: F-30	578 kg (1,275 lb)
F-30ES	412 kg (910 lb)
Max disc loading: F-30	10.1 kg/m² (2.07 lb/sq ft)
F-30ES	6.7 kg/m² (1.38 lb/sq ft)
Max power loading: F-30	7.05 kg/kW (11.59 lb/hp)
F-30ES	5.04 kg/kW (8.27 lb/hp)

PERFORMANCE:

Max operating speed: F-30	95 kt (177 km/h; 110 mph)
F-30ES	73 kt (135 km/h; 84 mph)
Cruising speed:	
F-30	65–70 kt (121–129 km/h; 75–80 mph)
F-30ES	56 kt (105 km/h; 65 mph)
Min flying speed: F-30	18 kt (33 km/h; 20 mph)
F-30ES	20 kt (36 km/h; 22 mph)
Max rate of climb at S/L: F-30	366 m (1,200 ft)/min
Service ceiling: both	3,050 m (10,000 ft)
T-O run: both	31–76 m (100–250 ft)
Landing run: both	0–6 m (0–20 ft)

AIRDALE FLYER

AIRDALE FLYER COMPANY

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MARKETING MANAGER: Steve Winder

Airdale has expanded its portfolio with acquisition of established light aircraft which it markets in kit form. These are the South Korean (SkyGear) Comet; and the Avid Mk IV and Magnum, previously manufactured by Avid until its dissolution.

Still available is Airdale's Flyer, a development of John Larsen's Pursang which, itself, derived from the Avid Mk IV.

AIRDALE AVID FLYER MARK IV

TYPE: Side-by-side ultralight kitbuilt.

PROGRAMME: First flown 1983; available as single kit, or six separate kits to spread cost of purchase. Strongly influenced design of Indaer-Peru Chuspi light aircraft (see under Peru in 1992–93 *Jane's*), and the SkyStar series of kitbuilt aircraft. Avid **Bandit** identical, except for 454 kg (1,000 lb) maximum T-O weight. An upgrade kit for earlier Flyers is available, comprising a new, 40 cm (16 in) longer fuselage frame and associated components.

CUSTOMERS: More than 1,600 Avid Flyer kits delivered, with over 900 flying.

COSTS: Kit: High Gross STOL USD19,550, Aerobatic Speedwing USD19,500, both firewall back; upgrade kit USD7,995 (all 2006).

DESIGN FEATURES: Strut-braced, high-wing ultralight of traditional configuration and construction. Two forms available (interchangeable), as original **High Gross STOL** with unique near full-span auxiliary aerofoil flaperons, and shorter span **Aerobatic Speedwing** using new wing section; cruising and stalling speeds raised with Aerobatic Speedwing fitted. Wings fold for storage. Quoted build time 650 hours.

FLYING CONTROLS: Manual. Junkers flaperons (see Design Features), elevators with adjustable trim tab, and rudder.

STRUCTURE: Aluminium wing spars and plywood ribs, covered with heat-shrunk Dacron. Welded steel tube fuselage, rudder, tailplane and elevators. Dacron covered except for fuselage nose which has premoulded GFRP cowlings. Fin integral with fuselage.

LANDING GEAR: Fixed; tricycle or tailwheel type. Two faired-in side Vs hinged to lower longerons, plus half-axles sprung under centreline with bungee cord. Tundra tyres and brakes. Wheel rim size 12.7 cm (5 in). Steerable tailwheel. Optional Aqua 1500 floats, skis and wheel/skis. Wider landing gear available as option, introduced 2001.

POWER PLANT: One 47.8 kW (64.1 hp) Rotax 582 two-stroke engine, driving a two- or three-blade propeller; fixed-pitch wooden propeller for STOL, three-blade ground-adjustable for Speedwing. Fuel capacity 53 litres (14.0 US gallons; 11.7 Imp gallons) for High Gross STOL and 68 litres (18.0 US gallons; 15.0 Imp gallons) for Aerobatic Speedwing; option to double capacity of each. Similar capacity fuel tanks may be added in port wing.

Avid Flyer Speedwing Mk 4 *(Paul Jackson)* 1158581

DIMENSIONS, EXTERNAL (A: STOL, B: Aerobatic Speedwing):

Wing span: A	9.11 m (29 ft 10½ in)
B	7.30 m (23 ft 11½ in)
Length overall	5.46 m (17 ft 11 in)
Height overall: tailwheel	1.80 m (5 ft 11 in)
tricycle	2.11 m (6 ft 11 in)

DIMENSIONS, INTERNAL:

Cabin max width	1.00 m (3 ft 3½ in)

AREAS (A and B as above):

Wings, gross: A	11.38 m² (122.5 sq ft)
B	9.04 m² (97.3 sq ft)

WEIGHTS AND LOADINGS (A and B as above):

Weight empty: A	200–231 kg (440–510 lb)
B	231 kg (510 lb)
Max baggage weight	16 kg (35 lb)
Max T-O weight: A	522 kg (1,150 lb)
B	476 kg (1,050 lb)

PERFORMANCE (A and B as above):

Max level speed at 1,525 m (5,000 ft):	
A, B	117 kt (217 km/h; 135 mph)
Max cruising speed: A	78 kt (145 km/h; 90 mph)
B	100 kt (185 km/h; 115 mph)
Stalling speed:	
A, flaps down, engine idling	28 kt (52 km/h; 32 mph)
B	37 kt (68 km/h; 42 mph)
Max rate of climb at S/L: A	518 m (1,700 ft)/min
B	366 m (1,200 ft)/min
Service ceiling: A, B	3,810 m (12,500 ft)
T-O run: A	27 m (90 ft)
B	38 m (125 ft)
Landing run: A	46 m (150 ft)
B	152 m (500 ft)
Range, no reserves: A	295 n miles (547 km; 340 miles)
B	491 n miles (910 km; 566 miles)

AIRDALE FLYER

TYPE: Side-by-side kitbuilt.

PROGRAMME: Designed by John Larsen in 1995 and initially known as the Pursang, itself a development of the Avid Flyer Mk IV Hauler, but with stretched fuselage and Subaru motorcar engine. Offered both as a kit and as an upgrade to existing aircraft.

CUSTOMERS: Four completed and flown by early 2004.

COSTS: Kit USD18,950; upgrade kit for Avid Flyer Mk IV USD7,995 (2004).

DESIGN FEATURES: Compared to Avid Flyer, has stretched fuselage to give better ground handling and range; re-raked windscreen; simplified control system with differential flaperon controls and redesigned cockpit area. Landing gear extensively redesigned with two-piece aluminium legs fitted into a box section that plugs into the bottom of the fuselage; if gear is damaged in a heavy landing the fuselage will not be distorted if the landing gear is twisted.

Quoted build time 500 hours.

FLYING CONTROLS: As Avid Flyer; differential flaperons.

STRUCTURE: As Avid Flyer; wing modified to allow increased MTOW.

LANDING GEAR: Tailwheel type; fixed. Superficially as Avid Flyer. Two-piece Grove aluminium landing gear; double tailsprings for better rough-terrain landings. Speed fairings.

POWER PLANT: Initial Pursang was powered by one 74.6 kW (100 hp) Subaru EA81 motorcar engine driving three-blade propeller; later power plants include Rotax and Teledyne Continental. Standard fuel capacity 106 litres (28.0 US gallons; 23.2 Imp gallons); can be increased to 136 litres (36.0 US gallons; 30.0 Imp gallons).

ACCOMMODATION: Compared to Avid Flyer, has redesigned windscreen and wider cockpit area; due to redesigned landing gear, tubes behind seating in Avid Flyer are no longer required, allowing easier access to larger baggage area; undersides reshaped to provide extra head and leg room. Wider cabin doors.

DIMENSIONS, EXTERNAL:
- Wing span ... 9.14 m (30 ft 0 in)
- Length overall ... 5.74 m (18 ft 10 in)
- Height overall ... 1.75 m (5 ft 9 in)
- Wheel track ... 1.88 m (6 ft 2 in)

AREAS:
- Wings, gross ... 12.26 m² (132.0 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty ... 318 kg (700 lb)
- Max T-O weight ... 635 kg (1,400 lb)
- Max wing loading ... 51.8 kg/m² (10.61 lb/sq ft)
- Max power loading: EA81 ... 8.52 kg/kW (14.00 lb/hp)

PERFORMANCE (74.6 kW; 100 hp EA81):
- Max level speed (VNE) ... 117 kt (217 km/h; 135 mph)
- Max cruising speed at 85% power ... 100 kt (185 km/h; 115 mph)
- Normal cruising speed at 75% power ... 94 kt (174 km/h; 108 mph)
- Stalling speed, power on: flaperons up ... 42 kt (78 km/h; 48 mph)
  - flaperons down ... 33 kt (60 km/h; 37 mph)
- Max rate of climb at S/L ... 366 m (1,200 ft)/min
- T-O to 15 m (50 ft) ... 244 m (800 ft)
- Landing run ... 122 m (400 ft)
- Range: with standard fuel ... 651 n miles (1,207 km; 750 miles)
  - with max fuel ... 869 n miles (1,609 km; 1,000 miles)

AIRDALE MAGNUM

TYPE: Side-by-side kitbuilt.

PROGRAMME: Development of original Avid Flyer.

CUSTOMERS: About 200 under construction with over 125 completed by mid 2006.

COSTS: Kit US$26,990 without engine (2003).

DESIGN FEATURES: High-wing braced monoplane, similar to Flyer, but in certified category, using a Textron Lycoming engine. Recent upgrades include larger rudder and new external baggage door. Quoted build time 750 hours.

FLYING CONTROLS: Similar to Avid Flyer.

STRUCTURE: Similar to Avid Flyer, with Poly Fiber covering.

LANDING GEAR: Available as tricycle or tailwheel, with Cleveland wheels and brakes; wheel fairings. Spring aluminium landing gear standard. Optional floats.

POWER PLANT: One Textron Lycoming engine in 80.5 to 134 kW (108 to 180 hp) range, including O-235, O-320 and O-360. Tricycle version also accepts 119 kW (160 hp) Subaru EJ22 engine. Fuel capacity 110 litres (29.0 US gallons; 24.1 Imp gallons) of which 106 litres (28.0 US gallons; 23.3 Imp gallons) are usable. Optional 45 litre (12.0 US gallon; 10.0 Imp gallon) wingtip tanks available.

ACCOMMODATION: Two seats side by side, with dual controls, plus optional jump seat for small adult or two children in 0.81 m³ (28.5 cu ft) baggage area.

DIMENSIONS, EXTERNAL:
- Wing span ... 10.06 m (33 ft 0 in)
- Wing chord, constant ... 1.37 m (4 ft 6 in)
- Wing aspect ratio ... 8.0
- Width, wings folded ... 2.59 m (8 ft 6 in)
- Length overall ... 6.40 m (21 ft 0 in)
- Height overall ... 1.86 m (6 ft 1¼ in)

DIMENSIONS, INTERNAL:
- Cabin max width ... 1.12 m (3 ft 8 in)

AREAS:
- Wings, gross ... 12.63 m² (136.0 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty ... 442 kg (975 lb)
- Max baggage weight ... 68 kg (150 lb)
- Max T-O weight ... 794 kg (1,750 lb)
- Max wing loading ... 62.8 kg/m² (12.87 lb/sq ft)
- Power loading (119 kW; 160 hp) ... 6.66 kg/kW (10.94 lb/hp)

PERFORMANCE (119 kW; 160 hp O-320 engine):
- Never-exceed speed (VNE) ... 134 kt (249 km/h; 155 mph)
- Cruising speed ... 113 kt (209 km/h; 130 mph)
- Stalling speed ... 31 kt (58 km/h; 36 mph)
- Max rate of climb at S/L ... 549 m (1,800 ft)/min
- Service ceiling ... more than 6,100 m (20,000 ft)
- T-O run ... approx 46 m (150 ft)
- T-O to 15 m (50 ft) ... 69 m (225 ft)
- Landing run ... 76 m (250 ft)
- Range ... 450 n miles (833 km; 517 miles)

AIR ELITE

AIR ELITE AVIATION

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Air Elite is licensed by Prestige Aircraft Company of Jackson, Michigan, to distribute in North America the products of the Italian SG Aviation company, with which Prestige has a 30-year manufacturing agreement. The first US-built aircraft, a Rally, was exhibited at Sun 'n' Fun in April 2006. It is proposed to add indigenously built versions of the Storm (known in the US as Century) and Sea Storm to the portfolio. All are initially intended for the LSA market, with the Sea Storm later gaining FAR Pt 23 certification.

AIR ELITE STORM RALLY

TYPE: Two-seat lightplane.

PROGRAMME: Initial US-built Storm Rally, N337SP, demonstrated at Sun 'n' Fun, Lakeland, Florida, April 2006. Second followed four months later. Design granted LSA approval in 2006.

DESIGN FEATURES: As for Italian-manufactured aircraft, except that brakes and all appropriate fittings, fixings and bearings are of US dimensions and/or manufacture. *As for SG Rally, except the following.*

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS2 flat-four driving a Warp Drive or Woodcomp three-blade, ground-adjustable pitch propeller through 1:2.43 reduction gear. Fuel capacity 133 litres (35.0 US gallons; 29.2 Imp gallons), of which 128 litres (34.0 US gallons; 28.3 Imp gallons) usable.

ACCOMMODATION: Two persons, side by side. Upward-hinged doors each side. Separate baggage compartment behind cockpit.

DIMENSIONS, EXTERNAL:
- Wing span ... 8.71 m (28 ft 7 in)
- Wing aspect ratio ... 6.4
- Length overall ... 7.08 m (23 ft 2¾ in)
- Height overall ... 2.31 m (7 ft 6¾ in)
- Tailplane span ... 2.97 m (9 ft 9 in)
- Propeller diameter: Woodcomp ... 1.78 m (5 ft 10 in)
  - Warp Drive ... 1.75 m (5 ft 9 in)
- Passenger door: Height ... 0.99 m (3 ft 3 in)
  - Width ... 0.86 m (2 ft 10 in)

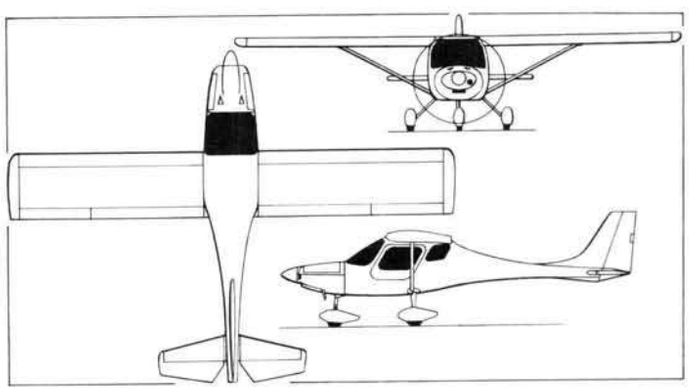
DIMENSIONS, INTERNAL:
- Cockpit (instrument panel to rear bulkhead):
  - Length ... 1.78 m (5 ft 10 in)
  - Max width ... 1.07 m (3 ft 6 in)
  - Max height (from seat) ... 1.02 m (3 ft 4 in)
- Baggage compartment volume ... 0.45 m³ (16.0 cu ft)

AREAS:
- Wings, gross ... 11.86 m² (127.7 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty ... 345 kg (760 lb)
- Max baggage weight ... 45 kg (100 lb)
- Max T-O weight ... 598 kg (1,320 lb)
- Max wing loading ... 50.5 kg/m² (10.34 lb/sq ft)
- Max power loading ... 8.15 kg/kW (13.38 lb/hp)

PERFORMANCE:
- Never-exceed speed (VNE):
  - aerodynamic ... 140 kt (259 kmh; 161 mph)

First Air Elite Storm Rally US-built version of SG Storm *(Paul Jackson)* 1159367



Air Elite Storm Rally *(James Goulding)* 1159393

- LSA limit ... 120 kt (222 km/h; 138 mph)
- Cruising speed at 75% power at 610 m (2,000 ft) ... 107 kt (198 km/h; 123 mph)
- Stalling speed, power off: flaps up ... 44 kt (82 km/h; 51 mph)
  - flaps down ... 35 kt (65 km/h; 41 mph)
- Max rate of climb at S/L ... 244 m (800 ft)/min
- Service ceiling ... 3,660 m (12,000 ft)
- T-O run ... 110 m (360 ft)
- T-O to 15 m (50 ft) ... 183 m (600 ft)
- Landing from 15 m (50 ft) ... 305 m (1,000 ft)
- Landing run ... 138 m (450 ft)
- Range with max fuel at 75% power ... 800 n miles (1,481 km; 920 miles)
- Endurance ... 7 h 10 min
- g limits ... +4.4/−1.76

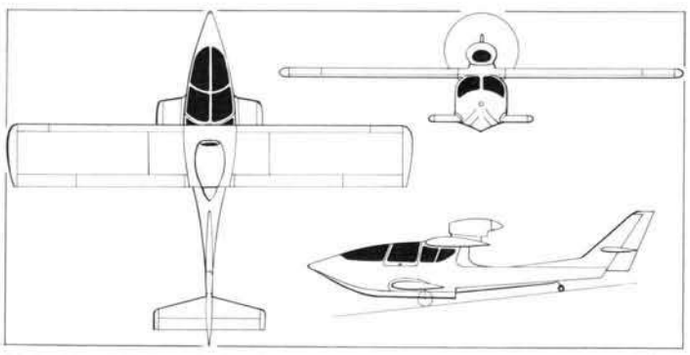
AIR ELITE SEASTORM

TYPE: Two-seat amphibian.

PROGRAMME: Derived by SG Aviation of Italy as Sea Storm from earlier ultralight version, with 59.7 kW (80 hp) engine and metal strut-braced wings, of which some 20 flying in Italy by 2002. First all-composites SG Sea Storm kitbuilt under construction in 2000/01 by SG's North American agent, Eric Dixon and first flew (N221ST) October 2001; later returned to

Italian-built SG Sea Storm two/four-seat amphibian *(Geoffrey P Jones)*

1044758



SG Sea Storm *(James Goulding)*

0093636

Italy. Ultralight Sea Storm with carbon wing and bracing struts under construction in 2003. Programme transferred to AirElite for potential manufacture as ready-to-fly LSA category amphibian under slightly revised name of SeaStorm; US LSA approval expected by end 2006.

Pending completion of US LSA trials, following data generally apply to former Italian-fabricated version.

CURRENT VERSIONS: **Z2:** Two-seat; baseline version.

Z4: Four-seat; increased wing span and power.

CUSTOMERS: Three sold in USA by April 2002; one Z2 to Australia in 2003. 26 sold (including earlier ultralight) by 2004, of which three then complete.

COSTS: Kit UL EUR34,600; Z2 EUR35,200. Z4 EUR38,900 (2005).

DESIGN FEATURES: High, constant-chord wing, moderately sweptback tailplane and highly sweptback fin; pusher propeller immediately aft of wing trailing-edge; mid-positioned stub-wing with stabilising floats. Quoted kit build time 700 hours.

Wing dihedral 0° 5'; incidence 2° 30'.

FLYING CONTROLS: Conventional and manual. Fowler flaps. Electric trim.

STRUCTURE: Composites fuselage and aluminium wing with main and rear spars.

LANDING GEAR: Optional retractable wheel landing gear attached immediately outboard of wingroots; 6.00-6 wheels.

POWER PLANT: One pusher piston/rotary engine.

Z2: Option of 73.5 kW (98.6 hp) Rotax 912 ULS or 84.6 kW (113.4 hp) Rotax 914 flat-four or 70.8 kW (95 hp) Mid-West AE 100 rotary driving an adjustable-pitch propeller. Textron Lycoming engines in the 82.0 to 119 kW (110 to 160 hp) range are also suggested. Standard fuel capacity 140 litres (37.0 US gallons; 30.8 Imp gallons), with optional extra 79 litre (20.9 US gallon; 17.4 Imp gallon) tanks available.

Z4: One 157 kW (210 hp) Textron Lycoming O-360; engines recommended in the range 149 to 224 kW (200 to 300 hp). Fuel capacity 200 litres (52.8 US gallons; 44.0 Imp gallons) as standard; optional 61 litre (16.1 US gallon; 13.4 Imp gallon) tanks available.

Idrovario hydraulic, flight-adjustable pitch, two- or three-blade propeller.

ACCOMMODATION: Two (side by side) or four persons in enclosed cabin with centreline-hinged door each side.

All data following (including dimensions) are approximate.

DIMENSIONS, EXTERNAL (A: Z2; B: Z4):

Wing span: A	9.60 m (31 ft 6 in)
B:	10.10 m (33 ft 1¾ in)
Length overall: A, B	7.44 m (24 ft 5 in)
Height overall: A, B	1.83 m (6 ft 0 in)

DIMENSIONS, INTERNAL:

Cabin max width: A, B	1.05 m (3 ft 5¼ in)

AREAS:

Wings, gross: A	12.96 m² (139.5 sq ft)
B	13.65 m² (146.9 sq ft)

WEIGHTS AND LOADINGS (A, B, as above):

Weight empty: A	510 kg (1,124 lb)
B	690 kg (1,521 lb)
Baggage capacity: A	30 kg (66 lb)
B	55 kg (121 lb)
Max T-O weight: A	810 kg (1,785 lb)
B	1,200 kg (2,645 lb)
Max wing loading: A	62.5 kg/m² (12.80 lb/sq ft)
B	87.9 kg/m² (18.01 lb/sq ft)
Max power loading:	
A (Rotax 912)	11.02 kg/kW (18.11 lb/hp)
B (157 kW; 210 hp)	7.64 kg/kW (12.56 lb/hp)

PERFORMANCE (A, B, as above):

Never-exceed speed (VNE):	
A	135 kt (250 km/h; 155 mph)
B	162 kt (300 km/h; 186 mph)
Max level speed: A	121 kt (225 km/h; 140 mph)
B	143 kt (265 km/h; 165 mph)
Cruising speed at 75% power at FL80:	
A	111 kt (205 km/h; 127 mph)
B	125 kt (232 km/h; 144 mph)
Stalling speed:	
flaps up: A	35 kt (64 km/h; 40 mph)
B	46 kt (85 km/h; 53 mph)
flaps down: A	33 kt (61 km/h; 38 mph)
B	40 kt (74 km/h; 46 mph)
Max rate of climb at S/L: A	240 m (787 ft)/min
B	330 m (1,082 ft)/min
Service ceiling: A	3,960 m (13,000 ft)
B	4,570 m (15,000 ft)
T-O run:	
on land: A	180 m (591 ft)
B	220 m (722 ft)
on water: A	195 m (640 ft)
B	350 m (1,150 ft)
Landing run:	
on land: A	200 m (656 ft)
B	250 m (820 ft)
on water: A	146 m (480 ft)
B	210 m (690 ft)
Range, no reserves:	
A	917 n miles (1,700 km; 1,056 miles)
B	540 n miles (1,000 km; 621 miles)
g limits: A	+4.2/−2.0
B	+3.2/−1.8

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Airframes (a certified repair station established in 1998) and its associate are manufacturers of kits and parts for the Piper Super Cub. They jointly offer the Super 18 kit, either complete for home builders or as selected components for refurbishment of Piper-built aircraft.

AIRFRAMES/DAKOTA SUPER 18

TYPE: Tandem-seat kitbuilt.
PROGRAMME: Description of Piper PA-18 Super Cub Crafters entry in US section of *Jane's All the World's Aircraft*. Super 18 is broadly similar.
COSTS: Kit USD33,530, excluding engine and avionics (2006).

AIR TRACTOR

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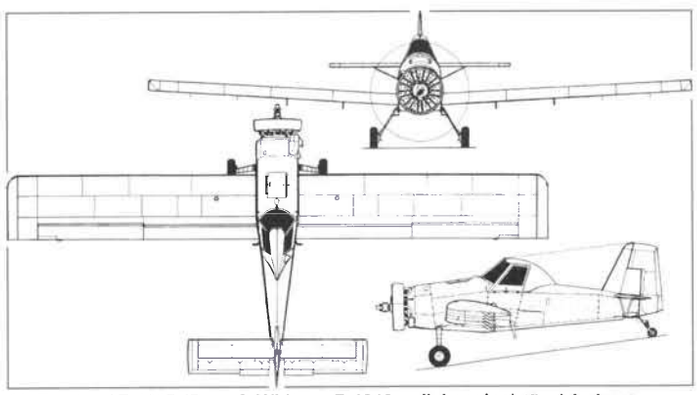
Air Tractor agricultural aircraft based on 50-year experience of Leland Snow, who produced Snow S-2 series, which later became Rockwell S-2R; AT-300/301/302 (587 built) no longer in production; 2,000th aircraft delivered in 2002. Eight versions available, powered by various P&W PT6A and R-1340 engines. Company now has 180 employees and total of 13,660 m² (147,000 sq ft) of manufacturing space at three plants.

AIR TRACTOR AT-401 AIR TRACTOR

TYPE: Agricultural sprayer.
PROGRAMME: AT-401 developed 1986 from AT-301, with increased wing span and larger hopper. AT-401A version with Polish PZL-3S radial engine abandoned, with just one aircraft produced. AT-401B version replaced the 401 and has Hoerner wingtips and increased wing span.
CURRENT VERSIONS: **AT-401B:** Standard version; *as described.*

Increased T-O weight: Optional version with landing gear of AT-402A and 517 kg (1,140 lb) of additional disposable load.

Radial-engined Air Tractor AT-401 agricultural sprayer 1195989



Air Tractor AT-401B (Pratt & Whitney R-1340 radial engine) *(Paul Jackson)* 1158972

CUSTOMERS: By December 2005, 198 AT-401s, one AT-401A and 77 AT-401Bs delivered to Argentina, Australia, Brazil, Canada, Colombia, Mexico, Spain and US. Production of AT-400/400A totalled 72 and 14, respectively.

COSTS: Standard AT-401B USD277,500; with customer-supplied engine USD235,300 (both 2004).

DESIGN FEATURES: Purpose-designed sprayer with cantilever low wing and hopper at CG. Constant-chord, unswept wings and tailplane; latter braced; moderately sweptback fin. High-mounted cockpit with protective reinforcement.

Wing aerofoil NACA 4415; dihedral 3° 30'; incidence 2°.

FLYING CONTROLS: Conventional and manual. Balance tabs on ailerons, elevators and rudders; ailerons droop 10° when electrically operated Fowler flaps deflected to their maximum of 26°.

STRUCTURE: Two-spar wing structure of 2024-T3 light alloy, with alloy steel lower spar cap; bonded doubler inside wing leading-edge to resist impact damage; glass fibre wingroot fairings and skin overlaps sealed against chemical ingress; wing ribs and skins zinc chromated before assembly; flaps and ailerons of light alloy. Fuselage of 4130N steel tube, oven stress relieved and oiled internally, with skin panels of 2024-T3 light alloy attached by Camloc fasteners for quick removal; rear fuselage lightly pressurised to prevent chemical ingress; cantilever fin and strut-braced tailplane of light alloy, metal-skinned and sealed against chemical ingress.

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted, cantilever heavy-duty E-4340 spring steel main gear, thickness 28.6 mm (1.125 in); flat spring suspension for castoring and lockable tailwheel. Cleveland mainwheels with tyre size 8.50-10 (8 ply), pressure 2.83 bar (41 lb/sq in). Tailwheel tyre size 5.00-5. Cleveland four-piston brakes with heavy-duty discs. Optional AT-402A-type landing gear.

POWER PLANT: One remanufactured 447 kW (600 hp) Pratt & Whitney R-1340 air-cooled radial engine with speed ring cowling or optional RamAir Scoopkit, driving a Hamilton Sundstrand 12D40/6101A-12 two-blade propeller; optional propellers include a Pacific Propeller 22D40/AG200-2 Hydromatic two-blade constant-speed metal and Hydromatic 23D40 three-blade propeller. Air Tractor has designed and is producing new FAA-approved replacement crankshaft for R-1340; other new replacement parts available include main and thrust bearings, and blower (impeller) bearings. Over 300 replacement crankshafts delivered by early 1997. 477 litre (126 US gallon; 105 Imp gallon) fuel tanks. Oil capacity 30 litres (8.0 US gallons; 6.7 Imp gallons). Orenda OE600 V-8 liquid-cooled piston engine of 447 kW (600 hp) tested in December 1999; development towards certification continued, with aim of deliveries during 2001.

ACCOMMODATION: Single seat with nylon mesh cover in enclosed cabin which is sealed to prevent chemical ingress. Downward-hinged window/door on each side. 'Line of sight' instrument layout, with swing-down lower instrument panel for ease of access for instrument maintenance. Baggage compartment in bottom of fuselage, aft of cabin, with door on port side. Cabin ventilation by 0.10 m (4 in) diameter airscoop.

SYSTEMS: 24 V electrical system, supplied by 35 A engine-driven alternator; 60 A alternator optional.

AVIONICS: Optional avionics include Bendix/King KX 155 nav/com/glideslope and ACK E-01 emergency locator transmitter.

EQUIPMENT: Agricultural dispersal system comprises a 1,514 litre (400 US gallon; 333 Imp gallon) Derakane vinylester resin/glass fibre hopper mounted in forward fuselage with hopper window and instrument panel-mounted hopper quantity gauge; 0.97 m (3 ft 2 in) wide Transland gatebox; Transland 5 cm (2 in) bottom loading valve; Agrinautics 6.4 cm (2½ in) spraypump with Transland on/off valve and five-blade variable-pitch plastics fan, and 38-nozzle stainless steel spray system with streamlined booms; swath width 24.39 m (80 ft 0 in). Ground start receptacle and hopper rinse system are standard.

Optional equipment includes night flying package comprising strobe and navigation lights, night working lights, retractable 600 W landing light in port wingtip; and ferry fuel system. Alternative agricultural equipment includes Transland 22358 extra high-volume spreader, Transland 54401 NorCal Swathmaster, and 40 extra spray nozzles for high-volume spraying. Three-piece safety plate glass centre windshield and washer system optional, as is a new crew seat.

DIMENSIONS, EXTERNAL:

Wing span	15.57 m (51 ft 1¼ in)
Wing chord, constant	1.83 m (6 ft 0 in)
Wing aspect ratio	8.5
Length overall	8.23 m (27 ft 0 in)
Height overall	2.59 m (8 ft 6 in)
Propeller diameter: standard	2.77 m (9 ft 1 in)
optional	2.59 m (8 ft 6 in)

AREAS:

Wings, gross	28.43 m² (306.0 sq ft)
Ailerons (total)	3.55 m² (38.20 sq ft)
Trailing-edge flaps (total)	3.75 m² (40.40 sq ft)
Fin	0.90 m² (9.70 sq ft)
Rudder	1.30 m² (14.00 sq ft)
Tailplane	2.42 m² (26.00 sq ft)
Elevators, incl tabs	2.36 m² (25.40 sq ft)

WEIGHTS AND LOADINGS (S: standard, IGW: increased gross weight):

Weight empty, spray equipped	1,925 kg (4,244 lb)
Max T-O weight: S	3,565 kg (7,860 lb)
IGW	4,082 kg (9,000 lb)
Max landing weight: S	2,721 kg (6,000 lb)
IGW	3,175 kg (7,000 lb)
Max wing loading: S	125.4 kg/m² (25.69 lb/sq ft)
IGW	143.6 kg/m² (29.41 lb/sq ft)
Max power loading: S	7.97 kg/kW (13.10 lb/hp)
IGW	9.13 kg/kW (15.00 lb/hp)

PERFORMANCE (at standard max T-O weight, except where indicated):

Max cruising speed at S/L, hopper empty	135 kt (251 km/h; 156 mph)
Cruising speed at FL40	124 kt (230 km/h; 143 mph)
Typical working speed	104–122 kt (193–225 km/h; 120–140 mph)
Stalling speed at 2,721 kg (6,000 lb) AUW:	
flaps up	64 kt (118 km/h; 73 mph)
flaps down	53 kt (99 km/h; 61 mph)
Stalling speed as usually landed	47 kt (87 km/h; 54 mph)
Max rate of climb at S/L:	
at max landing weight	335 m (1,100 ft)/min
at max T-O weight	158 m (520 ft)/min
T-O run	402 m (1,320 ft)
Range at econ cruising speed at FL80, no reserves	547 n miles (1,014 km; 630 miles)

AIR TRACTOR AT-402 TURBO AIR TRACTOR

TYPE: Agricultural sprayer.

PROGRAMME: Follow-on from AT-400 of 1980. AT-402 first flight August 1988; certified November 1988; first delivery late 1988. Current 402A and 402B have Hoerner wingtips and increased span.

CURRENT VERSIONS: **AT-402A:** Introduced in mid-1997, supplementing AT-402B, powered by a 410 kW (550 shp) P&WC PT6A-11AG. Aimed at first-time turbine buyer and priced accordingly, complete with spray dispersal equipment, lights and air conditioning.

AT-402B: Combines fuselage, tail surfaces and landing gear of AT-400 with turboprop engine and wing of AT-401B.

Description refers to AT-402B, and is generally as for AT-401, except that below.

CUSTOMERS: Total of 68 AT-402s, 112 AT-402As and 46 AT-402Bs delivered by December 2005. Production continuing at about 10 per year.

COSTS: Standard AT-402A with PT6A-11AG USD499,900; standard AT-402B USD599,500; or USD284,500 with customer-supplied PT6A-15AG, -27, -28 or -34AG engine (2006).

DESIGN FEATURES: Broadly as AT-401. All versions have steel alloy lower wing spar caps for long fatigue life and reinforced leading-edges to prevent birdstrike damage. Size 29×11.0-10 high-flotation tyres and wheels as standard.

POWER PLANT: One 507 kW (680 shp) P&WC PT6A-15AG, -27 or -28 turboprop, either new or customer-furnished, driving a Hartzell HCB3TN-3D/T10028N+4 three-blade constant-speed reversible-pitch propeller. Standard fuel capacity 644 litres (170 US gallons; 142 Imp gallons); optional fuel tankage 818 litres (216 US gallons; 180 Imp gallons) or 886 litres (234 US gallons; 195 Imp gallons).

SYSTEMS: 250 A starter/generator and two 24 V 21 Ah batteries.

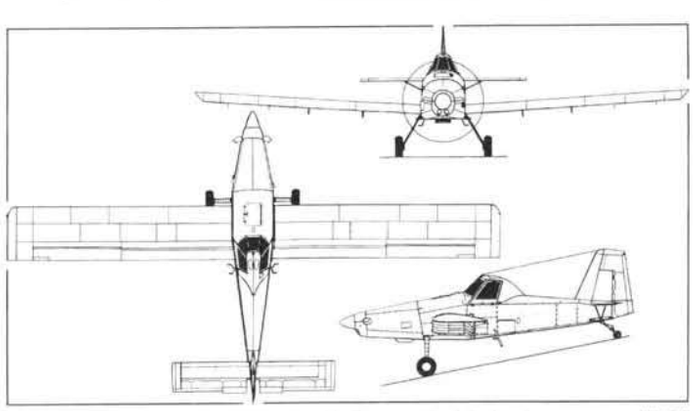
EQUIPMENT: Hopper and gatebox size as for AT-401; optional equipment includes Transland extra high-volume dispersal system; engine-driven air conditioning system.

DIMENSIONS, EXTERNAL:

Length overall	9.32 m (30 ft 7 in)
Height: propeller turning	3.40 m (11 ft 2 in)
to top of cockpit	2.90 m (9 ft 6 in)
Tailplane span	5.23 m (17 ft 2 in)
Wheel track	2.62 m (8 ft 7 in)

WEIGHTS AND LOADINGS:

Weight empty, spray equipped, both	1,783 kg (3,930 lb)
Certified gross weight (FAR Pt 23)	3,175 kg (7,000 lb)
Typical operating weight (CAM 8):	
AT-402A	3,901 kg (8,600 lb)
AT-402B	4,159 kg (9,170 lb)
Max landing weight, both	3,175 kg (7,000 lb)
Max wing loading	137.2 kg/m² (28.10 lb/sq ft)
Max power loading	7.70 kg/kW (12.65 lb/shp)



Air Tractor AT-402A/AT-402B Turbo Air Tractor *(Paul Jackson)* 1158971

Air Tractor AT-402A Turbo Air Tractor 1195990

PERFORMANCE:

Max level speed at S/L:	
clean	174 kt (322 km/h; 200 mph)
with dispersal equipment	160 kt (298 km/h; 185 mph)
Cruising speed at 283 kW (380 shp) at FL80	142 kt (264 km/h; 164 mph)
Typical working speed	113–126 kt (209–233 km/h; 130–145 mph)
Stalling speed at 2,721 kg (6,000 lb) AUW:	
flaps up	64 kt (118 km/h; 73 mph)
flaps down	53 kt (99 km/h; 61 mph)
Stalling speed at 2,041 kg (4,500 lb) typical landing weight	46 kt (86 km/h; 53 mph)
Max rate of climb at S/L, dispersal equipment installed:	
AUW of 2,721 kg (6,000 lb)	495 m (1,625 ft)/min
AUW of 3,565 kg (7,860 lb)	320 m (1,050 ft)/min
T-O run at 3,565 kg (7,860 lb) AUW	247 m (810 ft)
Landing run at 2,041 kg (4,500 lb) AUW	122 m (400 ft)
Range at econ cruising speed at FL80, no reserves	573 n miles (1,062 km; 660 miles)

Air Tractor AT-502 agricultural sprayer 1195992

AIR TRACTOR AT-502 TURBO

TYPE: Agricultural sprayer.

PROGRAMME: Developed as stretched AT-401. First flight of AT-502 April 1987; certified 23 June 1987.

CURRENT VERSIONS: **AT-502:** Original version.

Description refers to AT-502, and is generally as for AT-401, except that below:

AT-502A: Similar to AT-502B but with 820 kW (1,100 shp) PT6A-45R; slow turning (1,425 rpm) five-blade Hartzell (HCB5MP-3C/M10876AS) propeller; enlarged vertical tail surfaces. For operation in mountainous terrain or short strips. Prototype first flight February 1992; certified April 1992; 26 delivered by end 2005.

AT-502B: Stronger wing than AT-502, with 0.61 m (2 ft) longer span and Hoerner wingtips, which are stated to increase width of spray pattern by 0.91 m (3 ft); 349 delivered by end of 2005.

AT-503A: Dual control, tandem-seat trainer; PT6A-34AG engine. Prototype designated AT-503. In low-rate production.

CUSTOMERS: Total of 595 AT-500 series delivered by end of 2005, including out-of-production AT-501 (nine), AT-502 (208), AT-503 (one), plus AT-503A (three). Recent deliveries to Argentina, Australia, Brazil and US.

COSTS: Standard AT-502B USD654,900 with PT6A-15AG, or USD703,900 with-34AG; or USD334,500 with customer-supplied PT6A-15AG, -27, -28, -34AG (2004).

DESIGN FEATURES: See AT-401. 1,892 litre (500 US gallon; 416 Imp gallon) hopper handles low-density nitrogen-based fertilisers such as urea; safety glass centre windscreen with wiper. Alloy steel lower spar cap and bonded doubler on inside of wing leading-edge for increased resistance to impact damage, and glass fibre wingroot fairings.

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted, heavy-duty E-4340 spring steel main gear, thickness 37.2 mm (1.31 in); flat spring for castoring and lockable tailwheel. Cleveland mainwheels, with high-flotation tyres size 29×11.0–10, pressure 3.45 bar (50 lb/sq in); tailwheel tyre size 5.00–5; Cleveland six-piston brakes with heavy-duty discs.

POWER PLANT: One 507 kW (680 shp) Pratt & Whitney Canada PT6A-15AG, PT6A-27 or PT6A-28, or 559 kW (750 shp) PT6A-34 or PT6A-34AG turboprop, driving a Hartzell HCB3TN-3D/T10282+4 three-blade metal propeller. Standard fuel capacity 644 litres (170 US gallons; 142 Imp gallons). Optional capacities 818 litres (216 US gallons; 180 Imp gallons) and 886 litres (234 US gallons; 195 Imp gallons). AT-502A has 818 litre (216 US gallon; 180 Imp gallon) tanks as standard.

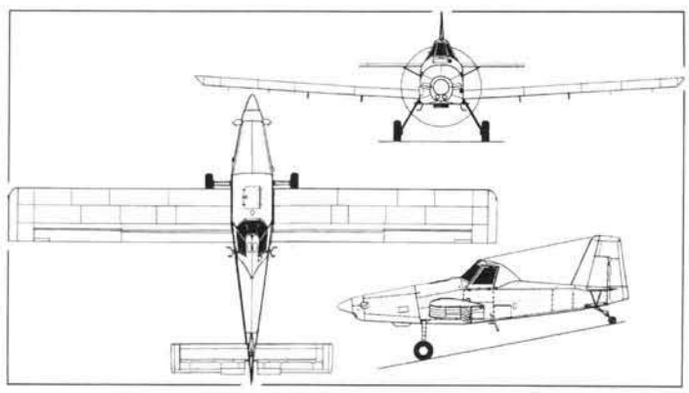
ACCOMMODATION: One or two persons (see Current Versions). Has quickly detachable instrument panel and removable fuselage skin panels for ease of maintenance.

SYSTEMS: Three 24 V 42 Ah batteries and 250 A starter/generator.

AVIONICS: *Comms:* Optional avionics include Bendix/King KX 155 nav/com/glideslope and KR 87 ADF, KY 196 VHF radio, KT 76A transponder and ACK E-01 emergency locator transmitter.

EQUIPMENT: Agricultural dispersal system comprises a 1,892 litre (500 US gallon; 416 Imp gallon) hopper mounted in forward fuselage with hopper window and instrument panel-mounted hopper quantity gauge; 0.97 m (3 ft 2 in) wide Transland gatebox; Transland 6.4 cm (2½ in) bottom loading valve; Agrinautics 6.4 cm (2½ in) spraypump with Transland on/off valve and five-blade variable-pitch plastics fan and 38-nozzle stainless steel spray system with streamlined booms. Optional dispersal equipment includes 7.6 cm (3 in) spray system with 119 spray nozzles, and automatic flagman; spray swath 25.91 m (85 ft 0 in).

Standard equipment includes safety glass centre windscreen panel, ground start receptacle, three-colour polyurethane paint finish, strobe and navigation lights; windscreen washer and wiper; and twin nose-mounted landing/taxi lights. Optional equipment includes engine-driven air conditioning system, night flying package, comprising night working lights, retractable 600 W landing light in port wingtip; fuel flowmeter, fuel totaliser and ferry fuel system. Alternative agricultural equipment includes Transland 22356 extra high-volume spreader, Transland 54401 NorCal Swathmaster, 40 extra spray nozzles for high-volume spraying, and eight- or 10-unit Micronair Mini Atomiser unit; hopper rinse tank is standard. New crew seat is also optional.



Air Tractor AT-502B agricultural aircraft *(Paul Jackson)* 1158970

DIMENSIONS, EXTERNAL:

Wing span: AT-502A/502B	15.85 m (52 ft 0 in)
AT-502	15.24 m (50 ft 0 in)
Wing chord, constant	1.83 m (6 ft 0 in)
Wing aspect ratio	8.7
Length overall	10.11 m (33 ft 2 in)
Height: propeller turning	3.63 m (11 ft 11 in)
to top of cockpit	3.12 m (10 ft 3 in)
Tailplane span	5.23 m (17 ft 2 in)
Wheel track	3.12 m (10 ft 3 in)
Wheelbase	6.64 m (21 ft 9½ in)
Propeller diameter: AT-502B	2.69 m (8 ft 10 in)

AREAS:
- Wings, gross: AT-502A/502B ..... 28.99 m² (312.0 sq ft)
- AT-502 ..... 27.87 m² (300.0 sq ft)
- Ailerons (total) ..... 3.53 m² (38.0 sq ft)
- Trailing-edge flaps (total) ..... 3.75 m² (40.4 sq ft)
- Fin ..... 0.90 m² (9.7 sq ft)
- Rudder ..... 1.30 m² (14.0 sq ft)
- Tailplane ..... 2.41 m² (26.0 sq ft)
- Elevators (total, incl tab) ..... 2.44 m² (26.3 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty, spray equipped ..... 1,949 kg (4,297 lb)
- Max T-O weight ..... 4,399 kg (9,700 lb)
- Max landing weight ..... 3,629 kg (8,000 lb)
- Max wing loading:
  - AT-502A/502B ..... 151.8 kg/m² (31.09 lb/sq ft)
- Max power loading: 502A ..... 5.37 kg/kW (8.82 lb/shp)
  - 502B (PT6A-34AG) ..... 7.87 kg/kW (12.93 lb/shp)
  - 502B (PT6A-15AG) ..... 8.68 kg/kW (14.26 lb/shp)

PERFORMANCE (AT-502B with spray equipment installed):
- Never-exceed speed (VNE) and max level speed at S/L, hopper empty ..... 156 kt (290 km/h; 180 mph)
- Cruising speed at FL80, 283 kW (380 shp) ..... 136 kt (253 km/h; 157 mph)
- Typical working speed ..... 104–126 kt (193–233 km/h; 120–145 mph)
- Stalling speed at 3,629 kg (8,000 lb) AUW:
  - flaps up ..... 72 kt (132 km/h; 82 mph)
  - flaps down ..... 59 kt (110 km/h; 68 mph)
- Stalling speed at 1,978 kg (4,360 lb) typical landing weight ..... 46 kt (86 km/h; 53 mph)
- Max rate of climb at S/L, AUW of 3,629 kg (8,000 lb):
  - with PT6A-15AG ..... 311 m (1,020 ft)/min
  - with PT6A-34AG ..... 360 m (1,180 ft)/min
- Max rate of climb at S/L, AUW of 4,309 kg (9,500 lb):
  - with PT6A-15AG ..... 232 m (760 ft)/min
  - with PT6A-34AG ..... 282 m (925 ft)/min
- T-O run at AUW of 3,629 kg (8,000 lb):
  - with PT6A-15AG ..... 236 m (775 ft)
  - with PT6A-34AG ..... 222 m (730 ft)
- T-O run at AUW of 4,309 kg (9,500 lb):
  - with PT6A-15AG ..... 356 m (1,170 ft)
  - with PT6A-34AG ..... 302 m (990 ft)
- Range with max fuel ..... 538 n miles (998 km; 620 miles)

AIR TRACTOR AT-602

TYPE: Agricultural sprayer.

PROGRAMME: Prototype first flew 1 December 1995. Certification completed 6 June 1996 and deliveries began the following month. Aircraft fits into Air Tractor range between AT-502B and AT-802A, being AT-502 with increased wing and tail spans, plus taller fin.

CUSTOMERS: Total of 141 produced by end of 2005.

COSTS: Standard AT-602 with PT6A-60AG USD925,000; with customer-supplied engine USD410,900 (2004).

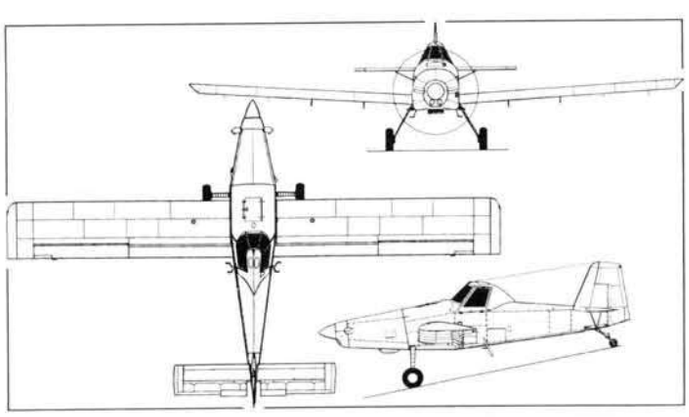
Description generally as for AT-401, except that following.

POWER PLANT: Choice of 783 kW (1,050 shp) Pratt & Whitney Canada PT6A-60AG turboprop, or PT6A-65AG of 966 kW (1,295 shp), driving a Hartzell five-blade constant-speed reversing propeller. Fuel capacity 818 litres (216 US gallons; 180 Imp gallons); optional fuel capacity 1,105 litres (292 US g; 243 Imp gallons).

EQUIPMENT: Glass fibre hopper, capacity 2,385 litres (630 US gallons; 525 Imp gallons); Transland 0.96 m (3 ft 2 in) wide gatebox; five-blade ground-adjustable spraypump fan; pump shut-off valve. Optional crew seat.

DIMENSIONS, EXTERNAL:
- Wing span ..... 17.07 m (56 ft 0 in)
- Wing chord, constant ..... 1.83 m (6 ft 0 in)
- Wing aspect ratio 9.3

Air Tractor AT-602 1195994



Air Tractor AT-602 (P&WC PT6A-60AG engine) *(Paul Jackson)* 1158969
- Length overall ..... 10.41 m (34 ft 2 in)
- Height: propeller turning ..... 3.71 m (12 ft 2 in)
- to top of fin ..... 3.38 m (11 ft 1 in)
- to top of cockpit ..... 3.17 m (10 ft 5 in)
- Tailplane span ..... 5.66 m (18 ft 7 in)
- Wheel track ..... 3.07 m (10 ft 1 in)
- Wheelbase ..... 6.71 m (22 ft 0 in)

AREAS:
- Wings, gross ..... 31.22 m² (336.0 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty, equipped ..... 2,540 kg (5,600 lb)
- Max T-O weight ..... 5,670 kg (12,500 lb)
- Max landing weight ..... 5,443 kg (12,000 lb)
- Max wing loading ..... 181.6 kg/m² (37.20 lb/sq ft)
- Max power loading ..... 7.25 kg/kW (11.90 lb/shp)

PERFORMANCE:
- Never-exceed speed (VNE) ..... 189 kt (350 km/h; 217 mph)
- Working speed ..... 130 kt (241 km/h; 150 mph)
- Stalling speed: flaps up ..... 86 kt (160 km/h; 99 mph)
- flaps down ..... 75 kt (139 km/h; 87 mph)

AIR TRACTOR AT-802

TYPE: Agricultural sprayer.

PROGRAMME: Design started July 1989; optional configuration as firefighter; first flight of prototype (N802LS) 30 October 1990; second aircraft flew November 1991, with PT6A-45R and configured as agricultural model with spraybooms, pump and Transland gatebox. Production deliveries started second quarter 1993.

CURRENT VERSIONS: **AT-802**: Tandem two-seater powered by P&WC PT6A-45R; certified for gross weight of 6,804 kg (15,000 lb) 27 April 1993. PT6A-65AG and -67AG versions certified April 1993 at maximum T-O weight of 7,257 kg (16,000 lb).

AT-802A: Single-seat version; third production aircraft in this configuration; can be powered by refurbished PT6A-65AG or -67AG engine. First flight 6 July 1992; FAA certification gained 17 December 1992; certified for gross weight of 6,804 kg (15,000 lb) with PT6A-45R on 27 April 1993. PT6A-65AG versions certified March 1993 at maximum T-O weight of 7,257 kg (16,000 lb).

AT-802AF Fire Boss: Amphibious firefighting version; Wiplane amphibious floats with water-scooping capability.

AT-802F: Two-seat firefighting version; PT6A-67AG engine. FAA certification at 5,670 kg (12,500 lb) maximum T-O weight 17 December 1992; certified at 7,257 kg (16,000 lb) on 27 April 1993, giving useful load of 3,987 kg (8,790 lb).

Data apply to AT-802F version, except where indicated.

CUSTOMERS: Total 225 registered by December 2005. Deliveries include two to Saudi Arabia for oil slick eradication. More than 120 engaged in firefighting duties in six countries during 2006. Recent customers include Compañia de Extincion General de Incendios SA (CEGISA) of Spain, which purchased the first two production AT-802AF Fire Bosses in late 2003, leasing one to Conair of Canada; several more followed in 2004. Forest Protection Limited (FPL) of New Brunswick, Canada, which ordered six AT-802Fs, one purchased after lease during 2001, two for delivery in 2002 and three delivered in 2003, to replace Grumman Avenger firebombers; and the US State Department's International Narcotics and Law Enforcement Division, which operates 13 AT-802s, for drug eradication duties in Colombia in a joint programme with the Colombian National Police. These aircraft are modified with self-sealing fuel tanks, armoured engine compartments and cockpits, with bulletproof windscreens, engine fire-extinguishing systems; oxygen system, GPS and HF radios.

COSTS: Standard AT-802A USD1,093,900 with new PT6A-65AG; with customer-supplied PT6A-65AG or -67AG USD516,900. Standard AT-802AF USD1,372,900 with PT6A-67AG; or USD691,500 with customer-supplied PT6A-67AG. Two-seat version with dual controls USD33,500 extra (all 2006).

DESIGN FEATURES: Generally as for AT-401. Largest aircraft built by company to date; full dual controls for training; also designed for firefighting; programmable logic computer with cockpit control panel and digital display enables pilot to select coverage level and opens hydraulically operated 'bomb bay' drop doors to prescribed width, closing them when selected amount of retardant released. Drop doors adjust automatically for changing head pressure and aircraft acceleration to provide a constant flow rate and even ground coverage.

Wing aerofoil section NACA 4415; dihedral 3° 30'; incidence 2°.

FLYING CONTROLS: Manually operated ailerons, elevators and rudder with balance tabs; electrically operated Fowler trailing-edge flaps deflect to maximum 30°.

STRUCTURE: Two-spar wing of 2024-T3 light alloy with alloy steel upper and lower spar caps and bonded doubler on inside of leading-edge for impact damage resistance; ribs and skins zinc chromated before assembly; glass fibre wingroot fairing and skin overlaps sealed against chemical ingress; flaps and ailerons of light alloy. Fuselage of welded 4130N steel tube, oven stress relieved and oiled internally, with skin panels of 2024-T3 light alloy attached by Camloc fasteners for quick removal; rear fuselage lightly pressurised to prevent chemical ingress. Cantilever fin and strut-braced tailplane of light alloy, metal skinned and sealed against chemical ingress.

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted, cantilever heavy-duty E-4340 spring steel main legs, thickness 44.5 mm (1.75 in); flat spring suspension for castoring and lockable tailwheel. Cleveland mainwheels with tyre size 11.00–12 (10 ply), pressure 4.14 bar (60 lb/sq in). Tailwheel tyre size 6.00–6. Cleveland eight-piston brakes with heavy-duty discs.

POWER PLANT: One Pratt & Whitney Canada PT6A-65AG or -67AG turboprop, rated at 966 kW (1,295 shp) for -65AG and 1,007 kW (1,350 shp) for -67AG, both driving a Hartzell five-blade feathering and reversible-pitch constant-speed metal propeller. Fuel in two integral wing tanks, total usable capacity 961 litres (254 US gallons; 211 Imp gallons); optional tanks increase capacity to 1,438 litres (380 US gallons; 317 Imp gallons). Engine air is filtered through two large pleated paper industrial truck filters.

ACCOMMODATION: One or two seats in enclosed cabin, which is sealed to prevent chemical ingress and protected with overturn structure. Four downward-hinged doors, two on each side. Windscreen is safety-plate auto glass, with washer and wiper. Air conditioning system standard.

SYSTEMS: Hydraulic system, pressure 207 bar (3,000 lb/sq in).

AVIONICS: Choice of avionics suites by Bendix/King and Garmin.

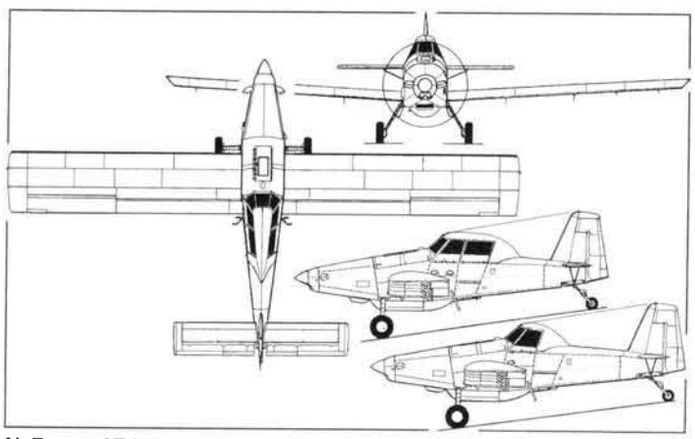
Comms: Bendix/King KX 155A nav/com; KY 99A or KY 196A transceivers; KLX 135 GPS/com; KT 76A transponder; KMA 24H audio control panel; Garmin GNS 430 or GNS 530 nav/com/GPS; GTX 320 transponder; GMA 340 audio panel.

Flight: Bendix/King KT 87 ADF; KCS 55A compass; KN 64 DME.

EQUIPMENT: Two removable Derakane vinylester hoppers forward of cockpit and 227 litre (60 US gallon; 50 Imp gallon) gate tank in ventral bulge, for agricultural chemical, fire retardant

Air Tractor AT-802 at work

1195996



Air Tractor AT-802 two-seat agricultural aircraft with extra side view (lower) of AT-802A single-seater *(Paul Jackson)*

1158968

or water; total capacity 3,028 litres (800 US gallons; 666 Imp gallons). Electronic spray monitoring system standard. Transland high-volume fertilising gate 0.96 × 0.25 m (3 ft 2 in × 10 in) optional.

DIMENSIONS, EXTERNAL:

Wing span	17.68 m (58 ft 0 in)
Wing chord, constant	2.07 m (6 ft 9½ in)
Wing aspect ratio	8.4
Length overall	10.95 m (35 ft 11 in)
Height overall	3.89 m (12 ft 9 in)
Tailplane span	6.03 m (19 ft 9½ in)
Wheel track	3.10 m (10 ft 2 in)
Wheelbase	7.25 m (23 ft 9½ in)
Propeller diameter (-65AG)	2.92 m (9 ft 7 in)

AREAS:

Wings, gross	37.25 m² (401.0 sq ft)
Ailerons (total)	4.61 m² (49.60 sq ft)
Trailing-edge flaps (total)	5.54 m² (59.60 sq ft)
Fin	1.24 m² (13.40 sq ft)
Rudder	1.57 m² (16.90 sq ft)
Tailplane	3.44 m² (37.00 sq ft)
Elevators (total, incl tab)	3.00 m² (32.30 sq ft)

WEIGHTS AND LOADINGS (AT-802A):

Weight empty, equipped: sprayer	2,867 kg (6,320 lb)
firefighter	3,270 kg (7,210 lb)
Max T-O and landing weight	7,257 kg (16,000 lb)
Max wing loading	194.8 kg/m² (39.90 lb/sq ft)
Max power loading (-67AG)	7.21 kg/kW (11.85 lb/shp)

PERFORMANCE:

Max level speed at S/L	182 kt (338 km/h; 210 mph)
Max cruising speed at FL80	192 kt (356 km/h; 221 mph)
Stalling speed, power off, flaps down, at max landing weight	79 kt (147 km/h; 91 mph)
Max rate of climb at S/L	259 m (850 ft)/min
Service ceiling	3,965 m (13,000 ft)
T-O run	610 m (2,000 ft)
Range with max fuel	696 n miles (1,289 km; 800 miles)

ALGIE

ALGIE COMPOSITE AIRCRAFT

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Web: www.members.iquest.net/~aca/

PROPRIETOR: David Algie

Mr Algie has applied his considerable experience of motorsport engineering to the design of a homebuilt aircraft which will be made available as an easy-assembly kit, powered by a motorcar engine.

ALGIE LP-1

TYPE: Side-by-side sportplane kitbuilt.

PROGRAMME: Elements of prototype displayed at AirVenture, Oshkosh, in July 2005. By September 2006, prototype estimated to be 20 months from first flight.

COSTS: Kit USD55,000, less engine and avionics (2006).

DESIGN FEATURES: High performance lightplane, suitable for air racing, powered by converted motorcar engine.

Wing section Riblett GA40A-215.

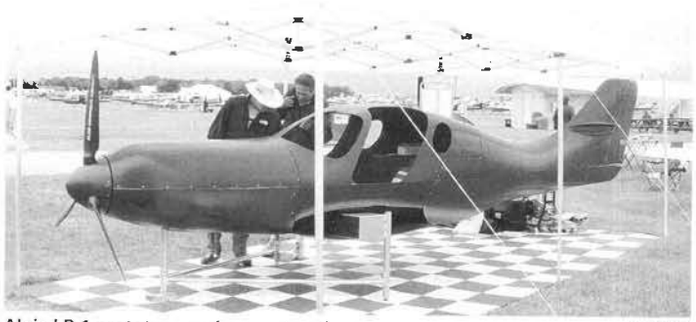
FLYING CONTROLS: Conventional and manual.

STRUCTURE: Generally of carbon fibre composites. Designed to assemble "like a scale plastic model": no fillet cover panels, as each part has half fillet built in; all fuselage components connect with knuckle joints for accurate alignment. Pressurised cockpit is a two-piece moulding including front and rear bulkheads. Elliptical planform wing houses four lightweight fuel bladders for improved fire prevention. Ribless wing uses Nomex honeycomb skins for structural support. Main and secondary spars are integral part of the skin and bond at the horizontal joint in the middle, as do horizontal and vertical stabilizer spars. Skin thus a true spar cap using unidirectional carbon for maximum strength and light weight.

Main and secondary spar carry-throughs in the cockpit are moulded-in to ensure accurate spar and wing fitting from below; also that the cockpit is sealed and that the fuselage can not expand due to internal pressurisation. Cockpit door is also integrally laid-up and of 'plug' type to withstand 0.7 bar (10 lb/sq in) differential pressure at FL300.

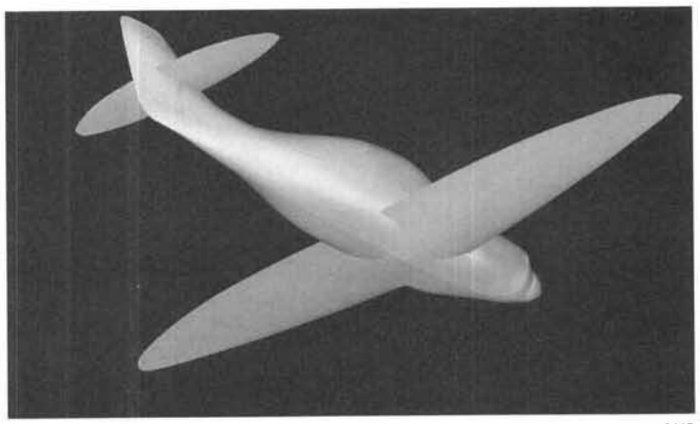
Main landing gear attached to rear of secondary spar inside the fuselage; nosewheel retracts into the front bulkhead, and is mounted by a lightweight carbon mount under the engine oil pan to aid engine protection in the event of a gear-up landing. Engine is removable while still on the landing gear. Access panels and wheel well covers are laid-up integrally, but still 90 per cent detached separate parts.

LANDING GEAR: Tricycle type; retractable. Oleo shock-absorbers on all units. Mainwheels retract by electric motor into aft section of cabin.



Algie LP-1 prototype under construction

1037953



Artist's impression of Algie LP-1 1195497

POWER PLANT: One 298 kW (400 hp) General Motors LS2 turbocharged V8 motorcar engine. Option of 395 kW (530 hp) LS7. All with 1.385:1 reduction gear. Fuel in wing tanks, total 235 litres (62.0 US gallons; 51.6 Imp gallons). Optional long-range tank under each wing, each 19 litres (5.0 US gallons; 4.2 Imp gallons).

ACCOMMODATION: Two persons in tandem. Accommodation pressurised.

DIMENSIONS, EXTERNAL:

Wing span	8.23 m (27 ft 0 in)
Wing aspect ratio	8.8
Length overall	6.40 m (21 ft 0 in)
Height overall	2.13 m (7 ft 0 in)
Tailplane span	3.05 m (10 ft 0 in)

DIMENSIONS, INTERNAL:

Cockpit max width	1.07 m (3 ft 6 in)
Baggage compartment:	
Length	0.97 m (3 ft 2 in)
Max width	0.56 m (1 ft 10 in)
Max height	0.38 m (1 ft 3 in)
Volume	0.21 m^3 (7.3 cu ft)

AREAS:

Wings, gross	7.66 m^2 (82.5 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	490 kg (1,080 lb)
Max T-O weight	862 kg (1,902 lb)
Max wing loading	112.6 kg/m^2 (23.05 lb/sq ft)
Max power loading (LS2)	2.89 kg/kW (4.76 lb/hp)

PERFORMANCE:

No estimates announced

AMD

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AMD was established in 1999 to produce and market the Zenair Zenith CH 2000 and CH2T. Its purpose-built, 2,600 m^2 (28,000 sq ft) factory became operational in December 1999; the first US-produced CH 2000 was completed in January 2000. In late 2003, partner Jordan Aerospace Industries (which see) began production of the SAMA CH 2000 derivative.

On 1 March 2001, AMD first flew the CH 640 kitbuilt, which draws on the CH 2000, but is now marketed by Zenair. In 2005, AMD began offering the LSA version of the CH 601XL.

AMD ZENITH CH 2000 ALARUS

TYPE: Two-seat lightplane.

PROGRAMME: Prototype C-FQCU first flown 26 June 1993; Canadian and US certification of prototypes 26 and 31 July 1994, respectively; first two production models (C-FRSK and C-FRSV) completed April 1994. First delivery September 1994; US type certification 25 July 1995 in Utility category and 29 January 2003 in Normal category. A test example fitted with 104.5 kW (140 hp) Lycoming O-320 was produced in 1995. Certified for IFR operations and spins on 2 October 1996. JAA certification received March 2000. Company revealed it would produce a lighter version during 2001, with 95 litre (25.0 US gallon; 20.8 Imp gallon) fuel capacity; this appears not to have occurred.

CURRENT VERSIONS: **CH 2000:** Standard production model, *as described*.

CH2T: Basic model intended for flight training market; avionics are not included.

SAMA CH2000: Produced by Jordan Aerospace Industries.

CUSTOMERS: Total of 43 delivered by time production moved from Canada to US in June 1999. First US-built aircraft (N17KA, one of 11 CH2Ts for KeyFlite Academy at Utica, New York, and Nashua, New Hampshire) received C of A on 14 January 2000 and delivered following day. Additionally, Zenair built production aircraft 0063 to 0065. A total of 134 built by September 2006.

COSTS: CH 2000 USD139,900 (2006). Provisional cost of lightweight version USD84,900 (2001).

DESIGN FEATURES: Side-by-side two-seat and smaller-span derivative of Tri-Z CH 300. Designed to conform to FAR Pt 23 (JAR-VLA equivalent level of safety). Conventional, low-wing configuration, with mid-mounted tailplane and sweptback fin.

Wing section LS (1) 0417 (mod).

FLYING CONTROLS: Manual. All-moving tailplane deflects 12° up and 9° 30' down with anti-balance tabs; all-moving fin/rudder with horn balance deflects 21° 30' each way. Electrically actuated split flaps lower to 50°; ailerons deflect ±15°.

STRUCTURE: Semi-monocoque fuselage of aluminium alloy, with stressed skins. Wings and tailplane aluminium skinned.

AMD Zenith CH 2000 Alarus *(Paul Jackson)* 1159753

LANDING GEAR: Non-retractable tricycle type with steerable (±14°) nosewheel. Shock-cord absorption on nosewheel. Cleveland 5.00–5 in wheels with hydraulic disc brakes on mainwheels. Optional wheel fairings.

POWER PLANT: One 86.5 kW (116 hp) Textron Lycoming O-235-N2C, driving metal Sensenich 72-CK-0-46 or 72-CK-0-48 two-blade propeller. Fuel capacity 106 litres (28.0 US gallons; 23.3 Imp gallons) standard of which 104 litres (27.5 US gallons; 22.9 Imp gallons) are usable. 129 litres (34.0 US gallons; 28.3 Imp gallons) optional. Oil capacity 5.7 litres (1.5 US gallons; 1.25 Imp gallons).

SYSTEMS: 12 V 60 A, heavy-duty battery.

ACCOMMODATION: Two persons, side by side, with dual controls; upward-hinged door each side; fixed windscreen; rear side windows. AmSafe inflatable Restraint system certified for use in April 2004 and standard from 2006 onward. Baggage shelf behind seats.

AVIONICS: *Comms:* Based around Garmin GNS 430 COM/VOR/GPS, GI 106A CDI, GMA 340 audio panel and GTX 327 transponder, plus Bendix King KX155 NAV/COM. Options include PS 100II intercom.

DIMENSIONS, EXTERNAL:

Wing span	8.79 m (28 ft 10 in)
Wing aspect ratio	5.4
Length overall	7.01 m (23 ft 0 in)
Height overall	2.08 m (6 ft 10 in)
Propeller diameter	1.83 m (6 ft 0 in)

DIMENSIONS, INTERNAL:

Cabin max width	1.17 m (3 ft 10 in)

AREAS:

Wings, gross	12.73 m^2 (137.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	533 kg (1,085 lb)
Max baggage weight	18 kg (40 lb)
Max T-O weight: Utility	728 kg (1,606 lb)
Normal	767 kg (1,692 lb)
Max wing loading: Utility	57.2 kg/m^2 (11.72 lb/sq ft)
Normal	60.3 kg/m^2 (12.35 lb/sq ft)
Max power loading: Utility	8.43 kg/kW (13.84 lb/hp)
Normal	8.88 kg/kW (14.59 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	139 kt (257 km/h; 160 mph)
Econ cruising speed	99 kt (183 km/h; 114 mph)
Stalling speed	48 kt (89 km/h; 55 mph)
Max rate of climb at S/L	229 m (750 ft)/min
Service ceiling	3,660 m (12,000 ft)
T-O to 15 m (50 ft)	500 m (1,640 ft)
Landing run	183 m (600 ft)
Landing from 15 m (50 ft)	555 m (1,820 ft)
Range with max payload: standard fuel	471 n miles (872 km; 542 miles)
optional fuel	851 n miles (1,577 km; 980 miles)
g limits, Utility category	+4.4/−2.2

AMD CH601XL

TYPE: Two-seat lightplane.

PROGRAMME: Introduced late 2005 as factory-manufactured version of popular CH 600/601 series of kitbuilt aircraft, meeting LSA criteria. Demonstrator N601NC (based on kitbuilt version) shown at AirVenture, Oshkosh, July 2005; first production SLSA was N601VA (built in Czech Republic); first US-built production aircraft was N601ZP (c/n 001S).

CURRENT VERSIONS: **AMD Zodiac CH601XL SLSA:** Baseline version; *as described*.

AMD Zodiac CH601XLi SLSA: IFR capable version, with heated pitot, full extenal lighting, dual electrical system and lightning protection, all based on that supplied for CH 2000 Alarus.

CUSTOMERS: Total 24 built by September 2006, including at least two CH601XLi versions.

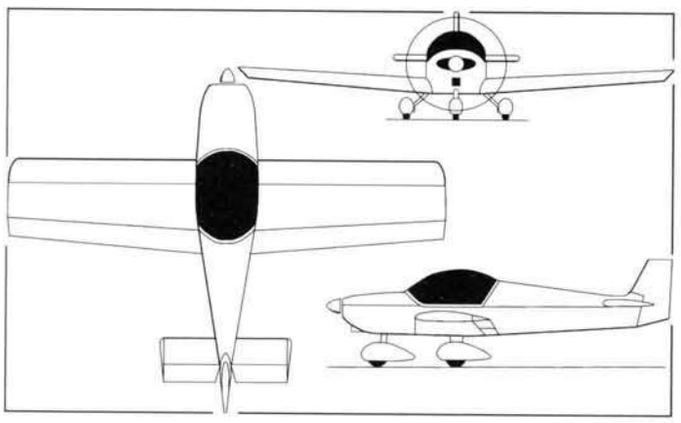
COSTS: CH601XL USD79,900; CH601XLi USD94,900 (2006).

DESIGN FEATURES: Conventional low-wing monoplane with all-moving vertical tail. Wing section NACA 23018 at root, NACA 23015 at tip; dihedral 6°; incidence 8°.

For details of the latest updates to *Jane's All the World's Aircraft* online and to discover the additional information available exclusively to online subscribers please visit
jawa.janes.com

Prototype of factory-built AMD Zenair CH601XL *(Paul Jackson)* 1159754

IFR-capable AMD Zenair CH601XLi *(Paul Jackson)* 1159755



AMD Zenair CH601XL SLSA general arrangement 1041708

FLYING CONTROLS: Manual. Long-span, 'piano hinged' ailerons; elevators; and Zenith all-moving vertical fin. Electric flaps.

STRUCTURE: All-aluminium monocoque.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted, spring aluminium cantilever mainwheel; 5.00-5 wheels and tyres throughout; hydraulic mainwheel brakes. Optional speed fairings on all three wheels.

POWER PLANT: One 74.6 kW (100 hp) Teledyne Continental O-200A flat-four driving two-blade Sensenich propeller. Fuel capacity 114 litres (30.0 US gallons; 25.0 Imp gallons) in two wing tanks.

ACCOMMODATION: Two persons, side by side, with dual controls; tinted single-piece forward opening canopy.

SYSTEMS: Electrical system 12 V.

AVIONICS: Standard instrumentation includes ASI, altimeter, compass, engine monitoring system. IFR version adds full gyro panel; options include Garmin GPS MAP396 with WX satellite weather system; SL40 COM, SL30 NAV/COM, GNC 250 XL GPS/COM; GTX 327/330 transponder and GMA 340 audio panel.

Options include wing baggage lockers and airbag seatbelts.

EQUIPMENT: Options include wing baggage lockers and airbag seatbelts.

DIMENSIONS, EXTERNAL:

Wing span	8.23 m (27 ft 0 in)
Wing chord: at main panel root	1.60 m (5 ft 3 in)
at tip	1.40 m (4 ft 7 in)
Wing aspect ratio	5.5
Length overall	6.10 m (20 ft 0 in)
Height overall	1.98 m (6 ft 6 in)
Tailplane span	2.31 m (7 ft 7 in)
Wheel track	2.13 m (7 ft 0 in)
Wheelbase	1.32 m (4 ft 4 in)

DIMENSIONS, INTERNAL:

Cabin: max width	1.12 m (3 ft 8 in)

AREAS:

Wings, gross	12.26 m² (132.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	363 kg (800 lb)
Max T-O weight	598 kg (1,320 lb)
Max wing loading	48.8 kg/m2 (10.00 lb/sq ft)
Max power loading	8.03 kg/kW (13.20 lb/hp)

PERFORMANCE:

Normal cruising speed	113 kt (209 km/h; 130 mph)
Stalling speed, power off: flaps up	46 kt (84 km/h; 52 mph)
flaps down	39 kt (71 km/h; 44 mph)
Max rate of climb at S/L	305 m (1,000 ft)/min
Service ceiling	3,658 m (12,000 ft)
Range	719 n miles (1,332 km; 828 miles)
Endurance	6 h 0 min
g limits	+6/–3.5

AMERICAN CHAMPION

AMERICAN CHAMPION AIRCRAFT CORPORATION

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PRESIDENT AND CEO: Jerry K Mehlhaff

GENERAL MANAGER: Dale Gauger

CHIEF ENGINEER: Jerry Mehlhaff Jr

ACAC offers new-build Citabria (now called Aurora, Adventure and Explorer), Super Decathlon and Scout, all designed by Aeronca. Model 7 (based on Second World War L-3 Grasshopper liaison/observation machine) certified 18 October 1945. Series later marketed by Champion Aircraft Corporation (1954); from 1970 by Bellanca Aircraft Corporation; and then, in 1982, Champion Aircraft Company. Assets transferred to Jerry Mehlhaff's American Champion Aircraft Corporation, which restarted production in 1990. By end of 2005, various manufacturers had built 14,827 of the Model 7 and Model 8 families, American Champion being responsible for 840. In addition, ACAC offers its new metal spar wing for retrofit on all models, including the original 7AC Champion.

AMERICAN CHAMPION 7EC CHAMP

TYPE: Two-seat lightplane.

PROGRAMME: Original Aeronca Model 7 and successors built in 16 subvariants, with various letter suffixes. Model 7AC Champion was initial production version, certified 18 October 1945 with 48.5 kW (65 hp) Continental A65 flat-four (7,200 built) from 1945 onwards. Model 7ACA Champ certified 30 April 1971 with 44.7 kW (60 hp) Franklin engine, but only 71 built by Bellanca.

American Champion proposed relaunch as 7ACA Champ with 59.7 kW (80 hV) Jabiru 2200 flat-four; new-build prototype (N82AC) displayed at EAA AirVenture Oshkosh in July 2000, shortly after first flight. This variant did not enter production; succeeded by 7EC Champ with Teledyne Continental O-200 engine, available from 2006, with three (N349AC, N707WM and N69SG, c/ns 101 to 103 respectively), registered in first half of that year. Designation duplicates 7EC Traveler version certified 30 November 1949 with 67.1 kW (90 hp) Continental C90 (773 built).

AMERICAN CHAMPION PRODUCTION
(at 1 January 2006)

Version	Certification	Number Built	Number built[1]	Recent Shipments					
		To 1989	To end-05	2001	2002	2003	2004	2005	ACA Total
7AC	18 Oct 45	7,200	7,201						1
7ACA	30 Apr 71	71	71						
7BCM	16 Sep 47	509	509						
7CCM	12 Jul 48	226	226						
7DC	12 Jul 48	184	184						
7EC	30 Nov 49	773	773						
7ECA	5 Aug 64	1,353	1,395	2	3	2	2	3	42
7GC	30 Oct 58	171	171						
7GCA/AA	17 Nov 59	396	501	8	12	9	12	12	105
7GCB/BA	28 Apr 60	195	195						
7GCBC	3 Dec 65	1,215	1,422[2]	21	13	12	24	26	207
7HC	6 Aug 59	39	39						
7JC	24 Feb 60	25	25						
7KC	10 Jan 61	4	4						
7KCAB	21 Dec 66	624	624						
8GCBC	30 Apr 74	360	475	6	11	8	18	9	115
8KCAB	16 Oct 70	642	1,012	19	14	32	38	39	370
Totals		**13,987**	**14,827**	**56**	**53**	**63**	**94**	**89**	**840**

[1] Shipment totals differ slightly from annual production totals
[2] Including 16 aircraft duplicating previous Bellanca c/ns

First production American Champion 7EC Champ making its public debut at AirVenture, Oshkosh, July 2006 *(R W Simpson)* 1162401

COSTS: USD84,900 (2006).

DESIGN FEATURES: High-wing cabin monoplane; wings braced by V-struts and two secondary struts each side; wire-braced fin and tailplane; constant-chord wings; all flying surfaces have rounded tips.

FLYING CONTROLS: Conventional and manual. Horn-balanced elevators and rudder. No flaps.

STRUCTURE: Welded Chromoly steel tube fuselage and tail surfaces; two-spar wing has aluminium spars and ribs. Dacron covering.

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted spring steel cantilever main legs.

POWER PLANT: One 74.6 kW (100 hp) Teledyne Continental O-200-A flat-four driving a Sensenich W72GK-44U two-blade fixed-pitch wooden propeller. Fuel capacity 68 litres (18 US gallons; 17.5 US gallons), of which 66 litres (17.5 US gallons; 1mp gallons) usable. Oil capacity 5.7 litres (1.5 US gallons; 1.3 Imp gallons).

ACCOMMODATION: Pilot and passenger in tandem. Door on starboard side, opening centre window on port side.

DIMENSIONS, EXTERNAL:

Wing span	10.21m (33 ft 6 in)
Wing aspect ratio	6.8
Length overall	6.74 m (22 ft 1¼ in)
Height overall	2.35 m (7 ft 8½ in)
Propeller diameter	1.83 m (6 ft 0 in)

DIMENSIONS, INTERNAL:

Cabin:	
Length	2.69 m (8 ft 10 in)
Max width	0.76 (2 ft 6 in)
Max height	1.19 m (3 ft 11 in)

AREAS:

Wings, gross	15.33 m² (165.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	417 kg (920 lb)
Max T-O weight	598 kg (1,320 lb)
Payload with max fuel	132 kg (292 lb)
Max baggage	45 kg (100 lb)
Max wing loading	39.06 kg/m² (8.00 lb/sq ft)
Max power loading	8.03 kg/kW (13.20 lb/hp)

PERFORMANCE:

g limits	+5/–2

AMERICAN CHAMPION 7ECA CITABRIA AURORA

TYPE: Two-seat lightplane.

PROGRAMME: Currently the lowest powered of the American Champion range, the 7EC was certified on 30 November 1949 and 7ECA on 5 August 1964; 773 of former and 1,369 of latter had been built up to 1984; was reintroduced into range during 1995 as the cheapest aircraft. Current production aircraft has improved ventilation and heating; redesigned instrument panel and quick-jettison door; and dual controls and brakes.

CUSTOMERS: Total 1,395 produced by late 2005. One delivered in the first six months of 2006.

COSTS: Standard aircraft USD90,900 (2006).

DESIGN FEATURES: High-wing cabin monoplane; wings braced by V-struts and two secondary struts each side; wire-braced fin and tailplane; constant-chord wings; sweptback fin with (current versions) squared tip.

Wing section NACA 4412; dihedral 1°.

FLYING CONTROLS: Conventional and manual. Horn-balanced elevators and rudder. Flight-adjustable trim tab in port elevator. No flaps. Control surface movements: ailerons +27° 30'/–19°; elevators ±24°; rudder ±25°. Aileron suspended balance tabs (spades) optional.

STRUCTURE: Stainless steel exhaust system. Fuselage and empennage are welded chromoly steel tube with Dacron covering; two-spar wing has aluminium spars and ribs, Dacron covering, GFRP tips and steel tube V struts.

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted, cantilever spring steel mainwheel legs; mainwheels 6.00–6 (4 ply); tailwheel 5.00, steerable. Hydraulic, toe-operated disc and parking brakes. Main wheel fairings optional. Floatplane option includes auxiliary fins above and below tailplane.

POWER PLANT: One 88 kW (118 hp) Textron Lycoming O-235-K2C flat-four piston engine driving a Sensenich 72 CKS8-0 fixed-pitch propeller. Fuel in two wing tanks, total capacity 136 litres (36.0 US gallons; 30.0 Imp gallons) of which 132 litres (35.0 US gallons; 29.1 Imp gallons) usable; overwing refuelling point for each tank. Oil capacity 5.7 litres (1.5 US gallons; 1.3 Imp gallons). Stainless steel exhaust system standard.

ACCOMMODATION: Pilot and passenger in tandem on foam-filled seats with folding backrests; five-point safety harness; quick jettison door on starboard side; pilot's port window hinged upwards and outwards. Space for baggage behind seats. Dual controls. Options include split door for photographic work, external bottom-hinged baggage door, greenhouse roof and tinted cabin windows, wide rear seat and rear seat heater.

SYSTEMS: Electric starter; 60 A alternator; 12 V gel-cell battery; voltage regulator with protector. Optional lighting system.

AVIONICS: To customer's choice.

Comms: Optional Communication Group includes Garmin GNC 250XL com/nav, GTX 327 transponder, broadband transmitting antenna, twin headset jacks, cabin speaker and noise cancelling microphone. Intercom system, front and rear PTT switches and ELT also optional.

Flight: Full vacuum gyro package and electric attitude indicator and directional gyro set optional.

Instrumentation: ASI, sensitive altimeter, magnetic compass, dual fuel gauges, lighted magnetic compass, oil temperature and pressure gauges and recording tachometer all standard. VSI, electric turn co-ordinator, OAT gauge, EGT gauge, CHT gauge, combination EGT/CHT eight-probe scanner, engine hours meter with oil pressure switch, and bullet spinner. Options include aileron spades, mainwheel fairings, split photo door, wide rear seat, rear seat heater, deluxe Duraplush interior fabrics, aluminium main landing gear legs, landing gear leg steps, speed kit including upper and lower wing strut fairings, CFP-2 corrosion protection, remote mounted Air-Wolf oil filter and oil quick drain and electric clock optional.

EQUIPMENT: Standard equipment includes navigation lights, landing light, cabin light, dual wingtip strobe lights, deluxe textured vinyl interior.

DIMENSIONS, EXTERNAL:

Wing span	10.21 m (33 ft 6 in)
Wing aspect ratio	6.8
Length overall	6.73 m (22 ft 1 in)
Height overall	2.35 m (7 ft 8½ in)
Propeller diameter	1.83 m (6 ft 0 in)

DIMENSIONS, INTERNAL:

Cabin: Length	2.69 m (8 ft 10 in)
Max width	0.76 m (2 ft 6 in)
Max height	1.19 m (3 ft 11 in)

AREAS:

Wings, gross	15.33 m² (165.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, equipped	508 kg (1,120 lb)
Max baggage weight	45 kg (100 lb)
Max T-O weight	793 kg (1,750 lb)
Payload with max fuel	191 kg (420 lb)
Max wing loading	51.8 kg/m² (10.61 lb/sq ft)
Max power loading	9.03 kg/kW (14.83 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	140 kt (260 km/h; 162 mph)
Max level speed at S/L	104 kt (193 km/h; 120 mph)
Cruising speed at 75% power	100 kt (185 km/h; 115 mph)
Stalling speed	46 kt (84 km/h; 52 mph)
Max rate of climb at S/L	226 m (740 ft)/min
Service ceiling	3,810 m (12,500 ft)
T-O run	198 m (650 ft)
T-O to 15 m (50 ft)	320 m (1,050 ft)
Landing from 15 m (50 ft)	270 m (885 ft)
Landing run	159 m (520 ft)
Range with max fuel, allowance for start, taxi, S/L T-O, climb and descent, no reserves:	
at 75% power	556 n miles (1,030 km; 640 miles)
at 55% power	617 n miles (1,142 km; 710 miles)
Endurance	5 h 6 min
g limits	+5/–2

American Champion 7ECA Citabria Aurora *(Paul Jackson)* 1158199

AMERICAN CHAMPION 7GCAA CITABRIA ADVENTURE

TYPE: Two-seat lightplane.

PROGRAMME: American Champion 7GCAA Adventure relaunched 1997. Model 7GCA originally certified 17 November 1959 and 7GCAA 30 July 1965; these built up to 1980.

CUSTOMERS: Total 505 built by June 2006, including 396 in first series.

COSTS: USD104,900 (2006).

DESIGN FEATURES: As for Aurora.

FLYING CONTROLS: As for Aurora except elevator movements +28/–24°.

STRUCTURE: As for Aurora.

LANDING GEAR: As for Aurora.

POWER PLANT: One 119 kW (160 hp) Textron Lycoming O-320-B2B flat-four engine driving a two-blade fixed-pitch Sensenich 74DM6S8-1-56 propeller. Fuel capacity as for Aurora, oil capacity 7.6 litres (2.0 US gallons; 1.67 Imp gallons).

ACCOMMODATION: As for Aurora.

SYSTEMS: As for Aurora.

AVIONICS: As for Aurora.

EQUIPMENT: As for Aurora.

American Champion 7GCAA Citabria Adventure *(Paul Jackson)* 1158207

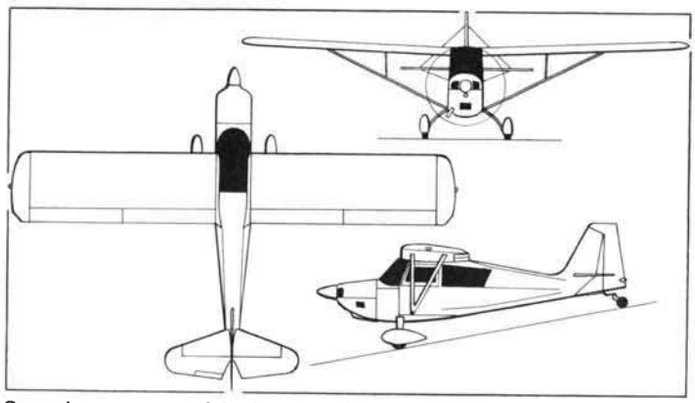
DIMENSIONS, EXTERNAL: As for Aurora, except:
Propeller diameter ..... 1.85 m (6 ft 1 in)
DIMENSIONS, INTERNAL: As for Aurora
AREAS: As for Aurora
WEIGHTS AND LOADINGS: As for Aurora, except:
Weight empty ..... 544 kg (1,200 lb)
Payload with max fuel ..... 154 kg (340 lb)
Max power loading ..... 6.66 kg/kW (10.94 lb/hp)
PERFORMANCE:
Never-exceed speed (VNE) ..... 140 kt (260 km/h; 162 mph)
Max level speed ..... 121 kt (225 km/h; 140 mph)
Max cruising speed at 75% power ..... 117 kt (217 km/h; 135 mph)
Stalling speed, power off ..... 46 kt (84 km/h; 52 mph)
Max rate of climb at S/L ..... 356 m (1,167 ft)/min
Service ceiling ..... 5,029 m (16,500 ft)
T-O run ..... 131 m (430 ft)
T-O to 15 m (50 ft) ..... 273 m (895 ft)
Landing from 15 m (50 ft) ..... 259 m (850 ft)
Landing run ..... 146 m (480 ft)
Range with max fuel:
at 75% power, no reserves ..... 482 n miles (893 km; 555 miles)
at 55% power ..... 595 n miles (1,102 km; 685 miles)
Endurance ..... 3 h 6 min
g limits ..... +5/–2

AMERICAN CHAMPION 7GCBC CITABRIA EXPLORER

TYPE: Two-seat lightplane.
PROGRAMME: Formerly Citabria 150S, certified 3 December 1965.
CURRENT VERSIONS: **Explorer:** *As described.*

High Country Explorer: Announced July 2004; powered by Superior Air Parts Inc Vantage O-360-A3A2 flat-four, unleaded fuel piston engine, derated to 134 kW (180 hp) and delivering 108 kW (145 hp) at 2,285 m (7,500 ft), compared with 87 kW (117 hp) of standard 7GCBA power plant, driving a Sensenich 76EM8S8-0-58 fixed-pitch propeller, diameter 1.93 m (6 ft 4 in). Other feathers include Micro Aerodynamics vortex generators aluminium main landing gear with 800 × 6 tyres, heavy duty Lord engine mounts, cowl flap, and upgraded exhaust system. Prototype flown mid-2004; demonstrated 549 m (1,800 ft)/min climb at S/L.

CUSTOMERS: Total of 1,431 built by June 2006.
COSTS: Standard aircraft USD108,900; with High Country package USD115,900 (both 2006).
DESIGN FEATURES: As for Aurora. Specific 7GCBC features include optional wheel fairings, NACA 4412 aerofoil section. Dihedral 2°; incidence 1°.
FLYING CONTROLS: As for Aurora, except elevator movements +28/–24°. Flaps; maximum deflection 35°.
STRUCTURE: Aluminium alloy (front) and steel tube (aft) bracing struts.
LANDING GEAR: As for Aurora.
POWER PLANT: As for Adventure. Fuel and oil as for Aurora.
ACCOMMODATION: As for Aurora.
SYSTEMS: As for Aurora.
AVIONICS: As for Aurora. Optional IFR package comprises heated pitot head, Bendix/King KR 22 marker beacon receiver, panel lighting and gyro backlighting upgrade.
EQUIPMENT: As for Aurora.
DIMENSIONS, EXTERNAL:
Wing span ..... 10.49 m (34 ft 5 in)
Wing chord, constant ..... 1.52 m (5 ft 0 in)
Wing aspect ratio 6.9
Length overall ..... 6.74 m (22 ft 1 in)
Height overall ..... 2.35 m (7 ft 8½ in)
Wheel track ..... 1.93 m (6 ft 4 in)
Wheelbase ..... 4.90 m (16 ft 1 in)
Propeller diameter ..... 1.85 m (6 ft 1 in)
DIMENSIONS, INTERNAL: As for Aurora
AREAS:
Wings, gross ..... 15.97 m² (171.9 sq ft)
Ailerons (total) ..... 1.53 m² (16.50 sq ft)
Fin ..... 0.65 m² (7.02 sq ft)
Rudder ..... 0.63 m² (6.83 sq ft)
Tailplane ..... 1.14 m² (12.25 sq ft)
Elevators (total, incl tab) ..... 1.35 m² (14.58 sq ft)
WEIGHTS AND LOADINGS:
Weight empty, equipped ..... 567 kg (1,250 lb)
Baggage capacity ..... 45 kg (100 lb)
Max T-O and landing weight ..... 816 kg (1,800 lb)



General arrangement of the American Champion 7GCBC Citabria Explorer *(James Goulding)*
1158208

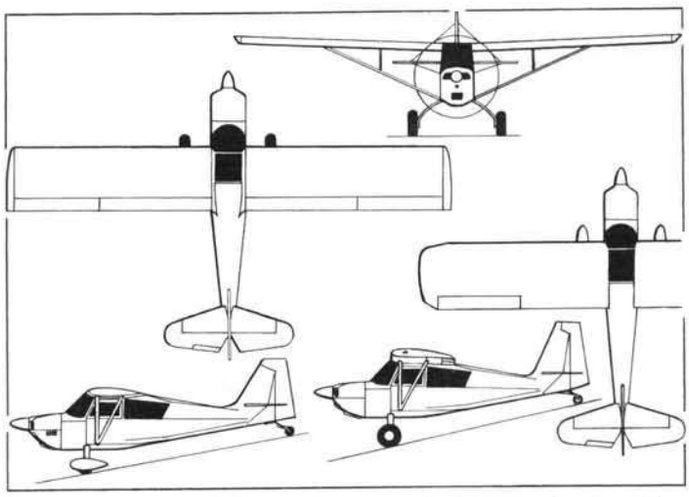
Max wing loading ..... 51.1 kg/m² (10.47 lb/sq ft)
Max power loading ..... 6.85 kg/kW (11.25 lb/hp)
PERFORMANCE:
Never-exceed speed (VNE) ..... 140 kt (261 km/h; 162 mph)
Max level speed at S/L ..... 115 kt (212 km/h; 132 mph)
Cruising speed:
at 75% power, at optimum height ..... 111 kt (206 km/h; 128 mph)
at 65% power ..... 107 kt (198 km/h; 123 mph)
Stalling speed, flaps up ..... 45 kt (82 km/h; 51 mph)
flaps down ..... 40 kt (74 km/h; 46 mph)
Max rate of climb at S/L ..... 344 m (1,130 ft)/min
Service ceiling ..... 5,182 m (17,000 ft)
T-O run ..... 126 m (412 ft)
T-O to 15 m (50 ft) ..... 200 m (656 ft)
Landing from 15 m (50 ft) ..... 226 m (740 ft)
Landing run ..... 110 m (360 ft)
Range with max fuel, allowance for start, taxi, S/L T-O, climb and descent, no reserves:
at 75% power ..... 431 n miles (799 km; 496 miles)
at 55% power ..... 521 n miles (966 km; 600 miles)
g limits ..... +5/–2

AMERICAN CHAMPION 8GCBC SCOUT

TYPE: Two-seat lightplane.
PROGRAMME: Model 8 series of Champion developed by Bellanca as heavy-duty version of Model 7; second subvariant was 8GCBC, which received type approval on 30 April 1974.
CUSTOMERS: Total of 478 built by mid-2006 including four in the first six months of 2006. Customers include the Department of Conservation and Land Management of Western Australia, which operates eight Scouts on fire spotting duties, replacing Piper Super Cubs.
COSTS: Two-blade constant-speed propeller USD129,900; three-blade constant-speed propeller USD134,000.
DESIGN FEATURES: Upgraded version of Bellanca/Champion Scout, with new lighter and stronger metal spar wing with 300 per cent less deflection than previous wooden wings; circuit breakers; modern avionics; revised interior; and high-gloss weather-resistant exterior finish. Can operate from short fields while towing glider or banner; low speed assists pipeline, border patrol, forestry and wildlife management roles.
Wing section NACA 4412; dihedral 1°; incidence 1°.
FLYING CONTROLS: As for Explorer. Control surface movements: ailerons +27° 30'/–19°; elevators +29/–26°; rudder ±25°. Four-position trailing-edge flaps droop 7, 16, 21 and 27°.
STRUCTURE: As for Explorer, but metal belly skin optional.
LANDING GEAR: As for Aurora; main tyres 8.50–6 (4/6 ply); tail 5.00–5 (4 ply). Optional EDO 89–2000 floats or amphibious floats, or skis.
POWER PLANT: One 134 kW (180 hp) Textron Lycoming O-360-C1G flat-four engine, driving a McCauley 1A200HFA80 fixed-pitch (Scout) or Hartzell HC-C2YR-1BF/FC7666A constant-speed propeller (Super Scout); three-blade 1.83 m (6 ft 0 in) Hartzell HC-C3YR-1RF/F7282 constant-speed propeller optional. Standard fuel capacity as for Aurora; optional additional tank increases usable total to 265 litres (70.0 US gallons; 58.3 Imp gallons). Oil capacity 7.5 litres (2.0 US gallons; 1.7 Imp gallons).
ACCOMMODATION: As for Aurora. Heated and ventilated.
SYSTEMS: As for Aurora.
AVIONICS: As for Aurora.

High Country version of American Champion 7GCBC Citabria Explorer *(Paul Jackson)*
1127943

American Champion 8GCBC Scout in seaplane configuration *(Paul Jackson)*
1162408



American Champion 8GCBC general arrangement, with scrap plan view and additional side view (left) of 8KCAB *(James Goulding)*
1158201

EQUIPMENT: External baggage door standard. Options include cropduster package, long-range fuel tank and glider tow assembly.

DIMENSIONS, EXTERNAL (A: Scout; B: Super Scout):
- Wing span ..... 11.02 m (36 ft 2 in)
- Wing chord, constant ..... 1.52 m (5 ft 0 in)
- Wing aspect ratio 7.3
- Length overall: A ..... 6.95 m (22 ft 9½ in)
  - B ..... 7.01 m (23 ft 0 in)
- Height overall: A ..... 2.65 m (8 ft 8½ in)
  - B ..... 2.96 m (9 ft 8½ in)
- Tailplane span ..... 3.10 m (10 ft 2¼ in)
- Propeller diameter: Hartzell ..... 1.93 m (6 ft 4 in)
  - McCauley ..... 2.03 m (6 ft 8 in)

DIMENSIONS, INTERNAL: As for Aurora

AREAS:
- Wings, gross ..... 16.70 m² (180.0 sq ft)
- Ailerons (total) ..... 1.57 m² (16.88 sq ft)
- Flaps (total) ..... 2.25 m² (24.26 sq ft)

WEIGHTS AND LOADINGS (A and B as above):
- Weight empty: A ..... 596 kg (1,315 lb)
  - B ..... 635 kg (1,400 lb)
- Baggage capacity ..... 45 kg (100 lb)
- Max T-O weight: Normal, A, B ..... 975 kg (2,150 lb)
  - Restricted: A ..... 1,179 kg (2,600 lb)
- Max wing loading:
  - Normal: A, B ..... 58.3 kg/m² (11.94 lb/sq ft)
  - Restricted: A ..... 70.5 kg/m² (14.44 lb/sq ft)
- Max power loading:
  - Normal: A, B ..... 7.28 kg/kW (11.94 lb/hp)
  - Restricted: A ..... 8.80 kg/kW (14.44 lb/hp)

PERFORMANCE:
- Never-exceed speed (VNE): A, B ..... 140 kt (260 km/h; 162 mph)
- Max level speed at S/L: A ..... 117 kt (217 km/h; 135 mph)
  - B ..... 125 kt (232 km/h; 144 mph)
- Cruising speed at 75% power: A ..... 106 kt (196 km/h; 122 mph)
  - B ..... 116 kt (216 km/h; 134 mph)
- Stalling speed, flaps up: A ..... 47 kt (87 km/h; 54 mph)
  - flaps down: A ..... 44 kt (81 km/h; 50 mph)
  - flaps down: B ..... 43 kt (79 km/h; 49 mph)
- Max rate of climb at S/L: A ..... 329 m (1,080 ft)/min
  - B ..... 381 m (1,250 ft)/min
- Service ceiling: A ..... 4,572 m (15,000 ft)
  - B ..... 5,334 m (17,500 ft)
- T-O run: A ..... 125 m (410 ft)
  - B ..... 119 m (390 ft)
- Range: at 75% power: standard fuel: A ..... 333 n miles (618 km; 384 miles)
  - B ..... 360 n miles (667 km; 415 miles)
  - optional fuel: A ..... 680 n miles (1,260 km; 783 miles)
  - B ..... 731 n miles (1,355 km; 842 miles)
  - at 55% power, optional fuel: A ..... 779 n miles (1,443 km; 897 miles)
  - B ..... 837 n miles (1,551 km; 964 miles)

AMERICAN CHAMPION 8KCAB SUPER DECATHLON

TYPE: Two-seat lightplane.

PROGRAMME: Original Decathlon was powered by a 112 kW (150 hp) Lycoming IO-320 or AEIO-320; certified 16 October 1970 in Normal and Aerobatic categories. Super introduced by American Champion; first flight (N38AC) July 1990. The Fixed-Pitch Decathlon (Sensenich propeller) is no longer marketed.

CUSTOMERS: Total of 1,020 delivered by mid-2006, including 13 in the first six months of 2006.

COSTS: Standard price USD137,900 (2006).

DESIGN FEATURES: Generally as for Aurora. Cleared for limited inverted flight; constant-speed propeller. Wing section NACA 1412 (modified); dihedral 1°; incidence 1° 30'.

FLYING CONTROLS: As for Aurora, but with balanced elevators. Control surface movements: ailerons ±30°; elevators ±20°; rudder ±30°.

STRUCTURE: As for Aurora. Optional metal wing spar.

LANDING GEAR: As for Aurora. Mainwheel tyres 6.00–6 or 8.00–6 (4 ply), tail tyre 5.00–5 (4 ply). Cleveland disc brakes; optional wheel fairings.

POWER PLANT: One 134 kW (180 hp) Textron Lycoming AEIO-360-H1B flat-four engine, driving a Hartzell HC C2YR 4CF/FC7666A-2 two-blade constant-speed propeller. Fuel capacity 151 litres (40.0 US gallons; 33.3 Imp gallons), of which 148 litres (39.0 US gallons; 32.5 Imp gallons) are usable. Oil capacity 9.5 litres (2.5 US gallons; 2.1 Imp gallons).

ACCOMMODATION: As for Aurora, but competition Hooker harness optional.

SYSTEMS: As for Aurora, plus accelerometer and electric fuel boost pump.

AVIONICS: As for Aurora.

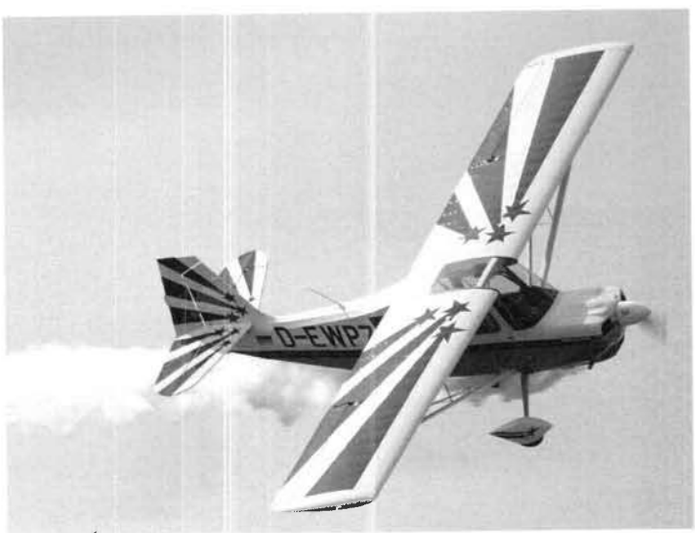
DIMENSIONS, EXTERNAL:
- Wing span ..... 9.75 m (32 ft 0 in)
- Wing chord, constant ..... 1.63 m (5 ft 4 in)
- Wing aspect ratio 6.1
- Length overall ..... 6.98 m (22 ft 10¾ in)
- Height overall ..... 2.36 m (7 ft 9 in)
- Tailplane span ..... 3.10 m (10 ft 2¼ in)
- Propeller diameter ..... 1.88 m (6 ft 2 in)

DIMENSIONS, INTERNAL: As for Aurora

AREAS:
- Wings, gross ..... 15.71 m² (169.1 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty ..... 608 kg (1,340 lb)
- Baggage capacity ..... 45 kg (100 lb)
- Max T-O weight ..... 816 kg (1,800 lb)
- Payload with max fuel ..... 103 kg (226 lb)
- Max wing loading ..... 52.0 kg/m² (10.64 lb/sq ft)
- Max power loading ..... 6.09 kg/kW (10.00 lb/hp)

PERFORMANCE:
- Never-exceed speed ..... 173 kt (321 km/h; 200 mph)
- Max level speed at FL70 ..... 135 kt (249 km/h; 155 mph)
- Cruising speed:
  - at 75% power ..... 128 kt (237 km/h; 147 mph)
  - at 55% power ..... 111 kt (206 km/h; 128 mph)
- Stalling speed, clean ..... 46 kt (86 km/h; 53 mph)
- Max rate of climb at S/L ..... 390 m (1,280 ft)/min
- Service ceiling ..... 5,182 m (17,000 ft)
- T-O run ..... 120 m (395 ft)
- T-O to 15 m (50 ft) ..... 276 m (904 ft)
- Landing from 15 m (50 ft) ..... 321 m (1,051 ft)
- Landing run ..... 130 m (425 ft)
- Range, no reserves:
  - at 75% power ..... 509 n miles (944 km; 587 miles)
  - at 55% power ..... 542 n miles (1,006 km; 625 miles)
- Endurance: at 75% power ..... 3 h 24 min
  - at 55% power ..... 4 h 24 min
- g limits ..... +6/−5



Aerobatic performance by American Champion 8KCAB Super Decathlon *(Paul Jackson)*
1158209

AMERICAN LEGEND

AMERICAN LEGEND AIRCRAFT COMPANY

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Web: www.legendaircraftcompany.com
PRESIDENT: Tim Elliott
VICE-PRESIDENT: Darin Heart
VICE-PRESIDENT, MANUFACTURING: Bryan Hurley

Legend was established in September 2004 to produce a version of Piper Cub in the US LSA category. Further variants with alternative engine and equipment standards were launched in 2006.

AMERICAN LEGEND CUB

TYPE: Two-seat lightplane.

PROGRAMME: Taylor J2 Cub became Piper J3 Cub in 1937 and built for USAAF in Second World War as L-4 Grasshopper. Several post-war variants, including PA-11 Cub Special, with fully enclosed engine. This eventually replaced by PA-18 Super Cub (which latter continues to be built by Cub Crafters).

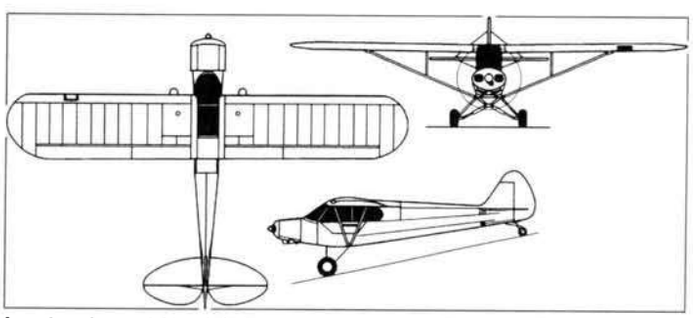
American Legend is one of several companies offering reproductions of early Cub versions. First Legend aircraft (N23787) completed February 2005 in J3 guise; second (N23838) as demonstrator for PA-11 equivalent; this shown at AirVenture, Oshkosh, in July 2005, together with initial production aircraft (N77335), another J3. LSA category approval awarded 21 July 2005.

CURRENT VERSIONS: **AL3C-100 Legend Cub:** J3 equivalent; exposed engine cylinders; Continental engine.

AL11C-100 Legend Cub: PA-11 equivalent (although without this variant's fully divided landing gear); full cowling for Continental engine.

AL11C-100 Legend Cub Special: Announced 3 April 2006 with extra features as standard, including leather interior, adjustable air vents, interior light, landing light, composites propeller, strobe navigation lights, and nav/com package of Garmin SL 40 radio, GTX 327 transponder, GPS Map 396, with option of 188 mm (7 in) Dynon FlightDEK-D180 EFIS.

AL11J-120 Legend Cub Special: Prototype Cub Special (N82LC) exhibited at Sun 'n' Fun, Lakeland, Florida, April 2006, with Jabiru 3300 engine, which intended as optional power plant from mid-2006.



American Legend AL11C Cub two-seat lightplane *(Paul Jackson)* 1129164

FloatCub: Floatplane; Continental engine. Weight empty 451 kg (995 lb); max level speed 80 kt (148 km/h; 92 mph); cruising speed 71 kt (132 km/h; 82 mph) at 75 per cent power; range 204 n miles (378 km; 235 miles).

CUSTOMERS: More than 30 ordered by July 2005, all of which had been registered by April 2006.

Piper built 20,290 J3/L-4s between 1938 and 1947 (not including 695 Taylor J2s); further 1,541 PA-11s followed. Original designation in doubt; Type Certificates (ATC 660 and A-691) (retained by New Piper) quote both J3 and J-3, but most aircraft registered as J3s, including all but 254 of 4,687 on the US register in 2005. Further 89 J2s and 545 PA-11s also remain in US.

COSTS: Cub USD74,000 flyaway (2005); Cub Special USD105,000 (2006).

DESIGN FEATURES: High wing braced by streamlined V-struts and auxiliary struts; rounded fin and tailplane mutually wire-braced. Option of traditional (rounded) or Hoerner wingtips. Legend Cub is optimised for US LSA category.

FLYING CONTROLS: Conventional and manual. Variable incidence tailplane. No flaps. Control actuation by cables.

STRUCTURE: Welded steel tube fuselage; metal wing structure; both fabric-covered, except metal engine cowling.

LANDING GEAR: Tailwheel type; fixed. Two faired-in side Vs hinged to lower longerons, with helical spring-damped half-axles attached to compression frame; hydraulic brakes. Mainwheels 8.00-6; steerable, solid tailwheel. Float attachments standard; optional Baumann floats.

POWER PLANT: One 74.6 kW (100 hp) Teledyne Continental O-200 flat-four driving a Sensenich two-blade, metal, fixed-pitch propeller. Optionally, from mid-2006, 89 kW (120 hp) Jabiru 3300 flat-six. Fuel capacity 83 litres (22.0 US gallons; 18.3 Imp gallons) of which 76 litres (20.0 US gallons; 16.7 Imp gallons) usable.

ACCOMMODATION: Two persons in tandem, with horizontally divided doors each side, upward/downward-hinged. Cockpit 8 cm (3 in) wider than original Cub.

DIMENSIONS, EXTERNAL:

Wing span	10.82 m (35 ft 6 in)
Wing chord, constant	1.60 m (5 ft 3 in)
Wing aspect ratio	7.1
Length overall: except FloatCub	6.83 m (22 ft 5 in)
FloatCub	7.29 m (23 ft 11 in)
Height overall: FloatCub	2.76 m (9 ft 0¾ in)
propeller turning: Cub	2.43 m (7 ft 11¾ in)
Cub Special	2.29 m (7 ft 6 in)
Tailplane span	2.88 m (9 ft 5½ in)

AREAS:

Wings, gross	16.58 m² (178.5 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	386 kg (850 lb)
Max T-O weight	598 kg (1,320 lb)
Max power loading	8.03 kg/kW (13.20 lb/hp)

PERFORMANCE (AL3C-100):

Max level speed	87 kt (161 km/h; 100 mph)
Cruising speed at 75% power	83 kt (153 km/h; 95 mph)
Stalling speed	33 kt (62 km/h; 38 mph)
Max rate of climb at S/L	213 m (700 ft)/min
Service ceiling	4,570 m (15,000 ft)
T-O run	64 m (210 ft)
Landing run	62 m (205 ft)
Range with max payload	234 n miles (434 km; 270 miles)

Prototype AL11J-120 Legend Cub Special powered by Jabiru engine *(Paul Jackson)* 1037966

AMV

AMV AIRCRAFT

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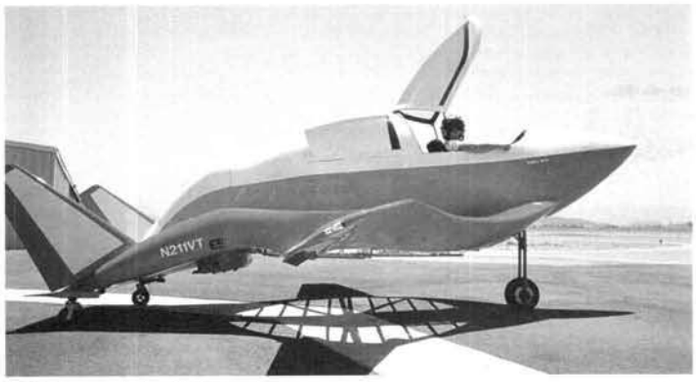
Tel/Fax: (+1 949) 457 11 84
Web: www.AMVaircraft.com
OWNER: Attila Melkuti

Mr Melkuti plans to fly an aircraft he describes as the world's first practical flying machine to have a single ducted propeller and be capable of short or vertical take-off and landing. Flight test attempts began in January 2006 but were curtailed by engine failure.

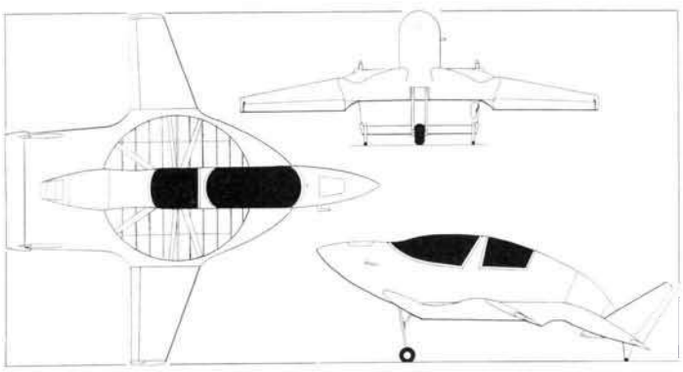
AMV 211

TYPE: Technology demonstrator.

PROGRAMME: Prototype completed in July 2003 shown statically at AirVenture, Oshkosh, later same month, following which preparations were to be made for flight. Registration N211VT reserved in 1999, but only activated in September 2003. Aircraft completed in October 2003; after initial ground tests, engine cooling was improved to prevent over-heating during hovering and modification were effected to the roll control system. Experimental category airworthiness certificate awarded July 2004; maiden flight was attempted in January 2006 but was thwarted by total engine failure when 15 cm (6 in) above the ground. Programme then suspended to allow installation of a more powerful turboshaft engine, increased fuel



AMV 211 ready for flight testing 1121789



AMV 211 technology demonstrator *(Paul Jackson)* 0580858

capacity and improved stability control for vertical flight. These changes not expected to change empty weight.

CURRENT VERSIONS: **Prototype:** As described.

Production: Slightly enlarged version with tandem seats; turboshaft engine in 447 to 597 kW (600 to 800 shp) class.

Six-seat: Certified, six-seat business aircraft with two turboshafts, each 597 to 671 kW (800 to 900 shp).

DESIGN FEATURES: Duct for eight movable louvres and horizontally mounted, five-blade propeller below fuselage, with wings outboard. Twin fins on tailbooms, each with rudder. Beaver tail with full-width elevator, including anti-balance tab.

For vertical take-off, louvres are vertical; after rising, craft tilted forward by inclination of louvres to deflect thrust, gradually gathering forward speed. When thrust plane reaches some 26° inclination, wing is horizontal, creating lift.

Wings NACA 65_3-215 at root; 64_1-112 at tip; no dihedral; incidence 1°; no twist.

FLYING CONTROLS: Full-span ailerons, elevator, and rudders balanced by weight (horn type). No flaps, but control louvers placed in the propeller slipstream for control during vertical flight and transition to horizontal flight. Rudders controlled by cables, elevator and ailerons by pushrods and bell cranks. Elevator equipped with electrically actuated trim tab. Control louvre, which controls pitch during hover, is mechanically connected to elevator roll controls for hover are mechanically connected to the ailerons. Torque (yaw) control during hover is achieved by two louvres moving in opposite directions these are located centrally in the propeller's slipstream, and are electrically actuated.

STRUCTURE: Load-bearing structure is welded, chromoly tubing. Fuselage wings, and other aerodynamic surfaces are moulded graphite epoxy composites. Propeller blades are graphite and Kevlar.

LANDING GEAR: Tricycle type; semi-retractable. Monowheel and twin, fixed tailwheels one beneath each fin. Monowheel hydraulically turned some 40 degrees rearwards for horizontal flight. Disk brakes on mainwheel.

POWER PLANT: One 336 kW (450 hp) Mazda turbocharged rotary engine initially fitted to prototype, but proved insufficiently powerful. Replacement by Textron Lycoming T53 turboshaft (of unspecified rating) under way in 2006. Fuel capacity originally 189 litres (50.0 US gallons; 41.6 Imp gallons) in four wing and fuselage tanks, but also expanded during 2006 modifications.

ACCOMMODATION: Two persons in tandem with individual canopies.

SYSTEMS: Electrical system 12 V; main and standby batteries. Hydraulic handpump, operating at 103 bar (1,500 lb/sq in) for landing gear actuation and movement of louvres between VTOL and horizontal flight mode.

DIMENSIONS, EXTERNAL:

Wing span	6.10 m (20 ft 0 in)
Length overall	6.10 m (20 ft 0 in)
Height overall	2.13 m (7 ft 0 in)
Propeller diameter	2.39 m (7 ft 10 in)

WEIGHTS AND LOADINGS (Mazda engine):

Weight empty	570 kg (1,256 lb)
Max T-O weight	907 kg (2,000 lb)
Max power loading	2.43 kg/kW (4.00 lb/hp)

PERFORMANCE (estimated):

Max level speed	243 kt (451 km/h; 280 mph)
Cruising speed at 60% power	217 kt (402 km/h; 250 mph)
Max rate of climb at S/L	914 m (3,000 ft)/min
Service ceiling	7,620 m (25,000 ft)
Range	1,000 n miles (1,852 km; 1,150 miles)

ARION

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CEO: Peter Krotje
PRODUCTION MANAGER: Nick Otterback

Company founders built Kolb, Titan, Vans and Vol Mediterrani light aircraft kits before combining the best features of these in the Lightning. Arion is named for Hercules' horse. The prototype Lightning flew in March 2006 and production began simultaneously.

ARION LIGHTNING

TYPE: Side-by-side kitbuilt.

PROGRAMME: Partly complete prototype exhibited at AirVenture, Oshkosh, in July 2005. First flight (N233AL) 3 March 2006; public debut at Sun 'n' Fun, Lakeland, Florida, 4 April 2006. First customer-built aircraft entered factory-assist centre in March 2006.

COSTS: Kit USD29,900, less engine, propeller and instruments (2006).

DESIGN FEATURES: Optimised for both US Experimental and LSA categories; goals included generous safety and strength margins; simplicity of kit assembly; high performance; and good flying qualities.

Resembles Vol Mediterrani Esqual, but with detail refinements, including revised canopy and rudder horn balance.

FLYING CONTROLS: Conventional and manual. Horn- and mass-balanced rudder; piano-hinged elevators without tabs; mass-balanced ailerons. Slotted flaps; electrically actuated. All controls actuated by pushrods.

STRUCTURE: Moulded glass fibre on 4130 steel frame; major components joined by bolts.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring tubular steel cantilever mainwheel legs; hydraulic brakes. Trailing link nosewheel; cantilever-sprung. Main tyres 5.00-5; nose 4.00-4. Optional speed fairings.

POWER PLANT: One 89.5 kW (120 hp) Jabiru 3300 flat-six, typically driving a Sensenich two-blade, composites, ground-adjustable pitch, scimitar propeller. Fuel in two wing tanks, combined capacity 87 litres (23.0 US gallons; 19.2 Imp gallons). Alternatively, 59.7 kW (80 hp) Jabiru 2200 in homebuilt LSA category.

Arion Lightning at its public debut in April 2006 *(Paul Jackson)* 1037971

ACCOMMODATION: Two persons, side-by-side beneath single-piece, forward-hinged canopy/windscreen; rear side windows.
EQUIPMENT: BRS-5 1350 ballistic recovery parachute.
DIMENSIONS, EXTERNAL:
Wing span ..... 8.53 m (28 ft 0 in)
Wing aspect ratio 8.6
Length overall ..... 6.10 m (20 ft 0 in)
Height overall ..... 1.98 m (6 ft 6 in)
DIMENSIONS, INTERNAL:
Cockpit max width ..... 1.11 m (3 ft 7¾ in)
AREAS:
Wings, gross ..... 8.45 m² (91.0 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 336 kg (740 lb)
Max T-O weight ..... 598 kg (1,320 lb)
Max wing loading ..... 70.0 kg/m² (14.51 lb/sq ft)
Max power loading ..... 6.70 kg/kW (11.00 lb/hp)
PERFORMANCE (estimated):
Never-exceed speed (VNE) ..... 180 kt (334 km/h; 208 mph)
Max level speed ..... 165 kt (306 km/h; 190 mph)
Manoeuvring speed ..... 122 kt (225 km/h; 140 mph)
Cruising speed ..... 152 kt (282 km/h; 175 mph)
Stalling speed: flaps up ..... 49 kt (91 km/h; 56 mph)
flaps down ..... 40 kt (73 km/h; 45 mph)
Max rate of climb at S/L ..... 366 m (1,200 ft)/min
T-O run ..... 96 m (315 ft)
Landing run ..... 153 m (500 ft)
Range, with reserves ..... 521 n miles (965 km; 600 miles)
Endurance ..... 4 h
g limits ..... ±5

ASII

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ASII was founded in 1990. North and South American markets are covered by US office.

ASII ULTRASPORT 254 and 331

TYPE: Single-seat ultralight helicopter kitbuilt.
PROGRAMME: Prototype (254 version) first flight 24 July 1993 and publicly displayed at Oshkosh that year. Two prototypes built and tested. Prototype 331 (N331UV) first flew December 1993. LBA certification was expected by early 2002: version is only marketed in countries where ultralight helicopters are regulated to company's satisfaction. In late 2002, it was announced that Huzhou Taixing Aviation Technology of Huzhou, China was producing helicopters from kits, including examples of Ultrasports.
CURRENT VERSIONS: Designations reflect empty weight in pounds.
Ultrasport 254: Single-seat, ultralight to FAR Pt 103.
Ultrasport 331: Initial experimental category version to FAR Pt 21.191(g); single-seat 'growth' model. Meets FAA 51 per cent amateur-built kit rules.
Ultrasport 331H: With 48.5 kW (65 hp) Hirth H32 added to range in 2003 and replaces the Ultrasport 331.
CUSTOMERS: Total of 70 single-seaters sold by end 2002, of which more than 50 were flying (latest information received).
COSTS: 254: USD35,000; 331: USD38,000 (2006).
DESIGN FEATURES: Design objective of 254 was basic weight not to exceed 115 kg (254 lb) in order to comply with FAR Pt 103. Two-blade composites construction main rotor with tip weights for momentum conservation in event of engine failure, 8° linear twist and infinite life; shielded two-blade tail rotor; tailplane with fins at tip; tail rotor drive carried in narrow streamlined tailboom. Centrifugal sprag clutch for starting engages rotors at 2,000 engine rpm and automatically disengages in the event of engine failure. Quoted build time 300 hours. Broad (2.44 m; 8 ft 0 in) skid track helps to prevent rollovers.
FLYING CONTROLS: Conventional collective, cyclic and yaw pedals. Floor-mounted cyclic option available since 1998; early models had top-mounted stick.
STRUCTURE: Generally of epoxy resin, graphite fabric and Nomex honeycomb; aluminium tailboom.
LANDING GEAR: Composites covered aluminium-honeycomb core legs with aluminium tube skids and steel skid shoes stressed for landings at up to 2.5 *g*; floats (weight 18 kg; 40 lb) optional.
POWER PLANT: *254:* One 41.0 kW (55 hp) Hirth 2703 dual-carburettor two-stroke engine with pull starter and 12:1 planetary transmission. Normal fuel capacity 19 litres (5.0 US gallons; 4.1 Imp gallons).
331: One 48.5 kW (65 hp) Hirth 2706 dual-carburettor two-stroke engine with electric starter (also option for 254) or Hirth H32 of same power in 331H; 12:1 planetary transmission. Fuel capacity 38 litres (10.0 US gallons; 8.3 Imp gallons).
ACCOMMODATION: Single seat partially enclosed (254 version); enclosed (331 version).
SYSTEMS: Electrical: 12 V battery; 14 V alternator fit appropriate to engine.
AVIONICS: Customer choice.
DIMENSIONS, EXTERNAL:
Main rotor diameter ..... 6.40 m (21 ft 0 in)
Main rotor blade chord ..... 0.17 m (6¾ in)
Tail rotor diameter ..... 0.76 m (2 ft 6 in)
Tail rotor blade chord ..... 0.05 m (2 in)
Fuselage: Length, main rotor folded ..... 5.84 m (19 ft 2 in)
Skid track: 254, 331 ..... 2.44 m (8 ft 0 in)
331H ..... 1.98 m (6 ft 6 in)
Height overall ..... 2.39 m (7 ft 10 in)
DIMENSIONS, INTERNAL:
Cabin: Length ..... 1.32 m (4 ft 4 in)
Max width ..... 0.76 m (2 ft 6 in)
Max height ..... 1.50 m (4 ft 11 in)
AREAS:
Main rotor disc ..... 32.2 m² (346.4 sq ft)
WEIGHTS AND LOADINGS:
Weight empty: 254 ..... 114 kg (252 lb)
331 ..... 150 kg (330 lb)
Max T-O and landing weight: 254 ..... 260 kg (575 lb)
331 ..... 294 kg (650 lb)
PERFORMANCE:
Max level speed: 254 ..... 55 kt (101 km/h; 63 mph)
331 ..... 90 kt (167 km/h; 104 mph)
Cruising speed: 254, 331 ..... 55 kt (101 km/h; 63 mph)
Max rate of climb at S/L ..... 305 m (1,000 ft)/min
Service ceiling ..... 3,660 m (12,000 ft)
Hovering ceiling: IGE ..... 3,290 m (10,800 ft)
OGE ..... 2,135 m (7,000 ft)
Range, normal fuel, 55 kt:
254 ..... 65 n miles (120 km; 75 miles)
331 ..... 130 n miles (241 km; 150 miles)

ASII Ultrasport 331 single-seat ultralight helicopter with doors removed *(Paul Jackson)* 0110714

ASII ULTRASPORT 496

TYPE: Two-seat ultralight helicopter kitbuilt.
Details as for 254 and 331, except as follows:
PROGRAMME: Developed from the 331, the Ultrasport 496 (N496AS) first flew in July 1995. Deliveries began in April 1997.
CURRENT VERSIONS: **Ultrasport 496:** Original version; no longer available.
Ultrasport 496RT: Announced 2002. Uses 84.6 kW (113.4 hp) Rotax 914 turbocharged engine with electric start and quadruple carburettors.
Ultrasport 496H: Replaced original 496 in late 2002; *as described.*
Sportscopter 600: New Zealand assembly; initial four registered in July 1999.
Vigilante: Remotely piloted version developed by Science Applications International Corporation (SAIC). **Vigilante 496** prototype (N496UV) evaluated as optionally piloted vehicle (OPV) by US Navy during first and second quarters of 1998. Improved **Vigilante 502** is UAV only. Further details in *Jane's Unmanned Aerial Vehicles and Targets.*
CUSTOMERS: By end 2001, 135 had been delivered of which 35 were then flying. No further information received.
COSTS: 496 USD62,900; 496RT USD77,900 (2006).
DESIGN FEATURES: Generally as for 254/331. Quick-build kit quoted build time 80 hours; dual controls standard.
STRUCTURE: Infinite-life composites rotor blades and fuselage. Shaft-driven four-blade composites tail rotor. Vertically mounted direct-drive helical spur gears 11:1 two-stage main transmission.
LANDING GEAR: Aluminium skids; track as for 254/331. Floats optional.
POWER PLANT: Original model had one 85.8 kW (115 hp) Hirth F30 quad-carburettor engine with electric starter; 75.0 kW (101 hp) Hirth H30E version designated 496H demonstrated at Sun 'n' Fun 2002 and has now supplanted F30. Fuel capacity 67 litres (17.6 US gallons; 14.7 Imp gallons).
EQUIPMENT: Ballistic parachute under consideration.

Two-seat Ultrasport 496 *(Paul Jackson)* 1159756

DIMENSIONS, EXTERNAL:
- Main rotor diameter ... 7.01 m (23 ft 0 in)
- Main rotor blade chord ... 0.17 m (6¾ in)
- Tail rotor diameter ... 0.76 m (2 ft 6 in)
- Tail rotor blade chord ... 0.05 m (2 in)
- Length, blades folded ... 6.02 m (19 ft 9 in)
- Height ... 2.51 m (8 ft 3 in)
- Width overall ... 2.21 m (7 ft 3 in)

DIMENSIONS, INTERNAL:
- Cabin: Length ... 1.35 m (4 ft 5 in)
- Max width ... 1.22 m (4 ft 0 in)
- Max height ... 1.50 m (4 ft 11 in)

AREAS:
- Main rotor disc ... 38.60 m² (415.5 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty: 496H ... 272 kg (600 lb)
- 496RT ... 299 kg (660 lb)
- Max T-O and landing weight: 496H ... 512 kg (1,130 lb)
- 496RT ... 499 kg (1,100 lb)

PERFORMANCE (at max T-O weight, ISA):
- Never-exceed speed (VNE) ... 90 kt (167 km/h; 104 mph)
- Max cruising speed ... 61 kt (113 km/h; 70 mph)
- Max rate of climb at S/L ... 305 m (1,000 ft)/min
- Hovering ceiling: IGE ... 3,290 m (10,800 ft)
- OGE ... 2,135 m (7,000 ft)
- Range ... 130 n miles (240 km; 149 miles)
- Endurance ... 3 h

ATAC

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OWNERS:
Don Friebel
Peter Lipa

ATAC, a small group of private businessmen and aviation enthusiasts, adapted a UAV design to meet requirements of the new Light Sport Airplane category introduced in 2004.

ATAC PATRIOT II

TYPE: Two-seat lightplane.

PROGRAMME: Unregistered prototype (later registered N2005M) displayed at AirVenture, Oshkosh, July 2005. Flying by April 2006. Design optimisation and certification by Aircraft Designs Inc.

COSTS: USD34,900 (2005).

DESIGN FEATURES: Able to accept variety of engines without structural change or alteration of CG. Wings removable in 10 minutes. Meets LSA and Experimental rules.

Constant-chord wing mounted high at rear of cockpit pod and above pusher power plant; empennage, including twin fins, mounted on two open booms. Wing and engine support struts normal to airflow are of streamlined section; other tubes are circular.

FLYING CONTROLS: Conventional and manual. Piano-hinged rudders with mass balance; two elevator tabs, one of which droops when flaperons deployed to counter pitch trim; other acts in standard fashion. Optional electrically actuated full span flaperons droop 15 and 25°.

STRUCTURE: Fuselage of welded 4130 steel tube with 0.020 gauge aluminium skins on empennage. Wings all-aluminium, with back-to-back C-channel 0.025 gauge webs and caps for main spar; 1.5 tube rear spar; 0.016 ribs; and 0.020 skin.

LANDING GEAR: Tricycle type; fixed. Castoring nosewheel and mainwheels on individual cantilever-sprung metal tube legs. Mainwheels 6.00-6; nosewheel 11×4.00-5. Cable operated brakes.

POWER PLANT: One piston engine (Suzuki 1300 inline four-cylinder with Raven reduction gear as factory standard) between 63.3 kW (85 hp) and 85.8 kW (115 hp), driving a pusher propeller; larger engine under consideration. Fuel capacity 68 litres (18.0 US gallons; 15.0 Imp gallons).

ACCOMMODATION: Two persons, side by side; door each side of cockpit. Accommodation heated and ventilated.

DIMENSIONS, EXTERNAL:
- Wing span ... 8.84 m (29 ft 0 in)
- Wing aspect ratio ... 6.0
- Length overall ... 6.10 m (20 ft 0 in)

AREAS:
- Wings, gross ... 13.01 m² (140.0 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty ... 315 kg (695 lb)
- Max T-O weight ... 596 kg (1,315 lb)

PERFORMANCE (85.8 kW; 115 hp engine, estimated):
- Never-exceed speed (VNE) ... 129 kt (239 km/h; 149 mph)
- Cruising speed ... 120 kt (222 km/h; 138 mph)
- Stalling speed: flaps up ... 44 kt (81 km/h; 50 mph)
- flaps down ... 39 kt (71 km/h; 44 mph)
- Max rate of climb at S/L ... 457 m (1,500 ft)/min
- T-O run ... 107 m (350 ft)
- Landing run ... 92 m (300 ft)
- g limits ... ±6

Prototype ATAC Patriot II *(Paul Jackson)*

1159757

ATG

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DIRECTOR, MARKETING: Bob Uhle
MANAGER, PROGRAMME: George Bullard
COMMUNICATIONS MANAGER: Sara Newton

Aviation Technology Group was formed in 1998 to develop the ATG Javelin two-seat jet; it was incorporated in June 2000. Lease of 5,200 m² (56,000 sq ft) assembly facility at Front Range Airport, Colorado, announced August 2005

Company 10 per cent owned by Israel Aircraft Industries, which has rights to develop and market Mks 20 and 30 versions of Javelin.

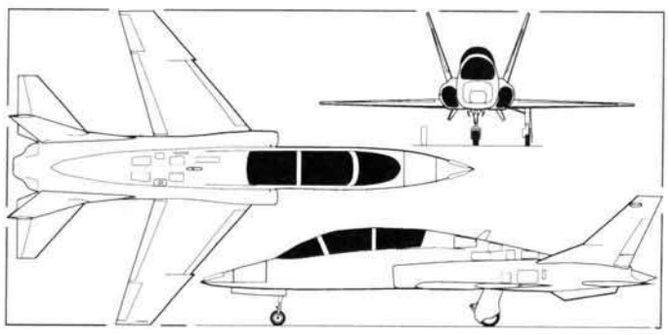
ATG-1 JAVELIN

TYPE: Two-seat jet sportplane.

PROGRAMME: Announced early 2001, at which time initial wind tunnel testing was being undertaken; this finished 28 February 2001. Construction of full-scale, non-flying mockup being undertaken during mid-2001. A second series of wind tunnel tests was completed in late 2001 and 2002. One (N104TG) non-conforming and two conforming prototypes to fly 1,400-hour test programme. N104TG rolled out 5 May 2005; first flight 30 September 2005; total of three flights completed by end of December 2005, during which the prototype had reached a maximum speed of 185 kt (343 km/h; 213 mph) with landing gear down, at altitudes up to 4,267 m (14,000 ft), and bank angles up to 45°. First flight with retraction of landing gear took place on 28 February 2006. By July 2006 the prototype had been flown at bank angles up to 450 and reached a maximum speed of 335 kt (620 km/h; 385 mph) and a maximum altitude of 6,096 m (20,000 ft).

Design refinements announced June 2006 for production version included additional 0.56 m (1 ft 10 in) wing span and 2.69 m² (29.0 sq ft) area; addition of Fowler flaps and leading edge flaps for up to 7 kt (13 km/h; 8 mph) decrease in stalling speed; rear-hinged

ATG-1B Javelin prototype during its first flight with landing gear retracted 1159207



Current configuration of ATG-1B Javelin *(Paul Jackson)* 1159827

canopy with electric actuation. Certification to FAR Pt 23 Amdt 52 (Aerobatic) and first deliveries intended October 2007. Target production 10 in 2007; 70 in 2008; 120 in 2009.

At the NBAA Convention in Las Vegas on 18 October 2004 ATG and Israel Aircraft Industries announced a strategic co-operation agreement for the design development and manufacture of the AJT variant, with IAI investing equity and matching funds in ATG and final assembly of the AJT to take place in the USA and Israel as part of an integrated system for advanced and lead-in pilot training that will include flight simulators, ground-based systems, maintenance and logistics infrastructures. Initial target is Israel Defence Force/Air Force requirement for replacement of Fouga Magister (IAI Tzukit) and advanced trainer versions of A-4 Skyhawk.

All data are provisional.

CURRENT VERSIONS: **ATG-1A:** Initial design. Mid-wing configuration and separate windscreen. Replaced by ATG-1B.

ATG-1B Javelin: Mockup unveiled 12 July 2002 and shown at NBAA Convention, Orlando, Florida, in September 2002. Low wing with leading-edge 'dog-tooth' and two-piece canopy. Several subvariants:

Javelin Mk 5 Scout: Basic civil version.

Javelin Mk 10: Civil version.

Javelin Mk 20: Military trainer version.

Javelin Mk 40 HDI: (Homeland Defense Interceptor) Single-seat version armed with pylon-mounted AIM-9 Sidewinder or air-to-air Stinger missiles, was announced in early 2002. Quoted maximum speed of M1.6.

Javelin Mk 30 AJT: (Advanced Jet Trainer) Two-seat version equipped with ejection seats and head-up displays to complement Javelin HDI.

Javelin Mk 50 UCAV: Unmanned combat version announced in July 2002.

CUSTOMERS: Production forecasts range from 711 to 1,638 units (2002 estimate). Deposits (US$25,000 each) taken on 26 aircraft by July 2002. By October 2004, the company had five distributorships (of intended six in USA) and orders for more than 80 aircraft, including 12 received during the NBAA Convention in Las Vegas that month, representing planned production until the end of 2007. Total 83 ordered by April 2005, comprising 75 from private owners and eight Mk 20s to be operated by EADS on behalf of French Navy; further seven and eight orders, respectively, then "pending".

COSTS: USD2.795 million (2005) including type rating course, plus tax. Development costs estimated at USD120 million up to certification. HDI version provisionally costed at under USD10 million; military trainer USD5.5 million. Direct operating cost USD542 per hour for basic trainer and USD700 per hour advanced trainer (2005).

DESIGN FEATURES: Extensive use of aluminium provides optimum strength to weight ratio.

FLYING CONTROLS: Conventional hydraulic and manual reversionary mode, initially with sidestick, but central column adopted from July 2006. Fowler flaps. Electrically trimmed slab-type stabiliser and twin 20° outward-canted vertical stabilisers. Leading-edge slats.

STRUCTURE: Fuselage of modular aluminium structure with swept cantilevered aluminium wing with leading edge root extensions. Quarter-chord sweep: wings 33° 10'; tailplane 37° 0'; fins 41° 0'. Sweptback tail; two aft body strakes. Announced suppliers include: ATK (fuselage structure); Applied Composite Technologies (wings, tail unit and control surfaces); Dukes Inc (cabin pressurisation control system); Mecaer (landing gear); Mecaplex (windscreen and canopy); Meggitt Thermal Systems, (environmental control and inlet de-icing systems); Northcoast Technologies (electrothermal airframe ice protection); and Parker Hannifin Corporation, (flight controls actuation).

LANDING GEAR: Hydraulically operated retractable tricyle type with oleo-pneumatic trailing-link struts. Michelin tyres. Anti-skid brakes.

POWER PLANT: Two Williams International FJ33-4-17M turbofan engines, each 8.00 kN (1,800 lb st). Prototype fitted with 6.67 kN (1,500 lb) FJ33-15M engines. Fuel capacity 1,060 litres (280 US gallons; 233 Imp gallons).

ACCOMMODATION: Pilot and passenger in tandem. Dual controls. Max cabin pressure differential 0.57 bar (8.3 lb/sq in). Maintains 2,440 m (8,000 ft) at 13,716 m (45,000 ft). Air conditioning standard. Rear-hinged canopy with integral explosive cords. Canopy sill line to be lowered by 10 cm (4 in) on production aircraft to improve downward visibility and cockpit access.

SYSTEMS: Combination of de-icing/anti-icing systems is planned: electro-expulsive de-icing for wings, bleed air heat for engine inlets, electric de-icing for windscreen and electric anti-icing for probes.

AVIONICS: Full IFR capability with three EFIS displays for PFD, MFD and EICAS functions. Options include head-up display and airborne video camera systems.

Comms: VHF/UHF radios; Mode S transponder.

Radar: Colour weather radar.

Flight: E-TCAS, TAWS, TCAS, EGPWS and GPS integrated FMS with waypoint map. Three axis autopilot.

Instrumentation: Avidyne FlightMax Entegra two-tube EFIS comprising one PFD and one MFD, each 264 mm (10.4 in), in each cockpit.

DIMENSIONS, EXTERNAL:

Wing span	7.65 m (25 ft 1 in)
Wing aspect ratio	4.2
Length overall	11.27 m (37 ft 0 in)
Height overall	3.20 m (10 ft 6 in)
Tailplane span	4.27 m (14 ft 0 in)

DIMENSIONS, INTERNAL:

Cockpit max width	0.91 m (3 ft 0 in)

AREAS:

Wings, gross	13.84 m² (149.0 sq ft)
Horizontal tail	3.25 m² (35.00 sq ft)
Vertical tail (each)	3.96 m² (42.60 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	2,111 kg (4,655 lb)
Max baggage weight	91 kg (200 lb)
Max fuel weight	850 kg (1,875 lb)
Max T-O weight	3,130 kg (6,900 lb)
Max wing loading	226.1 kg/m² (46.31 lb/sq ft)
Max power loading	195 kg/kN (1.92 lb/lb st)

PERFORMANCE (Javelin Mk 10):

Never exceed speed (VNE)	M0.96
Max level speed at FL350	M0.87/500 kt (926 km/h; 575 mph)
Econ cruising Mach No. at FL450	0.75
Approach speed:	98 kt (181 km/h; 113 mph) IAS
at max T-O weight	120 kt (222 km/h; 139 mph)
at typical landing weight	105 kt (194 km/h; 120 mph)
Stalling speed, landing gear and flaps down	98 kt (182 km/h; 113 mph)
Max rate of climb at S/L	2,743 m (9,000 ft)/min
Time to FL410	17 min
Max certified altitude	13,716 m (45,000 ft)
T-O run	610 m (2,000 ft)
T-O to 15 m (50 ft)	1,220 m (4,000 ft)
Landing from 15 m (50 ft)	1,037 m (3,400 ft)
Landing run at MLW	732 m (2,400 ft)
Range with max fuel, IFR reserves, at M0.80	1,000 n miles (1,852 km; 1,150 miles)
Endurance with max fuel	3 h 30 min
g limits	+6/−3

ATI

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ATI was incorporated in 2003 to develop its RT-700 twin-prop business aircraft.

ATI RT-700

TYPE: Business twin-prop.

PROGRAMME: In development since 2003. Launch funding being sought in late 2006.

CUSTOMERS: First order placed 18 April 2005 by US-based customer.

DESIGN FEATURES: Three-surface design with unswept foreplane and mainplane, sharply swept tailplane.

FLYING CONTROLS: Conventional and manual.

LANDING GEAR: Retractable tricycle type.

POWER PLANT: Originally proposed with two 261 kW (350 hp) Teledyne Continental TSIOL-550 liquid-cooled piston engines, with FADEC, mounted in pusher configuration. Diesel/Jet

Computer-generated image of ATI RT-700 twin-piston business aircraft

1158846

A-fuelled engine of same power had been adopted as standard by late 2006. Max usable fuel capacity 606 litres (160 US gallons; 133 Imp gallons).

ACCOMMODATION: Two crew and typical layout for four passengers in club configuration on 25 *g* reclining leather seats with fold-out work tables; refreshment/entertainment centre, seat-belted lavatory, and fore and aft flight-accessible baggage stowage, standard. Airbags optional. Cabin pressurised. Four cabin windows per side, with door on port side, aft of cockpit.

SYSTEMS: Aircraft recovery system (ARS) optional.

AVIONICS: EFIS cockpit standard, comprising two PFDs and one MFD, GPS/nav/com, Mode S transponder, engine monitoring systems, and autopilot, with mechanical standby instruments. GPWS, TCAS and weather radar optional. Systems from Avidyne, Chelton, Garmin and Honeywell under consideration in 2005.

DIMENSIONS, EXTERNAL:

Wing span	11.87 m (38 ft 11½ in)
Length overall	10.41 m (34 ft 2 in)
Height overall	3.86 m (12 ft 8 in)

DIMENSIONS, INTERNAL:

Cabin: Length	4.27 m (14 ft 0 in)
Max width	1.42 m (4 ft 8 in)
Max height	1.37 m (4 ft 6 in)

WEIGHTS AND LOADINGS:

Weight empty	1,612 kg (3,554 lb)
Max T-O weight	2,585 kg (5,699 lb)
Max power loading	4.96 kg/kW (8.14 lb/hp)

PERFORMANCE (estimated):

Max speed at FL250	281 kt (520 km/h; 323 mph)
Cruising speed at FL250	273 kt (506 km/h; 314 mph)
Econ cruising speed	243 kt (450 km/h; 280 mph)
Stalling speed, flaps down	71 kt (132 km/h; 82 mph)
Max rate of climb at S/L	610 m (2,000 ft)/min
T-O field length	427 m (1,400 ft)
Landing run	412 m (1,350 ft)
Range with reserves	1,308 n miles (2,422 km; 1,505 miles)

AVEOTECH

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VICE-PRESIDENT, SALES AND MARKETING: Rodeana Reynolds

Aveo USA, a division of AveoTech, holds marketing rights to the Polish-built Aero AT-3 in all countries except the UK, and US rights to the Flyitalia MD3 SportRider; the latter receiving certificate of LSA compliance on 16 September 2005. The company has also announced that it is designing a two-seat LSA-compliant amphibian, the AveoFreedom.

AVEOTECH AVEO X, XT and XTC

TYPE: Side-by-side ultralight/kitbuilt.

PROGRAMME: Version of Aero AT-3, manufactured in Poland, for US LSA category. Marketing launched at Sun 'n' Fun, Lakeland, Florida, April 2004, following delivery of US demonstrator (N55XT) in previous month. The aircraft was subsequently withdrawn, but promotion was continuing in 2006.

CURRENT VERSIONS: **AveoSport:** LSA/Sport Pilot version, later redesignated AveoXT. *As described.*

AveoX: Kit version. MTOW increased to 582 kg (1,283 lb), as for AT-3, but with upturned wingtips of AveoXT.

AveoXTC: AT-3 (span 7.55 m; 24 ft 9½ in) marketed in US under JAR-VLA bilateral certification agreement with Poland.

CUSTOMERS: Early sales of US versions included one to Venezuela.

COSTS: AveoXT USD95,000; AveoXTC USD69,500; AveoX kit USD25,000, or USD37,000 fast-build or USD49,000 with builder's assistance less engine and instruments (2005).

DESIGN FEATURES: Low-mounted, constant-chord wing with upturned tips; sweptback fin with significant (Pottier-type) rudder undercut for tailplane travel. Forward-hinged, single-piece canopy.

FLYING CONTROLS: Manual. All-moving tailplane with anti-balance tab and horn-balanced rudder. Split flaps; max deflection 40°.

STRUCTURE: Primarily metal, with some composites fairings, including wingtips and engine cowling.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted, cantilever sprung mainwheel legs and levered suspension nosewheel with rubber-in-compression shock absorber. Wheel speed fairings.

First US-registered AveoTech AveoSport at Sun 'n' Fun, April 2004
(Paul Jackson)

0576838

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912S flat-four driving an Aveo Sail three-blade propeller (GT-2 optional). Fuel tank ahead of cockpit, capacity 70 litres (18.5 US gallons; 15.4 Imp gallons).

DIMENSIONS, EXTERNAL:

Wing span	8.08 m (26 ft 6 in)
Length overall	6.25 m (20 ft 6 in)
Height overall	2.23 m (7 ft 3¾ in)

WEIGHTS AND LOADINGS:

Weight empty	318 kg (700 lb)
Max T-O weight	558 kg (1,232 lb)

PERFORMANCE:

Never-exceed (VNE) and max cruising speed	115 kt (213 km/h; 132 mph)
Cruising speed	108 kt (200 km/h; 124 mph) IAS
Stalling speed, flaps down	44 kt (82 km/h; 51 mph)
Max rate of climb at S/L	274 m (900 ft)/min
T-O and landing run	183 m (600 ft)
Range with max fuel	460 n miles (851 km; 529 miles)

AVIADESIGN

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PRESIDENT: Mark Ward
CHIEF DESIGNER: David Saunders

Long established as a provider of aer space services and products, Aviadesign announced its A-16 Sport Falcon in 2005. Its chief designer had earlier been responsible for the Saunders ST-27 twin-turboprop modification of the de Havilland D.H.114 Heron.

AVIADESIGN A-16 SPORT FALCON

TYPE: Two-seat lightplane.

PROGRAMME: Prototype (N166SF) exhibited and announced at Sun 'n' Fun April 2006, by which time had flown twice on unspecified dates. Deliveries then expected to begin in September 2006.

DESIGN FEATURES: Conforms to US LSA criteria. Low-drag configuration with easy cockpit access, spacious interior and good view. Constant-chord, parasol wing with dihedral outboard of narrow centre section and upturned tips; single, streamlined bracing strut each side; pusher propeller above tailboom; sweptback fin and low tailplane.

FLYING CONTROLS: Conventional and manual. Split flaps, electrically actuated. Aerodynamic- and mass-balanced rudder; horn-balanced, 'piano' hinged elevator without tabs.

STRUCTURE: Generally of riveted aluminium, with composites wingtips and nosecone.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring composites mainwheel legs; hydraulic brakes and wheel fairings. Steerable, levered suspension (helical spring and oleo) nosewheel with 3.50-4 tyre. Floatplane option.

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS liquid-cooled, flat-four piston engine; driving a Prince Aircraft two-blade, carbon fibre, fixed-pitch propeller. Fuel capacity 79 litres (21.0 US gallons; 17.5 Imp gallons).

ACCOMMODATION: Two in tandem, beneath starboard-hinged, single-piece windscreen/canopy; fixed side windows for passenger at rear. Fold-down section of cockpit port side simplifies access.

Aviadesign A-16 Sport Falcon *(Paul Jackson)* 1037976

DIMENSIONS, EXTERNAL:
Wing span ..... 8.84 m (29 ft 0 in)
Wing aspect ratio 6.5
Length overall ..... 8.23 m (27 ft 0 in)
AREAS:
Wings, gross ..... 11.98 m² (129.0 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 336 kg (740 lb)
Max T-O weight ..... 598 kg (1,320 lb)

PERFORMANCE (estimated):
Max level speed ..... 119 kt (220 km/h; 137 mph)
Cruising speed at 75% power ..... 104 kt (193 km/h; 120 mph)
Stalling speed, flaps down ..... 40 kt (73 km/h; 45 mph)
Max rate of climb at S/L ..... 305 m (1,000 ft)/min
T-O and landing run ..... 153 m (500 ft)
T-O to 15 m (50 ft) ..... 275 m (900 ft)
Range ..... 391 n miles (724 km; 450 miles)
g limits ..... +4.0/–2.0

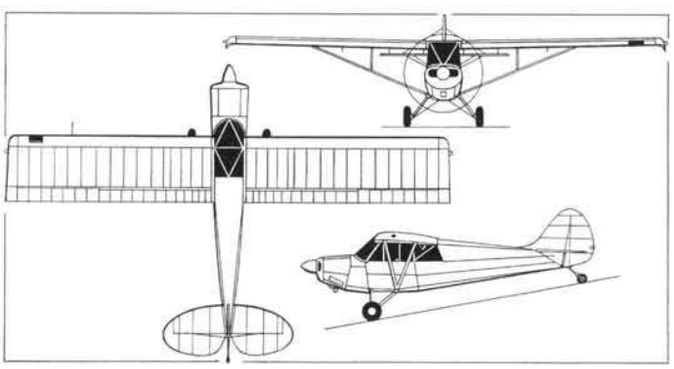
AVIAT

AVIAT AIRCRAFT INC

672 South Washington, PO Box 1240, Afton, Wyoming 83110
Tel: (+1 307) 885 31 51
Fax: (+1 307) 885 96 74
e-mail: aviat@aviataircraft.com
Web: www.aviataircraft.com
CHAIRMAN AND PRESIDENT: Stuart Horn
DIRECTOR OF SALES AND MARKETING: Bob James
NATIONAL SALES MANAGER: Mark James

The Pitts Aerobatics company was acquired by Christen Industries in 1983 along with manufacturing and marketing rights for the Pitts Special aerobatic aircraft. In turn, Aviat Aircraft Inc acquired Christen Industries in 1991 and production and type certificates for the Christen range. Aviat itself was bought by Stuart Horn in December 1995 and type certificates passed to Sky International Inc on 10 January 1996. The company has acquired manufacturing rights to the 1930s/1940s Globe Swift and Monocoupe 110, but a return to production has not been pursued. Aviat delivered a total of 83 aircraft in 1998, 85 in 1999, 91 in 2000, 57 in 2001, 55 in 2002, 64 in 2003, 42 in 2004 and 47 in 2005. Factory floor area (72,000 sq ft). Workforce stood at 58 in 2002.

Aviat Husky A-1B with current style of balanced ailerons *(Paul Jackson)* 1158202



Aviat Husky A-1B (2005 version) *(James Goulding)* 1158210

AVIAT HUSKY A-1

TYPE: Two-seat lightplane.

PROGRAMME: First flight (N6070H) 1986; FAA certification of original A-1 version under FAR Pt 23 achieved by Christen Industries 1 May 1987, this having 816 kg (1,800 lb) MTOW. Type Certificate passed to Aviat Inc, then White International on 3 December 1992, then Sky International on 10 January 1996.

CURRENT VERSIONS: **A-1**: Original version, now superseded; 398 built.

A-1A: Prototype N15LF. Certified 28 January 1998, with MTOW increased by 41 kg (90 lb). Total 69 built, 1998–99 only.

A-1B: Introduced as mission-specific version initially intended for government agencies. Has higher maximum take-off weight of 907 kg (2,000 lb). Certified 28 January 1998. *Data below refer to this version.*

A-1B200: Initially designated Husky MD. First flown August 2004. Initial production aircraft (N200HY) exhibited at AirVenture, Oshkosh, July 2005. FAR Part 23 certification achieved October 2005. Features 149 kW (200 hp) Textron Lycoming IO-360 engine with dual exhausts and dual oil coolers, 2.1 m (6 ft 10¾ in) diameter MT two-blade composites propeller, flaps of increased span, and dynamically balanced, spadeless ailerons. Compared with standard A-1B, cruising speed at 2,286 m (7,500 ft) is increased by 8 kt (15 km/h; 9 mph) and max rate of climb at S/L is 518 m (1,700 ft)/min.

A-1B160: Introduced during 2005. Feature 119 kW (160 hp) Textron Lycoming O-360 engine 1.88 m (6 ft 2 in) diameter Sensenich fixed-pitch propeller, optional long-span flaps as on A-1B200, and dynamically balanced, spadeless ailerons. Useful load 340 kg (750 lb); max fuel range 869 n miles (1,609 km; 1,000 miles).

CUSTOMERS: Total of some 820 built by mid-2006, including 350 A-1Bs. Recent annual production of 50, 34, 37, 30 and 41 in 2001-05.

COSTS: A-1B USD139,700 (2003).

DESIGN FEATURES: Conventional high-wing monoplane; constant-chord wing with V-strut bracing and auxiliary struts; wire-braced empennage with elliptical surfaces.

Wing has modified Clark Y US 35B section; optional drooped Plane Booster wingtips and vortex generator kit.

FLYING CONTROLS: Conventional and manual. Symmetrical section ailerons with spade-type mass balance; trim tabs in elevators; slotted high-lift flaps. Fixed tailplane; trim by adjustable bungee. Control surface movements: ailerons ±20°; elevators +29/–15°; rudder ±25°; flaps 30°.

Shorter-span, wider-chord ailerons, with dynamic and mass balancing but without 'spades', and longer span flaps, introduced from 2005, providing lighter stick force, increased roll rate of 30°/s and steeper rate of descent (at 244 m; 800 ft/min) for operation into short landing strips.

STRUCTURE: Tubular welded 4130 steel fuselage. Wing has two aluminium spars, metal ribs and metal leading-edge, Dacron covering overall. A-1B has 7075-T76 aluminium rear spar, replacing 6061-T6. Twin bracing struts each side of wings and wire- and strut-braced tail unit. Light alloy slotted flaps and ailerons, with Dacron covering. Fuselage and tail have chrome molybdenum steel tube frames, covered in Dacron except for metal skin to rear fuselage. Seven-coat corrosion protection.

LANDING GEAR: Tailwheel type; fixed. Two faired side Vs and half-axles hinged to lower longeron, sprung under centreline, with internal (under front seat) bungee cord shock-absorption. Cleveland mainwheels, tyres size 8.00–6 as standard; 6.00–6 or 8.50–6 tyres and 24×10–6 or 26×10.5–6 Tundra tyres optional. Cleveland mainwheel hydraulic disc brakes, toe-operated. Steerable leaf-spring tailwheel. Optional EDO 89–2000, Baumann BF-2100 and Wipline 2100 floats, Aero M1500, M1800, M2000 or M3000H wheel replacement skis, Aero wheel skis and Flairdyne hydraulic wheel-retracting skis.

POWER PLANT: One 134 kW (180 hp) Textron Lycoming O-360-A1P flat-four engine, driving a Hartzell HC-C2YK-1BF two-blade constant-speed metal propeller. MT-Propeller MTV-15B/210-58 two-blade, constant-speed, composites propeller optional and retrofittable. Fuel in two metal tanks, one in each wing, total capacity 208 litres (52.0 US gallons; 45.75 Imp gallons), of which 189 litres (50.0 US gallons; 41.6 Imp gallons) are usable. Fuel filler point in upper surface of each wing, near root.

ACCOMMODATION: Enclosed cabin seating two in tandem, on ergonomic lumbar and side support seats, with dual controls. Custom leather seats optional. Five-point safety harness. AmSafe Aviation inflatable restraints available from mid-2005. Downward-hinged door on starboard side, with upward-hinged window above. Optional skylight window in roof. A-1B has luggage door on starboard side as standard; optional on A-1A. Rear compartment for extra 13.6 kg (30 lb) baggage optional (structural provision standard) from 2000; external access starboard side, below rear window; certified retrofitting kits available.

SYSTEMS: 12 V electrical system includes lights, 22 Ah battery, and 60 A alternator.

AVIONICS: VFR standard; Loran C transponder, GPS, nav/com, intercom, and IFR instrumentation, including Garmin GNS530 GPS/com and VM 1000 panel, optional.

Instrumentation: Sensitive altimeter, ASI, magnetic compass, digital tachometer, oil temperature/pressure gauge, manifold pressure gauge and CHT gauge all standard.

EQUIPMENT: Rear seat heater and windscreen defroster standard on A-1B.

DIMENSIONS, EXTERNAL:

Wing span	10.82 m (35 ft 6 in)
Wing aspect ratio	6.9
Length overall	6.88 m (22 ft 7 in)
Height overall	2.01 m (6 ft 7 in)
Propeller diameter: Hartzell	1.93 m (6 ft 4 in)
MT	2.11 m (6 ft 11 in)

DIMENSIONS, INTERNAL:

Baggage hold volume	0.28 m^3 (10 cu ft)

AREAS:

Wings, gross	17.00 m^2 (183.0 sq ft)
Ailerons (total)	1.43 m^2 (15.40 sq ft)
Trailing-edge flaps (total)	2.09 m^2 (22.50 sq ft)
Fin	0.43 m^2 (4.66 sq ft)
Rudder	0.62 m^2 (6.76 sq ft)
Tailplane	1.48 m^2 (15.90 sq ft)
Elevators, incl tabs	1.31 m^2 (14.10 sq ft)

WEIGHTS AND LOADINGS (A-1B where different):

Weight empty	540 kg (1,190 lb)
Baggage capacity	23 kg (50 lb)
Max T-O weight:	
landplane	907 kg (2,000 lb)
floatplane	998 kg (2,200 lb)
Max wing loading:	
landplane	53.4 kg/m^2 (10.93 lb/sq ft)
floatplane	58.7 kg/m^2 (12.02 lb/sq ft)
Max power loading:	
landplane	6.76 kg/kW (11.11 lb/hp)
floatplane	7.44 kg/kW (12.22 lb/hp)

PERFORMANCE (landplane):

Never-exceed speed (VNE)	132 kt (245 km/h; 152 mph)
Max level speed	126 kt (233 km/h; 145 mph)
Cruising speed: at 75% power at 1,220 m (4,000 ft)	122 kt (225 km/h; 140 mph)
at 55% power	113 kt (209 km/h; 130 mph)
Stalling speed, flaps down:	
power on	37 kt (69 km/h; 43 mph)
power off	46 kt (86 km/h; 53 mph)
Landing speed	51 kt (94 km/h; 58 mph)
Max rate of climb at S/L	457 m (1,500 ft)/min
Service ceiling	6,100 m (20,000 ft)
T-O run, flaps down	61 m (200 ft)
T-O to 15 m (50 ft), flaps down	122 m (400 ft)
Landing from 15 m (50 ft), flaps down	244 m (800 ft)
Landing run, full flaps	107 m (350 ft)
Range: at 55% power, no reserves	695 n miles (1,287 km; 800 miles)

AVIAT HUSKY PUP A-1B

TYPE: Two-seat lightplane.

PROGRAMME: Developed as simplified, cheaper version of Husky for daytime VFR only. Prototype (N180HY) first flown 7 March 2002; public debut at EAA Sun 'n' Fun at Lakeland, Florida, in April 2002. Certification (as "engine option group" of A-1B Husky) achieved 18 August 2003, at which time a small batch of completed aircraft was being held at the factory for immediate issue to buyers. In 2005, seventh Pup (N143HP) exhibited at AirVenture, Oshkosh, with current standard of A-1B wing, including spadeless ailerons and installation of flaps; this version certified 21 October 2005 and first production aircraft (N101HY) registered January 2006.

CUSTOMERS: Three delivered in 2003, three in 2004, including one to UK, and one in 2005. Eight built by mid-2006, including two with flaps; c/ns prefixed NF or WF ('no flaps'; 'with flaps').

COSTS: USD115,000 VFR (2003).

DESIGN FEATURES: Generally as Husky.

FLYING CONTROLS: Generally as Husky, but with modified engine cowling and wingtips. Flaps deleted on initial aircraft. Flapped version has aileron movement restricted to ±15° 30'; other control movements as Husky.

STRUCTURE: As Husky.

LANDING GEAR: As for Husky A-1; mainwheel size 6.00–6 (4-ply), optionally 8.00–6 (4- or 6-ply) or 8.50-6 (6-ply). Cleveland wheels and brakes.

POWER PLANT: One 119.3 kW (160 hp) Textron Lycoming O-320-D2A flat-four, driving a Sensenich 74DM6S8-0-58 two-blade, fixed-pitch, metal propeller. Fuel as for Husky.

ACCOMMODATION: Two in tandem. Optional rear compartment, as Husky.

AVIONICS: VFR panel standard.

Comms: Becker com, GTX 320 transponder, PM 10000 II intercom.

Flight: Garmin GPS III.

Instrumentation: ASI, altimeter, compass, digital tachometer, oil pressure/temperature gauge, EGT/CHT gauge and ammeter all standard.

EQUIPMENT: Two-colour paint scheme and polished wheel hub caps standard.

DIMENSIONS, EXTERNAL: As for Husky except:

Propeller diameter	1.88 m (6 ft 2 in)

WEIGHTS AND LOADINGS:

Weight empty	517 kg (1,140 lb)
Max T-O weight:	907 kg (2,000 lb)
Max wing loading:	53.4 kg/m^2 (10.93 lb/sq ft)
Max power loading:	7.61 kg/kW (12.50 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	133 kt (246 km/h; 153 mph)
Cruising speed	122 kt (225 km/h; 140 mph)
Stalling speed, flaps up	43 kt (79 km/h; 49 mph)
Service ceiling	5,180 m (17,000 ft)
Max rate of climb at S/L	241 m (790 ft)/min
T-O run	186 m (610 ft)
Landing run	181 m (595 ft)
Range, with reserves	869 n miles (1,609 km; 1,000 miles)
Endurance	more than 7 h

Aviat Husky Pup with flapless wing *(Paul Jackson)* 1158270

AVIAT PITTS S-2C

TYPE: Aerobatic two-seat biplane.

PROGRAMME: Developed from Pitts S-2 series of two-seat biplanes using wing design from Curtis Pitts. Uses S-2B basic structure modified with differently-shaped wingtips, empennage tips, ailerons and lower fuselage.

Pitts S-1 first flew September 1944; available only from plans until S-1S certified 13 February 1973, followed by S-1T on 24 July 1975. Two-seat S-2 added to original Type Certificate on 8 March 1971; S-2A on 11 June 1971 (205 built); S-2S 29 May 1981; and S-2B 6 April 1983. S-2C certified in Normal and Aerobatic categories on 4 June 1998.

CUSTOMERS: Total 77 built by December 2005; four delivered in 2002, three in 2003, nine in 2004 and five in 2005.

COSTS: Basic price USD194,295 (2003).

DESIGN FEATURES: Compact, positive-stagger, single-bay biplane; constant-chord wings, upper of which sweptback; wire-braced tail surfaces. Optimised for aerobatic performance. Differs from S-2B in having symmetrical ailerons; squared fin-, tailplane- and wingtips; metal fuselage undersides removable for easier maintenance. Stretch-formed compound-curved engine cowling. Rate of roll is greater than 300°/s.

Wing sections NACA 6400 series on upper wing, 00 series on lower wings. Both wings have 1° 30' incidence and lower wing has 3° dihedral.

FLYING CONTROLS: Conventional and manual. Rudder and elevators aerodynamically balanced. Compared to S-2B, the S-2C only has a trim tab on starboard elevator. Control surface deflections: ailerons +28° 30'/–22°; elevator ±27°; rudder ±30°.

STRUCTURE: Fuselage 4130 steel tube with wooden stringers, aluminium top decking and side panels; remainder Dacron covered. Steel tube, Dacron-covered fixed tail surfaces; Dacron-covered control surfaces.

LANDING GEAR: Tailwheel type; fixed. Two faired mainwheel legs with half-axles sprung under centreline with internal bungee suspension. Mainwheels 5.00–5; tyre pressure 2.34 bar (34 lb/sq in).

POWER PLANT: One 194 kW (260 hp) Textron Lycoming AEIO-540-D4A5 flat-six driving a Hartzell HC-C3YR-1A/C7690C or E 'Claw' three-blade aerobatic constant-speed (hydraulic) composites propeller. Fuel capacity 110 litres (29.0 US gallons; 24.0 Imp gallons) of which 106 litres (28.0 US gallons; 23.3 Imp gallons) are usable; for aerobatic flight, the 19 litre (5.0 US gallon; 4.2 Imp gallon) wing tank is not used. Oil capacity 11.4 litres (3.0 US gallons; 2.5 Imp gallons).

ACCOMMODATION: Pilot and passenger in tandem under one-piece rearward-sliding canopy; single-piece windscreen. Optional replacement upper decking for single-seat operation, comprising front cockpit flush fairing and shortened canopy.

EQUIPMENT: Options include custom paint and exterior design, electronic gauges, custom parachutes, and canopy covers.

DIMENSIONS, EXTERNAL:

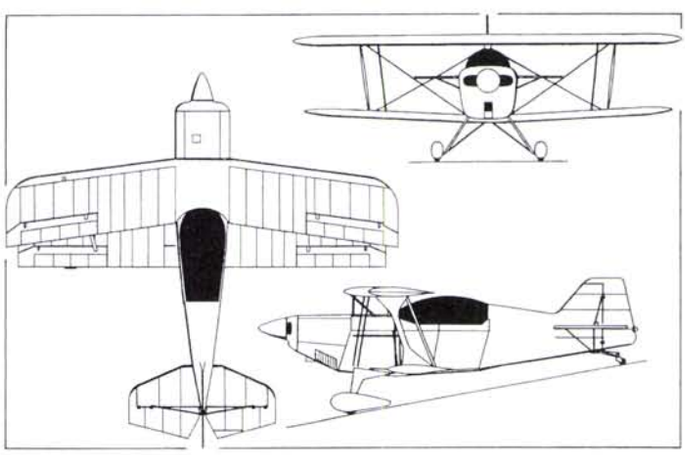
Wing span	6.10 m (20 ft 0 in)
Length overall	5.41 m (17 ft 9 in)
Height overall	1.96 m (6 ft 5 in)
Wheel track	1.54 m (5 ft 0¾ in)
Wheelbase	4.14 m (13 ft 7 in)
Propeller diameter	2.03 m (6 ft 8 in)

DIMENSIONS, INTERNAL:

Cabin: Length	2.11 m (6 ft 11 in)
Max width	0.71 m (2 ft 4 in)
Max height	1.19 m (3 ft 11 in)

AREAS:

Wings, gross	11.85 m^2 (127.5 sq ft)



Aviat Pitts S-2C (Textron Lycoming flat-six) *(Paul Jackson)* 1158211

Pitts S-2C flown by 20,000-hour, aerobatic pilot Fred R Cabanas *(Paul Jackson)* 1158203

WEIGHTS AND LOADINGS:
- Weight empty ..... 524 kg (1,155 lb)
- Baggage capacity ..... 9 kg (20 lb)
- Max T-O and landing weight ..... 771 kg (1,700 lb)
- Payload with max fuel ..... 168 kg (371 lb)
- Max wing loading ..... 65.1 kg/m² (13.33 lb/sq ft)
- Max power loading ..... 3.98 kg/kW (6.54 lb/hp)

PERFORMANCE:
- Never-exceed speed (VNE) ..... 185 kt (342 km/h; 212 mph)
- Max level speed ..... 169 kt (313 km/h; 194 mph)
- Manoeuvring speed ..... 134 kt (248 km/h; 154 mph) IAS
- Cruising speed at 75% power ..... 150 kt (278 km/h; 173 mph)
- Stalling speed, power off ..... 56 kt (104 km/h; 65 mph)
- Max rate of climb at S/L ..... 884 m (2,900 ft)/min
- Max roll rate ..... more than 300°/s
- T-O run ..... 169 m (555 ft)
- T-O to 15 m (50 ft) ..... 262 m (860 ft)
- Landing from 15 m (50 ft) ..... 366 m (1,200 ft)
- Landing run ..... 229 m (750 ft)
- Max range at 75% power, 30 min reserves ..... 246 n miles (457 km; 284 miles)
- Endurance, 30 min reserves ..... 1 h 36 min
- g limits ..... +6/−5

AVIAT (CHRISTEN) EAGLE II

TYPE: Tandem-seat biplane kitbuilt.

PROGRAMME: Originated as rival to Pitts S-1, designed by Frank Christensen. First flown in February 1977. Kit production began October 1977, initially by Christen Industries.

CUSTOMERS: More than 350 completed and flown by mid-2001, including 320 in the United States. Promotion and production continuing in 2006.

COSTS: Kit USD85,000 (2002) less engine and propeller.

DESIGN FEATURES: Positive stagger, single-bay biplane; constant-chord wings with rounded tips, upper with sweepback; wire-braced, elliptical tail surfaces. Available in 24 individual subassemblies; quoted build time 1,822 hours.

FLYING CONTROLS: Conventional and manual. Ailerons on both sets of wings.

STRUCTURE: Fabric-covered wings with wooden spars and ribs plus metal leading- and trailing-edges. Welded 4130 steel tube fuselage, fabric covered aft of cockpit; metal panelled before.

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted, spring steel cantilever mainwheel legs with wheel fairings. Hydraulic brakes.

POWER PLANT: One 149 kW (200 hp) Textron Lycoming AEIO-360-A1D driving a Hartzell HC-C2YK-4/C7666A-2 constant-speed two-blade metal propeller. Fuel capacity 94.6 litres (25.0 US gallons; 20.8 Imp gallons), of which 90.8 litres (24.0 US gallons; 20.0 Imp gallons) are usable.

Non-standard black and gold variant of standard paint scheme applied to a UK-registered Aviat Eagle II *(Paul Jackson)* 1158225

ACCOMMODATION: Pilot and passenger in tandem; flown solo from rear seat. Optional single-seat upper decking assembly comprises front cockpit flush fairing and shortened canopy.

SYSTEMS: Inverted oil system and manual fuel pump system as standard.

DIMENSIONS, EXTERNAL:
- Wing span ..... 6.07 m (19 ft 11 in)
- Length overall ..... 5.46 m (17 ft 11 in)
- Height overall ..... 1.98 m (6 ft 6 in)

AREAS:
- Wings, gross ..... 11.61 m² (125.0 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty ..... 465 kg (1,025 lb)
- Max T-O and landing weight ..... 715 kg (1,578 lb)
- Max baggage weight ..... 13.6 kg (30 lb)
- Max wing loading ..... 61.6 kg/m² (12.62 lb/sq ft)
- Max power loading ..... 4.80 kg/kW (7.89 lb/hp)

PERFORMANCE:
- Never-exceed speed (VNE) ..... 182 kt (338 km/h; 210 mph)
- Max operating speed ..... 159 kt (296 km/h; 184 mph)
- Cruising speed ..... 143 kt (266 km/h; 165 mph)
- Stalling speed ..... 51 kt (90 km/h; 58 mph)
- Max rate of climb at S/L ..... 640 m (2,100 ft)/min
- Service ceiling ..... 5,180 m (17,000 ft)
- Max roll rate ..... 187°/s
- T-O run ..... 244 m (800 ft)
- Landing from 15 m (50 ft) ..... 480 m (1,575 ft)
- Range with 30 min reserves ..... 380 n miles (703 km; 437 miles)
- g limits ..... +9/−6

AVIATION DEVELOPMENT

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JOINT OWNERS:
Rick Schneider
Steve Sollars

Aviation Development International was formed in 1997 to build and market the Alaskan Bushmaster kitbuilt from an earlier design by Mr Schneider. The company has a 1,486 m² (16,000 sq ft) facility at Highland County Airport, Hillsboro.

Another company product is the Loadmaster, an Aermacchi AL-60 re-engined with a VOKBM M-14P nine-cylinder radial of 294 kW (394 hp). It was planned to convert two further AL-60s with a 560 kW (751 shp) Walter M 601 turboprop, but nothing further has become known.

AVIATION DEVELOPMENT ALASKAN BUSHMASTER

TYPE: Four-seat kitbuilt.

Aviation Development Alaskan Bushmaster *(Paul Jackson)* 1133259

PROGRAMME: Developed during 1980s by Alaskan bush pilot Rick Schneider to replace his Piper Super Cub. Initial design based on Merlin Explorer. Original production ceased in 1990 but restarted in 1997.

CUSTOMERS: 12 original examples and one new-build version flying by April 2001, at which time 10 further aircraft on order. One registered to Southland Holdings of Wilmington, Delaware, in July 2002; three on US register in September 2006.

COSTS: Kit USD22,500, excluding engine, propeller, instruments and upholstery.

DESIGN FEATURES: Piper Tri-Pacer family development. No welding, machining or heavy forming required during construction. Quoted build time 600 hours.

FLYING CONTROLS: Conventional and manual. Stainless steel control cables. Horn-balanced elevators and rudder; flight-adjustable tabs in both elevators.

STRUCTURE: Fabric-covered fuselage and tail of welded 4130 steel tube; fabric-covered extruded aluminium wings, flaps and ailerons. Wing braced with two extruded aluminium lift struts; tailplane and fin braced by wires.

LANDING GEAR: Tailwheel type; fixed. Spring aluminium main legs and tailwheel. Bungee cord suspension. Mainwheels 8.50–6. Options include Tundra tyres, Schneider Wheel Skis, skis and floats.

POWER PLANT: Prototype had 149 kW (200 hp) Textron Lycoming O-320 flat-four engine driving a two blade fixed-pitch propeller; recommended engine power between 112 and 224 kW (150 and 300 hp), including engines from Teledyne Continental and LOM. Standard fuel capacity 114 litres (30.0 US gallons; 25.0 Imp gallons) per tank; option of two, four or six wing tanks, taking maximum possible capacity to 681 litres (180 US gallons; 150 Imp gallons).

ACCOMMODATION: Pilot and three passengers in two pairs of seats. Dual controls. Door each side, plus freight door to port, rear.

DIMENSIONS, EXTERNAL:

Wing span, without tips	11.89 m (39 ft 0 in)
Wing aspect ratio	7.2
Length overall: O-320 engine	7.09 m (23 ft 3 in)
LOM 322 engine	7.49 m (24 ft 7 in)
Height overall	2.08 m (6 ft 10 in)
Tailplane span	3.48 m (11 ft 5 in)
Wheel track	2.29 m (7 ft 6 in)

DIMENSIONS, INTERNAL:

Cabin max width	1.04 m (3 ft 5 in)

AREAS:

Wings, gross	19.51 m² (210.0 sq ft)
Ailerons (total)	1.77 m² (19.00 sq ft)
Flaps (total)	2.15 m² (23.10 sq ft)
Horizontal tail surfaces (total)	3.58 m² (38.50 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, typical	680 kg (1,500 lb)
Max baggage weight	91 kg (200 lb)
Max T-O weight	1,361 kg (3,000 lb)
Max wing loading	69.7 kg/m² (14.29 lb/sq ft)
Max power loading, 119 kW (160 hp) engine	11.41 kg/kW (18.75 lb/hp)

PERFORMANCE (119 kW; 160 hp engine):

Never-exceed speed (V_{NE})	130 kt (241 km/h; 150 mph)
Normal cruising speed	100 kt (185 km/h; 115 mph)
Stalling speed: flaps up	38 kt (70 km/h; 43 mph)
flaps down	31 kt (57 km/h; 35 mph)
Max rate of climb at S/L	305 m (1,000 ft)/min
T-O run	244 m (800 ft)
Landing run	91 m (300 ft)
Range with standard fuel	536 n miles (993 km; 617 miles)

AVIPRO

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At AirVenture 2003, AviPro launched a kitbuilt version of the previously plans-only Bearhawk. The first set of components was shipped from the company's factory at Atlixco, Mexico, on 22 July 2002. In 2006, the workforce numbered 18.

AVIPRO BEARHAWK

TYPE: Four-seat kitbuilt.

PROGRAMME: Prototype RB-4 (N6890R) first flew with Lycoming O-360 engine in December 1993, but not promoted until 1995; plans marketed by designer, Robert Barrows; second prototype (N33RB) flew 27 October 1999 with Lycoming O-540 engine and large cargo doors; by mid-2003, eight Bearhawks were flying (including two prototypes with total of 1,000 hours). First plans-built aircraft (N156RM) flown by Robert Marek on 4 May 2001; others completed with Ford V-6 and Rover V-8 motorcar engines. Two-seat Patrol (N289R) prototype first flown by Mr Barrows in mid-2003, but decision on commercial launch had not then been taken.

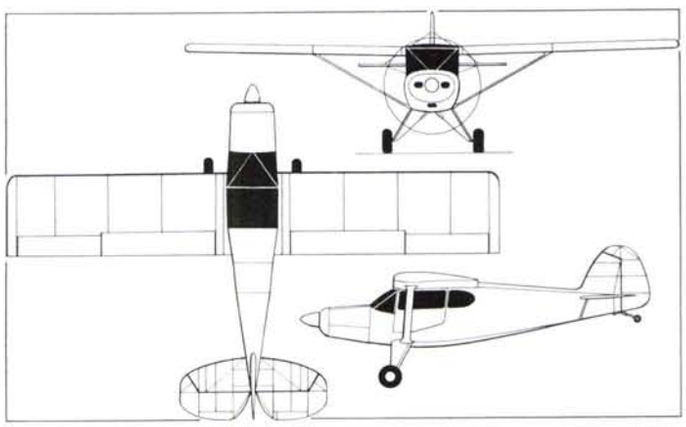
Marketing of AviPro kits began in 2003, with first airframe displayed at AirVenture, Oshkosh, from 29 July 2003. FAA 51 per cent rule certification received end November 2003; first production kit (N303AP) made first flight 4 December 2003.

CURRENT VERSIONS: **Bearhawk:** Base model, *as described*.

Bearhawk Patrol: Tandem-seat two-place version, available as plans only.

CUSTOMERS: 73 kits delivered by September 2006, kit deliveries then set at two per month in 2004; in addition 880 sets of plans had been sold by September 2006 with 250 under construction; 30 Bearhawks of all versions were flying.

COSTS: Kit USD32,725, excluding engine, propeller and instruments; estimated completed cost, minus instruments, USD50,400-USD91,875, depending on engine and propeller (2006).



AviPro Bearhawk *(James Goulding)* 1159696

DESIGN FEATURES: Four-seat utility design capable of carrying full load of occupants and fuel; cabin size exceeds Cessna 172. High, strut-braced wing and mutually braced empennage; 1° dihedral. Aerofoil section modified NACA 4412. Quoted build time 1,200 hours.

FLYING CONTROLS: Conventional and manual. Horn-balanced rudder and elevators; elevator travel +30/ 20°; aileron ±20°; rudder ±30°. Large four-position (0, 15, 40, 50°) flaps. Flight-adjustable tabs in both elevators.

STRUCTURE: Welded 4130 steel tube fuselage with fabric covering. All aluminium wing with fabric-covered control surfaces attached to rear spar and glass fibre tips. Metal engine cowling from Pitts Special; windscreen based on Cessna 170, cut to size.

LANDING GEAR: Tricycle type; fixed. Montana Floats optional. Mainwheels 7.00–6. Steerable tailwheel, size 2.80/2.50–4. Rubber-in-compression suspension.

POWER PLANT: Recommended piston engines include 119 kW (160 hp) Textron Lycoming O-320; 134 kW (180 hp) O-360; 194 kW (260 hp) O-540; and Teledyne Continental O-470 of 179 kW (240 hp). Three-blade propeller, typically Hartzell F7693F.

Normal fuel capacity 189 litres (50.0 US gallons; 41.6 Imp gallons) in two wing tanks. Optional capacity 257 litres (68.0 US gallons; 56.6 Imp gallons).

First kitbuilt AviPro Bearhawk *(Paul Jackson)* 1159758

ACCOMMODATION: Four persons in two side-by-side pairs, with baggage area to rear. Rear seat removable. Door each side, front, split horizontally; front- and rear-hinged double doors, starboard, provide access to rear seats and baggage.

DIMENSIONS, EXTERNAL:

Wing span	10.06 m (33 ft 0 in)
Wing aspect ratio	6.1
Length overall	7.16 m (23 ft 6 in)
Rear doors (starboard): Width	1.83 m (6 ft 0 in)

DIMENSIONS, INTERNAL:

Cabin: Length	2.95 m (9 ft 8 in)
Max width	1.07 m (3 ft 6 in)

AREAS:

Wings, gross	16.72 m² (180.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	522 to 612 kg (1,150 to 1,350 lb)
Max T-O weight: landplane	1,134 kg (2,500 lb)
floatplane	1,224 kg (2,700 lb)
Max wing loading: landplane	67.8 kg/m² (13.89 lb/sq ft)
floatplane	73.2 kg/m² (15.00 lb/sq ft)

PERFORMANCE:

Never-exceed speed (VNE)	152 kt (281 km/h; 175 mph)
Normal cruising speed at 60% power:	
260 hp engine	139 kt (257 km/h; 160 mph)
180 hp engine	122 kt (225 km/h; 140 mph)
Stalling speed, flaps down	35 kt (65 km/h; 40 mph)
Max rate of climb at S/L	518 m (1,700 ft)/min
T-O and landing run	107 m (350 ft)
Range at 50% power	782 n miles (1,448 km; 900 miles)

BEAR

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SALES MANAGER Jim Rahm

Bear is teamed with Yakovlev Aircraft of Russia in US promotion of the Strela-built Bear 360 high performance sportplane (described elsewhere) and, in 2002, formed a Polish subsidiary to resume production of the PZL Mewa licence-built Piper Seneca, although no new manufacture of the latter had been independently reported by mid-2006.

Longer-term projects are BearJet six-seat mono-jet and Global Bear/Global Dragon six-seat twin-jet which are intended for production by PZL in Poland and Shenyang in China, respectively, although neither of these foreign manufacturers has appraised *Jane's* of the programme.

Artist's impression of single-engine BearJet 1159014

Projected Global Bear twin-jet 1159028

BEDE

BEDECORP LLC

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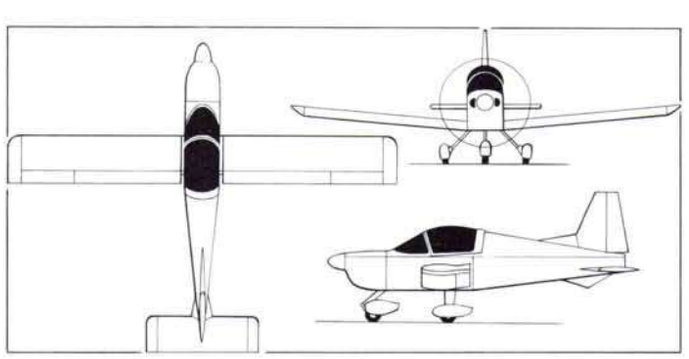
Web: www.bedecorp.com
PRESIDENT: James 'Jim' R Bede

Bedecorp specialises in design of high-performance aircraft for private ownership; civilian version of a previous product, BD-10, was transferred to Vortex Aircraft Company as the Phoenix. In June 2000, Bede announced it was working on the BD-17 Nugget, an all-metal low-wing single-seater and is actively marketing the BD-6 development of the BD-4; details of the BD-6 appeared in *Jane's All the World's Aircraft* 1977–78 edition. Bedecorp is also offering plans for the BD-4.

In mid-2003, Bedecorp revealed that it is working on the BD-18 two-place derivative of the BD-17 Nugget; sales are handled by co-located JLN Distributions Inc.

Bede BD-17 Nugget *(Paul Jackson)* 1133261



Bede BD-17 Nugget single-seat kitbuilt *(James Goulding)* 0121112

BEDE BD-17 NUGGET and BD-18 NUGGET

TYPE: Single-seat sportplane kitbuilt; side-by-side sportplane kitbuilt.

PROGRAMME: Announced June 2000; prototype (N624BD) completed by end of that year and first flew 11 February 2001. Certification programme under way. Public debut at Sun 'n' Fun, April 2001.

CURRENT VERSIONS: **BD-17**: Single-seat version, *as described*.

BD-18: Two-seat derivative, announced mid-2003. First flight was scheduled for June 2003 but slipped and had not been achieved by September 2006. Construction as BD-17.

COSTS: BD-17 USD19,975, BD-18 USD28,500, both less engine (2006).

CUSTOMERS: At least 18 BD-17 kits sold and four aircraft registered by September 2006.

DESIGN FEATURES: Intended to be extremely easy to build, with approximately 110 parts. Optional folding wings. Constant-chord wings. Fin fillet.

Wing section (BD-18) NACA 64416A (mod).

FLYING CONTROLS: Conventional and manual. No flaps on prototype BD-17; production kits have flaps. BD-18 maximum flap deflection 30°.

STRUCTURE: All-metal honeycomb sandwich. Honeycomb fuselage covered with 5 mm (0.20 in) aluminium sheet; control surfaces of urethane foam. Constant-chord wings have extruded tube spar.

LANDING GEAR: Fixed; choice of tricycle or tailwheel layout. Fuselage-mounted spring plywood mainwheel legs. Optional castoring nosewheel on forward-raked, spring steel tube cantilever leg. Speed fairings optional. Differential braking. Prototype BD-17 has 5.00-5 mainwheel tyres and 25 cm (10 in) nosewheel tyre.

POWER PLANT: *BD-17:* Power plants in the range 33.6 to 59.7 kW (45 to 80 hp) being considered; prototype has 44.7 kW (60 hp) HKS-700 two-cylinder four-stroke engine. Fuel capacity 76 litres (20.0 US gallons; 16.7 Imp gallons).

BD-18: Power plants in the range 59.7 to 89.5 kW (80 to 120 hp) recommended, though engines as large as 134 kW (180 hp) are being considered. Prototype has 59.7 kW (80 hp) Jabiru 2200. Fuel capacity 163 litres (43.0 US gallons; 35.8 Imp gallons).

ACCOMMODATION: Pilot only in BD-17, pilot and passenger side-by-side in BD-18, rearward-sliding canopy.

All data provisional.

DIMENSIONS, EXTERNAL:

Wing span: BD-17 ..... 6.55 m (21 ft 6 in)
BD-18 ..... 7.77 m (25 ft 6 in)
Wing chord, constant: BD-17 ..... 0.76 m (2 ft 6 in)
BD-18 ..... 1.03 m (3 ft 4½ in)
Wing aspect ratio: BD-17 ..... 8.6
BD-18 ..... 7.7
Length overall: BD-17 ..... 5.47 m (17 ft 11½ in)
BD-18 ..... 5.97 m (19 ft 7 in)
Height overall: both ..... 2.36 m (7 ft 9 in)

DIMENSIONS, INTERNAL:

Cockpit max width: BD-17 ..... 0.89 m (2 ft 11 in)
BD-18 ..... 1.19 m (3 ft 11 in)

AREAS:

Wings, gross: BD-17 ..... 4.97 m² (53.5 sq ft)
BD-18 ..... 7.86 m² (84.6 sq ft)

WEIGHTS AND LOADINGS (BD-18 with 89.4 kW; 120 hp engine):

Weight empty: BD-17 ..... 254 kg (560 lb)
BD-18 ..... 306 kg (675 lb)
Max T-O weight: BD-17 ..... 430 kg (950 lb)
BD-18 ..... 567 kg (1,250 lb)

PERFORMANCE (estimated; BD-18 with 89.4 kW; 120 hp engine):

Never-exceed speed (VNE) ..... 169 kt (313 km/h; 195 mph)
Cruising speed: BD-17 ..... 129 kt (238 km/h; 148 mph)
BD-18 ..... 137 kt (254 km/h; 158 mph)
Stalling speed, flaps up:
BD-17, BD-18 ..... 55 kt (102 km/h; 63 mph)
flaps down: BD-17 ..... 48 kt (89 km/h; 55 mph)
BD-18 ..... 47 kt (87 km/h; 54 mph)
Max rate of climb at S/L: BD-17 ..... 290 m (950 ft)/min
BD-18 ..... 442 m (1,450 ft)/min
T-O run: BD-17 ..... 213 m (700 ft)
BD-18 ..... 168 m (550 ft)
Landing run: BD-17 ..... 189 m (620 ft)
BD-18 ..... 165 m (540 ft)
Range, max fuel and reserves:
BD-17 ..... 825 n miles (1,528 km; 950 miles)
BD-18 ..... 912 n miles (1,689 km; 1,050 miles)

BEECH

RAYTHEON AIRCRAFT COMPANY

At the September 2002 NBAA Convention, held in Orlando, Florida, Raytheon Aircraft (under which heading further details will be found) announced its intention to revert to separate marketing of its Beechcraft and Hawker lines of private and executive aircraft, reducing the emphasis on its corporate name.

Beech Aircraft Corporation founded in 1932 by Walter and Olive Ann Beech; trading name Beechcraft; became wholly owned subsidiary of Raytheon on 8 February 1980 and incorporated within Raytheon Aircraft Company upon its foundation on 15 September 1994. In 2003, the former Beechjet 400 was transferred to the Hawker marque

Most recent product improvements have concerned avionics upgrades.

BEECHCRAFT (3000) T-6 TEXAN II

Canadian Forces name: CT-156 Harvard II

TYPE: Basic turboprop trainer.

PROGRAMME: US version of Pilatus PC-9 Advanced Turbo Trainer (which see). For participation in USAF/USN Joint Primary Aircraft Training System (JPATS) competition, Beech and Pilatus reached agreement on joint approach in August 1990; Beech received two standard PC-9s from Pilatus, one of which (N26BA) converted as engineering development prototype and completed more than 260 hours' flight testing to reduce programme risk and develop engineering design baseline before return to Pilatus. It was followed by two Beech-built production prototypes (Beech designation PD373; later, Beech 3000), first flights December 1992 (N8284M/PT-2) and July 1993 (N209BA/PT-3); PT-2 used to complete flight test programme and evaluate systems performance; PT-3 incorporated several improvements and was principal aircraft for USAF/USN flight evaluation; one prototype and four production aircraft completed more than 1,400 hours of flight testing to achieve FAA certification on 30 July 1999. Promotional name for the purposes of competition was **Beech Mk II**.

USAF T-6A TEXAN II PROCUREMENT
(at 1 November 2005)

FY	Lot	Qty	First Aircraft	Order	Delivery
95	1	1[1]	95–3000	Jun 95	1999
95	2	3[2]	95-3001	Jul 96	1999–2000
96	3	6	95-3004	Sep 96	2000
97	4	15	96-3010	Apr 97	2000
98	5	22	98-3025	Feb 98	2000–01
99	6	22	99-3547	May 99	2001–02
00	7	29	00–3569	Jun 00	2002
01	8	34	01-3598	Feb 01	2003–04
02	9	40	02-3632	Dec 01	2004
03	10	35	03-3672	Nov 02	2004-05
04	11	52	04-3707?	Feb 04	2005-06
05	12	53	05-3759?	Feb 05	2006-07
06	13	54	06-3812?	Feb 06	2007-08
07	14	49	07-3866?	Feb 07	2008-09
08	15	40	08-3915?	Feb 08	2009-10
Total		**455**			

Notes: Serial number prefixes of early aircraft do not necessarily indicate year of order, as is usual in USAF. Early aircraft numbered 95-3000 to 3009, 96-3010 to 3013 and 97-3014 onwards

[1] Engineering and manufacturing development aircraft
[2] 95–3001 subsequently transferred to US Navy as 165958

US NAVY T-6A TEXAN II PROCUREMENT
(at 1 November 2005)

FY	Lot	Qty	First Aircraft
00	1	12	165958[1]
01	2	24	165970
02	3	7	165994
03	4	4	166001
04	5	2	166005
05	6	3	166007
Total		**52**	

[1] Formerly USAF 95-3001

Selection as JPATS winner announced 22 June 1995; total requirement for 782 aircraft (454 USAF, 328 US Navy) by 2017; all to be built in USA; contract valued at USD4.7 billion awarded February 1996; allocated designation T-6 Texan II (in advance of T-4 and T-5) to honour North American AT-6 Texan of Second World War era; Canadian name reflects British Commonwealth name for AT-6.

First metal cut February 1997; roll-out of manufacturing development aircraft (N23262/95–3000/PT-4) 29 June 1998; first flight 15 July 1998; first delivery (95-3003/PT-7) to Randolph AFB, June 1999, for technical evaluation; further two were to have followed in third quarter of 1999 for six month multiservice operational test and evaluation programme (by first two Lot-3 aircraft), but were delayed by engineering fault with PT6 engine. First handover was 95-3004 on 1 March 2000; first squadron of 12th FTW, the 559th FTS, began equipping on 23 May 2000.

Initial production rate 12 aircraft per year, rising to about 70 by 2004, with potential to increase to maximum of 96; Milestone III authorisation to proceed with full-rate production granted by USAF on 3 December 2001. Early aircraft to 12th FTW at Randolph AFB for instructor training; IOC with USAF at Moody AFB, Georgia, in June 2001, with student pilot training beginning on 10 October; all USAF units to be fully equipped by 2011. First two aircraft for US Navy formally accepted at Wichita factory 31 August 2002; delivered to Pensacola, Florida, on 1 November 2002 and assigned to Training Wing Six; following initial training of instructors and maintenance personnel, formal student tuition began on 5 August 2003 with VT-4 and VT-10 squadrons. Delivery of 200th T-6A took place at beginning of September 2003, by which time USAF had received 108 and US Navy 21, balance comprising 45 for Greece and 26 for NATO; 300th T-6A delivered 8 March 2005 (to USAF). FlightSafety selected on 21 April 1997 to provide associated ground training system at cost over 24 years of USD500 million.

By 1 July 2004, 266 aircraft in service (155 USAF, 40 USN, 26 Canadian and 45 Greek) had flown 211,900 hours with 98.5 per cent mission reliability, demonstrating 2.54 mmh/fh and sortie turnround (Canada) of 5 to 8 minutes. Deliveries to US armed forces by end of 2004 totalled 178 Air Force and 43 Navy. Further six received by US Navy by end of October 2005, at which time Training Wing Six had 46, with remaining three all at Patuxent River with VX-20 test squadron (one aircraft) and Navy Test Pilots' School (two). Approximately 225 had been received by the US Air Force at this time.

CURRENT VERSIONS: **T-6A Texan II:** USAF/USN version, *as described*.

T-6A-1/CT-156 Harvard II: Version for NATO Flying Training in Canada (NFTC) programme; generally similar to Texan II, but with blind-flying hood, dual VOR and ADF, and back-up VHF comm in place of UHF.

T-6B: Trainer and light attack (**AT-6B**) derivative of T-6A announced at Farnborough International in July 2002. Commonality with T-6A is 85 per cent. Incorporates revised cockpit management systems, with avionics suite provided by Flight Visions; latter includes FV-4000 modular mission display processor (MMDP), SparrowHawk HUD, stores management system and three 127 × 178 mm (5 × 7 in) colour multifunction displays (MFDs). Six underwing pylons provided for carriage of up to 680 kg (1,500 lb) of weaponary beneath each wing, including guns, bombs and rockets, permitting use in light attack/counter-insurgency role. Prototype N3000B first flown 14 May 2004 and exhibited at Farnborough International, July 2004. T-6B demonstrator began six-month tour of nine countries in late January 2005; first to be visited was UK, others including Australia, Israel, Malaysia, Spain, Thailand and the United Arab Emirates. Target date for certification by FAA is late 2006.

Beech/Pilatus PC-9 Mk II: Designation of Greek aircraft as initially announced by Raytheon, although generally known as T-6; first 20 in USAF/US Navy configuration, remaining 25 produced to Greek-specified New Trainer Aircraft (NTA) configuration, with weapon sighting system plus provision for carriage of weaponry and auxiliary fuel tanks on three stores stations beneath each wing. Weapons trials, including tests with gun and rocket armament, conducted at Eglin AFB, Florida, in first half of 2002. NTA variant is not to FAR Pt 23.

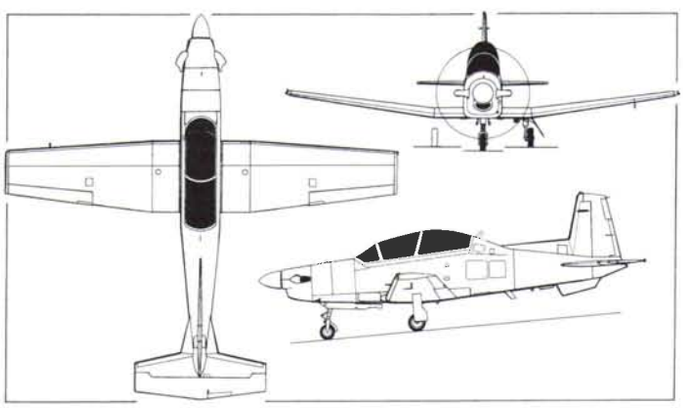
CUSTOMERS: USAF initial operator was 12th Flying Training Wing at Randolph AFB, Texas; second was 479th Flying Training Group at Moody AFB, Georgia (49 aircraft during 2001–02); subsequent deliveries to 47th FTW, Laughlin AFB, Texas (96 aircraft during 2002–04, of which first four delivered 15 November 2002); 71st FTW, Vance AFB, Oklahoma (91 aircraft during 2005–06), 14th FTW, Columbus AFB, Mississippi (89 aircraft during 2006–08) and 80th FTW, Sheppard AFB, Texas (69 aircraft during 2008–09). Initial Navy aircraft included in USAF Lot 7; first deliveries to US Navy on 1 November 2002, with training beginning on 5 August 2003; operating units will eventually be TW-4 at Corpus Christi, Texas, TW-5 at Whiting Field, Florida, and TW-6 at Pensacola, Florida. US Navy aircraft allocated serial numbers 165958 to 166285.

Chilean Air Force signed a letter of intent in late 1996 for future purchase of 16 to 25 Beech Mk IIs, but has still to place firm order. Colombia reportedly interested in acquiring AT-6B version as replacement for Cessna A-37B Dragonfly.

Bombardier Services of Canada ordered 24 T-6A-1s in December 1997 for its NFTC programme for delivery to No 2 FTS at Moose Jaw between April and December 2000; first delivery (156103) 29 February 2000; NFTC inaugurated 6 July 2000; all 24 aircraft handed over by end 2000. Further two aircraft, ordered in mid-2002, were delivered in 2003. On 9 October 1998, Greek Air Force announced selection of T-6 and ordered 45, delivered between 2000 and 2003; option held on further five has not yet been converted to firm order.

Beechcraft T-6A Texan II in display pose *(Paul Jackson)* 1151711

Prototype/demonstrator Beechcraft T-6B *(Paul Jackson)* 1151710



Beechcraft T-6A Texan II primary trainer *(Paul Jackson)* 1047589

First delivery (0011) 17 July 2000 to 361 Squadron at Kalamata; training of student pilots began September 2001.

Raytheon holds marketing rights to PC-9 Mk II in all countries except Switzerland.

T-6A TEXAN II DELIVERIES BY CALENDAR YEAR

CY	USAF	USN	NATO/Canada[1]	Greece	Total
1999	1				1
2000	19		24	6	49
2001	37			10	47
2002	40	7[2]		13	60
2003	28	22	2	16	68
2004	53	14			67
2005	56	6			62
Total	**234**	**49**	**26**	**45**	**354**

[1] Known locally as CT-156 Harvard II

[2] Includes one ex-USAF, also counted earlier

COSTS: Programme USD7 billion, of which USD362 million contracted by March 1998 for first 47 aircraft, comprising one manufacturing development aircraft and 46 production aircraft in five lots. Flyaway cost USD5.41 million over 740 aircraft (1998). Contracts for first 168 aircraft and associated ground training systems amount to USD852.6 million. Lot 10 batch of 35 aircraft cost USD169.9 million, including associated training devices and manuals. Contract for two additional NFTC aircraft plus support valued at approximately USD11.6 million. T-6B unit cost estimated as USD6.2 million (2004).

DESIGN FEATURES: Certified to FAR Pt 23 in Aerobatic category, including 15s inverted flying and 5s intentional zero g. Prohibited manoeuvres are slow roll, stall turn (hammerhead), vertical roll, sustained vertical nose-down and knife-edge.

Approximately 90 per cent redesign of PC-9. Initial improvements in T-6 prototypes comprised new aft fuselage for improved flying qualities; new canopy shape for pressurisation and strengthening for birdstrike resistance; new engine cowling; single-point refuelling; zero/zero ejection seats; cockpit redesign to accommodate 95 per cent of body sizes; laser-initiated canopy fracture system; improved seat mountings; increased engine power, plus digital engine control to replicate jet response; continuous inertial particle separator for engine intake; HFC air conditioning; addition of large aft-fuselage avionics bay; and digital avionics with active matrix LCDs.

Following JPATS selection, further changes involved OBOGS; maintenance-free hydraulic accumulator; redesigned hydraulics system, wheels and brakes for simpler maintenance; improved corrosion protection; 18,720 hour fatigue life in JPATS mission profiles; 4 m (13 ft)/s landing sink rate provision; removable vertical stabiliser for improved maintenance; on-condition hot section inspections; and 4,500 hour engine TBO. NATO T-6As in Canada additionally provided with cold weather start capability.

FLYING CONTROLS: Conventional and manual. Selectable trim aid device (TAD) by Aeromach Labs automatically trims rudder in conjunction with throttle position to minimise effect of torque. Flight-adjustable rudder and elevator tabs; aileron trim by biased centring spring. Stall strip on starboard wing. Control deflections include rudder ±24°; elevators 18° up/16° down; ailerons 20° up/11° down; and flaps 23° for take-off, 50° for landing. Airbrake maximum deflection of 67° 30'.

STRUCTURE: Generally all-metal; durability and damage-tolerant (DADT) structure includes wing and tailplane leading-edges reinforced for bird resistance; 18,000 hour service life. Avionics bay behind rear cockpit; forward-hinged door each side. Airframe built entirely in USA.

LANDING GEAR: Goodrich wheels and brakes. Capable of withstanding sink rates up to 4 m (13 ft)/s. Mainwheels 20×4.4 (14 ply (tubeless); nosewheel 16×4.4 (8 ply) tubeless. Otherwise generally as for PC-9.

POWER PLANT: One 1,274 kW (1,708 shp) Pratt & Whitney Canada PT6A-68 turboprop flat rated at 820 kW (1,100 shp) max continuous (104 per cent), driving a Hartzell HC-E4A-2/E9612 four-blade, fully-feathering propeller at a constant 2,000 rpm. Raytheon/P&WC power management unit provides jet-type linear throttle response. T-6A has integral 348 litre (92.0 US gallon; 76.6 Imp gallon) tank in each wing leading-edge; tanks freely interconnected; total fuel capacity 697 litres (184 US gallons; 153 Imp gallons), of which 681 litres (180 US gallons; 150 Imp gallons) are usable. AT-6B fuel capacity 852 litres (225 US gallons; 187 Imp gallons). AT-6B has provision for two underwing auxiliary fuel tanks, each 265 litres (70.0 US gallons; 58.3 Imp gallons). Pressure refuelling/defuelling point in lower fuselage, adjacent to port wingroot; gravity refuelling points at three quarters' span in each wing upper surface. Oil capacity 17 litres (4.5 US gallons; 3.75 Imp gallons).

ACCOMMODATION: Two pilots in stepped cockpits on Martin-Baker Mk 16LA zero/zero ejection seats. Limited HOTAS controls in T-6A; full multifunction HOTAS in AT-6B. Three-piece, Pilkington Aerospace acrylic starboard-hinged canopy; integral windscreen 19 mm (¾ in) thick for resistance to strike by 1.8 kg (4 lb) bird at 270 kt (500 km/h; 311 mph); other panels 9 mm (⅜ in) thick. ATK canopy fracturing initiation unit and

Teledyne McCormick fracturing system. Accommodation pressurised and air conditioned; warm air canopy defrosting/demisting. Baggage compartment in rear fuselage, behind avionics bay; upward-hinged door port side.

SYSTEMS: Generally as PC-9. Dowty Aerospace hydraulics; Enviro Systems air conditioning unit; Litton OBOGS. Cockpit pressurisation system has 0.24 bar (3.5 lb/sq in) max differential. Battery 28 V. Goodrich emergency power system.

AVIONICS: Honeywell primary contractor.

Comms: VHF/UHF transceiver, plus back-up VHF with separate antenna; intercom and interphone. MST 67A Mode S transponder. Back-up UHF in Canadian aircraft. T-6A's radio management unit replaced in AT-6B by up-front control panel below HUD.

Flight: Dual VNS-41 navigation systems (including VN-411B receivers) for VOR, localiser, glideslope and marker beacon functions through common antenna. DFS-43A ADF (DF-431 receiver and AT-434 loop/sense antenna); KLN 90 GPS (combined INS-GPS in AT-6B); and Rockwell Collins 252-channel DM-441B DME. Litef fibre optic gyro for AHRS. Goodrich collision warning system. Flight data recorder. Extended ADF navigation in Canadian aircraft. Integrated radar altimeter in AT-6B.

Instrumentation: Two independent EFIS 50 127 mm (5 in) square active matrix LCDs, plus control panel, in each cockpit; attitude director indicator portion of EFIS provides primary attitude display, turn rate, mode selection annunciation, localiser/glideslope deviation as appropriate; horizontal situation indicator for primary heading display, primary navigation display, course select indication, navigation source annunciation, DME, localiser and glideslope deviation, remote map presentation and selected heading reference marker. Additional three 76 mm (3 in) square MFDs per cockpit provide engine and auxiliary instrument information, including fuel state and pressurisation (engine MFD being replaced in AT-6B by 152 × 203 mm; 6 × 8 in MFD). Standby instrumentation comprises airspeed, attitude, turn-and-slip and magnetic compass (electromechanical in T-6A, digital in AT-6B). Korry Electronics warning panels. Flight Visions SparrowHawk HUD with 25° field of view and three 127 × 178 mm (5 × 7 in) colour active matrix, liquid crystal MFDs in T-6B version. AT-6B is compatible with Gen 4 NVGs. Provision for three-screen EFIS version, with HUD and integrated display panel for advanced training.

Mission: Dual-mission computers. FN Herstal weapons control system and Avimo gunsight in AT-6B. Provision for laser range-finder.

ARMAMENT: AT-6B version has three hardpoints under each wing; total weapons payload of 680 kg (1,500 lb) per wing. Typical loads include (a) two HMP 0.5 in machine gun pods; (b) two external fuel tanks; (c) six BDU-33 50 lb practice bombs; (d) two BDU-33s, two HMPs and two LAU-68 seven-round rocket pods; and (e) two Mk 82 500 lb bombs.

DIMENSIONS, EXTERNAL: As for PC-9M

AREAS:

Wings, gross	16.29 m² (175.3 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	2,136 kg (4,709 lb)
Baggage capacity	36 kg (80 lb)
Max fuel weight	499 kg (1,100 lb)
Max underwing stores (AT-6B)	1,415 kg (3,120 lb)
Max T-O and landing weight	2,948 kg (6,500 lb)
Max ramp weight	2,971 kg (6,550 lb)
Max zero-fuel weight	2,495 kg (5,500 lb)
Max wing loading	181.0 kg/m² (37.08 lb/sq ft)
Max power loading	3.60 kg/kW (5.91 lb/shp)

PERFORMANCE:

Never-exceed speed (VNE)	350 kt (648 km/h; 402 mph)
Max level speed: at altitude	310 kt (575 km/h; 357 mph)
at low level	270 kt (500 km/h; 311 mph) IAS
Max operating Mach No.	0.67
Manoeuvring speed	236 kt (437 km/h; 272 mph)
Max cruising speed at 2,285 m (7,500 ft)	230 kt (426 km/h; 265 mph)
Approach speed	100 kt (185 km/h; 115 mph) IAS
Stalling speed, power off:	
flaps up	82 kt (152 km/h; 95 mph)
flaps down	74 kt (137 km/h; 86 mph)
Max rate of climb at S/L	1,372 m (4,500 ft)/min
Max certified altitude	9,450 m (31,000 ft)
Service ceiling, T-6	10,670 m (35,000 ft)
T-O run	437 m (1,435 ft)
T-O to 15 m (50 ft)	654 m (2,145 ft)
Landing from 15 m (50 ft)	1,030 m (3,380 ft)
Landing run	739 m (2,425 ft)
Training runway requirement	1,219 m (4,000 ft)
Range at altitude	850 n miles (1,574 km; 978 miles)
Endurance at max cruising speed	3 h
g limits	+7/−3.5

BEECHCRAFT BONANZA 36

TYPE: Six-seat utility transport.

PROGRAMME: Descended from Model 35 of 1945 (10,403 built in V tail configuration), but now has little more than the name in common; further 1,911 late Model 33s built as Bonanzas, earlier version being Debonair. Model 36 certified 1 May 1968; developed from Bonanza E33A; A36 certified 24 October 1969 and introduced 1970; current subvariant announced 3 October 1983, succeeding model powered by 212.5 kW (285 hp) Continental IO-520-BB; certified in FAA Utility category.

CURRENT VERSIONS: **Bonanza G36:** Garmin G1000 avionics suite announced 12 April 2005 and introduced late 2005 for '2006 Model' Bonanzas, resulting in change of designation from A36. First G36, N500W (c/n E-3630) exhibited at AirVenture, Oshkosh, 25 to 31 July 2005. FAA certification granted 2 November 2005; announced 3 November; initial delivery on 4 November to Ron Boyer of Portland, Oregon. Version officially remains A36. Production began at c/n E-3636.

Bonanza A36: Immediately previous version. Introduced Garmin GNS 430 nav/com/GPS in 2001, but renamed G36 in 2005 on adoption of full Garmin suite.

Description applies to A36, except where otherwise stated.

Bonanza B36TC: Discontinued. Previously turbocharged variant.

CUSTOMERS: Total of 4,329 Model 36 Bonanzas delivered by end of 2005. Total of 21 A36s/G36s delivered in the first six months of 2006. Recent customers for A36 include the Israeli Government, which took delivery of 18 between November 2004 and April 2005.

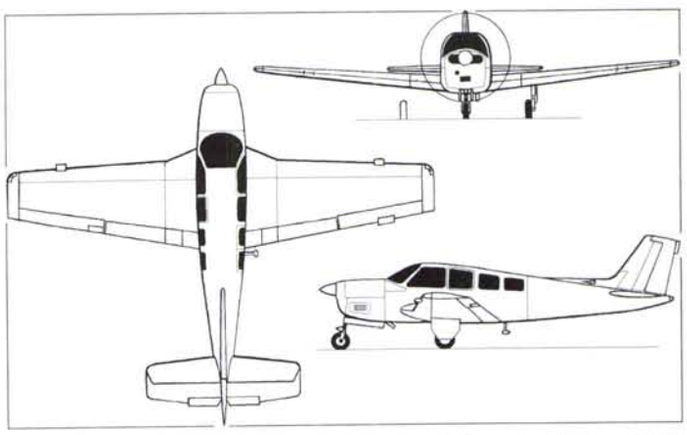
COST: USD626,600 typically equipped (2004).

DESIGN FEATURES: Conventional low-wing cabin monoplane. Tapered wings with leading-edge gloves; tapered tailplane and sweptback fin.

Beech modified NACA 23016.5 wing section at root, modified 23012 at tip; dihedral 6°; incidence 4° at root and 1° at tip.

Beechcraft Bonanza G36 *(Paul Jackson)* 1158238

Garmin G1000 panel in Beechcraft Bonanza G36 1158230



Beechcraft Bonanza A36 four/six-seat utility aircraft *(James Goulding)* 0568990

FLYING CONTROLS: Conventional and manual. Electrically actuated trim tab in each elevator; ground-adjustable tabs in ailerons and rudder; single-slotted, three-position flaps. Control surface deflections: ailerons ±20°; elevators ±25/ 20°; rudder 25° left/23° right; flaps 12° and 30°.

STRUCTURE: Light alloy, with two-spar wing torsion box and stressed-skin tail surfaces. Conventional construction.

LANDING GEAR: Electrically retractable tricycle type, with steerable nosewheel. Mainwheels retract inward into wings, nosewheel rearward. Beech oleo-pneumatic shock-absorbers in all units. Cleveland mainwheels, size 6.00-6, and tyres, size 7.00-6 (6 ply), pressure 2.28 to 2.76 bar (33 to 40 lb/sq in). Cleveland nosewheel and tyre, size 5.00-5 (4 ply), pressure 2.76 bar (40 lb/sq in). Cleveland ring disc hydraulic brakes. Parking brake. Magic Hand landing gear system optional.

POWER PLANT: One 224 kW (300 hp) Teledyne Continental IO-550-B Raytheon Special Edition flat-six engine, driving a Hartzell three-blade constant-speed metal propeller. The engine is equipped with an altitude-compensating fuel pump which automatically makes the fuel/air mixture leaner and richer during climb and descent respectively. Fuel in wing tanks, combined capacity 303 litres (80.0 US gallons; 66.7 Imp gallons), of which 280 litres (74.0 US gallons; 61.6 Imp gallons) usable.

ACCOMMODATION: Enclosed cabin seating four to six persons on individual seats. Pilot's seat is vertically adjustable. Dual controls standard. Two rear removable seats and two folding seats permit rapid conversion to utility configuration. Optional club seating with rear-facing third and fourth seats, executive writing desk, refreshment cabinet, headrests for third and fourth seats, reading lights and fresh air outlets for fifth and sixth seats. Double doors of bonded aluminium honeycomb construction on starboard side facilitate loading of cargo. As an air ambulance, one stretcher can be accommodated with ample room for a medical attendant and/or other passengers. Extra windows provide improved view for passengers.

SYSTEMS: Optional 12,000 BTU refrigeration-type air conditioning system comprises evaporator located beneath pilot's seat, condenser on lower fuselage, and engine-mounted compressor. Air outlets on centre console, with two-speed blower. Electrical system supplied by 28 V 100 A alternator, 24 V 15.5 Ah battery; optional standby generator. Hydraulic system for brakes only. Standby vacuum pump standard. Pneumatic system for instrument gyros optional. Oxygen system and electric propeller de-icing optional.

AVIONICS: Garmin G1000 fully integrated avionics system announced 12 April 2005 and is standard equipment on 2006 Model, available from late-2005. Features include two-screen EFIS for primary flight display (PFD) and multifunction display (MFD); integrated solid-state AHRS; digital air data computer; engine monitoring display; Garmin GFC 700 three-axis AFCS; Mode S transponder with Traffic Information Service; dual integrated radio modules that provide WAAS-capable IFR oceanic-approved GPS; VHF navigation

BEECHCRAFT MODEL 36 CIVILIAN PRODUCTION

Year	Version/Quantity			
	36	A36	A36TC	B36TC
1968	105			
1969	79			
1970		56		
1971		42		
1972		81		
1973		113		
1974		128		
1975		161		
1976		161		
1977		224		
1978		220		
1979		223	32	
1980		172	126	
1981		166	113	1
1982		118		50
1983		60		65
1984		95		55
1985		87		9
1986		61		10
1987		50		12
1988		65		15
1989		51		12
1990		67		13
1991		101		15
1992		81		15
1993		68		14
1994		82		15
1995		74		12
1996		65		9
1997		83		14
1998		74		21
1999		74		19
2000		77		15
2001		57		27
2002		60		6
2003		53		
2004		41		
2005		59		
Totals	**184**	**3450**	**271**	**424**

with ILS; VHF communication with 16-watt tranceivers and 8.33 kHz channel spacing; integrated Class B TAWS with worldwide database; integrated XM WX satellite weather datalink; and integrated digital audio control system enabling more than 120 channels of digital radio to be received. Options include L-3 Communications SkyWatch 497 traffic advisory system, Stormscope WX500 weather mapping system and Honeywell KN63 DME selectively coupled with NAV 1 or NAV 2.

EQUIPMENT: Standard equipment includes LCD digital chronometer, EGT and OAT gauges, rate of climb indicator, turn co-ordinator, 3 in horizon and directional gyros, four fore- and aft-adjustable and reclining seats, armrests, headrests, single diagonal strap shoulder harness with inertia reel for all occupants, pilot's storm window, ultraviolet-proof windscreen and windows, sun visors, large cargo door, emergency locator transmitter, stall warning device, alternate static source, heated pitot, rotating beacon, three-light strobe system, carpeted floor, super soundproofing, control wheel map lights, entrance door courtesy light, internally lit instruments, coat hooks, glove compartment, in-flight storage pockets, approach plate holder, utility shelf, cabin dome light, reading lights, instrument post lights, control wheel map light, electroluminescent subpanel lighting, landing light, taxying light, full-flow oil filter, three-colour polyurethane exterior paint, external power socket, static wicks and towbar.

Optional equipment includes propeller de-icing, dual controls, leather seats, co-pilot's wheel brakes, air conditioning, fifth passenger seat, fresh air vent blower and ground com switch.

DIMENSIONS, EXTERNAL:

Wing span ..... 10.21 m (33 ft 6 in)
Wing chord: at root ..... 2.13 m (7 ft 0 in)
at tip ..... 1.07 m (3 ft 6 in)
Wing aspect ratio 6.2
Length overall ..... 8.38 m (27 ft 6 in)
Height overall ..... 2.62 m (8 ft 7 in)
Tailplane span ..... 3.71 m (12 ft 2 in)
Wheel track ..... 2.92 m (9 ft 7 in)
Wheelbase ..... 2.39 m (7 ft 10¼ in)
Propeller diameter: A36 ..... 2.03 m (6 ft 8 in)
Forward cockpit door: Height ..... 0.91 m (3 ft 0 in)
Width ..... 0.94 m (3 ft 1 in)
Baggage compartment door: Height ..... 0.61 m (2 ft 0 in)
Width ..... 0.99 m (3 ft 3 in)
Rear passenger/cargo door: Height ..... 0.89 m (2 ft 11 in)
Width ..... 1.14 m (3 ft 9 in)

DIMENSIONS, INTERNAL:

Cabin (aft of firewall, incl extended baggage compartment): Length ... 3.84 m (12 ft 7 in)
Max width ..... 1.07 m (3 ft 6 in)
Max height ..... 1.27 m (4 ft 2 in)
Volume ..... 3.88 m³ (137 cu ft)

AREAS:

Wings, gross ..... 16.80 m² (181.0 sq ft)
Ailerons (total) ..... 1.06 m² (11.40 sq ft)
Trailing-edge flaps (total) ..... 1.98 m² (21.30 sq ft)
Fin ..... 0.93 m² (10.00 sq ft)
Rudder, incl tab ..... 0.52 m² (5.60 sq ft)
Tailplane ..... 1.75 m² (18.82 sq ft)
Elevators, incl tabs ..... 1.67 m² (18.00 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, standard: ..... 1,148 kg (2,530 lb)
Basic operating weight (single pilot) ..... 1,225 kg (2,700 lb)
Baggage capacity ..... 181 kg (400 lb)
Max T-O weight ..... 1,655 kg (3,650 lb)
Max ramp weight ..... 1,661 kg (3,663 lb)
Max zero-fuel weight ..... 1,592 kg (3,509 lb)
Payload with max fuel ..... 313 kg (689 lb)
Max wing loading ..... 98.5 kg/m² (20.17 lb/sq ft)
Max power loading ..... 7.40 kg/kW (12.17 lb/hp)

PERFORMANCE:

Max level speed (min weight) ..... 184 kt (340 km/h; 212 mph)
Max cruising speed (mid-cruise weight):
at FL60 ..... 176 kt (326 km/h; 202 mph)
at FL80 ..... 174 kt (322 km/h; 200 mph)
at FL100 ..... 171 kt (317 km/h; 197 mph)
Normal cruising speed:
at FL60 ..... 165 kt (306 km/h; 190 mph)
at FL80 ..... 167 kt (309 km/h; 192 mph)
at FL100 ..... 163 kt (302 km/h; 188 mph)
Long-range cruising speed:
at FL60 ..... 134 kt (248 km/h; 154 mph)
at FL80 ..... 140 kt (259 km/h; 161 mph)
at FL100 ..... 143 kt (265 km/h; 165 mph)
Approach speed ..... 80 kt (148 km/h; 92 mph)
Stalling speed, power off:
flaps up ..... 68 kt (126 km/h; 78 mph) IAS
30° flap ..... 59 kt (109 km/h; 68 mph) IAS
Max rate of climb at S/L ..... 375 m (1,230 ft)/min
Service ceiling ..... 5,640 m (18,500 ft)
T-O field length ..... 583 m (1,913 ft)
Landing from 15 m (50 ft) ..... 442 m (1,450 ft)
Landing run ..... 290 m (950 ft)
Range, pilot and two passengers, VFR reserves:
max cruising speed: at FL60 ..... 671 n miles (1,242 km; 772 miles)
at FL80 ..... 713 n miles (1,320 km; 820 miles)
at FL100 ..... 751 n miles (1,390 km; 864 miles)
normal cruising speed: at FL60 ..... 736 n miles (1,363 km; 847 miles)
at FL80 ..... 746 n miles (1,381 km; 858 miles)
at FL100 ..... 775 n miles (1,435 km; 891 miles)
long-range cruising speed: at FL60 ..... 919 n miles (1,702 km; 1,057 miles)
at FL80 ..... 923 n miles (1,709 km; 1,062 miles)
at FL100 ..... 916 n miles (1,696 km; 1,054 miles)

BEECHCRAFT BARON 58

TYPE: Six-seat utility twin.

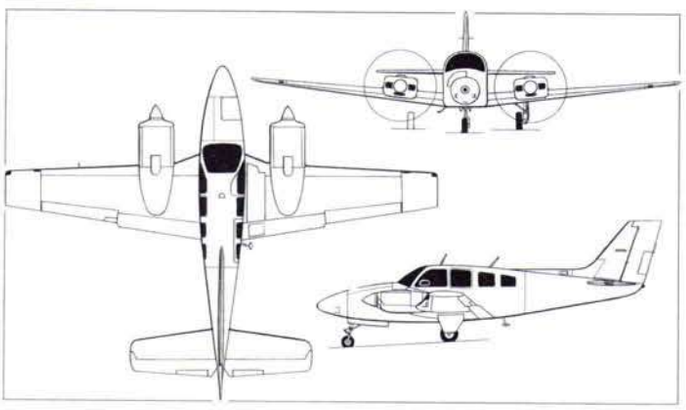
PROGRAMME: Prototype Beech 55 Baron flew 29 February 1960; total 3,657 built, not including 70 military C-42 Cochises and 94 Model 56 Turbo Barons. Model 58 derived from E55 with 25 cm (10 in) fuselage stretch, plus internal rearrangement to lengthen cabin by 76 cm (30 in); certified in FAA Normal category 19 November 1969; marketing began in following month. Raytheon delivered 2,000th standard Model 58 (N558TH) in July 2001. Beech 58P Pressurised Baron and 58TC turbocharged version no longer produced.

CURRENT VERSIONS: **Baron G58:** Garmin G1000 avionics suite announced 12 April 2005 and introduced late 2005 for '2006 Model', resulting in change from Baron 58. FAA certification 2 December 2005; introduced from c/n TH-2125.

Baron 58: Immediately previous version. Dual Garmin GNS 530 nav/comm/GPS introduced in '2001 Model' and replaced by full Garmin equipment for 2006, becoming G58.

CUSTOMERS: Operators include several commercial aviation flying schools. Total 2,124 of current version built by end of 2005, or 2,772 in all. Further 18 in first six months of 2006.

Beechcraft Baron G58 with Garmin G1000 avionics *(Paul Jackson)* 1158237



Beechcraft Baron 58 (two Teledyne Continental IO-550-C piston engines) *(Dennis Punnett)* 0568989

COST: USD1,099,600 typically equipped (2004).

DESIGN FEATURES: Conventional low-wing monoplane, ultimately derived from Beech Bonanza. Tapered wing with leading-edge gloves inboard of engines; sweptback fin.

Wing section NACA 23015.5 at root, 23010.5 at tip; dihedral 6°; incidence 4° at root and 0° at tip.

FLYING CONTROLS: Conventional and manual. Manually operated trim tabs in elevators, rudder and port aileron; electrically operated single-slotted flaps. Control surface movements: ailerons ±20°; elevator ±30/–15°; rudder ±25°; flap settings 15° for approach, 28° maximum.

STRUCTURE: Light alloy with two-spar wing box; elevators have smooth magnesium alloy skins.

LANDING GEAR: Electrically retractable tricycle type. Main units retract inward into wings, nosewheel aft. Beech oleo-pneumatic shock-absorbers in all units. Steerable nosewheel with shimmy damper. Cleveland wheels, with mainwheel tyres size 6.50–8 (8 ply) tubed, pressure 3.59 to 3.96 bar (52 to 56 lb/sq in) or 19.5×6.75–8 (10 ply) tubeless. Nosewheel tyre size 5.00–5 (6 ply) tubed, pressure 3.79 to 4.14 bar (55 to 60 lb/sq in) or 15×6.0-6 (4 ply) tubed. Cleveland ring disc hydraulic brakes. Heavy-duty brakes optional. Parking brake.

POWER PLANT: Two 224 kW (300 hp) Teledyne Continental IO-550-C Raytheon Special Edition flat-six engines, each driving a Hartzell three-blade constant-speed fully feathering metal propeller. The standard fuel system contents 652 litres (172 US gallons; 143 Imp gallons), usable capacity 628 litres (166 US gallons; 138 Imp gallons). Optional 'wet wingtip' installation also available, increasing contents to 379 litres (100 US gallons; 83.3 Imp gallons) and usable capacity to 734 litres (194 US gallons; 161.5 Imp gallons).

ACCOMMODATION: Standard version has four individual seats in pairs in enclosed, soundproofed, heated and ventilated cabin, with door on starboard side for pilot(s). Single diagonal strap shoulder harness with inertia reel standard on all seats. Pilot's vertically adjusting seat is standard. Co-pilot's vertically adjusting seat, folding fifth and sixth seats, or club seating comprising folding fifth and sixth seats and aft-facing third and fourth seats, are optional. Adjustable rudder pedals (retractable on starboard side). Executive desk available as option with club seating. Baggage compartment in nose. Double passenger/cargo doors on starboard side of cabin (split vertically: forward-hinged at front, aft portion rear-hinged) provide access to space for baggage or cargo behind the third and fourth seats. Pilot's storm window. Openable windows adjacent the third and fourth seats are used for ground ventilation and as emergency exits. Windscreen defrosting standard.

SYSTEMS: Cabin heated by Janitrol 50,000 BTU heater, which serves also for windscreen defrosting. Oxygen system of 1,389 litres (49 cu ft) or 1,814 litres (64 cu ft) capacity optional. Electrical system includes two 28 V 100 A engine-driven alternators with alternator failure lights and two 12 V 25 Ah batteries. Two 100 A alternators optional. Hydraulic system for brakes only. Pneumatic pressure system for air-driven instruments, and optional wing and tail unit de-icing system. Oxygen system, cabin air conditioning and windscreen electric anti-icing optional.

AVIONICS: Garmin G1000 suite (as for Beechcraft G36 Bonanza) standard from late-2005 production, plus radar.

Radar: Honeywell RDR 2000 VP colour weather radar.

BEECHCRAFT BARON 58 PRODUCTION

Year	Version/Quantity		
	58	58P	58TC
1969	1		
1970	98		
1971	75		
1972	89		
1973	121		
1974	140		
1975	155	2	
1976	93	83	34
1977	100	37	26
1978	100	46	24
1979	107	65	25
1980	114	83	24
1981	104	68	12
1982	58	47	4
1983	39	11	1
1984	41	28	1
1985	69	27	
1986	3		
1987	24		
1988	13		
1989	31		
1990	37		
1991	36		
1992	28		
1993	31		
1994	31		
1995	26		
1996	41		
1997	32		
1998	44		
1999	35		
2000	54		
2001	44		
2002	33		
2003	25		
2004	24		
2005	28		
Totals	**2,124**	**497**	**151**

EQUIPMENT: Standard equipment includes ultraviolet-proof windscreen and cabin windows, super soundproofing, heated pitot head, instrument panel floodlights, navigation and position lights, steerable taxying light, dual landing lights, heated fuel vents, heated fuel and stall warning vanes and external power socket.

Options include alternate static source, internally illuminated instruments, strobe lights, electric windscreen anti-icing, wing ice detection light, static wicks, leather seat trim, cabin club seating, cockpit relief tube, cabin fire extinguisher and ventilation blower.

DIMENSIONS, EXTERNAL:

Wing span ..... 11.53 m (37 ft 10 in)
Wing chord: at root ..... 2.13 m (7 ft 0 in)
at tip ..... 0.90 m (2 ft 11½ in)
Wing aspect ratio 7.2
Length overall ..... 9.09 m (29 ft 10 in)
Height overall ..... 2.97 m (9 ft 9 in)
Tailplane span ..... 4.85 m (15 ft 11 in)
Wheel track ..... 2.92 m (9 ft 7 in)
Wheelbase ..... 2.72 m (8 ft 11 in)
Propeller diameter ..... 1.96 m (6 ft 5 in)
Rear passenger/cargo doors:
Max height ..... 0.89 m (2 ft 11 in)
Width ..... 1.14 m (3 ft 9 in)
Baggage door (fwd): Height ..... 0.56 m (1 ft 10 in)
Width ..... 0.64 m (2 ft 1 in)

DIMENSIONS, INTERNAL:

Cabin (incl rear baggage area):
Length ..... 3.84 m (12 ft 7 in)
Max width ..... 1.07 m (3 ft 6 in)
Max height ..... 1.27 m (4 ft 2 in)
Floor area ..... 3.72 m² (40.0 sq ft)
Volume ..... 3.9 m³ (137 cu ft)
Baggage compartment: nose ..... 0.51 m³ (18.0 cu ft)

AREAS:

Wings, gross ..... 18.51 m² (199.2 sq ft)
Ailerons (total) ..... 1.06 m² (11.40 sq ft)
Trailing-edge flaps (total) ..... 1.98 m² (21.30 sq ft)
Fin ..... 1.46 m² (15.67 sq ft)
Rudder, incl tab ..... 0.81 m² (8.75 sq ft)
Tailplane ..... 4.95 m² (53.30 sq ft)
Elevators, incl tabs ..... 1.84 m² (19.80 sq ft)

WEIGHTS AND LOADINGS:

Weight empty ..... 1,764 kg (3,890 lb)
Basic operating weight, typical ..... 1,896 kg (4,180 lb)
Baggage capacity: cabin ..... 181 kg (400 lb)
nose ..... 136 kg (300 lb)
Max T-O weight ..... 2,495 kg (5,500 lb)
Max ramp weight ..... 2,506 kg (5,524 lb)
Max zero-fuel weight ..... 2,365 kg (5,215 lb)
Payload with max fuel ..... 213 kg (470 lb)
Fuel with max payload ..... 140 kg (309 lb)
Max landing weight ..... 2,449 kg (5,400 lb)
Max wing loading ..... 134.8 kg/m² (27.61 lb/sq ft)
Max power loading ..... 5.58 kg/kW (9.17 lb/hp)

PERFORMANCE (cruising speeds at average cruise weight):

Max level speed at S/L ..... 208 kt (386 km/h; 239 mph)
High cruising speed, 2,100 rpm:
at FL60 ..... 202 kt (374 km/h; 223 mph)
at FL80 ..... 200 kt (370 km/h; 230 mph)
at FL100 ..... 198 kt (367 km/h; 228 mph)
Normal cruising speed, 2,300 rpm:
at FL60 ..... 190 kt (352 km/h; 219 mph)
at FL80 ..... 192 kt (356 km/h; 221 mph)
at FL100 ..... 189 kt (350 km/h; 217 mph)
Long-range cruising speed, 2,500 rpm:
at FL60 ..... 159 kt (294 km/h; 183 mph)
at FL80 ..... 164 kt (304 km/h; 189 mph)
at FL100 ..... 167 kt (309 km/h; 192 mph)
Approach speed ..... 95 kt (176 km/h; 109 mph)
Stalling speed, power off:
flaps up ..... 84 kt (156 km/h; 97 mph) IAS
flaps down ..... 75 kt (139 km/h; 86 mph) IAS
Max rate of climb at S/L ..... 518 m (1,700 ft/min)
Rate of climb at S/L, OEI ..... 119 m (390 ft/min)
Time to FL100 ..... 10 min
Service ceiling ..... 6,305 m (20,680 ft)
Service ceiling, OEI ..... 2,220 m (7,280 ft)
T-O field length ..... 701 m (2,300 ft)
Landing from 15 m (50 ft) ..... 747 m (2,450 ft)
Landing run ..... 396 m (1,300 ft)
Range, pilot and four passengers, VFR reserves ..... 802 n miles (1,485 km; 922 miles)
Range, pilot with two passengers, VFR reserves:
high cruising speed: at FL60 ..... 885 n miles (1,639 km; 1,018 miles)
at FL80 ..... 936 n miles (1,733 km; 1,077 miles)
at FL100 ..... 981 n miles (1,816 km; 1,128 miles)
normal cruising speed: at FL60 ..... 962 n miles (1,781 km; 1,107 miles)
at FL80 ..... 979 n miles (1,813 km; 1,126 miles)
at FL100 ..... 1,027 n miles (1,902 km; 1,181 miles)
long-range cruising speed: at FL60 ..... 1,294 n miles (2,396 km; 1,489 miles)
at FL80 ..... 1,276 n miles (2,363 km; 1,468 miles)
at FL100 ..... 1,287 n miles (2,383 km; 1,481 miles)
Ferry range ..... 1,379 n miles (2,553 km; 1,587 miles)

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BEECHCRAFT KING AIR 90

TYPE: Business twin-turboprop.

PROGRAMME: King Air 90 first flew 21 November 1963. C90B announced at NBAA Convention, October 1991; superseded King Air 90, A90, B90, C90, C90-1, C90A; introduced four-blade McCauley propellers, special interior soundproofing, updated and redesigned interior, updated cockpit features and interior noise and vibration levels substantially reduced. A model delivered on 24 June 1996 to Jeld-Wen of Klamath Falls, Oregon, was the 5,000th King Air of all versions to be produced.

By early 2006 more than 6,100 King Airs of all models had been produced, and were operating in 105 countries; total fleet time stood at more than 40 million hours.

CURRENT VERSIONS: **C90B:** Standard version from 1991, but engineering designation remains 90A.

Detailed description applies to C90B.

King Air C90GT: Optimised for private owner/operator requiring additional speed. Two P&WC PT6A-135-A turboprops flat-rated at 410 kW (550 shp) from 559 kW (750 shp), with Hartzell HC-E4N-3N/D8990SK four-blade, fully reversing propellers of 2.29 m (7 ft 6 in) diameter, offering 272 kt (504 km/h; 313 mph) cruising speed, some 27 kt (50 km/h; 31 mph) higher than that of C90B; up to 50 per cent reduction in time to climb to FL300; and reduction in maximum takeoff weight field length to 729 m (2,392 ft). FAA certification granted 16 December 2005. Prototype, N690GT (c/n LJ-1727), unveiled at AirVenture, Oshkosh, 25 July 2005; second aircraft c/n LJ-1754; series production from LJ-1756.

King Air 200 and 350: Described separately.

CUSTOMERS: Total 1,751 commercial and 226 military King Air 90/A90/B90/C90/C90-1/C90A/C90B delivered by end of 2005 plus 19 in the first six months of 2006.

COSTS: C90B USD2,750 million, typically equipped (2004); C90GT USD2,950 million (2005).

DESIGN FEATURES: Conventional low-wing, twin-engined monoplane. Wing section NACA 23014.1 (modified) at root, 23016.22 (modified) at outer end of centre-section, 23012 at tip; dihedral 7°; incidence 4° 48' at root, 0° at tip; tailplane 7° dihedral.

FLYING CONTROLS: Conventional and manual. Trim tabs on port aileron, in both elevators (trim and anti-balance) and rudders; single-slotted aluminium flaps. Control surface deflections: ailerons ±25/–15°; rudder 24° right/19° left; flaps 43°.

STRUCTURE: Generally light alloy; magnesium ailerons. Internal corrosion-proofing.

LANDING GEAR: Hydraulically retractable tricycle type. Nosewheel retracts rearward, mainwheels forward into engine nacelles. Mainwheels protrude slightly beneath nacelles when retracted, for safety in a wheels-up emergency landing. Fully castoring steerable nosewheel with shimmy damper. Beech oleo-pneumatic shock-absorbers. Goodrich mainwheels with tyres size 8.50-10 (8 ply) tubeless, pressure 3.79 bar (55 lb/sq in). Goodrich nosewheel with tyre size 6.50–10 (6 ply) tubeless, pressure 3.59 bar (52 lb/sq in). Goodrich heat-sink and air-cooled multidisc hydraulic brakes. Parking brake. Minimum ground turning radius 10.82 m (35 ft 6 in).

POWER PLANT: Two 410 kW (550 shp) Pratt & Whitney Canada PT6A-21 turboprops, each driving a Hartzell HC-B3TN-3/T10173K-8 or (later aircraft option) McCauley 4HFR34C768/94LMA-4 four-blade constant-speed fully feathering propeller. Environmental fuel drain collection system, magnetic chip detector, automatic propeller feathering and propeller synchrophaser standard. Fuel in two tanks in engine nacelles, each with usable capacity of 231 litres (61.0 US gallons; 50.8 Imp gallons), and auxiliary bladder tanks in outer wings, each with capacity of 496 litres (131 US gallons; 109 Imp gallons). Total usable fuel capacity 1,454 litres (384 US gallons; 320 Imp gallons). Refuelling points in top of each engine nacelle and in wing leading-edge outboard of each nacelle. Oil capacity 13.2 litres (3.5 US gallons; 2.9 Imp gallons) per engine.

ACCOMMODATION: Two four-way adjustable seats side by side in cockpit with dual controls standard. Normally, four reclining seats in main cabin, in two pairs facing each other fore and aft. Standard furnishings include cabin forward partition, with fore and aft partition and coat rack, hinged nose baggage compartment door, seat belts and inertia reel shoulder harnesses for all seats. Standard accommodation for six passengers, four in club arrangement, one on sideways-facing seat adjacent door, and one on lavatory/seat in baggage area. Baggage racks at rear of cabin on starboard side, with lavatory on port side. Door on port side aft of wing, with built-in airstairs. Emergency exit on starboard side of cabin. Entire accommodation pressurised, heated and air conditioned. Electrically heated windscreen, windscreen defroster and windscreen wipers standard.

SYSTEMS: Pressurisation by dual engine bleed air system with pressure differential of 0.34 bar (5.0 lb/sq in), maintaining a sea level cabin environment to 3,373 m (11,065 ft). Cabin heated by 45,000 BTU dual engine bleed air system and auxiliary electrical heating system. Hydraulic system for landing gear actuation. Electrical system includes two 28 V 300 A starter/generators, 24 V 34 Ah air-cooled Ni/Cd battery with failure detector. Oxygen system, 623 litres (22 cu ft) or 1,814 litres (64 cu ft) capacity, optional. Vacuum system for flight instruments. Automatic pneumatic de-icing of wing/fin/tailplane leading-edges standard. Engine and propeller anti-icing systems standard. Engine fire detection and extinguishing system optional.

AVIONICS: Standard Rockwell Collins Pro Line II package with two-tube EFIS-84 in sectional instrument panel.

Comms: Dual VHF-22A transceivers with CTL-22 controls; dual TDR-64 transponders; dual DB Systems Model 415 audio systems; dual Lockheed Martin Fairchild CVR A1005; dual Flite-Tronics PC-250 inverters; edgelight radio panel; ELT; avionics master switch; ground clearance switch on com 1; control wheel push-to-talk switches; dual hand microphones and cockpit speakers; dual Telex headsets.

Radar: WXR-270 colour weather radar.

BEECHCRAFT KING AIR 90 CIVILIAN PRODUCTION

Version/Quantity										
Year	65-90	65-A90	B90	C90	C90-1	C90A	C90B	E90	F90	F90-1
1964	7									
1965	69									
1966	36	71								
1967		134								
1968			91							
1969			73							
1970			20							
1971				32						
1972				34				22		
1973				41				51		
1974				33				44		
1975				32				39		
1976				28				45		
1977				40				50		
1978				61				50	1	
1979				67				26	7	
1980				56				14	73	
1981				67				6	75	
1982				16	37				41	
1983					17				6	
1984					24					11
1985						41				11
1986						13				11
1987						23				
1988						27				
1989						37				
1990						42				
1991						26				
1992						2	25			
1993							30			
1994							35			
1995							35			
1996							36			
1997							41			
1998							37			
1999							37			
2000							40			
2001							35			
2002							22			
2003							21			
2004							25			
2005							37			
Totals	**112**	**205**[1]	**184**	**507**	**78**	**211**	**456**	**347**	**203**	**33**

[1] Excluding two conversions from Beech 65-88

Notes: Further 66 H90s built as T-44 military trainers, plus three A90-2/RU-21Bs, two A90-3/RU-21Cs and 16 A90-4/various U-21

Beechcraft King Air C90GT *(Paul Jackson)*

1158229

Flight: Dual VIR-32 VOR/LOC/GLS/MKR receivers with CTL-32 controls; ADF-60A with CTL-62 control; DME-42 with IND-42 indicator; RMI-30; dual MCS-65 compass systems. Goodrich WX-1000+ Stormscope optional. APS-65H autopilot/flight director with EADI-84 and EHSI.

Instrumentation: EFIS-84; ALT-50A radio altimeter; pilot's encoding altimeter; dual 2 in electric turn and bank indicators; co-pilot's 75 mm (3 in) horizon indicator; co-pilot's HSI. Dual blind-flying instrumentation with dual instantaneous VSIs; standby magnetic compass; digital OAT gauge; LCD digital chronometer clock; vacuum gauge; de-icing pressure gauge; cabin rate of climb indicator; cabin altitude and differential pressure indicator; flight hour recorder; automatic solid-state warning and annunciator panel. Primary and secondary instrument lighting systems.

EQUIPMENT: Standard equipment includes fresh air outlets; oxygen outlets with overhead-mounted diluter demand masks with microphones; removable low-profile lavatory with shoulder harness and lap belt; two cabin tables; cabin fire extinguisher; wing ice lights; dual landing lights; nosewheel taxying light; flush position lights; dual rotating beacons; rheostat-controlled white cockpit lighting; wingtip recognition lights; wingtip and tail strobe lights; and vertical tail illumination lights.

Optional equipment includes electric flushing lavatory; engine fire detection system; oxygen bottle; cabinet with three drawers and stereo tape deck storage; and pilot-to-cabin paging with four stereo speakers.

DIMENSIONS, EXTERNAL:

Wing span	15.32 m (50 ft 3 in)
Wing chord: at root	2.15 m (7 ft 0½ in)
at tip	1.07 m (3 ft 6 in)
Wing aspect ratio	8.6
Length overall	10.82 m (35 ft 6 in)
Height overall	4.34 m (14 ft 3 in)
Tailplane span	5.26 m (17 ft 3 in)
Wheel track	3.89 m (12 ft 9 in)
Wheelbase	3.73 m (12 ft 3 in)
Propeller diameter: Hartzell	2.36 m (7 ft 9 in)
McCauley	2.29 m (7 ft 6 in)
Propeller ground clearance: Hartzell	0.30 m (1 ft 0 in)
McCauley	0.34 m (1 ft 1½ in)
Passenger door: Height	1.30 m (4 ft 3½ in)
Width	0.69 m (2 ft 3 in)
Height to sill	1.22 m (4 ft 0 in)

DIMENSIONS, INTERNAL:

Pressurised area: Length	5.43 m (17 ft 10 in)
Cabin: Length	3.835 m (12 ft 7 in)
Max width	1.37 m (4 ft 6 in)
Max height	1.45 m (4 ft 9 in)
Floor area	6.50 m² (70.0 sq ft)
Volume: cabin	6.4 m³ (227 cu ft)
including flight deck	8.98 m³ (317 cu ft)
Baggage compartment volume, rear	1.4 m³ (48 cu ft)

AREAS:

Wings, gross	27.31 m² (293.9 sq ft)
Ailerons (total)	1.29 m² (13.90 sq ft)
Trailing-edge flaps (total)	2.72 m² (29.30 sq ft)
Fin	2.30 m² (23.67 sq ft)
Rudder, incl tab	1.30 m² (14.00 sq ft)
Tailplane	4.39 m² (47.25 sq ft)
Elevators, incl tabs (total)	1.66 m² (17.87 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	3,086 kg (6,803 lb)
Basic operating weight, typical	3,193 kg (7,040 lb)
Max fuel weight	1,167 kg (2,573 lb)
Max T-O weight	4,581 kg (10,100 lb)
Max ramp weight	4,608 kg (10,160 lb)
Max zero-fuel weight	4,378 kg (9,212 lb)
Max landing weight	4,354 kg (9,600 lb)
Fuel with max payload	430 kg (948 lb)
Max wing loading	167.8 kg/m² (34.36 lb/sq ft)
Max power loading	5.59 kg/kW (9.18 lb/shp)

PERFORMANCE:

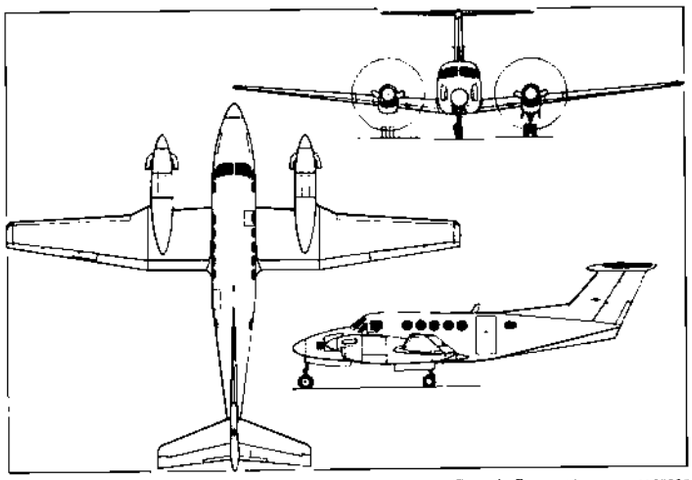
Max level speed	249 kt (461 km/h; 286 mph)
High cruising speed:	
at FL160	246 kt (456 km/h; 283 mph)
Long-range cruising speed at FL260	196 kt (363 km/h; 226 mph)
Approach speed	101 kt (187 km/h; 116 mph)
Stalling speed, power off:	
wheels and flaps up	88 kt (163 km/h; 101 mph) IAS
flaps down	78 kt (144 km/h; 90 mph) IAS
Max rate of climb at S/L	610 m (2,003 ft/min)
Rate of climb at S/L, OEI	151 m (494 ft/min)
Max certified altitude	9,150 m (30,000 ft)
Service ceiling	8,809 m (28,900 ft)
Service ceiling, OEI	4,511 m (14,800 ft)
Time to FL250	22 min
T-O run	620 m (2,035 ft)
T-O field length	826 m (2,710 ft)
Accelerate/stop distance	1,113 m (3,650 ft)
Landing field length at max landing weight, with propeller reversal	698 m (2,290 ft)
Range, with NBAA IFR reserves, 100 n mile (185 km; 115 mile) alternate:	
with max payload	191 n miles (353 km; 219 miles)
with max fuel	1,207 n miles (2,235 km; 1,389 miles)
with four passengers	1,040 n miles (1,926 km; 1,196 miles)
ferry range	1,264 n miles (2,340 km; 1,454 miles)

BEECHCRAFT KING AIR 200

Israel Defence Force name: Tsofit (Thrush)
Swedish Air Force designation: Tp 101

TYPE: Utility turboprop twin.

PROGRAMME: Design of Super King Air 200 began October 1970 as T-tail version of King Air 100 (383 built); 'Super' prefix deleted from all 200, 300 and 350 series King Airs in 1996; first flight (c/n BB1) 27 October 1972; certified to FAR Pt 23 plus icing requirements of FAR Pt 25, 14 December 1973; design of B200 (prototype c/n BB343) began March 1980; production started May 1980; FAA certification 13 February 1981; on sale March 1981.



Beechcraft King Air B200 twin-turboprop transport *(Dennis Punnett)* 1158228

CURRENT VERSIONS: **King Air B200:** Baseline version.

Detailed description applies to B200.

King Air B200C: As B200 but with 1.32 × 1.32 m (4 ft 4 in × 4 ft 4 in) cargo door. Two, identified as military C-12R/AP, ordered by US Army on behalf of Greece, January 2000; special missions fit includes cameras for geophysical survey, removable for VIP transport; delivered mid-2002.

King Air B200T: Standard provision for removable tip tanks, adding total 401 litres (106 US gallons; 88.25 Imp gallons), making total 2,460 litres (650 US gallons; 541 Imp gallons). Span without tip tanks 16.92 m (55 ft 6 in). Total 38 built up to 1993. Four ordered by US Army Missile Command in October 1998 for delivery by June 2000; however, these appear to be part of batch of five for Israel Defence Force, also completed in June 2000 and increasing production total to 43. Further three built in 2002 for undisclosed customer; total 46, all converted on production line from B200s.

King Air B200CT: Combines tip tanks and cargo door as standard. Four built by 1983 for Chile (one) and Peru (Navy, three). All converted on production line from King Air 200. Israel Defence Force/Air Force ordered five, of which first was delivered on 4 September 2002, with deliveries completed in June 2003. All B200T/CTs converted on production line from King Air 200s.

Maritime patrol B200T: Production discontinued.

Beechcraft 200 HISAR: Radar surveillance platform. Launched 1997; based on Beech 200T airframe; demonstrator (N4277E) undertook 16-country tour in 1997–98. First international sale to Traffic 2000 of Germany, November 1997, for North Sea environmental monitoring. Ventral radome for Hughes Integrated Synthetic Aperture Radar (HISAR) suitable for border surveillance, remote sensing, pollution monitoring, EEZ patrol and agricultural monitoring. Equipment operator's console in cabin.

C/RC/UC-12: Military versions; described in 2002-03 and earlier editions; see table for production summary.

King Air 300LW: Production discontinued..

King Air 350: *Described separately.*

CUSTOMERS: Deliveries by 31 December 2005 totalled 1,920 baseline Beechcraft 200s, 146 of cargo-door 200C family and 339 military-optimised versions (described in previous *Jane's All the World's Aircraft*) to US armed forces and foreign customers. Further 18 delivered in the first six months of 2006.

French Institut Géographique National has three B200Ts fitted with twin Wild RC-10 Superaviogon camera installations and Doppler navigation; maximum endurance 10 hours 20 minutes; high flotation landing gear; special French certification for maximum T-O weight 6,350 kg (14,000 lb) and maximum landing weight 6,123 kg (13,500 lb). Egyptian government acquired one King Air 200 in 1978 for water, uranium and other natural resources exploration over Sinai and Egyptian deserts as follow-up to satellite surveys; fitted with remote sensing gear, specialised avionics and special cameras. Navaid checking versions supplied to Taiwan government (one) and Malaysian government (two). Other special missions aircraft delivered to Taiwan Ministry of Interior May 1979; Royal Hong Kong Auxiliary Air Force (later Government Air Service) (two) 1986 and 1987; at one time, four King Air 200s operated by Swedish Air Force as **Tp 101**.

King Air B200 selected by UK Serco Group plc for Royal Air Force Cranwell Multi-Activity Contract (MAC) and Multi-Engine Pilot Training Interim Solution (replacing BAe Jetstreams); first two (of seven) handed over on 12 December 2003, with remainder following by March 2004. 6,000th King Air, delivered 24 January 2005, was B200 N625GA/BB-1884 to Granite Air LLC of North Carolina. Recent customers include Gama Aviation Limited of UK, which took delivery of two B200Cs in March 2006 for operation on behalf of the Scottish Air Ambulance Service from 1 April under a UK National Health Service contract to provide medical airlift in the Scottish highlands and islands.

COSTS: B200 USD4.970 million (2004).

DESIGN FEATURES: Generally as for earlier versions. Wing aerofoil NACA 23018 to 23016.5 over inner wing, 23012 at tip; dihedral 6°; incidence 3° 48' at root, −1° 7' at tip; swept vertical and horizontal tail.

FLYING CONTROLS: Conventional and manual. Trim tabs in port aileron and both elevators; anti-servo tab in rudder; single-slotted trailing-edge flaps; fixed tailplane.

STRUCTURE: Two-spar light alloy wing; safe-life semi-monocoque fuselage.

LANDING GEAR: Hydraulically retractable tricycle type, with twin wheels on each main unit. Single wheel on steerable nose unit, with shimmy damper. Main units retract forward, nosewheel rearward. Beech oleo-pneumatic shock-absorbers. Goodrich mainwheels and tyres size 18×5.5 (10 ply) tubeless, pressure 7.25 bar (105 lb/sq in). Oversize and/or 10 ply mainwheel tyres optional. Goodrich nosewheel size 6.50×10 (8 ply) tubeless, with tyre size 22×6.75-10, pressure 3.93 bar (57 lb/sq in). Goodrich hydraulic multiple-disc brakes. Parking brake.

POWER PLANT: Two 634 kW (850 shp) Pratt & Whitney Canada PT6A-42 turboprops, each driving a Hartzell four-blade, constant-speed, reversible-pitch, metal propeller with autofeathering and synchrophasing. Bladder fuel cells in each wing, with main system capacity of 1,461 litres (386 US gallons; 321.5 Imp gallons) and auxiliary system capacity of 598 litres (158 US gallons; 131.5 Imp gallons). Total usable fuel capacity 2,059 litres (544 US gallons; 453 Imp gallons). Two refuelling points in upper surface of each wing. Wingtip tanks optional, providing an additional 401 litres (106 US gallons; 88.3 Imp

Beechcraft B200 version of King Air *(Paul Jackson)*

1158236

BEECHCRAFT KING AIR 200 CIVILIAN PRODUCTION

Year	200	200T	B200T	RU-21J	B200	200C	B200C	200CT	R200CT
1972	1								
1974	13			3					
1975	71								
1976	99	1							
1977	110	2							
1978	113	1							
1979	152	7				4			
1980	167	7				9			
1981	107	3			84	22	7	1	
1982		1	2		146		14		1
1983		1	4		68		11		2
1984			1		26		47[1]		2
1985			1		52		3		
1986					18		1		
1987					25		2		
1988			1		27		3		
1989					33		3		
1990					43		2		
1991					23		2		
1992					27		1		
1993			6		29		2		
1994			6		26				
1995					21				
1996					28				
1997					43				
1998					43				
1999					44				
2000			5		47		1		
2001					45				
2002					22		6		
2003			3		38				
2004					43		2		
2005					37		2		
Totals	**833**	**23**	**23**	**3**	**1038**	**35**	**107**	**1**	**3**
			1,920				**146**		

[1] Including 46 C-12Fs for USAF. Other diversions to various armed forces and governments are included in the "civilian" delivery totals

Notes: Plus 339 military aircraft almost exclusively for US forces:
75 C-12A
66 UC-12B
30 C-12C
55 C-12D
19 RC-12D/H
12 U/RC-12F
29 C-12F/R
3 RC-12G
36 RC-12K/N/P/Q
2 RC-12K
12 U/RC-12M

gallons) and raising maximum usable capacity to 2,460 litres (650 US gallons; 541 Imp gallons). Oil capacity 29.5 litres (7.8 US gallons; 6.5 Imp gallons).

ACCOMMODATION: Pilot only, or crew of two side by side, on flight deck, with full dual controls and instruments as standard. Seven cabin seats standard, each equipped with seat belts and inertia reel shoulder harness; optional seats in baggage compartment raise passenger capacity to nine. Partition with sliding door between cabin and flight deck, and partition at rear of cabin. Door at rear of cabin on port side, with integral airstair. Large cargo door optional. Inward-opening emergency exit on starboard side over wing. Lavatory and stowage for baggage in rear fuselage. Maintenance access door in rear fuselage; radio compartment access doors in nose. Cabin is air conditioned and pressurised, with electric heat panels to warm cabin before engine starting.

SYSTEMS: Cabin pressurisation by engine bleed air, with a maximum differential of 0.44 bar (6.5 lb/sq in), maintaining a sea level cabin environment to 4,661 m (15,293 ft). Cabin air conditioner of 32,000 BTU capacity. Auxiliary electric cabin heating. Oxygen system for flight deck, and 623 litre (22 cu ft) oxygen system for cabin, with automatic drop-down face masks; 2,182 litre (77 cu ft) system optional. Dual vacuum system for instruments. Hydraulic system for landing gear retraction and extension, pressurised to 171 to 191 bar (2,475 to 2,775 lb/sq in). Separate hydraulic system for brakes. Electrical system has two 300 A 28 V starter/generators and a 24 V 34 Ah air-cooled Ni/Cd battery with failure detector. AC power provided by dual 300 VA inverters. Engine fire detection system standard; engine fire extinguishing system optional. Pneumatic de-icing of wings and tailplane standard. anti-icing of engine air intakes by hot air from engine exhaust, electrothermal anti-icing for propellers.

AVIONICS: Standard Rockwell Collins Pro Line II package. Pro Line 21 available as option from 2003.

Comms: Cockpit-to-cabin paging standard. Bendix/King KHF 950 transceiver, Fairchild A-100A cockpit voice recorder standard, AirCell ST 3100 iridium satcom optioanl.

Radar: Rockwell Collins WXR-270 colour weather radar standard, WXR-840 or WXR-850 turbulence detecting radar optional.

Flight: Collins APS-65H autopilot/flight director, Universal UNS-1D and UNS-1K navigation management systems, with GPS optional.

Instrumentation: Rockwell Collins EFIS-84/B-14, pilot's ALT-80A encoding altimeter; dual maximum allowable airspeed indicators, and flight director standard. Options include Rockwell Collins three-tube EFIS-85B with MFD.

EQUIPMENT: Standard/optional equipment generally as for King Air C90B except fluorescent cabin lighting, one-place couch with storage drawers, flushing chemical toilet, cabin electric heating, cockpit/cabin partition with sliding doors, and airstair door with hydraulic snubber and courtesy light, standard. FAR Pt 135 operational configuration includes cockpit fire extinguisher and 2.2 m³ (77 cu ft) oxygen bottle with cockpit oxygen pressure indicator as standard. A range of optional cabin seating and cabinetry configurations is available, including quick-removable fold-up seats.

DIMENSIONS, EXTERNAL:

Wing span	16.61 m (54 ft 6 in)
Wing chord: at root	2.18 m (7 ft 1¾ in)
at tip	0.90 m (2 ft 11½ in)
Wing aspect ratio	9.8
Length overall	13.36 m (43 ft 10 in)
Height overall	4.52 m (14 ft 10 in)
Tailplane span	5.61 m (18 ft 5 in)
Wheel track	5.23 m (17 ft 2 in)
Wheelbase	4.56 m (14 ft 11½ in)
Propeller diameter	2.39 m (7 ft 10 in)
Propeller ground clearance	0.43 m (1 ft 4¾ in)
Distance between propeller centres	5.23 m (17 ft 2 in)
Passenger door: Height	1.31 m (4 ft 3½ in)
Width	0.68 m (2 ft 2¾ in)
Height to sill	1.17 m (3 ft 10 in)
Cargo door (optional): Height	1.32 m (4 ft 4 in)
Width	1.24 m (4 ft 1 in)
Nose avionics service doors (port and stbd):	
Max height	0.57 m (1 ft 10½ in)
Width	0.63 m (2 ft 1 in)
Height to sill	1.37 m (4 ft 6 in)
Emergency exit (stbd): Height	0.66 m (2 ft 2 in)
Width	0.50 m (1 ft 7¾ in)

DIMENSIONS, INTERNAL:

Cabin:	
Length: between pressure bulkheads	6.71 m (22 ft 0 in)
aft of cockpit divider	5.08 m (16 ft 8 in)
Max width	1.37 m (4 ft 6 in)
Max height	1.45 m (4 ft 9 in)
Floor area	7.80 m² (84 sq ft)
Volume, including flight deck	10.99 m³ (388 cu ft)
Baggage hold, rear of cabin:	
Volume	1.57 m³ (55.3 cu ft)

AREAS:

Wings, gross	28.15 m² (303.0 sq ft)
Ailerons (total)	1.67 m² (18.00 sq ft)
trailing-edge flaps (total)	4.17 m² (44.90 sq ft)
Fin	3.46 m² (37.20 sq ft)
Rudder, incl tab	1.40 m² (15.10 sq ft)
Tailplane	4.52 m² (48.70 sq ft)
Elevators, incl tabs (total)	1.79 m² (19.30 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	3,757 kg (8,283 lb)
Basic operating weight, typical (one pilot)	3,869 kg (8,530 lb)
Baggage capacity	249 kg (550 lb)
Max fuel	1,653 kg (3,645 lb)
Fuel with max payload	721 kg (1,590 lb)
Max T-O and landing weight	5,670 kg (12,500 lb)
Max ramp weight	5,710 kg (12,590 lb)

Max zero-fuel weight	4,990 kg (11,000 lb)
Max wing loading	201.4 kg/m² (41.25 lb/sq ft)
Max power loading	4.48 kg/kW (7.35 lb/shp)
PERFORMANCE:	
Never-exceed speed (VNE)	259 kt (480 km/h; 298 mph) IAS
Max operating Mach No.	0.52
High cruising speed at FL220	292 kt (541 km/h; 336 mph)
Long-range cruising speed at FL290	221 kt (409 km/h; 254 mph)
Stalling speed: flaps up	99 kt (183 km/h; 114 mph) IAS
flaps down	75 kt (139 km/h; 86 mph) IAS
Approach speed	103 kt (191 km/h; 119 mph)
Max rate of climb at S/L	750 m (2,460 ft)/min
Rate of climb at S/L, OEI	226 m (740 ft)/min
Service ceiling	10,670 m (35,000 ft)
Service ceiling, OEI	6,675 m (21,900 ft)
T-O field length	786 m (2,580 ft)
Accelerate-stop distance	1,040 m (3,411 ft)
Landing distance	867 m (2,845 ft)
Range with NBAA IFR reserves, 100 n mile (185 km; 115 mile) alternate:	
with max payload	407 n miles (753 km; 468 miles)
with max fuel	1,755 n miles (3,250 km; 2,019 miles)
with four passengers	1,483 n miles (2,746 km; 1,706 miles)
Ferry range	1,818 n miles (3,366 km; 2,092 miles)

BEECHCRAFT KING AIR 350

US Army designation: C-12S
JGSDF designation: LR-2

TYPE: Utility turboprop twin.

PROGRAMME: Replaced King Air 300 (1991–92 *Jane's*); first flight (N120SK) September 1988; introduced at NBAA Convention 1989; certified to FAR Pt 23 (commuter category) 12 December 1989; first delivery 6 March 1990; Russian certification to AP 23 in November 1995; FAA approval for operation from unprepared runways granted during 1997.

CURRENT VERSIONS: **King Air 350:** Baseline version.

Detailed description applies to King Air 350.

King Air 350C: Has 132 × 132 cm (52 × 52 in) freight door with built-in airstair passenger door.

King Air 350 Special Mission: Version available from last half of 2004 for homeland security, aerial photography and airways and ground-based navaid checking. Max take-off and landing weight 7,484 kg (16,500 lb), maximum ramp weight 7,530 kg (16,600 lb), max zero-fuel weight 5,897 kg (13,000 lb); provision for HISAR and SeaVue reconnaissance systems; wing fuel lockers; mission endurance seven hours.

Australian Army received King Air 350 VH-HPJ in 1998 as follow-on (to Douglas C-47 Dakota) test platform for Ingara SAR/MTI radar in ventral pannier; installation by Hawker Pacific.

King Air 350ER: Extended range special mission version for surveillance and reconnaissance operations, introduced at the Paris Air Show in June 2005. Features nacelle fuel tanks, heavy duty landing gear and increased maximum take-off weight of 7,484 kg (16,500 lb). Typical mission profile involves a 100 n mile (185 km; 115 mile) flight to on-station; low-altitude surveillance sortie for 7 hours 20 minutes; and return to base with 45 minutes' fuel reserve. Certification announced 20 September 2005 of King Air 350 in Commuter category at new weight, this to be followed by installation and certification of nacelle tanks to produce full 350ER standard.

In September 2006, Iraq requested details for possible purchase of 24 in transport role, plus 24 equipped with synthetic aperture radar (APY-8, or APY-12, or AN/APS-134, or AN/APS-143, or RDR 700 or AN/APS-144) and Wescam MX-15 EO/IR system. Initial order, in January 2007, covered five surveillance and one transport version, together worth USD132 million, for delivery before April 2008.

RC-350 Guardian: Elint version, converted from 350 prototype 1991 by Beech Aircraft Corporation; mission avionics include Raytheon AN/ALQ-142 ESM, Watkins-Johnson 9195C communications interceptor, Honeywell laser INS, GPS receiver and Cubic secure digital datalink; can loiter on station at 10,670 m (35,000 ft) for more than 6 hours; can locate/monitor radar emitters in 20 MHz to 18 GHz range, and intercept communications within 20 to 1,400 MHz bandwidths. Wingtip pods house AN/ALQ-142 antennas; underfuselage bulge contains antenna for comint system.

LR-2: Japan Ground Self-Defence Force funded two in FY97 for liaison and reconnaissance (undisclosed sensor in ventral radome). Total requirement for 20, of which third funded in 1999, fourth in FY00, fifth in FY01 and sixth in FY02; none in subsequent four years. First delivery (23051) 22 January 1999; initial operator is the HQ Flight of 1st Helicopter Brigade at Kisarazu.

C-12S: US Army version with quick-change cargo capability and seating for up to 15 passengers. No aircraft of this type have been identified in service.

CUSTOMERS: Total 460 King Air 350s and 13 350Cs delivered by end of 2005; first 350C delivery in 1990 to Rossing Uranium, Namibia. Further 17 in the first six months of 2006. Recent customers include the Royal Australian Air Force, which signed a lease contract on 20 November 2002 for seven King Air 350s for delivery from June 2003, to be operated by 32 Squadron for the RAAF School of Navigation at East Sale, replacing H.S. 748s and King Air 200s. Seven delivered in 1999 to Japan Maritime Safety Agency with large observation window each side of rear fuselage.

COSTS: 350 USD5.802 million (2004).

DESIGN FEATURES: Compared with King Air 300, fuselage stretched 0.86 m (2 ft 10 in) by plugs 0.37 m (1 ft 2½ in) forward of main spar and 0.49 m (1 ft 7½ in) aft; wing span increased by 0.46 m (1 ft 6 in) with NASA winglets 0.61 m (2 ft 0 in) high; two additional cabin windows each side. Can depart with full payload and full tanks. Raisbeck dual aft body strakes (DABS), standard on production aircraft from c/n FL-312 (N3165M) in first quarter 2001, reduce drag, improve handling and stability and relax or eliminate restrictions on operations with inoperative yaw damper.

Low-mounted wing carrying engine pod outboard; leading-edge glove immediately outboard of engine nacelle; winglets. T-tail with sweptback fin.

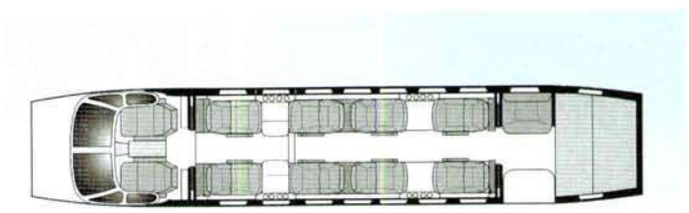
Wing sweep zero at 25 per cent chord; dihedral 6°. Tailplane sweep 17° at 25 per cent chord; no dihedral. Fin sweep 37° 6' at 25 per cent chord.

BEECHCRAFT KING AIR 350 PRODUCTION

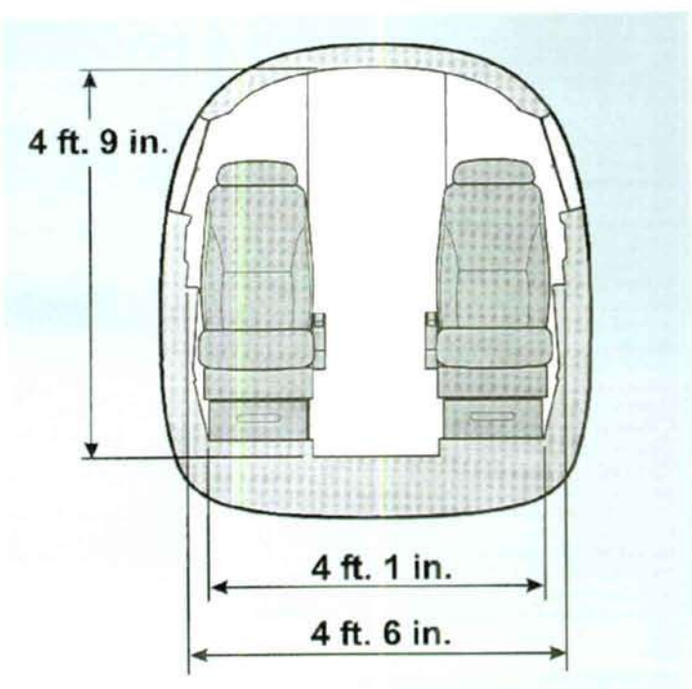
Year	Version/Quantity	
	350	350C
1990	34	1
1991	35	2
1992	18	5
1993	26	1
1994	12	
1995	5	
1996	21	1
1997	32	
1998	39	
1999	38	1
2000	42	
2001	28	
2002	24	
2003	25	1
2004	37	
2005	44	1
Totals	**460**	**13**

Beechcraft King Air 350 *(Paul Jackson)* 1129199

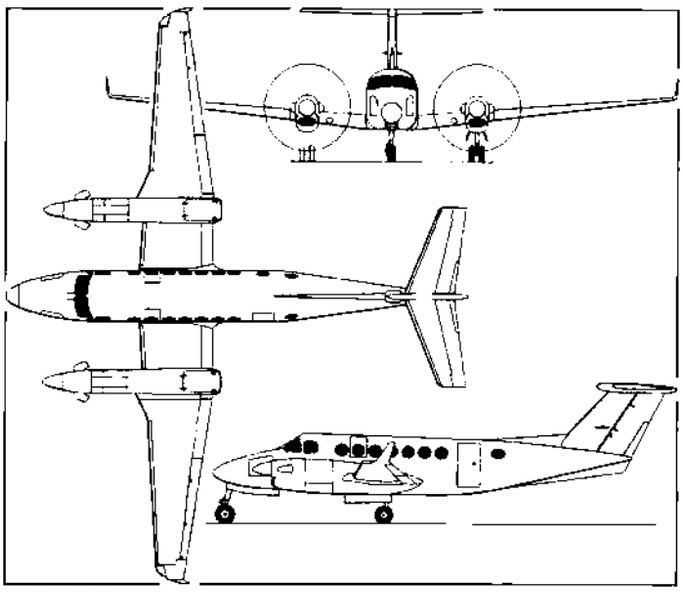
Japan Maritime Safety Agency Beechcraft King Air 350 fitted with observation window 1158235



Floor plan of Beechcraft King Air 350 1159699



Beechcraft King Air 350 cabin cross-section 1159700



Beechcraft King Air 350 *(Paul Jackson)* 1159686

FLYING CONTROLS: Conventional and manual. Actuation by control cables, push-pull rods and mechanical linkages. Ailerons with inset hinges; no tabs. Flight-adjustable tab in port elevator and rudder, latter manually operated. Electrically actuated flaps in two sections (inboard and outboard of engine nacelle) on each wing, with automatic power disconnection in the event of asymmetrical condition. Flap positions: up, approach and down.

Rudder boost system, when armed, operates electric servo to assist pilot when engine torque exceeds preset level. Four flaps are mounted on the wings.

STRUCTURE: Multiframe fuselage of high strength aluminium alloy, with appropriate use of steel and other materials, plus bonded doublers and small panel sizes on the primary structure to add strength. Wing is of semi-monocoque construction, incorporating dual spar structures from tip to tip. Front and rear spars are similar in construction, consisting of upper and lower cap extrusions, stiffeners and webs. Inboard section of each spar consists of a combination of channel fittings, assembled back to back, of 7075 aluminium plate, plus forgings for front and rear spar fittings. Wings are attached to fuselage by eight bolts. Main landing gear attached to rear spar. Flaps attached to wing trailing-edges, consisting of front spar, a rear spar, ribs, side plates, skins and a fairing. Composites winglets.

LANDING GEAR: Tricycle type; retractable. Twin mainwheels on each leg; single nosewheel. Main legs retract forwards into engine nacelles; nose gear aft; oleo-pneumatic shock-absorbers on all legs. Retraction electrically controlled and hydraulically actuated; pairs of mechanically-actuated landing gear doors throughout. Emergency extension hand-pump. Nosewheel steering mechanically actuated; maximum towing angle ±49°, limited to 14° port and 12° starboard through rudder pedal control. Four hydraulically-operated, multi-disc, metallic-lined brake assemblies, one at each main gear wheel. Brake de-icing uses bleed air heat.

POWER PLANT: Two 783 kW (1,050 shp) Pratt & Whitney Canada PT6A-60A turboprops, each driving a Hartzell HC-B4MP-3C/M10476K four-blade, constant-speed, fully feathering, reversible-pitch, metal propeller with normal operating limits 1,450 to 1,700 rpm. Bladder cells and integral tanks in each wing, with usable capacity of 1,438 litres (380 US gallons; 316.5 Imp gallons); auxiliary tanks inboard of engine nacelles, capacity 601 litres (159 US gallons; 132.5 Imp gallons). Total fuel capacity 2,040 litres (539 US gallons; 449 Imp gallons). No provision for wingtip tanks. Oil capacity 30.2 litres (8.0 US gallons; 6.7 Imp gallons).

Closed loop fire detection system and fire extinguishing system. Autofeather system, when armed, will feather propeller of engine which fails on T-O. Syncrophaser system matches propeller speeds and also phases blade positions (45° stagger) to prevent simultaneous tip passage adjacent to fuselage.

Fuel system consists of two separate subsystems connected by valve-controlled crossfeed; each engine's system is further divided into main and auxiliary systems. Main consists of nacelle tank, two wing leading edge tanks, two box section bladder tanks, and integral (wet cell) tank, all interconnected to flow into the nacelle tank by gravity. Tanks are filled near each wingtip. Auxiliary fuel system consists of centre-section tank with its own filler opening, and an automatic fuel transfer system to transfer fuel to main system. When the auxiliary tanks are filled, they are used first.

ACCOMMODATION: Two cockpit seats with dual controls and, typically eight passenger seats in double club arrangement, plus lavatory opposite door and baggage locker at extreme rear. Certified for single-pilot operation.

Fuselage divided into three subsections: unpressurised nose section; pressurised flight deck and cabin; unpressurised tail section. Nose accommodates avionics, weather radar antenna, landing lights and nose landing gear; avionics in upper portion are accessible through lockable port and starboard doors. Cockpit and passenger cabin has maximum operational differential pressure of 0.46 bar (6.6 lb/sq in). Cabin door port, behind wing trailing edge; emergency exits each side, adjacent to wing leading edge. Tail section contains oxygen bottle, cockpit voice recorder and, optionally, flight data recorder.

Each passenger seat has fore- and aft travel, swivel and reclining capability. Standard cabinetry consists of upright pyramid-style refreshment cabinet on forward, port side. Center pyramid cabinets each side, between double club seating. Stowable tables between each pair of seats. Belted seat in lavatory.

"Quiet Cabin" noise control features 83 tuned dynamic vibration absorbers mounted throughout cabin and flight deck, plus Scotchdamp skin stiffener and 76 mm (3 in) of bagged glass fibre insulation. Baggage compartment at rear is heated and pressurised and accessible in flight. Raisbeck nacelle lockers behind engines. Windscreens, of glass and acrylic sandwich, are anti-iced using electro-thermal elements between panes. Rain removal on the ground and during low speed flight is by wipers.

SYSTEMS: Hydraulic system powered by electric motor-driven pump and provides pressure for landing gear retraction and extension. Electrical power from two 28V DC, 300 A engine-driven starter/generators. Battery, 24 V 42 Ah, supplies electrical power for engine starting and emergencies. A 28V DC external power receptacle under starboard wing, outboard of engine. Power distributed through multi-bus DC system, each source is connected through relays and line contactors. Inverter, 500 VA, in starboard wingroot, provides 115 volt 60 Hz AC power to four electrical outlets in cabin.

Pressurisation and environmental systems use engine bleed air and are replaced by ram air for cabin ventilation when system not in use. Regulation by variable isobaric controller to drive an outflow valve through a pneumatic relay. Both outflow and safety valves open automatically at max differential pressure to prevent overpressure. Air conditioning by vapour cycle refrigeration system, having compressor driven by the starboard engine.

Oxygen system, capacity 21.8 litres (77 cu ft), for crew and passengers at cabin pressure altitude up to 10,670 m (35,000 ft). Crew has quick-donning oxygen masks; supplies for passengers provided through drop-down masks deploying automatically if cabin altitude rises above 3,810 m (12,500 ft).

Engine bleed air is used for anti-ice protection engine intake and (via air-driven pneumatic boots) wing and tailplane leading edges. Windscreen de-fogging by air conditioning system. Windscreen, pitot mast, fuel vent, propellers and stall warning vane are electrically heated. Oil-to-fuel heat exchanger, located on the engine accessory case, prevents ice in fuel control unit.

Collins FGC-3000 automatic flight guidance system provides integrated fail-passive three-axis autopilot with yaw damper, flight guidance operation, automatic pitch trim and rudder boost. Consists of two identical FGC-3000 flight guidance computers, three primary servos and FGP-3000 flight guidance panel. System is capable of 5½°, steep approaches with the autopilot coupled.

MDC-3000 maintenance diagnostic computer data can be downloaded to CD or laptop.

AVIONICS: *Comms:* Dual Rockwell Collins VHF-4000 VHF; tuning through CDU or RTU. Dual Collins TDR-94 solid-state, airborne, Mode S transponders. dB System Model 700 (pilot) and Model 800 (co-pilot) audio systems. Cabin paging system with five speakers. L3 Communications FA2100 solid-state cockpit voice recorder with remote area microphone (30 min recording time). Artex 110-4 ELT.

Radar: Rockwell Collins TWR-850 four-colour weather radar.

Flight: Dual Rockwell Collins ADC-3000 air data computers, RVSM capable. Dual Collins AHC-3000 AHRS; Collins FMS-3000 flight management system using VOR/DME, DME/DME and GPS signals to determine position.

Instrumentation: Rockwell Collins Integrated AFD-3010 EFIS, consisting of primary flight display (PFD) on the pilot's and co-pilot's panels and multifunction display (MFD) adjacent to the pilot's PFD. PFD includes attitude, flight guidance, airspeed, vertical speed, altitude, HSI, navigation and flight guidance mode information. MFD displays engine parameters, map and radar information. Avionics maintenance history and checklists can be accessed through MFD. The DCP-3000 display control panels (DCP) provide barometric pressure correction, secondary engine display control, V-speed reference setting, navigation source selection, bearing source selection, weather radar control and display range selection. EFIS displays are also capable of showing L3 Communications TCAS I and Honeywell EGPWS Mk V terrain information.

Single Rockwell Collins NAV-4000 navigation receiver integrates VOR/LOC/GS/ADF/MKR functions. Single RTU-4200 Comm/Nav tuning unit provides primary tuning capability for Comm and Nav radios. Single Collins DME-4000 DME, ALT-4000 radio altimeter and GPS 4000A GPS.

L3 Communications Skywatch TCAS I; Honeywell Mk VIII EGPWS provides terrain awareness and warning system (TAWS) displayed on the MFD in normal mode or PFD in reversionary mode.

DIMENSIONS, EXTERNAL: As for B200 except:

Wing span over winglets	17.65 m (57 ft 11 in)
Wing mean aerodynamic chord	1.78 m (5 ft 10 in)
Wing aspect ratio	10.8
Length overall	14.22 m (46 ft 8 in)
Height overall	4.37 m (14 ft 4 in)
Tailplane span	5.61 m (18 ft 5 in)
Wheelbase	4.95 m (16 ft 3 in)
Wheel track (c/l shock-absorbers)	5.23 m (17 ft 2 in)
Propeller diameter	2.67 m (8 ft 9 in)
Propeller ground clearance	0 29 m (11½ in)
Door: Min height	1.31 m (4 ft 3½ in)
Min width	0.68 m (2 ft 2¾ in)
Emergency exit (each side of cabin, above wing):	
Height	0.66 m (2 ft 2 in)
Width	0.50 m (1 ft 7¾ in)

DIMENSIONS, INTERNAL:

Cabin: Length: between pressure bulkheads	7.57 m (24 ft 10 in)
excluding cockpit	5.94
Width: max	1.37 m (4 ft 6 in)
at floor	1.24 m (4 ft 1 in)
Height	1.45 m (4 ft 9 in)
Volume	10.05 m^3 (355 cu ft)
Baggage volume: internal	1.6 m^3 (55 cu ft)
nacelle lockers	0.45 m^3 (16 cu ft)

AREAS:

Wings, gross	28.80 m^2 (310.0 sq ft)
Vertical tail surfaces	4.86 m^2 (52.30 sq ft)
Horizontal tail surfaces	6.32 m^2 (68.00 sq ft)

WEIGHTS AND LOADINGS:

Operating weight empty	4,457 kg (9,825 lb)
Basic operating weight, typical (one pilot)	4,341 kg (9,570 lb)
Max baggage weight: internal	249 kg (550 lb)
nacelle lockers (total)	272 kg (600 lb)
Max fuel weight (usable)	1,638 kg (3,611 lb)
Fuel with max payload	1,179 kg (2,600 lb)
Max T-O and landing weight	6,804 kg (15,000 lb)
Max ramp weight	6,849 kg (15,100 lb)
Max zero-fuel weight	5,670 kg (12,500 lb)
Max wing loading	236.2 kg/m^2 (48.39 lb/sq ft)
Max power loading	4.35 kg/kW (7.14 lb/shp)

PERFORMANCE:

Max level speed	315 kt (584 km/h; 363 mph)
High cruising speed at FL240	310 kt (574 km/h; 357 mph)
Long-range cruising speed at FL330	237 kt (439 km/h; 273 mph)
Stalling speed at max landing weight, flaps and wheels down	81 kt (150 km/h; 94 mph)
Approach speed	109 kt (202 km/h; 125 mph)
Max rate of climb at S/L	832 m (2,731 ft)/min
Rate of climb at S/L, OEI	168 m (552 ft)/min
Time to FL250	15 min
Service ceiling	10,670 m (35,000 ft)
Service ceiling, OEI	6,555 m (21,500 ft)

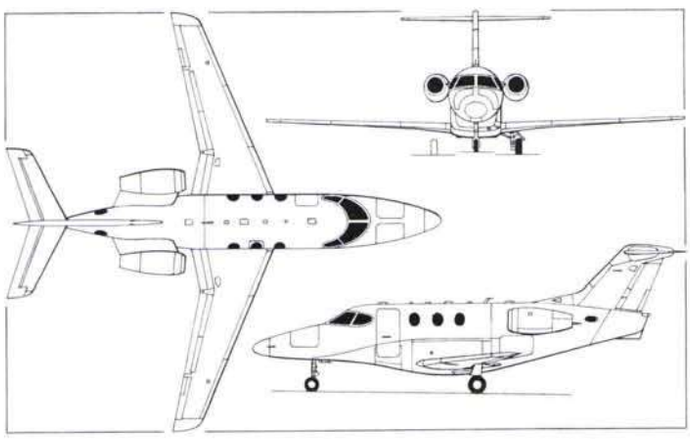
T-O balanced field length ..... 1,006 m (3,300 ft)
Landing distance ..... 821 m (2,695 ft)
Range, NBAA IFR reserves, 100 n mile (185 km; 115 mile) alternate: long-range cruise:
with max payload ..... 947 n miles (1,753 km; 1,089 miles)
with max fuel ..... 1,598 n miles (2,959 km; 1,839 miles)
with four passengers ..... 1,725 n miles (3,194 km; 1,985 miles)
high-speed cruise:
with four passengers ..... 1,470 n miles (2,722 km; 1,691 miles)
Ferry range ..... 1,814 n miles (3,359 km; 2,087 miles)
g limits ..... +3.1/–1.24
OPERATIONAL NOISE LEVELS:
T-O at max T-O weight ..... 72.9 dB(A)

BEECHCRAFT 390 PREMIER

TYPE: Light business jet.

PROGRAMME: Design started early 1994 as PD374 (later PD390) and approved early 1995; originated in former Beech design offices, but was first aircraft to carry only the Raytheon name; brief details of 'new light business jet' revealed June 1995; launched at National Business Aircraft Association Convention in Las Vegas 26 September 1995 with full-scale fuselage/cabin mockup; wind-tunnel tests of one-eighth model conducted early 1996 at Boeing, Boeing V/STOL, NASA-Lewis and Wichita State University facilities; to compete with Cessna CitationJet.

First forward fuselage completed in February 1997 and mated to aft fuselage in April 1998; roll-out (N390RA, c/n RB-1) 19 August 1998; first flight 22 December 1998. Second aircraft (N704T) first flown 4 June 1999, followed by third (N390TC), first with complete interior, on 17 September 1999; public debut (N390TC) at National Business Aviation Association Convention at Atlanta, Georgia, October 1999; more than 720 flight test hours accumulated by 23 December 1999, at which time eight production aircraft were in final assembly; static testing of wing to 150 per cent of design load completed on 17 December 1999; four aircraft undertook 1,400 hour flight test programme culminating in FAA FAR Pt 23 certification on 23 March 2001, followed by German certification on 3 September 2001; FAA RVSM approval granted in May 2003; certified in Bermuda, Denmark, Mexico, Israel, South Africa and Switzerland in 2002, and in China in November 2003. Deliveries began with three aircraft in third quarter of 2001: RB-4, –6 and –7 to Tyrose Investments, Raytheon and Town & Country Food Markets, respectively. 100th Premier I production fuselage completed 24 July 2003. Target production rate 60 per year from 2003. Total flight time stood at more than 23,000 flight hours by May 2004.



Beechcraft Premier IA (two Williams FJ44 turbofans) *(James Goulding)* 1133724

CURRENT VERSIONS: **Premier I:** Baseline version.

Premier IA: Redesigned interior and avionics enhancements; announced and made the type's public debut at EBACE, Geneva, 18 May 2005. Prototype/demonstrator N6182F/N3901A (c/n RB-102). Certification announced 24 October 2005; production standard from c/n RB-135.

Incorporates cabin interior modelled on Hawker 800XP, upgraded Pro Line 21 avionics, lowered approach speed, 'lift-dump on demand' control and other improvements and options.

CUSTOMERS: "More than 300 orders" said to have been received by October 2001 from customers in 27 countries, of which some 100 were from outside the USA and 51 from Europe, representing a backlog until 2005. However, 146th aircraft only delivered on 29 December 2005. Total of 11 delivered in first six months of 2006. Customers include Raytheon Travel Air, the fractional ownership subsidiary of Raytheon Aircraft, which has ordered 71 for delivery beginning 2001; Aviation Leasing Group (ALG Transportation Inc) of London, which ordered three in August 2000, two of which will be used by the Civil Aviation Training Centre (CATC) in Thailand for training student pilots for Thai Airways International and other Pacific Rim carriers and Hangzhou Daoyuan Chemical Fibre Group of China, which took delivery of one in 2005, and Guardian LP Services, which has ordered nine for its Ontario, California-based charter operation, the first two of which were delivered on 16 June 2006. The 100th delivery took place in April 2004, to FDRS Air Inc of Norfolk, Virginia.

BEECHCRAFT PREMIER PRODUCTION

	Quantity	
Model Year[1]	Premier I	Premier IA
1998	1	
1999	2	
2000	0	
2001	19	
2002	29	
2003	35	
2004	31	
2005	16	13
Total	**133**	13
Grand total	**146**	

[1] Not necessarily calendar year when production version is changed

COSTS: USD5.250 million (2004).

DESIGN FEATURES: Conventional small business jet, developed with assistance of CATIA programmes. Rear-mounted engines, T tail and wing mounted below fuselage for additional cabin space. Sweepback 20° at 25 per cent chord; 2° 30' dihedral; tailplane sweepback 25° at 25 per cent chord; zero dihedral; vertical tail sweepback 40° 24' at 25 per cent chord.

FLYING CONTROLS: Conventional and manual. Activation via pushrods and cables. Pitch trim via electrically actuated, variable incidence tailplane and mechanically driven geared tab on each elevator; electrically actuated trim tab on each aileron; electrically actuated rudder trim tab. Electrically signalled, hydraulically powered, three-segment spoilers on upper surface of each wing augment aileron roll control; outboard and middle panels provide roll, airbrake and post-landing lift-dump functions; inboard panel provides lift-dump function only. Control surface maximum deflections: rudder 25°; rudder trim ±20°; elevators 20° up, 9° 36' down; elevator trim 3° 3.6' up, 12° 36' down; tailplane incidence 1° 24' leading-edge up, 7° leading-edge down; ailerons 15° 30' up, 12° 30' down; aileron trim ±20°; roll-sontrol spoilers, outboard panels 9°, mid panels 8° 3'; speedbrakes 23°; lift dumpers, inboard panels 60°, mid and outboard panels 45°. 75 per cent span, four-segment, electrically controlled Fowler flaps, deflections 0, 10, 20 and 30°. Rudder boost, for asymmetric thrust and yaw damper, standard.

STRUCTURE: Fuselage of graphite/epoxy laminate and honeycomb composites, formed by Cincinnati Milacron Viper automatic fibre-placement machines over aluminium mandrel,

Beechcraft Premier IA, current version since late 2005 1158231

placing fibres at speeds up to 46 m (150 ft) per minute, enabling entire fuselage to be completed in one week; elimination of all internal frames, and skin thickness of 20 mm (0.78 in), increase cabin volume by 13 per cent and afford a weight saving of some 20 per cent over conventional alloy construction. Wing of aluminium alloy with six-spar wing box, manufactured using high-speed equipment capable of machining more than 93 m^2 (1,000 sq ft) of material per minute, and automatic riveting machines; with exception of three small bays along trailing-edge, entire wing is used for fuel storage. Ailerons and flaps of graphite/epoxy composites; fin has aluminium alloy spars and ribs with graphite/epoxy honeycomb skin; tailplane has one-piece, composites forward-and-rear spar with alloy centre rib, composites mid– and tip ribs and Nomex composites skin.

LANDING GEAR: Hydraulically actuated, retractable tricycle type with free-fall emergency extension system; single wheel on each unit. Mainwheel size 22×8.2 (12 ply); nosewheel 18×4.4 (6 ply). Mainwheels retract inwards; nosewheel forwards. Steerable nosewheel, maximum pedal-commanded deflection ±35°, increasing to ±45° with differential braking and asymmetric thrust. Hydraulic disc brakes with electric anti-skid system.

POWER PLANT: Two pod-mounted Williams FJ44-2A turbofans, each rated at 10.23 kN (2,300 lb st). Fuel contained in integral wing tanks, each of four sections, plus inboard collector tank; total capacity 2,092.6 litres (552.8 US gallons; 460.3 Imp gallons), of which 2,073.6 litres (547.8 US gallons; 456.1 Imp gallons are usable (for c/n RB-75 and later, gravity-filled), with gravity filling point on each wing. Single-point pressure refuelling/defuelling optional, with slightly reduced maximum and usable capacities.

ACCOMMODATION: Crew of one or two, with dual controls standard; six passengers in cabin, comprising four in standard club seating arrangement with tracking, swivelling and reclining capability and stowable writing tables and two on fixed forward-facing seats to rear; lavatory at rear, doubling as flight-accessible baggage compartment, maximum capacity 64 kg (140 lb). Refreshment/hang-up baggage cabinet on forward starboard side of cabin. Airstair door on port side to rear of flight deck; single plug-type emergency exit on starboard side. Three cabin windows on each side. Accommodation is air conditioned and pressurised. Externally accessible, unpressurised main baggage compartment to rear of cabin, with upward-opening door on port side, can accommodate large items such as skis; heating optional; forward baggage compartment in nose on port side with swing-up door. A new cabin sound damping system using a lightweight acoustic liner was introduced from c/n RB-112, and is retrofittable to earlier production aircraft.

SYSTEMS: Pressurisation system, maximum differential 0.58 bar (8.4 lb/sq in), maintains sea level cabin environment to 6,523 m (21,400 ft) and 2,440 m (8,000 ft) cabin altitude to 12,500 m (41,000 ft). Vapour cycle, ozone-safe R134a air conditioning system. Hydraulic system, maximum pressure 207 bar (3,000 lb/sq in), for landing gear, brakes, anti-skid and spoilers. Electrical system comprises two 28 V 325 A engine-driven starter/generators, 24 V 42 Ah lead/acid main battery, 24 V 3.5 Ah standby battery and 28 V external power receptacle; system is configured so that load-shedding is primarily automatic in the event of failure of any or all main electrical power sources. Oxygen system, capacity 1,134 litres (40 cu ft) standard, 2,182 litres (77 cu ft) optional, with diluter-demand masks for crew and continuous flow masks for passengers. Engine bleed-air anti-icing for wing leading-edges and nacelle inlets; electromagnetic expulsion de-icing (EMED) for tailplane leading-edges, automatically activated by dual nose-mounted, heated, ice detectors; electrically heated windscreens (with silicone coating for rain dispersal), pitot tubes and AoA probes.

AVIONICS: Rockwell Collins Pro Line 21 EFIS avionics suite as core system. Premier IA equipment as under.

Comms: Dual Rockwell Collins VHF-4000 transceivers, TDR-94 Mode S transponders and DB-700 audio systems; four-speaker cabin paging unit. Artex ELT-C406-2 ELT.

Radar: Rockwell Collins WXR-800 colour weather radar.

Flight: Dual Rockwell Collins AHC-3000 AHRS, ADC-3000 air data computers, CDU-3000 control/display units; IAPS-3000 lightweight, integrated avionics processing system; FGC-3000 flight guidance system, FMS-3000 flight management system with database, GPS-4000A, NAV-4000 ADF, NAV-4500 GS/MKR, DME-4000, Honeywell Mk V EGPWS, ALT-4000 radio altimeter, MDC-3110 maintenance diagnostic computer and L3 Communications FA2100 solid-state cockpit voice recorder with remote area microphone.

Instrumentation: Rockwell Collins AFD-3010E integrated EFIS comprising two 254 × 203 mm (10 × 8 in) active matrix LCD adaptive flight displays providing PFD and MFD functions, with CRT HSI and back-up electromechanical rate/sensor/attitude instrument and ASI on right side; second PFD optional, but not mandatory for RVSM compliance. Standby 2 in altitude indicator, ASI and altimeter.

DIMENSIONS, EXTERNAL:

Wing span	13.56 m (44 ft 6 in)
Wing aspect ratio	8.0
Length overall	14.02 m (46 ft 0 in)
Height overall	4.67 m (15 ft 4 in)
Tailplane span	4.90 m (16 ft 1 in)
Wheel track	2.79 m (9 ft 2 in)
Wheelbase	5.36 m (17 ft 7 in)
Crew/passenger door: Height	1.27 m (4 ft 2 in)
Width	0.64 m (2 ft 1½ in)

DIMENSIONS, INTERNAL:

Cabin:	
Length: between pressure bulkheads	5.69 m (18 ft 8 in)
excl flight deck	4.11 m (13 ft 6 in)
excl flight deck and lavatory	3.40 m (11 ft 2 in)
Width: max	1.68 m (5 ft 6 in)
at floor	1.22 m (4 ft 0 in)
Max height	1.65 m (5 ft 5 in)
Volume excl flight deck and lavatory	8.9 m^3 (315 cu ft)
Baggage volume:	
external, nose	0.28 m^3 (10.0 cu ft)
external, tailcone	1.25 m^3 (44 cu ft)
internal, forward	0.08 m^3 (3.0 cu ft)
internal (lavatory)	0.56 m^3 (19.9 cu ft)

AREAS:

Wings, gross	22.95 m^2 (247.0 sq ft)
Horizontal tail surfaces (total)	4.65 m^2 (50.00 sq ft)
Vertical tail surfaces (total)	4.78 m^2 (51.5 sq ft)

WEIGHTS AND LOADINGS:

Empty weight	3,683 kg (8,120 lb)
Equipped basic operating weight, typical	3,810 kg (8,400 lb)
Baggage capacity:	
external, nose	68 kg (150 lb)
external, tailcone	181 kg (400 lb)
internal, forward	27 kg (60 lb)
internal (lavatory)	63.5 kg (140 lb)
Max fuel weight (usable)	1,665 kg (3,670 lb)
Max-T-O weight	5,670 kg (12,500 lb)
Max ramp weight	5,710 kg (12,590 lb)
Max landing weight	5,262 kg (11,600 lb)
Max zero-fuel weight	4,536 kg (10,000 lb)
Fuel with max payload	1,175 kg (2,590 lb)
Max wing loading	247.1 kg/m^2 (50.61 lb/sq ft)
Max power loading	277 kg/kN (2.72 lb/lb st)

PERFORMANCE:

Max operating speed:	
S/L to FL270	320 kt (593 km/h; 368 mph)
above FL270	M0.80
High cruising speed at FL330	451 kt (835 km/h; 519 mph)
Long-range cruising speed at FL410	369 kt (683 km/h; 425 mph)
Approach speed	119 kt (220 km/h; 137 mph)
Max operating altitude	12,500 m (41,000 ft)
Service ceiling, OEI	8,534 m (28,000 ft)
Time to FL370	17 min
T-O field length	1,156 m (3,793 ft)
Landing distance	966 m (3,170 ft)
Range, NBAA IFR reserves, 100 n mile (185 km; 115 mile) alternate:	
with max payload	826 n miles (1,529 km; 950 miles)
with max fuel	1,460 n miles (2,703 km; 1,680 miles)
with four passengers	1,290 n miles (2,389 km; 1,484 miles)
Ferry range	1,502 n miles (2,781 km; 1,728 miles)
g limits	+3.2/−1.28

BELL

BELL HELICOPTER TEXTRON INC (SUBSIDIARY OF TEXTRON INC)

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During 1970–81, Bell Helicopter Textron was unincorporated division of Textron Inc; became wholly owned subsidiary of Textron Inc from 3 January 1982. Bell Helicopter Textron Canada (see Canadian section) formed at Montréal/Mirabel under contract with Canadian government October 1983; transfer to Mirabel, completed January 1987, of Bell 206B JetRanger and 206L LongRanger production. Production of Bell 212/412 transferred mid-1988 and early 1989 respectively; Bell 230, 407, 427, 429 and 430 programmes also undertaken in Canada, although 230 now terminated. In early 2004, Bell Helicopter had workforce of more than 7,500; revenue for 2005 was USD2.1 billion.

Bell and Boeing collaborate in design and manufacture of V-22 Osprey tiltrotor aircraft, as described in the following entry. New 41,800 m^2 (450,000 sq ft) factory at Amarillo International Airport, Texas, completed in 1999 as a Tiltrotor Assembly Centre (TAC) for the V-22 and the commercial BA609; latter tiltrotor, previously also a joint venture with Boeing, became a solely Bell programme on 1 March 1998 and later (temporarily with the AB139) the core of a joint venture effort undertaken in conjunction with Agusta of Italy; an agreement establishing the Bell/Agusta Aerospace Company was signed in November 1998; this title remains, despite later formation of AgustaWestland. Amarillo factory will also be final assembly centre for US Marine Corps AH-1Z and UH-1Y helicopters. Existing assembly hall being extended by 10,525 m^2 (113,300 sq ft) to accommodate AH-1Z and UH-1Y, with new 6,700 m^2 (72,000 sq ft) flight hangar due for completion at beginning of 2006.

Bell helicopters built in USA detailed here. Those currently built in Canada listed under Canada; other models built under licence by Dirgantara in Indonesia and AgustaWestland in Italy; KAI co-produced Bell 427 as SB 427 in Republic of Korea; Bell Helicopter Asia (Pte) Ltd is wholly owned Singapore-based company for marketing and support in Southeast Asia.

In late 2003, Bell announced intention to establish new organisation known as XworX; this concentrates on advanced development projects, such as production of the full-scale TR918 Eagle Eye UAV technology demonstrator, which made its maiden flight in March 2006, as well as a variety of tiltrotor concepts.

BELL UH-1Y

TYPE: Multirole medium helicopter.

PROGRAMME: Single-engined XH-40 (Bell 204) first flew 20 October 1956 and ordered in large numbers for US Army and numerous other air arms as UH-1 (briefly HU-1); enlarged cabin introduced from UH-1D (Bell 205) onwards; and twin-engines from UH-1N (Bell 212) in 1969.

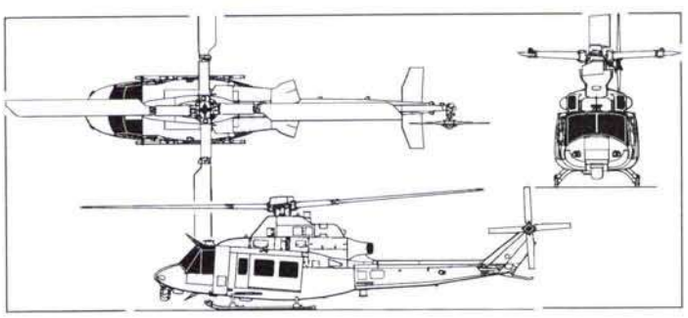
When launched in 1996, UH-1Y programme intended as an upgrade, involving remanufacture of 100 existing US Marine Corps UH-1Ns, offering 84 per cent commonality with similarly enhanced AH-1Z SuperCobra combat helicopter. New General Electric T700 turboshaft engines and four-blade rotor assembly were key features of remanufacture, in conjunction with new avionics suite, 'glass cockpit' and other improvements; resulting UH-1Y designed to operate with twice the payload and at least twice the range of the UH-1N it will replace.

Maiden flight of first of two UH-1Y prototypes (160446) occurred on 20 December 2001 at Bell's Arlington, Texas, factory, the helicopter thereafter demonstrating 190 kt (352 km/h; 219 mph) in shallow dive and 166 kt (307 km/h; 191 mph) in level flight before being transferred to Naval Air Test Center at Patuxent River, Maryland, on completion of just over 50 hours of company flight testing.

First flight at Patuxent River accomplished on 3 July 2002; maiden flight of second UH-1Y (159193) on 20 September 2002, this subsequently arriving at Navy test facility by end of 2002; these two helicopters re-serialled 166475 and 166476, respectively, at end of May 2003. By September 2003, both UH-1Y prototypes undergoing reconfiguration, in which new avionics suite incorporated and preparations made for addition of Thales

Rocket firing trials of Bell UH-1Y 1037996

Bell UH-1Y multirole medium helicopter *(US Navy)* 1037907



Bell UH-1Y naval utility helicopter *(Paul Jackson)*

TopOwl helmet-mounted sighting system (HMSS). Following this, flight trials resumed and continued throughout 2004, test activity including initial evaluation of defensive aids subsystem and first weapons trials, with launch of unguided 2.75 in rockets and firing of gun armament.

Decision also taken in 2004 to incorporate HIRSS (hover infra-red suppression system) featuring so-called 'turned exhaust'. In this, efflux nozzles canted outward, thus diverting exhaust plume away from tailboom and significantly alleviating heat-induced fatigue, while not affecting aircraft performance and handling qualities. 'Turned nozzle' configuration first flown on AH-1Z in June 2004; subsequently applied to UH-1Y by end of that year and is to be retrospectively incorporated on existing AH-1W and forthcoming AH-1Z SuperCobra combat helicopters of Marine Corps.

Delivery of UH-1Y to US Marine Corps for operational evaluation (OpEval) was originally expected in late 2004, but was delayed; OpEval began 9 May 2006 on departure from Patuxent River of two helicopters destined to spend six months at China Lake, California and will be headed by VX-9 squadron at China Lake, California. In meantime, development testing was stated to be about 80 per cent complete shortly before the end of 2004, with some 2,500 hours' flight time accumulated by two UH-1Ys and three AH-1Zs assigned to the test programme; at this point, expansion of the flight envelope had been completed, with the remaining work concerned with systems integration. At the beginning of June 2005, the combined helicopter fleet recorded the 3,000th hour, this milestone being passed during trials of weapons accuracy at Yuma, Arizona. Less than a month earlier, on 7 May, single examples of the UH-1Y and AH-1Z successfully completed the first shipboard operations aboard USS *Bataan* by both day and night.

Defense Acquisition Board approval to begin low-rate initial production (LRIP) received in October 2003, with FY04 budget appropriation covering six UH-1Ys (and three AH-1Zs), all of which are re-manufactured machines; four more UH-1Ys (and three AH-1Zs) funded in FY05, these also being remanufactured. Delivery of these 10 UH-1Ys is due to be completed by October 2007. However, following a review undertaken in 2004 which identified a potential serious shortfall in UH-1N numbers if the remanufacture programme proceeded as planned, it was announced on 15 April 2005 that subsequent acquisitions will all be new-build helicopters, starting with eight in FY06 and 15 in FY07, probably to be followed by 14 in each of FY08 to FY11, with final 11 in FY12.

First new-build UH-1Y is due for delivery in January 2008, with IOC anticipated in March 2008. Initial deliveries (remanufactured aircraft) will be to training unit HMT-303 at Camp Pendleton, California, during FY06, with Fleet Marine Force Pacific front-line squadrons transitioning thereafter, followed by conversion of Fleet Marine Force Atlantic squadrons from first quarter of FY09. Maiden deployment aboard amphibious vessel for sea duty currently expected to occur in 2010.

CUSTOMERS: US Marine Corps to acquire 100 UH-1Y helicopters (10 remanufactured machines and 90 new-build examples).

COSTS: Total procurement cost of H-1 upgrades (UH-1Y and AH-1Z) estimated at USD6.68 billion (FY06 budget projection).

DESIGN FEATURES: Four-blade main rotor and four-blade anti-torque rotor; tailplane with sweptback leading-edges. Aerodynamic elements of rotors foldable outboard of arm yokes, to facilitate stowage; limiting wind speed 45 kt (83 km/h; 52 mph). Two blades folded (one fore, one aft) for normal stowage; all four (two forward, two aft) in heavy weather. Main rotors mounted on two stacked glass fibre yokes and can function after direct hit by 23 mm cannon fire. Adjustable trim tabs for main rotor tracking adjustment. Tail rotor assembly of two stacked, teetering rotors on a single output shaft using spined trunnions on the pusher side of the helicopter; elastomeric bearings in trunnions provide load path for drive torque and thrust loads, and permit flapping motion. A 0.53 m (1 ft 9 in) plug has been added to the forward section ahead of the door post, mainly for the purpose of housing avionics racks. Airframe design life, including main blades, is 10,000 flight hours.

FLYING CONTROLS: Conventional cyclic, collective and directional pedals for pilot and co-pilot. Mechanical linkages and pushrods relay inputs to hydraulically boosted controls.

STRUCTURE: Embodies combination of conventional metal construction and some composites materials to reduce cost and weight as well as offer improved reliability and greater tolerance of battle damage. Main rotor principally of composites, combining spar assembly, leading-edge protective strip, skins, honeycomb core and trailing-edge strip. Fuselage comprises two main assemblies, specifically the forward section (including cockpit, cabin, landing gear, power plants and transmission) and the aft section (including boom, tail rotor assembly and tail rotor drive).

LANDING GEAR: Non-retractable tubular skid type with limiting sink speed of 3.66 m (12 ft)/s.

POWER PLANT: Two General Electric T700-GE-401C turboshaft engines, each rated at 1,153 kW (1,546 shp) max continuous; 1,264 kW (1,695 shp) for 30 minutes; and 1,363 kW (1,828 shp) OEI, 2 min 30 s. Transmission rated at 1,957 kW (2,625 shp). Internal fuel capacity 1,438 litres (380 US gallons; 316 Imp gallons), plus provision for carriage of two 291 litres (77.0 US gallon; 64.1 Imp gallon) external fuel tanks; total capacity 2,021 litres (534 US gallons; 445 Imp gallons).

ACCOMMODATION: Two pilots, crew chief and gunner; up to eight troops in main cabin on energy-attenuating crashworthy seats. Can accommodate six litters when used for casualty evacuation. 1151447

SYSTEMS: On board inert gas generating system (OBIGGS) reduces fire hazard in event of sustaining combat damage to fuel tanks. Hamilton Sundstrand APU. Primary DC generation by two 400 A, 28 V DC generators driven by the combining gearbox; AC power system of two 1,500 VA three-phase inverters; system accommodate load-shedding for emergency power. Ni-Cd battery, 25 Ah, able to power all essential systems for 20 minutes. Hydraulic system of two primary flight control systems (PC-1 and PC-2); pressure 207 bar (3,000 lb/sq in); systems power three main rotor actuators and one directional actuator of flight control system. One cylinder of each actuator powered by PC-1; other by PC-2. Both systems include transmission-driven hydraulic pump, bootstrap (pressurised) reservoir, filter module, flight control actuators, integral stability and control augmentation system, oil cooler fan hydraulic motor and other components; PC-1 also includes rotor brake control unit.

Automatic, four-axis flight control system with heading, altitude, attitude, speed and hover holds, hover wave-off and force trim.

AVIONICS: *Comms:* AN/ARC-210 UHF/VHF radio with satcom and comsec features.

Flight: Embedded GPS/INS; AN/ARN-153 Tacan, VHF/UHF direction finder.

Instrumentation: Two 203 × 152 mm (8 × 6 in) multifunction displays at each crew station; single 107 × 107 mm (4.2 × 4.2 in) dual function display and data entry keyboard for each crew member in centre cockpit console.

Mission: FLIR Systems BRITE Star navigation thermal imaging system (NTIS). Thales TopOwl helmet-mounted sighting system (HMSS).

Self-defence: Northrop Grumman AN/APR-39B(V)2 RWR; AN/AAR-47(V)2 combined missile/laser warning system; AN/ALE-47 countermeasures dispenser system with 360° coverage.

EQUIPMENT: Fast rope gantries permanently installed on each side are deployable from within cabin.

ARMAMENT: Unguided Mk 66 2.75 in rockets in either LAU-61 (19 tube) or LAU-68 (seven tube) launcher pods; can be launched singly, in pairs or as salvo. GAU-16A 0.50 in machine gun, GAU-17A 7.62 mm minigun or M240D 7.62 mm lightweight machine gun.

DIMENSIONS, EXTERNAL:

Main rotor diameter	14.63 m (48 ft 0 in)
Main rotor blade chord	0.63 m (2 ft 1 in)
Tail rotor diameter	2.97 m (9 ft 9 in)
Lenght: overall, rotors turning	17.78 m (58 ft 4 in)
fuselage	14.88 m (48 ft 10 in)
Height overall, tail rotor turning	4.44 m (14 ft 7 in)
Main rotor minimum ground clearance: static	2.62 m (8 ft 7 in)
rotors turning	3.78 m (12 ft 5 in)
Width: over skids	2.59 m (8 ft 6 in)
rotors folded	4.60 m (15 ft 1 in)
Tailplane span	3.05 m (10 ft 0 in)
Fuselage ground clearance	0.43 m (1 ft 5 in)

AREAS:

Main rotor disc	168.1 m^2 (1,809.6 sq ft)
Tail rotor disc	6.94 m^2 (74.66 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	5,370 kg (11,839 lb)
Max underslung load	2,268 kg (5,000 lb)
Max internal fuel weight	1,172 kg (2,584 lb)
Max T-O weight	8,391 kg (18,500 lb)
Max disc loading	49.9 kg/m^2 (10.22 lb/sq ft)
Transmission loading at max T-O weight and power	4.29 kg/kW (7.05 lb/shp)

PERFORMANCE:

Max level speed	198 kt (366 km/h; 227 mph)
Normal cruising speed	153 kt (283 km/h; 176 mph)
Max rate of climb at S/L	768 m (2,520 ft)/min
Rate of climb at S/L, OEI	226 m (740 ft)/min
Service ceiling	6,100 m (20,000 ft)
Mission radius, with eight troops, 30 min on station and 20 min reserves	125 n miles (232 km; 144 miles)
Max range	350 n miles (648 km; 402 miles)
Endurance, absolute	3 h 30 min
g limit	+2.8

BELL 449 SUPERCOBRA

US Navy/Marine Corps designation: AH-1Z

TYPE: Attack helicopter.

PROGRAMME:

DEVELOPMENT MILESTONES

Official go-ahead	Nov 1996
First order (development)	Nov 1996
Rolled out	20 Nov 2000
First flight	7 Dec 2000
Production go-ahead	23 Oct 2003
First delivery (trials)	Mar 2001

Prototype Bell 209, derived from single-engined UH-1, first flew as tandem-seat combat aircraft on 7 September 1965. Built for US armed forces and export and under licence in Japan, as described in previous editions. Universally known as HueyCobra.

First twin-engined Cobra was AH-1J SeaCobra, delivered from mid-1970; AH-1T Improved SeaCobra followed from 1977. All surviving US Marine Corps AH-1J SeaCobras withdrawn and 44 (including one ground-based trainer) AH-1T Improved SeaCobras converted to AH-1W to augment new production. Further improvement, to AH-1Z standard, launched in 1996 (refer to table above).

CURRENT VERSIONS: **AH-1Z:** Following abandonment of the proposed Integrated Weapon System (IWS) project in July 1995 and the Marine Observation and Attack Aircraft programme which was intended to provide a replacement for both the AH-1W SuperCobra and the UH-1N Iroquois, the US Marine Corps opted for a two-stage upgrade of the AH-1W that culminated in the AH-1Z Phase 1 concerned installation of the Israeli Tamam laser Night Targeting System (NTS), for dual TOW/Hellfire day, night and adverse weather capability. Deliveries of modified aircraft to operational units of the USMC began in June 1994.

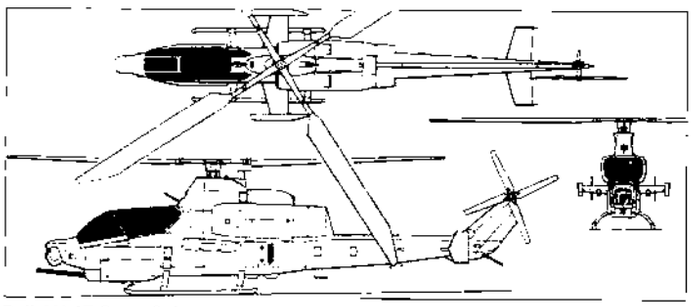
A further improvement programme, involving installation of an Embedded Global Positioning System/Inertial Navigation System (EGI), was subsequently undertaken, with EGI installed on new-build aircraft from Lot 9 onwards, as well as older AH-1Ws in a retrofit programme

Phase 2 was even more ambitious, centring around adoption of the Bell 680 four-blade rotor, offering a 70 per cent reduction in vibration; this was formerly designated **AH-1W (4BW)**. Initial trials of the four-blade rotor system were undertaken with AH-1W 161022; bench testing of the new drive system began in second quarter of 1999 and was completed in first quarter of 2000. Bell also demonstrated 30-minute run-dry capability of new intermediate and tail rotor gearboxes in March 2000.

AH-1Z has new four-blade, all-composites, hingeless/bearingless rotor system; four-blade composites tail rotor; new transmission rated at 1,957 kW (2,625 shp) and new wing assemblies able to carry twice the number of anti-armour missiles, as well as more fuel and additionally permitting concurrent carriage of two air-to-air self-defence missiles. Horizontal tail surfaces increased in size; these initially had endplates, which were subsequently deleted. Compared with AH-1W, current AH-1Z offers 130 per cent of rotor power; 133 per cent internal fuel; 108 per cent cruise airspeed with mission load; 156 per cent useful load; 217 per cent mission payload and 330 per cent mission radius with 1,134 kg (2,500 lb) of weapons.

Lockheed Martin selected to develop and manufacture AN/AAQ-30 Hawkeye advanced target sighting system (TSS), with work on USD8 million, 54 month, engineering development and integration programme beginning in July 1998. TSS features imaging technology by L-3 Wescam of Canada and Lockheed Martin's Sniper third-generation FLIR, as well as colour TV camera, laser ranger, spot-tracker and designator.

Also featured on the AH-1Z are 'glass cockpits'; Northrop Grumman (formerly Litton Industries) selected as prime contractor for this aspect of the upgrade. Digital transfer of information on tactical situation, weaponry and flight data will enable crew interchangeability and allow AH-1Z to be flown from either front or rear seat. Major subcontractors include Rockwell Collins, which supplies active matrix liquid crystal displays (AMLCDs); Smiths Industries (fire-control system); Meggitt Avionics (standby air data and inertial sensing devices); and BAE Systems (air data computers). Other elements of the upgrade include new stores management system, onboard systems monitoring, mission data loader, HOTCC (hands on throttle, collective and cyclic) controls, airborne target handover system and a new EW suite. Deal concluded in February 2004 with Taiwanese Aerospace Industrial Development Corporation (AIDC) covering manufacture of tailboom and elevator assemblies for AH-1Z and UH-1Y programmes.



Bell AH-1Z SuperCobra *(Paul Jackson)*

A USD310 million cost-plus-fixed-fee contract was awarded to Bell in November 1996, for design, development, fabrication, installation, test and delivery of three engineering development AH-1W SuperCobra Upgrade Aircraft. Assembly of first AH-1Z begun at Hurst, Texas, in April 1999, by which time 85 per cent of drawings had been released, with design work completed by end of 1999. Initial AH-1Z (166477, c/n 59001, previously 162549) completed in second quarter of 2000 and moved to Bell Flight Research Center at Arlington, Texas, for installation of instrumentation and functional testing that included restrained ground running. Formal roll-out at Arlington on 20 November 2000, with first flight on 7 December. Subsequently redesignated as NAH-1Z; removed from flight status and deleted from Navy inventory March 2005 for ballistic tolerance test purposes at China Lake, California. Second development aircraft (166478, c/n 59002, previously 163933) was due to fly in 2001, but handling quality problems that emerged early in flight test programme necessitated redesign of horizontal stabiliser assembly and caused delay; this eventually flew for first time on 4 October 2002, having been forestalled by third development aircraft (166479, c/n 59003, previously 162532), which made its maiden flight on 26 August 2002. By mid-November 2002, all three aircraft had accumulated 390 flight hours, demonstrating 160 kt (296 km/h; 184 mph) cruise and 220 kt (407 km/h; 253 mph) maximum speed; 1,000th hour milestone passed in January 2004. Programme includes flight test and evaluation at Patuxent River, Maryland, to where first AH-1Z was airlifted by C-5 Galaxy on 31 March 2001. Initial operational assessment began 12 February 2003 and was completed on 27 March, involving total of just under 12 flight hours and using third AH-1Z development aircraft; in May 2003, first AH-1Z undertook series of high altitude tests (with first UH-1Y) at Alamosa, Colorado. Weapons testing at Yuma Proving Ground, Arizona from February 2004, with other trials at China Lake, California. Second operational assessment by Marine Corps completed by June 2004, at which time major operational evaluation expected to begin February 2005; this subsequently re-scheduled for June 2005 and then further delayed into 2006, following problems experienced earlier with exhaust efflux impinging on tailboom and during live fire weapons testing in July 2004. Former problem caused weakening of tailboom assembly but satisfactorily resolved by redesign of exhaust nozzles, with new outward-canted arrangement flight tested in latter half of 2004; new nozzle to be fitted as standard on AH-1Z and retrofitted to existing AH-1Ws from early 2005 onwards. By June 2005, combined AH-1Z and UH-1Y test fleet had accumulated 3,000 flight hours; OpEval, by VX-9 squadron, launched 9 May 2005 when two AH-1Zs transferred from Patuxent River to China Lake, California, for six months.

Testing of full-scale AH-1Z structural test article at Arlington began in April 2000; on 22 November 2002, significant milestone passed with completion of 20,000 hour fatigue life demonstration, but further fatigue and static loads evaluation to follow, with airframe also earmarked for survivability assessment on completion of test duty. IOC originally scheduled for 2007, but has slipped to October 2009. Initial deliveries will be to training unit HMT-303 at Camp Pendleton, California.

AH-1Z King Cobra: Version for Turkey, which planned to acquire 145 attack helicopters at cost of USD4 billion; type formally selected in July 2000, but failure to reach agreement on cost and technology transfer details finally resulted in Turkey abandoning plans to go ahead with deal, decision to this effect being reached during meeting of Defence Industries Undersecretariat on 14 May 2004. On 10 February 2005, Turkey issued new RFP for direct purchase of initial batch of 50 attack helicopters; AH-1Z again a contender, facing competition from A129 Mangusta, AH-64D Apache Longbow, Rooivalk, Tiger, Ka-50 and Mi-28. However, on 18 March 2005, Bell withdrew from contest, citing concern over risks associated with contract as reason.

ARH-1Z: Designation allocated to version unsuccessfully proposed for Australian Army Project Air 87 armed reconnaissance helicopter.

NAH-1Z: Designation allocated to first engineering development aircraft (166477), indicating permanent assignment to test duty. Stricken from inventory in March 2005 for use in live-fire testing of ballistic tolerance at China Lake, California.

CUSTOMERS: Remanufacture programme for USMC originally called for 180 AH-1Zs to be produced, with procurement of first Low-Rate Initial Production (LRIP) batch of three helicopters (plus six UH-1Ys) in FY04, with delivery scheduled for 2006; another LRIP batch of seven helicopters will follow in FY05, comprising four UH-1Ys and three AH-1Zs, these for delivery in 2007. FY06 budget appropriates funds for total of 10 helicopters, including two AH-1Zs, with further three examples among 15 helicopters to be funded in FY07.

Peak production rate likely to be about 24 per year in remanufactured form, although possibility that some new-build examples would be acquired by Marine Corps emerged in mid-2004. At that time, it was becoming evident that majority of UH-1Ys would be new aircraft, with Bell proposing that about 40 new-build AH-1Zs be included in overall total; this would enable Marine Corps to maintain current operational tempo and also take into account anticipated attrition during next few years.

Taiwan has existing requirement for 30 attack helicopters and was expected to announce decision in early 2005, following evaluation of AH-1Z and Boeing AH-64D Apache. However, funding shortages have resulted in delay but AH-1Z appears favourite, with strong possibility of indigenous production to meet Taiwanese Army requirements. AIDC, which already supplies tailboom assemblies to Bell for the AH-1Z and UH-1Y, is most likely candidate to undertake production in event of deal being concluded.

Bell AH-1Z combat helicopter *(US Navy)* 1037995

COSTS: In late 2002, total cost of remanufacturing 180 AH-1Zs and 100 UH-1Ys estimated to be USD6.2 billion. Procurement of LRIP 1 production batch valued at USD308.6 million, covering remanufacture of three AH-1Zs and six UH-1Ys by January 2007.

DESIGN FEATURES: Essentially first-generation attack helicopter, with slightly stepped tandem seating and stub wings for armament. AH-1Z incorporates new four-blade, bearingless, hingeless, hyperbolic tip main rotor system with semi automatic blade folding, plus new transmission, including four-blade tail rotor repositioned to port side; these components all have 10,000 hour life. Exhaust gases distributed through horizontally-fanned pipes, compared to vertical units of earlier versions.

STRUCTURE: Airframe conventional semi-monocoque, incorporating aluminium and glass fibre honeycomb construction with aluminium alloy skins. AH-1Z survivability features include main and tail rotors resistant to 23 mm rounds; main driveshaft, mast and rotor controls to 12.7 mm fire; and fuel system to 12.7 to 20 mm. Main gearboxes are run-dry design.

LANDING GEAR: Non-retractable tubular skid type, incorporating new, lighter design with rectangular cross tubes. Ground handling wheels optional.

POWER PLANT: Two General Electric T700-GE-401 turbo-shafts, each rated at 1,285 kW (1,723 shp). Transmission flat rated at 1,957 kW (2,625 shp). Fuel (JP5) for AH-1Z contained in two internal cells; forward fuselage one contains 705 litres (186.3 US gallons; 155.1 Imp gallons), while aft fuselage cell contains 468 litres (123.7 US gallons; 103.0 Imp gallons); also has larger stub-wings, each containing 193 litres (51 US gallons; 42.5 Imp gallons) of fuel, increasing total internal capacity to 1,560 litres (412 US gallons; 343 Imp gallons). Fuel system protection measures include self-sealing cells and fuel lines and OBIGGS. Gravity refuelling point in forward fuselage, pressure refuelling point in rear fuselage. Provision for carriage on underwing stores stations of two or four external fuel tanks each of 291 litres (77.0 US gallons; 64.1 Imp gallons) capacity; or two 379 litre (100 US gallon; 83.3 Imp gallon) tanks; or two 100 and two 77.0 US gallon tanks; large tanks on outboard pylons only. AH-1Z can also operate with 871 litre (230 US gallon; 191.5 Imp gallon) external fuel tanks, allowing maximum external carriage of 2,498 litres (660 US gallons; 550 Imp gallons) at present, with potential for increase to 3,483 litres (920 US gallons; 766 Imp gallons). Oil capacity 19 litres (5.0 US gallons; 4.2 Imp gallons).

ACCOMMODATION: Crew of two in tandem on crash attenuating seats, with interchangeable stations for co-pilot/ gunner and pilot. Cockpit heated, ventilated and air conditioned. Dual controls; lighting compatible with night vision goggles, and armour protection standard. Forward crew door on port side and rear crew door on starboard side, both upward-opening. Inflatable body and head restraint system by Simula of Phoenix, Arizona.

SYSTEMS: Three independent hydraulic systems, pressure 207 bar (3,000 lb/sq in), for flight controls and other services. Electrical system comprises two 28 V 400 A DC generators, two 24 V 34.5 Ah batteries and three inverters: main 115 V AC, 1 kVA, single-phase at 400 Hz, standby 115 V AC, 750 VA, three-phase at 400 Hz and a dedicated 115 V AC 365 VA single-phase for AIM-9 missile system. Hamilton Sundstrand APU. Honeywell environmental control unit. Engine and APU fire extinguishers.

AVIONICS: *Comms:* AH-1Z has AN/ARC-210(V) dual UHF/VHF radios, plus embedded satcom, embedded communication security (COMSEC) and AN/APX-100(V) IFF.

Radar: None at present installed, but pod-mounted version of Longbow radar could be fitted as so-called Cobra Radar System. Mockup of possible installation displayed at Asian Aerospace show in Singapore, February 2002, this depicting pod-mounted radar sited above wing assembly.

Flight: Rockwell Collins AN/ARN-153(V)4 Tacan and DF-301E VHF/UHF DF. AH-1Z also has CN-1689(V2)/ASN Embedded Global Positioning System/Inertial Navigation System (EGI), incorporating embedded radar altimeter and associated digital moving map display. Rockwell Collins CDU-800 control/display unit and dual Rockwell Collins ICU-800 processors.

Instrumentation: Two 203 × 152 mm (8 × 6 in) Rockwell Collins flat-panel colour AMLCD multifunction displays installed in each cockpit of AH-1Z, which also has single 107 × 107 mm (4.2 × 4.2 in) limited-function AMLCD for standby flight instruments. Helmet-mounted sighting/aiming device selected June 2002 in form of Thales TopOwl ; first helmet delivered to Northrop Grumman for trials in November 2002, with operational testing on AH-1Z concluded in mid-2004.

Mission: Lockheed Martin AN/AAQ-30 Hawkeye XR (extended range) third generation multisensor electro-optical/IR target sight system (TSS) installed in AH-1Z; this features large-aperture mid-wave FLIR, colour TV camera, laser range-finder/designator, laser spot tracker and on-gimbal inertial measurement system. First flight of AH-1Z with Hawkeye sensor system accomplished August 2002.

Self-defence: Improved countermeasures suite in AH-1Z comprises AN/APR-39B(V)2 radar warning receiver, with AN/AVR-2A laser detecting set (LDS) embedded in AN/AAR-47(V)2 missile warning set. AH-1Z also fitted with AN/ALE-47 chaff/flare dispensing subsystem. ITT AN/ALQ-211 SIRFC available as optional alternative for export aircraft.

ARMAMENT: Electrically operated General Electric undernose A/A49E-7(V4) turret housing an M197 three-barrel 20 mm gun. A 750-round ammunition container is located in the fuselage

Rear view of Bell AH-1Z SuperCobra, showing turned (horizontally fanned) exhausts

1037991

directly aft of the turret; firing rate is approximately 650 rds/min; a 16-round burst limiter is incorporated in the firing switch. Either crew member can fire the gun, which can be slaved to a helmet-mounted sight/aiming device. Gun can be tracked 110° to each side, 18° upward, and 50° downward, but barrel length of 1.52 m (5 ft 0 in) makes it imperative that the M197 is centralised before wing stores are fired. Six wing stores stations with underwing attachments for up to four LAU-61A (19-tube), LAU-68A, LAU-68A/A, LAU-68B/A or LAU-69A (seven-tube) 2.75 in Hydra 70 rocket launcher pods; Mk 81/82 bombs; two CBU-55B fuel-air explosive weapons; four SUU-44/A flare dispensers; two M118 grenade dispensers; Mk 45 parachute flares; or two GPU-2A or SUU-11A/A Minigun pods.

Provision for carrying totals of up to 16 TOW missiles or 16 AGM-114 Hellfire missiles (or mixture of the two), two AIM-9L Sidewinder or AGM-122A Sidearm missiles, on outboard underwing stores stations.

DIMENSIONS, EXTERNAL:

Main rotor diameter	14.63 m (48 ft 0 in)
Main rotor blade chord	0.63 m (2 ft 1 in)
Tail rotor diameter	2.95 m (9 ft 8 in)
Tail rotor blade chord	0.305 m (1 ft 0 in)
Distance between rotor centres	8.89 m (29 ft 2 in)
Wing span	3.28 m (10 ft 9 in)
Wing aspect ratio	3.7
Length: overall, rotors turning	17.75 m (58 ft 3 in)
fuselage	13.87 m (45 ft 6 in)
Width overall	3.28 m (10 ft 9 in)
Height: to top of rotor head	4.11 m (13 ft 6 in)
overall	4.37 m (14 ft 4 in)
Ground clearance, main rotor turning	2.64 m (8 ft 8 in)
Elevator span	2.11 m (6 ft 11 in)
Width over skids	2.21 m (7 ft 3 in)

AREAS:

Main rotor blades (each)	6.13 m^2 (66.0 sq ft)
Tail rotor blades (each)	0.45 m^2 (4.835 sq ft)
Main rotor disc	168.11 m^2 (1,809.6 sq ft)
Tail rotor disc	6.94 m^2 (74.70 sq ft)
Vertical fin	2.01 m^2 (21.70 sq ft)
Horizontal tail surfaces	1.41 m^2 (15.20 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	5,579 kg (12,300 lb)
Mission fuel load (internal, usable)	1,296 kg (2,858 lb)
Max useful load (fuel and disposable ordnance)	2,615 kg (5,764 lb)
Max T-O and landing weight	8,391 kg (18,500 lb)
Max hover weight, hot/high, OGE	7,666 kg (16,900 lb)
Max disc loading	49.9 kg/m^2 (10.22 lb/sq ft)
Transmission loading at max T-O weight and power	4.29 kg/kW (7.05 lb/shp)

PERFORMANCE:

Never-exceed speed (V_{NE})	222 kt (411 km/h; 255 mph)
Max level speed at S/L	152 kt (282 km/h; 175 mph)
Normal cruising speed	143 kt (265 km/h; 165 mph)
Max rate of climb at S/L	850 m (2,790 ft)/min
Rate of climb at S/L, OEI	327 m (1,074 ft)/min
Service ceiling: AH-1W	more than 6,100 m (20,000 ft)
Service ceiling, OEI	more than 3,660 m (12,000 ft)
Hovering ceiling: IGE	4,495 m (14,740 ft)
OGE	915 m (3,000 ft)
Mission radius, with 1,134 kg (2,500 lb) payload	125 n miles (232 km; 144 miles)
Range at S/L with standard fuel, 20 minute reserves	370 n miles (685 km; 426 miles)
Max endurance with standard fuel	3 h 30 min
g limits	+2.8/−0.5

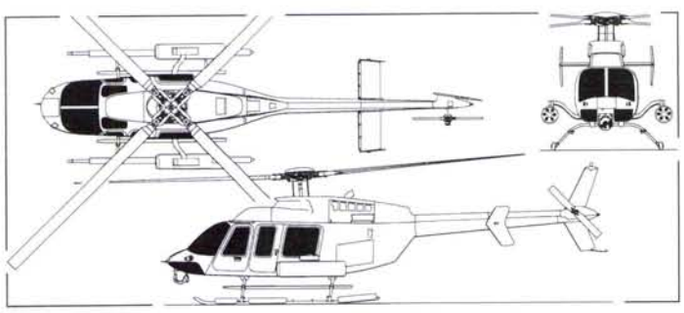
BELL RH-70

TYPE: Armed observation helicopter.

PROGRAMME: US Army requirement for new Armed Reconnaissance Helicopter (ARH) emerged in aftermath of 2004 cancellation of Boeing-Sikorsky RAH-66 Comanche. Army stipulated use of COTS (commercial off-the-shelf) airframe with NDI (non-developmental item) mission equipment package. Request for proposals issued 9 December 2004, with final bids submitted in early February 2005. Bell submission based on commercial Model

Prototype Bell ARH 1116416

Model of Bell 407 armed version as offered to India *(Paul Jackson)* 1037932



Bell RH-70 ARH *(Paul Jackson)* 1133244

407; competing Boeing/MD Helicopters Inc proposal envisaged derivative of MH-6 Little Bird. Prototype (N91796), converted from second-hand airframe by Bell's XworX, first flew at Arlington, Texas, 2 June 2005. Mockup (c/n 52903, unregistered) also exhibited at Paris in June 2005; both followed civil Bell 407 lines, although concurrent artist's impressions showed engine cowling built up at rear, in style of later OH-58s.

On 29 July 2005, US Army announced selection of Bell ARH and award of USD211 million contract covering three-year SDD (system development and demonstration) phase; formal signature of contract followed on 29 August 2005. RH-70 designation adopted in early 2006, shortly before first flight of initial aircraft which programmed for first quarter of 2006.

Original plan anticipated procurement of initial batch of 10 Lot 1 LRIP helicopters in FY06 and 28 Lot 2 LRIP examples in FY07; however, by February 2006, it was apparent that this had been significantly revised, with LRIP 1 batch now comprising 18 helicopters to be acquired in FY07, followed by 20 LRIP 2 machines in FY08 and batches of 72 in each of FY09, FY10 and FY11. Total procurement originally to be 368, which had been increased to 480 by March 2006, with additional helicopters earmarked to replace AH-64A Apache with four US Army National Guard battalions. First delivery scheduled for February 2008, with first combat-ready unit due in fourth quarter of 2008.

CUSTOMERS: US Army plans to acquire 480 RH-70s to replace OH-58D Kiowa Warrior.

COSTS: Total programme cost according to FY06 budget documentation is USD2.36 billion, with SDD contract valued at USD211 million. Flyaway unit cost for LRIP 1 aircraft quoted as USD5.42 million, falling to USD5.12 million for FY07 aircraft.

CURRENT VERSIONS: **RH-70**: US Army version. *As described.*

Armed Bell 407: Version of commercial Bell 407, loosely termed ARH-70A, offered to Indian Army in competition with Eurocopter Ecureuil; expected to have some commonality with RH-70, including nose turret. Model shown at Singapore in 2006 emitted centre side window on each side and had more compact weapons pylons. Indian requirement for 197, including local assembly of some two-thirds (variously quoted as 137 and 142), for service entry in 2010. Procurement process had stalled by early 2006 because of objections to exclusion of indigenous helicopters from competition.

ARH-70A data include: 1,746 kg (3,850 lb) operational empty weights; HTS900-2-1D engine limited to 559 kW (750 shp); fuel capacity 379 litres (100 US gallons; 83.3 Imp gallons) usable. Minimum performance at 1,220 m (4,000 ft) at 35° C (95° F): cruising speed 110 kt (204 km/h; 127 mph); hover OGE at 2,585 kg (5,700 lb); range 191 n miles (354 km; 220 miles); endurance 2 h 20 min.

DESIGN FEATURES: Basically similar to commercial Bell 407; two RH-70s can be airlifted aboard C-130 Hercules transport and made ready for operations within 15 minutes of being unloaded.

STRUCTURE: Generally similar to commercial Bell 407.

LANDING GEAR: Generally similar to commercial Bell 407.

POWER PLANT: One Honeywell HTS900-1.4D turboshaft engine with dual-channel FADEC, torque limited to 564 kW (756 shp) at 6,317 rpm; transmission ratings and fuel capacity as for Bell 407.

ACCOMMODATION: Crew of two; up to three passengers can be accommodated (four in case of single-pilot operation).

SYSTEMS: Rockwell Collins common avionics architecture system.

AVIONICS: *Comms:* AN/ARC-210D and AN/ARC-231 radios, plus satcom terminal. Telephonics secure digital intercom (SDI).

Flight: H-764 ACE Global Navigation Systems; AN/ARN-153(V4) Tacan; Honeywell embedded GPS/INS (EGI) and HG7210CA01 radar altimeter.

Mission: Chin turret containing FLIR Systems BRITE Star II sensor, incorporating FLIR, colour TV, laser spot tracker/designator and laser rangefinder.

Self-defence: AN/APR-39B(V2) RWR, AN/AAR-47(V2) missile approach warning system (MAWS) and AN/ALE-47 chaff/flare dispensers.

ARMAMENT: GAU-19 .50 in or GAU-17 7.62 mm gun. Up to 38 2.75 in FFARs can be carried in two pods; also compatible with AGM-114 Hellfire anti-armour missile.

WEIGHTS AND LOADINGS:

Weight empty, equipped	1,712 kg (3,778 lb)
Max T-O weight:	
with internal load	2,494 kg (5,500 lb)
with 1,008 kg (2,222 lb) underslung load	2,721 kg (6,000 lb)
Max hovering weight, OGE	2,564 kg (5,653 lb)

PERFORMANCE:
Cruising speed ..... 114 kt (211 km/h; 131 mph)
Range ..... 195 n miles (362 km; 225 miles)
Operational radius for 1 h on station ..... 56 n miles (104 km; 64 miles)
Endurance ..... 2 h 20 min

BELL QUAD TILTROTOR

TYPE: Multimission tiltrotor.

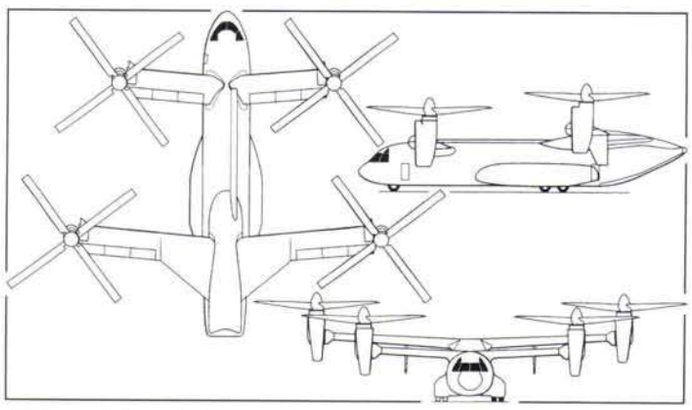
PROGRAMME: Bell announced in early 1999 that it was studying a proposed Quad TiltRotor (QTR) to meet Future Transport Rotorcraft (FTR) requirements. As projected, the aircraft would feature a fuselage approximately the size of that of a Lockheed Martin C-130-30, mated to two sets of wings, engines and tiltrotors, the rear units mounted on stub wings to extend span and ensure adequate fuselage clearance. Rear tiltrotors could fold in cruising flight, with their engines providing supplemental thrust. As then envisaged, Quad TiltRotor would have been able to accommodate up to 90 passengers, or an AH-64, AH-1Z, RAH-66, UH-1Y or UH-60 helicopter, or three HMMWVs, or up to eight 463L pallets.

Provisional specifications then included four engines in the 8,948 kW (12,000 shp) class; VTOL maximum T-O weight 45,360 kg (100,000 lb); STOL maximum T-O weight 63,505 kg (140,000 lb); and a payload up to 18,144 kg (40,000 lb). The Quad TiltRotor was in the conceptual design phase in mid-2000, with water tunnel testing of a 1/48th scale model to visualise complex airflow patterns around the tandem wings and four tiltrotors completed.

In mid-2000 DARPA awarded Bell a USD400,000 phase 1 contract as part of a three-phase, USD6 million cost- sharing programme to study the feasibility of the QTR concept. Phase 1 involved a detailed technology study. In phase 2, a 1/14th scale hovering model of the QTR was test-flown. Phase 3 comprised wind tunnel tests to determine loads and aerodynamic performance of the full-size aircraft. The study is being undertaken by Bell's XWORX facility in Arlington, Texas jointly with Boeing. Partners awarded USD3.45 million, 18-month, conceptual design and analysis contract by US Army on 24 September 2005; possible application is Joint Heavy Lift (JHL) aircraft.

By 2006, JHL-optimised Quad TiltRotor envisaged 20 to 30 tonne payload (nine 463L pallets, three TEU containers or one Stryker combat vehicle or Heavy Expanded Mobility Tactical Truck) or 150 passengers or 106 combat troops; T-O run up to 458 m (1,500 ft); cruising speed 275 kt (509 km/h; 316 mph); aerial refuelling probe; self-deployment, unrefuelled, over 2,100 n miles (3,889 km; 2,416 miles) with 11 tonnes; and combat range (to 1,220 m/4,000 ft, 35° C/95° F landing zone), of 500 n miles (926 km; 575 miles) VTOL or 1,000 n miles (1,852 km; 1,150 miles) STOL. Design requires four as-yet non-existent 9,700 to 11,200 kW (13,000 to 15,000 shp) turboshafts. Testing of 20 per cent scale model conducted at NASA's Langley facility between 27 June and 13 September 2006.

Bell Quad TiltRotor model exhibited in 2006 *(Paul Jackson)* 1162407



Bell Quad TiltRotor design as envisaged in 2006 *(Paul Jackson)* 1164904

BELL BOEING

BELL HELICOPTER TEXTRON AND THE BOEING COMPANY

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COMMUNICATIONS MANAGERS:
Ward Carroll (US Navy Public Affairs);
Carl Harris (Bell Helicopter Textron);
Douglas C Kinneard (Boeing)

BELL BOEING V-22 OSPREY

US Air Force designation: CV-22
US Navy designation: HV-22
US Marine Corps designation: MV-22
Manufacturer's model: 901

TYPE: Multimission tiltrotor.

PROGRAMME:

DEVELOPMENT MILESTONES

Design began	26 Apr 1983
First order (prototypes)	2 May 1986
First flight	19 Mar 1989
First flight, pre-production	Feb 1997
First flight, production	30 Apr 1999
First delivery (Marine Corps)	14 May 1999

Based on Bell/NASA XV-15 tiltrotor; initiated as US Department of Defense Joint Services Advanced Vertical Lift Aircraft (JVX), run by US Army, FY82; programme transferred to US Navy January 1983; 24 month US Navy preliminary design contract 26 April 1983; aircraft named V-22 Osprey January 1985; seven year full-scale development (FSD) programme began 2 May 1986 with order for six prototypes (Nos. 1, 3 and 6 to be built by Bell at Arlington, Texas; Nos. 2, 4 and 5 by Boeing at Wilmington, Delaware) plus static test airframes.

Prototype (163911) first flew 19 March 1989; joined by four further aircraft by June 1991; sixth not flown; all now retired (last flight 27 March 1997 by 163913).

Osprey passed critical design review 13 December 1994; simultaneous defence review authorised V-22 production for Marines and special forces, but latter version subsequently delayed, with decision to proceed with EMD phase not reached until January 1997. In meantime, contract for five Lot 1 low-rate initial production (LRIP) aircraft awarded June 1996.

All four EMD Ospreys flown in 1997–98. EMD Ospreys — see Current Versions (specific) — have significant changes from earlier aircraft, including substantial reduction in empty weight to approximately 14,800 kg (32,628 lb); aluminium cockpit cage, replacing titanium, but with smaller windows to preserve structural strength; upgraded flight controls; enhanced engine and drive system; improved tail unit construction (built by Aerostructures) including fibre placement aft fuselage; redesigned rotor system; absence of fin tuning weights; improved wing constructional techniques; redesigned wiring; and pyrotechnic escape hatches.

Manufacture of first LRIP MV-22B (165433) began 7 May 1997; splicing of three major fuselage sections took place in Philadelphia on 25 February 1998, with completed fuselage airlifted by C-17 to Arlington on 8 September 1998 for final assembly. Second LRIP aircraft also completed at Arlington, whereupon assembly process transferred to new factory at Amarillo, Texas.

First flight of first LRIP MV-22B on 30 April 1999, followed by official roll-out and handover to US Marine Corps on 14 May, with delivery to New River later in May; subsequently to Patuxent River for flight testing. Next major milestone was operational evaluation; seven-month effort began 2 November 1999 with first two LRIP MV-22Bs, which joined by two more by January 2000. These four aircraft had accumulated 805 flight hours in 522 sorties at end of evaluation in July 2000.

OpEval included trials in USS *Essex* with four MV-22Bs in first quarter 2000 and one aircraft temporarily sent to Kirtland AFB, New Mexico, in March 2000 for testing with USAF 58th Special Operations Wing, before programme halted on 8 April 2000 when Osprey grounded following fatal crash of fourth LRIP MV-22B (165436) at Avra Valley Airport, Arizona. Subsequent investigation established most likely cause as 'power settling', a condition in which it becomes difficult to stop descent because of recirculating air from rotor downwash. Clearance to return to flight given on 25 May 2000, with operations resuming on 5 June. Final phase included trials at China Lake, California, and New River, North Carolina.

Further brief grounding order imposed on 11 aircraft (four EMD and seven LRIP machines) on 25 August 2000 in wake of problem encountered with retaining assembly for one of the interconnect driveshaft couplings; this came loose in flight, necessitating precautionary landing and inspection before flight operations resumed 1 September 2000.

Subsequent events included final assessment by Multiservice Operational Test Team that MV-22 was operationally effective and suitable, with announcement on 8 November 2000 recommending fleet introduction. Thereafter, decision on move to full-rate production was expected in December, but was put on hold following loss of eighth LRIP MV-22B (165440) near New River on 11 December and imposition of grounding order. Cause of accident reported to be hydraulic system failure in first instance, compounded by error in software inputs to flight control system.

At time of grounding on 11 December 2000, V-22 total flight time was 3,884 hours, during which aircraft had demonstrated speed of 342 kt (633 km/h; 394 mph), 7,620 m (25,000 ft) height, 27,442 kg (60,500 lb) MTOW and 3.9 *g* load factor.

V-22 remained grounded throughout 2001, although production continued at low rate while various studies and reports prepared. In December 2001, it was decided to continue with the Osprey programme, subject to successful completion of further testing during 2002–04; in meantime, Bell Boeing directed to store total of 19 V-22s, comprising already completed examples and some to come from assembly line during 2002. On conclusion of test programme, these stored aircraft to be upgraded and fitted with latest safety features; upgrading process begun 26 May 2005 when first MV-22B was returned from Amarillo to Philadelphia, this being one of five Lot 4 aircraft due for redelivery to Marines between June 2006 and June 2007; another five Lot 4 aircraft and four from Lot 3 to be upgraded by April 2009.

Flight testing resumed on 29 May 2002 at Patuxent River, with eventual total of seven (two EMD and five LRIP) aircraft to participate in 18-month programme that will evaluate improved hydraulic and electrical systems, plus upgraded software; test objectives also to include exploration of aspects including vortex ring state boundaries, formation flying and low-speed hover and landing conditions. Test programme will involve 1,800 flight hours, with icing, cargo handling and radar warning systems also to be studied. Flight activity initially used only the fourth EMD aircraft (164942), but this joined by 21st Osprey (165443) which flew for first time at Amarillo, Texas, on 7 September 2002 and was flown to Patuxent River on 12 October. One week later, the number of flyable aircraft at Patuxent River increased to three, with the first post-grounding sortie by the second EMD machine (164940). Subsequent developments include assignment of additional aircraft to test effort during 2003; these include 22nd (165444) and 24th (165838) Ospreys, with latter departing from Patuxent River on 7 November at start of six-month period of cold weather trials to be conducted from Canadian Forces Base Shearwater, Nova Scotia. Initial testing of anti-icing system completed in April 2004, with second extended deployment to Nova Scotia by 24th Osprey beginning in November 2004 and ending with return to Patuxent River on 29 April

Bell Boeing MV-22 Osprey of Naval Air Systems Command V-22 Integrated Test Team *(PM2 Daniel J McLain)* 1128914

VMX-22 Marine Tiltrotor OT&E Squadron Osprey aboard USS *Wasp* in November 2005 *(PM Zachary L Borden)* 1128915

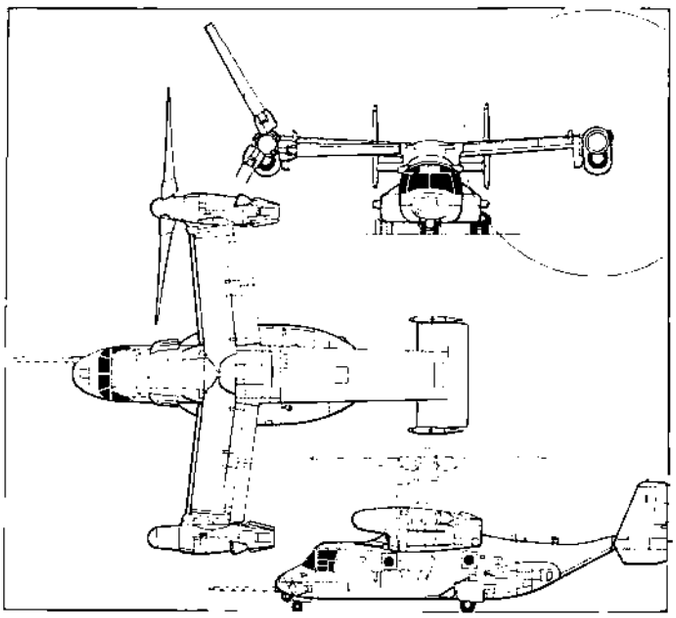
2005. Earlier, in late 2003, aircraft 10 and 22 embarked on USS *Bataan* for shipboard testing (including assessment of effects of rotor downwash), following on from earlier deck-handling trials on USS *Iwo Jima* by aircraft 10 in mid-January 2003. Additional shipboard testing undertaken in 2004, aboard USS *Iwo Jima* in June and USS *Wasp* in November, with both series of trials involving two Ospreys.

Other notable tests undertaken in 2003 included three-week visit by aircraft 21 to Fort Bragg, North Carolina, for series of airdrop trials; continuing expansion of flight envelope, with emphasis on high rates of descent; and exploration of vortex ring state characteristics. Despite a brief hiatus in March, when the test fleet was grounded for 10 days to replace suspect hydraulic lines, a Defence Acquisition Board programme review on 10 May reported favourably, although it did not authorise an increase in production rate. Following resumption of flight testing in May 2002, Osprey fleet passed 500th flight hour on 30 May 2003, this total rising to more than 1,000 hours by December 2003.

At Edwards AFB, the first CV-22 EMD aircraft returned to flight duty on 11 September 2002; second CV-22 EMD aircraft placed in Benefield Anechoic Chamber at Edwards for three-month assessment of electronic warfare antennae configuration that was completed on 5 October 2002; it returned to flight status on 14 July 2003. These joined on 26 February 2005 by a third modified aircraft (Osprey No. 25, 165839) to permit accelerated flight testing of mission avionics and EW equipment. First of two new-build PRTV (Production Representative Test Vehicle) CV-22s (02-0024) arrived Edwards AFB on 19 September 2005, with second example (02-0025) following just over five weeks later.

US Marine Corps has continued purchasing Ospreys at rate of 11 per year (including some CV-22Bs); Milestone III authorisation of full-rate production granted by Defense Acquisition Board on 28 September 2005, after completion of operational evaluation (OpEval) by VMX-22. This involved total of eight Lot 6 aircraft and began on 28 March 2005; initial phase undertaken at New River, followed by assessment of assault capability and tactics at Nellis AFB, Nevada; survivability trials and tactics development at China Lake, California; environmental studies at Bridgeport, Connecticut; before concluding with two weeks of further shipboard compatibility trials on USS *Bataan* in June. OpEval formally concluded on 23 June 2005, with subsequent report rating MV-22 as operationally effective, suitable and survivable.

MV-22B version to progressively improved standard, starting with Block A in 2003, incorporating re-routed and separated hydraulic lines and electrical wiring, as well as a redesigned nacelle assembly. The redesigned nacelle was initially installed on aircraft 34 (165848) as part of the Block A upgrade, which affects the 25th to 49th Ospreys; with effect from the 50th aircraft (166383), Block A enhancements incorporated during production.



Bell Boeing MV-22B Osprey multimission tiltrotor with retractable refuelling probe *(James Goulding)* 1158082

Block B standard, introduced by the 70th MV-22, has enhanced maintenance access, a retractable in-flight refuelling probe, upgraded wheels and brakes, avionics upgrades and reliability and maintainability improvements. The fuselage of the first Block B aircraft (166491) was shipped from Philadelphia to the final assembly plant at Amarillo on 2 May 2005; following completion, it was accepted by the Marine Corps on 8 December 2005 and flown to New River to join the first operational squadron (VMM-263) on the next day. VMM-263 was expected to complete transition in March 2006, being followed by VMM-162 in November 2006 and VMM-266 in about March 2007. The proposed Block C version is expected to feature operational improvements, including revised environmental control system and other changes intended to improve payload and performance capabilities; development of Block C configuration will begin in 2006, with fielding expected in 2011.

CURRENT VERSIONS (SPECIFIC): **No.7/164939:** Assembly began 15 February 1995; fuselage sections mated at Boeing's Philadelphia plant on 1 August 1995; followed two months later by wing and nacelle mating at Fort Worth. Fuselage to Fort Worth for fitting of wings and engines. Ground vibration testing completed in late July 1996; tests of hydraulic lines concluded soon after, with integrated functional testing commencing in August. First flight in helicopter mode 5 February 1997 (at Fort Worth); first transition to conventional flight 6 March 1997; aircraft to V-22 Integrated Test Team at Patuxent River on 15 March 1997; ensuing objectives (structural, load and vibration tests) completed by mid-1998. Prepared at Arlington for trials of CV-22 version's auxiliary fuel tanks and terrain-following/terrain-avoidance radar system; modification work began 1 July 1999; flight status regained on 28 February 2000. Grounded throughout 2001, but resumed test flying at Edwards on 11 September 2002. During 2003, trials work included evaluation of multimode radar, notable highlights occuring on 4 April, when it achieved low altitude target for aeroplane flight mode, and also demonstrated safe operation of terrain-following radar mode. Trials continued throughout 2005.

No. 8/164940: First flight 15 August 1997; to Patuxent River on 13 September 1997 and allocated to propulsion and systems testing and envelope expansion, including high-altitude trials and external loads demonstrations in 1998. During latter, it set new unofficial world record in August 1998 by carrying 4,536 kg (10,000 lb) external load at 220 kt (407 km/h; 253 mph). Grounded throughout 2001, but returned to flight at Patuxent River on 19 October 2002. Assigned to test duties throughout 2003-05.

No. 9/164941: First flight 17 July 1997; to Patuxent River 30 October 1997; allocated to validation of FLIR, navigation and other mission systems, as well as government technical evaluation. Had achieved total of 318 flight hours in 140 sorties, when arrived at Arlington on 7 June 1999 to be remanufactured as prototype for CV-22 special missions version, at cost saving of US$50 million; work completed in mid-2000, with aircraft joining 418th Flight Test Squadron at Edwards AFB, California, on 18 September 2000 for 18-month trials programme. Grounded throughout 2001; used for electronic warfare testing in Benefield Anechoic Facility at Edwards during third quarter of 2002 and eventually resumed flight test duty on 14 July 2003, thereafter being used to evaluate mission-related equipment, including defensive countermeasures avionics and multimode radar. Trials with AN/ALQ-211 SIRFC using range facilites at China Lake, California, accomplished in March 2004, followed by testing of chaff/flare dispensers at Edwards AFB, September-October 2004. Trials continued throughout 2005.

No. 10/164942: Wing and fuselage mating accomplished at Fort Worth in September 1996. To Patuxent River 15 February 1998, following first flight on 15 January; underwent modification in mid-1998, before participating (with No. 9) in operational evaluation during September and October 1998; performed sea trials in USS *Saipan* in January-February and USS *Tortuga* and *Saipan* in August-September 1999. First V-22 to resume flying after 17-month grounding, 29 May 2002. Assigned to test duties throughout 2003-05.

CURRENT VERSIONS (GENERAL): **MV-22B:** Basic US Marine Corps transport; original requirement for 552 (now 360), to replace CH-46 Sea Knight and CH-53 Sea Stallion. First delivery (to Patuxent River via New River) in late May 1999 with three more handed over to test unit HMX-1 by January 2000. First unit was planned to be VMMT-204 at New River, North Carolina, which officially redesignated (from HMT-204) on 10 June 1999; received four opeval aircraft from HMX-1 at end of July 2000 to function as fleet replacement squadron and also train USAF pilots; training operations interrupted by subsequent grounding order. Task of conducting exhaustive operational evaluation of MV-22B in first half of 2005 assigned to VMX-22, which activated at New River on 28 August 2003. VMX-22 received first MV-22B shortly before end of 2003 and had total of 14 on hand in January 2005, including seven of eight Block A production examples that would be used in OpEval programme which began on 28 March of same year. USMC plans called for 18 regular and four Reserve MV-22 squadrons (each with 12 aircraft), plus training unit already mentioned. IOC now set for 2007. First operational squadron will be VMM-263, followed by VMM-162 and VMM-266, all at New River.

HV-22B: US Navy combat search and rescue (CSAR), special warfare and fleet logistics model. Requirement for 48 (originally 50), with procurement expected to begin in 2010-12 time frame. In April 2004, it was revealed that HV-22 designation to be dropped, with US Navy instead to receive suitably modified version of MV-22.

CV-22B: US Air Force long-range special missions aircraft to replace MH-53M helicopter and augment MC-130 (Hercules) with Air Force Special Operations Command (AFSOC). Two of four EMD aircraft used for initial development, with 25th MV-22 (165839) joining test effort in February 2005; first new-build CV-22s are pair of PRTV aircraft, which were delivered to Edwards AFB on 19 September 2005 (02-0024) and 27 October 2005 (02-0025). Original requirement for 80 reduced to 55 then 50. Current procurement plan calls for purchases to continue to FY17, but AFSOC urging accelerated programme to conclude by FY12. Delivery of first production example (04-0026) took place at Amarillo on 1 March 2006; on 20 March, this became first CV-22B to arrive at Kirtland AFB, New Mexico, for training with 71st Special Operations Squadron (SOS), with IOC expected in 2009. Before that, operational evaluation planned to begin in mid-2006, using PRTV aircraft. CV-22B will carry 12 troops or 1,306 kg (2,880 lb) internal cargo over 520 n mile (964 km; 599 mile) radius at 250 kt (463 km/h; 288 mph), with ability to hover OGE at 1,220 m (4,000 ft) at 35°C (95°F). EMD go-ahead authorised in January 1997, with award of USD490 million contract; critical design review completed in mid-December 1998.

Key feature of CV-22B is ITT Avionics AN/ALQ-211 SIRFC (suite of integrated RF countermeasures); USD20.7 million LRIP contract awarded by Bell Boeing in January 2001 for four systems plus spares and engineering support. First SIRFC was delivered in 2002, with full-rate production decision dependent on successful outcome of flight testing.

Production to begin with Block 0 version, equivalent to Block B aircraft of Marine Corps, plus multimode radar and SIRFC; next version will be Block 10, which adds directed infra-red countermeasures capability to Block 0 configuration; final USAF version will be Block 20, equivalent to Block C of Marines plus Block 10 DIRCM and further mission enhancements and upgrades.

V-22 was also under consideration for USAF combat search and rescue (CSAR) mission as potential replacement for Sikorsky HH-60G, but was withdrawn from contest in late 2005.

CUSTOMERS: Production of 458 Ospreys planned, comprising 360 MV-22Bs for Marine Corps, 50 CV-22Bs for Air Force and 48 MV-22s for Navy; see table for details of procurement. In early 2006, it was reported that Israel was considering acquisition of the Osprey to replace CH-53 in special forces and combat SAR roles.

OSPREY PROCUREMENT

Year	Lot	MV-22B	CV-22B	Total
FY97	1	5		5
FY98	2	7		7
FY99	3	7		7
FY00	4	11		11
FY01	5	9		9
FY02	6	9	2	11
FY03	7	11		11
FY04	8	9	2	11
FY05	9	8	3	11
FY06	10	9	2	11
FY07	11	14	2	16
Total		99	11	110

Notes: FY02 CV-22B are dedicated test aircraft

COSTS: Estimated cost (1991) to complete full-scale development, USD2,750 million. Unit cost said to be USD32.3 million (November 1997). Bell Boeing received USD1.5 billion contract in August 2002 to produce 20 tiltrotors, comprising nine MV-22s in each of FY01 and FY02 for delivery by September 2004, plus two production representative CV-22 test vehicles to be completed by October 2005. FY06 request includes USD1.5 billion for nine MV-22s and two CV-22s, plus USD274 million for RDT&E expenditures. FY07 request includes USD2 billion for procurement and USD295 million for RDT&E. Separate USD490 million contract modification awarded by USN in December 1996 for EMD of CV-22 special operations version; acquisition costs of 50 CV-22s estimated at USD3.72 billion based on FY01-08 procurement plan. Flyaway cost of MV-22B reported to be USD68.4 million (September 2002); this stated to have risen to USD74 million in late 2003, despite implementation of economy efforts intended to reduce unit cost to USD58 million. Latter is still a major objective, but achievement may be delayed as consequence of proposed slow down of procurement until after FY11.

DESIGN FEATURES: Unconventional design, with proprotors and engines mounted at tips of wings. Fuselage optimised for transport, featuring upswept rear, with loading ramp and twin fins of moderate sweepback. High-mounted, constant-chord wings with slight forward sweep; unswept tailplane; prominent landing gear sponsons.

During vertical take-off, wing begins to produce lift and ailerons, elevators and rudders become effective at between 40 and 80 kt (74 and 148 km/h; 46 and 92 mph). At this point, rotary-wing controls are gradually phased out by the flight control system. At approximately 100 to 120 kt (185 to 222 km/h; 115 to 138 mph), wing is fully effective and cyclic pitch control of proprotors is locked out.

In conversion from aeroplane flight to hover, fuselage and wing are free to remain in level attitude, eliminating tendency for wing to stall as speed decreases. Rotor lift fully compensates for decrease in wing lift. Because of great variability between aircraft and nacelle attitude, conversion corridor (range of permissible airspeeds for each angle of nacelle tilt) is very wide (about 100 kt; 185 km/h; 115 mph).

Engines are connected by shaft through wing. Under dual engine operations, shaft transmits very little power, but if one engine is lost, half remaining power is transferred to opposite proprotor. In event of double engine failure, can maintain proprotor rpm while descending without power. Pilot has options of making wingborne or rotorborne descent.

Engines, transmission and proprotors tilt through 97° 30' between forward flight and steepest approach gradient or tail-down hover; cross-shaft keeps both proprotors turning after engine loss. Three-blade, contrarotating proprotors have special high-twist tapered format blades with elastomeric bearings and powered folding mechanisms; separate swashplates produce respectively yaw and fore-and-aft translation in hover and sideways flight in level attitude; tip speed 202 m (662 ft)/s.

Wing-fold sequence from helicopter mode involves power-folding of blades parallel to wing leading-edge, tilting engine nacelles down to horizontal and rotating entire wing/engine/proprotor group clockwise on stainless steel carousel to lie over fuselage; entire procedure for stowage takes about 90 seconds and MV-22B occupies same amount of deck space as Sikorsky CH-53E.

FLYING CONTROLS: Three-lane fly-by-wire (Moog actuators) with automatic stabilisation, full autopilot and formation-flying modes. Conventional aeroplane stick, rudder pedals and throttle automatically function as in helicopter cyclic stick, yaw pedals and collective control. Automatic control of configuration change during transition and of transfer of control from aerodynamic surfaces to rotor-blade pitch changing; flaperons and ailerons

droop during hover to reduce download on wing. Pilot also controls nacelle angle. Failure of one nacelle actuator automatically results in both nacelles reverting to helicopter mode for a vertical or run-on emergency landing.

Rotors have separate cyclic control swashplates for sideways flight and fore-and-aft control (symmetrical for forward and rearward flight and differential for yaw) in hover Lateral attitude controlled in hover by differential rotor thrust. Integrated electronic cockpit with six electronic display screens; helicopter-style control columns rather than aileron wheels, but left-handed power levers move forward for full power in opposite sense to helicopter collective lever Using nacelle control provides additional method of manoeuvring, completely independent of fuselage attitude or cyclic pitch Minimum time to accomplish a full conversion from hover to aeroplane flight mode is 12 seconds.

STRUCTURE: Approximately 43 per cent of airframe is composites; main composites are Hercules IM-6 graphite/epoxy in wing and AS4 in fuselage and tail; proprotor blades of graphite/glass fibre; nacelle cowlings and pylon supports are of GFRP. Cabin has composites floor panels and aluminium window frames. Crew seats of boron carbide/polyethylene laminate.

Different design approach adopted for EMD and subsequent production aircraft, whereby integrated product teams (IPTs) were tasked with using best available materials to reduce cost and weight and simultaneously improve quality. In consequence, fuselage is now a hybrid structure, with mainly aluminium frames and composites skins. Benefits of IPT process are a 1,200 kg (2,645 lb) reduction in weight and a reduction in cost of over 22 per cent, with part count falling by 36 per cent and fastener count by 34 per cent.

High-strength wing, torsion box made up from one-piece upper and lower skins with moulded ribs and bonded stringers; two-segment graphite single-slotted flaperons with titanium fittings; three-segment detachable leading-edge of aluminium alloy with Nomex honeycomb core. Wing locking and unlocking with Lucas Aerospace actuators; fuselage sponsons contain landing gear, air conditioning unit and fuel; tail unit of Hercules AS4 graphite/epoxy, built by Bell from first EMD aircraft onwards. Bell also contributes wing, nacelles, proprotor, ramp, overwing fairing and transmission systems and integrates engines Boeing responsible for fuselage, landing gear, electric and hydraulic systems and integrates avionics.

LANDING GEAR: Dowty hydraulically actuated retractable tricycle type, with twin wheels and oleo-pneumatic shock-absorbers on each unit, Menasco Canada steerable nose unit. Main gear accommodated in sponsons on lower sides of centre-fuselage. Dowty Toronto two-stage shock-absorption in main gear is designed for landing impacts of up to 3.66 m (12 ft)/s normal, 4.48 m (14.7 ft)/s maximum, and has been drop tested to 7 32 m (24 ft)/s. Nosewheels retract rearward, mainwheels forward (was rearward on FSD aircraft only) Manual and nitrogen pressurised standby systems for emergency extension. Parker Bertea wheels and multidisc hydraulic carbon brakes. Main tyres 8.50-10 (12 ply) tubeless; nose tyres 18×5.7–8 (14 ply) tubeless.

POWER PLANT: Two Rolls-Royce Liberty AE1107C (formerly T406-AD-400) turboshafts, each with normal rating of 4,586 kW (6,150 shp) and maximum (OEI and T-O) rating of 5,093 kW (6,830 shp), installed in Bell-built hydraulically actuated tilting nacelles at wingtips and driving a three-blade proprotor incorporating substantial proportion of graphite/epoxy and glass fibre materials. Nacelle configuration subject to redesign in 2002, with new unit first installed on aircraft number 34 for test purposes; subsequently fitted to new production with effect from 50th Osprey.

Engine output transferred to each rotor via proprotor gearbox which also drives tilt-axis gearbox, each of which absorbs 315 kW (423 shp) for electric and hydraulic pressure generation. Tilt-axis gearboxes connected by segmented shaft, driving (in fuselage) single mid-wing gearbox and APU. Transmission rating 3,865 kW (5,183 shp) for T-O; 3,408 kW (4,570 shp) max continuous. With total engine failure, aircraft generators can maintain essential systems on 67 per cent of rotor rpm. Transmission has 30 minute run dry capability.

Each nacelle has a Honeywell IR emission suppressor at rear. Air particle separator and Lucas inlet/spinner ice protection system for each engine. Lucas Aerospace FADEC for each engine, with analogue electronic back-up control. Pratt & Whitney originally named as second production source for engines, starting with production Lot 5.

Fuel capacity varies according to role; basic internal usable fuel (JP-5) in four crash-resistant, self-sealing (nitrogen pressurised) ILC Dover flexible fuel tanks: one 1,809 litre (478 US gallon; 398 Imp gallon) forward cell in each sponson and a 333 litre (88.0 US gallon; 73.3 Imp gallon) feed tank in each outer wing; basic fuel (MV-22) 4,285 litres (1,132 US gallons; 943 Imp gallons) Additional fuel for long range contained in 1,196 litre (316 US gallon; 263 Imp gallon) cell in rear of starboard sponson (MV-22 option 5,481 litres; 1,448 US gallons; 1,206 Imp gallons) and four 280 litre (74 0 US gallon; 61.6 Imp gallon) auxiliary cells in each wing leading-edge (CV-22 baseline 7,722 litres; 2,040 US gallons; 1,699 Imp gallons). Self deployment aided by up to two 3,028 litre (800 US gallon; 666 Imp gallon) auxiliary tanks in cabin. (Not all versions have all tanks.) Pressure refuelling point in starboard sponson leading-edge; gravity point in upper surface of each wing Simmonds fuel management system In-flight refuelling probe in lower starboard side of forward fuselage. Fixed 4.88 m (16 ft) probe installed initially, but now replaced by retractable 5.49 m (18 ft) probe on CV-22B and MV-22B.

ACCOMMODATION: Normal crew complement of pilot (in starboard seat), co-pilot and crew chief in USMC variant. USAF CV-22B will have third seat for flight engineer. Flight crew accommodated on Simula Inc crashworthy armoured seats capable of withstanding strikes from 0 30 in armour-piercing ammunition, 30 *g* forward and 14.5 *g* vertical decelerations. Flight deck has overhead and knee-level side transparencies in addition to large windscreen and main side windows, plus an overhead rearview mirror.

Cabin can accommodate up to 24 combat-equipped troops, on IAI — Golan Industries inward-facing crash-worthy foldaway seats, plus two gunners; up to 12 litters plus medical attendants; or a 9,070 kg (20,000 lb) cargo load with energy absorbing tiedowns. Cargo handling provisions include a 907 kg (2,000 lb) capacity cargo winch and pulley system and removable roller rails. Main cabin door at front on starboard side, top portion of which opens upward and inward, lower portion (with built-in steps) downward and outward. Full-width rear-loading ramp/door in underside of rear fuselage, operated by Parker Bertea hydraulic actuators. Emergency exit windows on port side; escape hatch in fuselage roof aft of wing.

SYSTEMS: Environmental control system, utilising engine bleed air; control unit in rear of port main landing gear sponson. For NBC protection, ECS provides 0.062 bar (0.9 lb/sq in) flight deck pressure differential, and 0.048 bar (0.7 lb/sq in) in cabin. Three hydraulic systems (two independent main systems and one standby), all at operating pressure of 345 bar (5,000 lb/sq in), with Parker Bertea reservoirs

Electrical power initially supplied by two Leland 40 kVA constant frequency AC generators, although these being replaced by Smiths Aerospace unit from 2004 onwards; V-22 also has two 50/80 kVA variable frequency DC generators (one driven by APU), rectifiers, and a 24 Ah lead-acid battery Latter provides 20 minutes' emergency flight power

GE Aerospace triple redundant digital fly-by-wire flight control system, incorporating triple primary FCS (PFCS) and triple automatic FCS (AFCS) processors, and triple flight control computers (FCC) each linked to a MIL-STD-1553B databus; two PFCSs and one AFCS are fail-operational. FBW system signals hydraulic actuation of flaperons, elevator and rudders, controls aircraft transition between helicopter and aeroplane modes, and can be programmed for automatic management of airspeed, nacelle tilting and angle of attack. FCCs provide interfaces for swashplate, conversion actuator, flaperon, elevator, rudder and engine nacelle primary actuators, flight deck central drive, force feel, and nosewheel steering. Dual 1750A processors for PFCS and single 1750A for AFCS incorporated in each FCC. Non-redundant standby analogue computer (in development aircraft only) provides control of aircraft, including FADEC and pylon actuation, in the event of FBW system failure

Hamilton Sundstrand Turbomach T-62T-46-2 224 kW (300 shp) APU, in rear portion of wing centre-section, provides power for mid-wing gearbox which, in turn, drives two electrical generators and an air compressor. Anti-icing of windscreens and engine air intakes; de-icing of proprotors and spinners. Clifton Precision combined oxygen (OBOGS) and nitrogen (OBIGGS) generating systems for cabin and fuel tank pressurisation respectively. Systron Donner pneumatic fire protection systems for engines, APU and wing dry bays.

AVIONICS: *Comms:* VHF/AM-FM, HF/SSB and (USAF only) UHF secure voice com; IFF. CV-22B will have four DCS2000 radios, combining AN/ARC-210 transceiver and KY-58 communications security encoder. Crash position indicator also to be installed on CV-22B.

Radar: USAF and USN only. Raytheon AN/APQ-174D terrain-following, terrain-avoidance multifunction radar in offset (to port) nose thimble for USN; advanced version, designated AN/APQ-186, with lower-altitude TF capability, in USAF aircraft.

Flight: AN/ARN-153(V) Tacan, AN/ARN-147 VOR/ILS, AHRS, AN/APN-194(V) radar altimeter, OA-8697/ARC UHF/VHF automatic direction-finder, lightweight inertial navigation system (LWINS), miniature airborne GPS receiver (MAGR) and digital map displays; Jet Inc ADI-350W standby attitude indicator; L-3 Communications data acquisition and storage system. Two Control Data AN/AYK-14 mission computers, with Boeing/IBM software. Low probability of intercept/detection radar altimeter may be added to CV-22B version at later date.

Instrumentation: Elbit/BAE Systems North America AN/AVS-7 pilots' night vision and integrated display system. Four full-colour, multifunction displays (MFDs) in cockpit provide pilots with primary flight symbology to control and navigate aircraft, plus video imagery such as FLIR and digital map data; these originally relied on CRTs, but replaced by EFW Inc flat-panel active matrix liquid crystal displays (AMLCDs) on US Marine Corps MV-22Bs starting in FY99. AMLCDs installed on USAF CV-22B from outset. Lighting compatible with night vision goggles. Additional AMLCD control display unit and engine indication and crew alerting system (CDU/EICAS) in centre of console.

Mission: Raytheon AN/AAQ-27 FLIR incorporating laser range-finder in undernose fairing, with wide and narrow fields of view. Additional equipment expected to satisfy unique mission requirements of special operations forces and Navy combat search and rescue.

Self-defence: Honeywell AN/AAR-47 missile warning system; AN/APR-39A radar warning system; IR warning system; BAE Systems North America AN/ALE-47 countermeasures dispenser system (CMDS). CV-22B for USAF to utilise ITT Avionics AN/ALQ-211 suite of integrated RF countermeasures (SIRFC), incorporating radar warning receiver, ESM radar location and jammers and will also have AN/AVR-2A laser detector system and a second, forward-firing, AN/ALE-47 dispenser system. Dedicated electronic warfare display (DEWD) unit also under development for CV-22B by Meggitt Avionics.

EQUIPMENT: Provision for internally stowed Goodrich rescue hoist over forward (starboard) cabin door on CV-22B. MV-22B initially had hoist in cabin, for deployment through side door, but hoist later moved to new position near the rear ramp. USMC and USAF Ospreys have three fast rope/rope ladders to facilitate insertion/extraction operations.

ARMAMENT: Provision stipulated in December 1994 for nose cannon; budget constraints resulted in this being deleted, but consideration again given in late 1998 to installing nose-mounted turreted defensive gun on MV-22B and this was evaluated in 2000, with General Dynamics Armament Systems 12.7 mm weapon based on GAU-19/A selected in September 2000. However, plans to install integrated gun again shelved in late 2002 on cost grounds, with decision taken to rely instead on manually operated 0.5 in machine guns.

DIMENSIONS, EXTERNAL:

Rotor diameter, each	11.61 m (38 ft 1 in)
Rotor blade chord: at root	0 90 m (2 ft 11½ in)
at tip	0.56 m (1 ft 10 in)
Wing span: excl nacelles	14.02 m (46 ft 0 in)
incl nacelles	15.52 m (50 ft 11 in)
Width: rotors turning	25.78 m (84 ft 7 in)
stowed	5.61 m (18 ft 5 in)
Wing chord, constant	**2.54 m (8 ft 4 in)**
Wing aspect ratio, excl nacelles	**5.5**
Distance between proprotor centres	**14.20 m (46 ft 7 in)**
Length: fuselage, excl probe	**17.47 m (57 ft 4 in)**
overall, wings stowed/blades folded	**19.20 m (63 ft 0 in)**
Height: over tailfins	**5.46 m (17 ft 11 in)**
wings stowed/blades folded	**5.56 m (18 ft 3 in)**
overall, nacelles vertical	**6.73 m (22 ft 1 in)**
Tail span, over fins	5.61 m (18 ft 5 in)
Wheel track (c/l of outer mainwheels)	4.64 m (15 ft 2½ in)
Wheelbase	7.62 m (25 ft 0 in)
Nacelle ground clearance, nacelles vertical	1.32 m (4 ft 4 in)
Proprotor ground clearance, nacelles vertical	6.35 m (20 ft 10 in)
Dorsal escape hatch: Length	1.02 m (3 ft 4 in)
Width	0.74 m (2 ft 5 in)

DIMENSIONS, INTERNAL:

Cabin: Length	7.37 m (24 ft 2 in)
Max width	1.80 m (5 ft 11 in)
Max height	1.83 m (6 ft 0 in)
Usable volume	24.3 m^3 (858 cu ft)

AREAS:

Rotor discs, each	**105.36 m^2 (1,134.1 sq ft)**
Rotor blades: each	**4.05 m^2 (43.58 sq ft)**
total	**24.30 m^2 (261.5 sq ft)**
Wing, total incl flaperons and fuselage centre-section	**35.49 m^2 (382.0 sq ft)**
Flaperons, total	**8.25 m^2 (88.80 sq ft)**
Fins, total	**21.63 m^2 (232.80 sq ft)**
Rudders, total	**3.27 m^2 (35.20 sq ft)**
Tailplane	8.22 m^2 (88.50 sq ft)
Elevators, total	4.79 m^2 (51.54 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	15,177 kg (33,459 lb)
Max fuel weight: MV-22 baseline	3,493 kg (7,700 lb)
MV-22 option	4,468 kg (9,850 lb)
CV-22 baseline	6,282 kg (13,850 lb)

CV-22 with cabin tanks ..... 11,970 kg (26,390 lb)
Max internal payload (cargo) ..... 9,072 kg (20,000 lb)
Cargo hook capacity: single ..... 4,536 kg (10,000 lb)
two hooks (combined weight) ..... 6,804 kg (15,000 lb)
Rescue hoist capacity ..... 272 kg (600 lb)
Normal mission T-O weight: VTO ..... 21,545 kg (47,500 lb)
STO ..... 25,855 kg (57,000 lb)
Max VTO weight ..... 23,859 kg (52,600 lb)
Max STO weight for self-ferry ..... 27,442 kg (60,500 lb)
Max floor loading (cargo) ..... 1,464 kg/m² (300 lb/sq ft)
Max disc loading: VTO ..... 113.2 kg/m² (23.19 lb/sq ft)
STO ..... 130.2 kg/m² (26.67 lb/sq ft)
Transmission loading at max permissible T-O weight and power ..... 3.55 kg/kW (5.83 lb/shp)

PERFORMANCE:
Max level speed at S/L ..... 275 kt (509 km/h; 316 mph)
Max cruising speed at S/L ..... 241-257 kt (446-476 km/h; 277-296 mph)
Max forward speed with max slung load ..... 214 kt (396 km/h; 246 mph)
Max rate of climb at S/L: vertical ..... 332 m (1,090 ft)/min
inclined ..... 707 m (2,320 ft)/min
aeroplane mode ..... 975 m (3,200 ft)/min
Service ceiling ..... 7,529 m (24,700 ft)
Service ceiling, OEI ..... 3,139 m (10,300 ft)
Hovering ceiling OGE ..... 1,646 m (5,400 ft)
T-O run at normal mission STO weight ..... less than 152 m (500 ft)
Range:
amphibious assault ..... 515 n miles (953 km; 592 miles)
VTO with 4,536 kg (10,000 lb) payload ..... 350+ n miles (648+ km; 403+ miles)
VTO with 2,721 kg (6,000 lb) payload ..... 700+ n miles (1,296+ km; 806+ miles)
STO with 4,536 kg (10,000 lb) payload ..... 950+ n miles (1,759+ km; 1,093+ miles)
STO at 27,442 kg (60,500 lb) self-ferry gross weight, no payload ..... 2,100 n miles (3,892 km; 2,418 miles)
g limits ..... +4/−1

BELLANCA

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Bellanca company has undergone several reincarnations since formed by G M Bellanca before Second World War to manufacture Model 14 and is separate from Bellanca Aircraft Corporation (Aviabellanca), currently owned by August T Bellanca, the founder's son.

Alexandria Aircraft formed by six former Bellanca Inc employees who, on 30 April 2002, acquired Type Certificates for most Bellanca subvariants upon liquidation of former company and restarted manufacture in original location at Alexandria, Minnesota.

Also owns rights to Eagle DW-1 crop-sprayer, of which 96 built in Alexandria between 1980 and 1984; entire programme, including jigs and tools, offered for sale.

BELLANCA 17-30 SUPER VIKING

TYPE: Four-seat lightplane.

PROGRAMME: Model 17-30 Viking certified 23 September 1966, being derivative of Model 14 Bellanca 260 and earlier Cruisair and Cruisemaster. First aircraft built under current ownership was 17-30A Super Viking N283SV, first flown 23 July 2005 and immediately repositioned for public debut at AirVenture, Oshkosh, two days later.

CURRENT VERSIONS: **17-30A Super Viking:** Subvariant certified in Normal category 12 December 1969 with 224 kW (300 hp) Continental IO-520-K engine and increased maximum take-off weight. Current version has IO-550 engine.

CUSTOMERS: Some 1,360 Model 17s built by previous companies, most recently 30 Model 17-30As between 1988 and 2000. Alexandria Aircraft production began in 2005 at c/n 05-301031.

COSTS: USD510,000 (2006).

DESIGN FEATURES: Low-mounted, tapered wing and tailplane; wide-chord, sweptback fin.

Wing section Bellanca B; dihedral 4° 30'; incidence 0° at root, −3° at tip. No tailplane dihedral.

FLYING CONTROLS: Conventional and manual. Dynamically balanced ailerons; dynamically and statically balanced elevators and rudder. Actuation by cables. Flight-adjustable trim tab in port elevator. Electrically actuated flaps. Control surface movements: ailerons ±20°; elevator +22/−15°; rudder ±22°; flaps +46°.

STRUCTURE: Welded 4130 steel tube fuselage, including empennage, with wooden stringers, Dacron fabric covering and glass fibre engine cowling. Wooden wing (including ailerons and flaps) comprising two Sitka spruce spars, spruce ribs and mahogany plywood skin.

First new-production Bellanca Super Viking built by Alexandria Aircraft
(Paul Jackson) 1158263

LANDING GEAR: Tricycle type; hydraulically retractable. Nosewheel retracts rearward; mainwheels forward into underwing fairings, with doors and hydraulic disc brakes as standard. Oleo shock-absorbers; mainwheel 6.00-6, tyre pressure 3.8 bar (55 lb/sq in); steerable nosewheel, tyre pressure 2.4 bar (35 lb/sq in).

POWER PLANT: One 224 kW (300 hp) Teledyne Continental IO-550 flat-six driving a McCauley three-blade, metal, constant-speed propeller. Two wing fuel tanks, each 136 litres (36.0 US gallons; 30.0 Imp gallons), in wings, and one auxiliary tank of 57 litres (15.0 US gallons; 12.5 Imp gallons) in fuselage, between rear seat and baggage compartment; combined capacity 330 litres (87.0 US gallons; 72.5 Imp gallons), of which 318 litres (84.0 US gallons; 70 Imp gallons) usable.

ACCOMMODATION: Four seat in pairs; baggage space (including 'ski tube') behind seats, accessible from cabin and via external glass fibre door. Moulded glass fibre door starboard side. Accommodation heated and ventilated.

SYSTEMS: Electrical system 12 V DC. Hydraulic system pressure (landing gear) 100 bar (1,450 lb/sq in).

AVIONICS: *Comms:* Garmin GNS 430 and GNS 530 NAV/COM/GPS; GTX 327 Mode C transponder; GMA 340 audio panel.

Flight: S-Tec 55X autopilot. Bendix/King KI 256 flight director; EDM 700 engine monitoring and fuel management system.

DIMENSIONS, EXTERNAL:
Wing span ..... 10.41 m (34 ft 2 in)
Length overall ..... 8.02 m (26 ft 4 in)
Height overall ..... 2.24 m (7 ft 4 in)
Tailplane span ..... 3.71 m (12 ft 2 in)
Wheel track ..... 2.74 m (9 ft 0 in)
Wheelbase ..... 2.24 m (7 ft 4 in)
Propeller diameter ..... 2.03 m (6 ft 8 in)
Cabin door: Height ..... 0.95 m (3 ft 1½ in)
Max width ..... 0.88 m (2 ft 10½ in)
Baggage door: Height ..... 0.61 m (2 ft 0 in)
Max width ..... 0.51 m (1 ft 8¼ in)

DIMENSIONS, INTERNAL:
Cabin (firewall to rear wall): Length ..... 3.10 m (10 ft 2 in)
Max width ..... 1.09 m (3 ft 7 in)
Max height ..... 1.19 m (3 ft 11 in)
Baggage compartment volume ..... 0.34 m³ (12.1 cu ft)

AREAS:
Wings, gross ..... 15.00 m² (161.5 sq ft)
Ailerons (total) ..... 1.09 m² (11.77 sq ft)
Trailing edge flaps (total) ..... 1.50 m² (16.16 sq ft)
Fin ..... 1.21 m² (13.00 sq ft)
Rudder ..... 0.56 m² (6.00 sq ft)
Tailplane ..... 1.54 m² (16.60 sq ft)
Elevators (total) ..... 1.19 m² (12.80 sq ft)

WEIGHTS AND LOADINGS:
Weight empty ..... 1,043 kg (2,300 lb)
Max baggage weight ..... 84 kg (186 lb)
Max T-O weight ..... 1,508 kg (3,325 lb)
Max wing loading ..... 100.5 kg/m² (20.58 lb/sq ft)
Max power loading ..... 6.75 kg/kW (11.08 lb/hp)

PERFORMANCE:
Never-exceed speed (VNE) ..... 196 kt (363 km/h; 226 mph)
Max level speed ..... 181 kt (335 km/h; 208 mph)
Cruising speed at 75% power ..... 175 kt (325 km/h; 202 mph)
Stalling speed, flaps down ..... 61 kt (113 km/h; 70 mph)
Max rate of climb at S/L ..... 369 m (1,210 ft)/min
Service ceiling ..... 6,100 m (20,000 ft)
T-O to 15 m (50 ft) ..... 433 m (1,420 ft)
Landing from 15 m (50 ft) ..... 409 m (1,340 ft)
Range ..... 868 n miles (1,609 km; 1,000 miles)

BOEING

THE BOEING COMPANY

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SENIOR VICE-PRESIDENT, COMMUNICATIONS: Tod R Hullin

Company founded July 1916. Currently organised into major business segments as detailed below, plus several smaller elements. Revenues for 2005 were USD54.8 billion, an increase of USD2.39 billion over 2004.

Boeing and McDonnell Douglas merger under the Boeing name was completed on 4 August 1997, elevating Boeing to status of largest aerospace company in the world. Headquarters remained in Seattle, Washington, until September 2001, when moved to Chicago, Illinois. In late 2005, Boeing had 153,600 employees. Total of 358 aircraft delivered in 2003, 362 in 2004 and 378 in 2005.

Following further reorganisation in latter half of 2002, major operating components of The Boeing Company comprise:

BOEING CAPITAL CORPORATION
CONNEXION BY BOEING
BOEING INTEGRATED DEFENSE SYSTEMS: Follows this entry
BOEING COMMERCIAL AIRPLANES: Follows Integrated Defense Systems

Supporting elements comprise:

BOEING SHARED SERVICES GROUP: Follows Boeing Commercial Airplanes
PHANTOM WORKS: Follows Boeing Shared Services Group

INTEGRATED DEFENSE SYSTEMS

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Created in latter half of 2002 through merger of Military Aircraft and Missile Systems with Space and Communications, Boeing Integrated Defense Systems (IDS) has overall responsibility for military business activities. Management of aircraft and helicopter programmes as detailed below reflects the military customer base, but several subordinate organisations exist to oversee other key areas. At the beginning of 2006, IDS implemented a major reorganisation into three main profit and loss business centres as detailed below.

In early 2006, business was valued at USD30.5 billion and had over 75,000 employees. IDS revenue in 2005 was USD30.8 billion.

Major business units of Integrated Defense Systems are as follows:

PRECISION ENGAGEMENT AND MOBILITY SYSTEMS BUSINESS CENTER:
PRESIDENT: John A Lockar (Northern Virginia)

NETWORK AND SPACE SYSTEMS BUSINESS CENTER:
PRESIDENT: Roger A Krone (Northern Virginia)

SUPPORT SYSTEMS BUSINESS CENTER:
PRESIDENT: Patrick J Finneran Jr (St Louis, Missouri)

ADVANCED DEFENSE AND SECURITY SYSTEMS UNIT:
PRESIDENT: George K Muellner (Long Beach, California)

BOEING F-15E EAGLE

Israel Defence Force name: Ra'am (Thunder)
Republic of Korea Air Force name: Slam Eagle

TYPE: Multirole fighter.

PROGRAMME:

DEVELOPMENT MILESTONES

Official go-ahead	24 Feb 1984
First flight, production	11 Dec 1986
First delivery	12 Apr 1988
Entered service	28 Dec 1988

F-15 initially employed as air superiority fighter, having first flown on 27 July 1972. Demonstration of industry-funded Strike Eagle prototype (71-0291) modified from F-15B, including accurate blind weapons delivery, completed at Edwards AFB and Eglin AFB in 1982; product improvements for the F-15E were tested on four Eagles between November 1982 and April 1983, including first take-off at 34,019 kg (75,000 lb), 3,175 kg (7,000 lb) more than F-15C with conformal tanks; new weight included conformal tanks, three other external tanks and eight 500 lb Mk 82 bombs; 16 different stores configurations tested, including 2,000 lb Mk 84 bombs, and BDU-38 and CBU-58 weapons delivered visually and by radar.

Full programme go-ahead announced 24 February 1984; first flight of first production F-15E (86-0183) 11 December 1986; first delivery to Luke AFB, Arizona, 12 April 1988; first delivery 29 December 1988 to 4th Wing at Seymour Johnson AFB, North Carolina.

In mid-2001, USAF and Boeing examining various options for mid-life upgrade of F-15E known as Block 6; these included adoption of active electronically scanned array (AESA) radar, update of radar warning receiver equipment, re-engining with version of General Electric F110 turbofan and installation of new wing structure incorporating carbon fibre skin that would provide increased take-off weight and accommodate two extra hardpoints. Of these, it was revealed in third quarter of 2004 that AESA to be installed on entire fleet in latter half of present decade.

CURRENT VERSIONS: **F-15E**: Basic version, *as detailed*.

F-15F: Proposed single-seat version, optimised for air combat; not built.

F-15H: Proposed export version, lacking specialised air-to-ground capability; supplanted by F-15S. Designation subsequently allocated to version for Greece, which eventually selected F-16 Fighting Falcon.

F-15I Ra'am: Israeli export version of F-15E; selected November 1993; confirmed 27 January 1994; 21 ordered 12 May 1994; option on four more converted to firm order in November 1995. First flight of initial (unpainted) aircraft on 12 September 1997; this was subject of formal roll-out and handover ceremony at St Louis on 6 November 1997, with first pair of aircraft to be delivered leaving St Louis on 16 January 1998 and arriving in Israel three days later; total of 16 delivered during 1998, with remainder following in 1999. Operating unit No. 69 Squadron. Tactical electronic warfare system deleted; replaced by Israeli-built SPS-2100 integrated system including active jamming, radar and missile warning, and dispenser subsystems.

Otherwise identical to USAF F-15E, with F100-PW-229 engines, LANTIRN pods, full capability AN/APG-70 radar, Kaiser holographic HUD, Litton ring laser INS and VHSIC central computer. Associated equipment includes four Sanders mission planning subsystems and one Sanders common mapping production system (CMPS) to assist ground planning, briefing and debriefing activities at total cost of USD6.2 million. F-15I includes significant number of co-produced components, such as airframe and wing subassemblies, heat exchangers and weapons pylons.

F-15K Slam Eagle: Version conceived to satisfy Republic of Korea's F-X fighter requirement; preliminary bids submitted in June 2000. Selection expected in second half of 2001, but decision delayed, with formal announcement made on 19 April 2002, when Korea revealed intent to purchase 40 aircraft at total cost of USD4.2 billion. F-15K incorporates General Electric F110-GE-129 engine, AN/APG-63(V)1 radar, Raytheon AN/AWW-13K advanced data link pod for missile guidance and mid-course updating of SLAM-ER weapon, expanded weapons capability (including JDAM, SLAM-ER and AIM-9X) and improved environmental control system, plus Lockheed Martin TIGER Eyes sensor suite including AN/AAS-42 infra-red search and track system, Boeing Joint Helmet-Mounted Cueing System and revised cockpit with seven 152 × 152 mm (6 × 6 in) Kaiser Electronics AMLCDs. Final assembly of initial aircraft began in May 2004; completed aircraft rolled out November 2004, with installation of engines, avionics and other equipment preceding first flight on 3 March 2005. First pair of aircraft (actually the third and fourth F-15Ks) ferried to Seongnam Air Base, arriving on 7 October 2005 and subsequently participating in Seoul air show before being flown to Daegu Air Base for official hand-over in early November; first two aircraft retained in US for flight testing and software integration until May 2006. Next two aircraft to be delivered to Korea were fifth and sixth F-15Ks in December 2005, to be followed by two more in May 2006, with additional pairs arriving at intervals of about 75 days until August 2008. Operating units will be 110th and 151st Tactical Fighter Squadrons at Daegu. Follow-on order remains a possibility, since original requirement was for 120; Korea requested price data for another 40 aircraft in mid-2004.

F-15L: Proposed less costly version offered to Israel by Boeing in unsuccessful attempt to secure order for new combat aircraft; F-16I eventually selected.

F-15S: Saudi Arabian export version of F-15E, lacking some air-to-air and air-to-ground capabilities; Saudi Arabian request for 72 aircraft approved by US government in December 1992; initially designated **F-15XP**; first funds assigned by US government on 23 December 1992; contract signature by Saudi government May 1993; planned delivery rate halved, early 1994, to one per month, beginning 1995. First F-15S flown 19 June 1995; official roll-out and handover 12 September 1995. First two examples delivered to Saudi Arabia in November 1995 were second and third built; total of 49 received by end of 1998 and 70 by end of 1999, with final two following in late July 2000.

Saudi versions comprise 24 optimised for air-to-air missions and 48 optimised for air-to-ground: AN/APG-70 radar. Despite planned restrictions, aircraft delivered with full F-15E capability, plus conformal fuel tanks and tangential stores attachments. Armament includes AGM-65D/G Maverick, AIM-7 Sparrow, AIM-9M and AIM-9S Sidewinder missiles, CBU-87 submunitions dispenser and GBU-10/12 bombs.

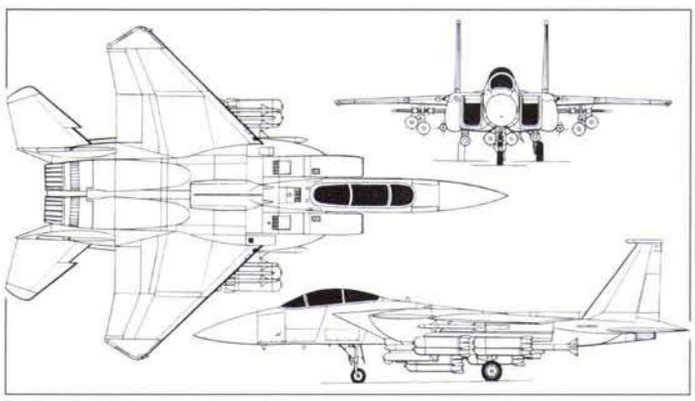
F-15SE: Proposed single-seat version of F-15E for USAF, for which pricing data supplied to Department of Defense as part of Quadrennial Defense Review. Not proceeded with.

F-15SG: Version (initially known as F-15T) offered to Singapore, which requires up to 24 new fighters, with initial tranche to be delivered in 2008–09. Original six contenders reduced to shortlist of three on 10 October 2003, with F-15T in competition with Dassault Rafale and Eurofighter Typhoon. Two F-15Es leased by Boeing for Asian Aerospace show in late February 2004 remained in Singapore for formal three-week evaluation by Air Force. F-15 selected as winner in September 2005; order for 12 announced 12 December 2005; further eight on option. Details of configuration and equipment not yet available, but will feature multimode version of Raytheon AN/APG-63(V)3 AESA radar and more modern countermeasures suite as well as improved sensor systems and navigation equipment and General Electric F110-GE-129 engines. Weapon options expected to include AIM-120C AMRAAM, AIM-9X Sidewinder, JDAM and versions of the AGM-154 JSOW.

F-15U: Version conceived to satisfy United Arab Emirates requirement for long-range interdictor aircraft, in which it was competing against Lockheed Martin F-16 (selected), Dassault Rafale, Eurofighter Typhoon and Sukhoi Su-30MK. **F-15U Plus** proposal anticipated extended range, with additional 2,570 kg (5,665 lb) of fuel in thicker clipped-delta, 50° leading-edge sweep wing; more stores stations and internally situated IR navigation and targeting sensor suite in lieu of LANTIRN. Typical ordnance loads would have comprised nine 2,000 lb Mk 84 bombs or seven laser-guided GBU-24s.

Boeing F-15E Eagle serving US Air Force in Europe *(Paul Jackson)* 1151719

Republic of Korea Air Force Boeing F-15K Slam Eagle *(Peter R Foster)* 1151720



Boeing F-15E Eagle equipped for high ordnance payload air-to-ground mission *(Dennis Punnett)* 0507280

F-15MANX: Stealthy, tail-less proposal based on technology developed for ACTIVE thrust-vectoring programme. Concept appears dormant.

CUSTOMERS: USAF funding for originally planned 392 reduced to 200; however, further nine funded in FY91 and FY92, comprising three Gulf War loss replacements and six with proceeds of sale to Saudi Arabia of 24 F-15C/Ds. Additional six in FY96 budget, despite not being requested by USAF. Further six aircraft in FY97 and five in FY98, raising total USAF buy to 226, with another five in FY00 and five in FY01. US Congress added funding for advance procurement of one attrition reserve aircraft for USAF in FY05 and FY06 budgets; firm order still awaited, with delivery expected in January 2010. Saudi Arabia 72 (F-15S); Israel 25 (F-15I); Republic of Korea 40 (F-15K); Singapore (12 F-15SG).

USAF F-15E PROCUREMENT

FY	Batch	Qty	First aircraft
86	Lot 1	8	86-0183
87	Lot 2	42	87-0169
88	Lot 3	42	88-1667
89	Lot 4	36	89-0471
90	Lot 5	36	90-0227
91	Lot 6	36	91-0300
91	Lot 7	6	91-0600
92	Lot 8	3	92-0364
96	Lot 9	6	96-0200
97	Lot 10	6	97-0217
98	Lot 11	5	98-0131
00	Lot 12	5	00-3000
01	Lot 13	5	01-2000
Total		**236**	

Initial USAF combat-capable unit, 4th Wing, declared operational October 1989, currently with 333, 334, 335 and 336 Fighter Squadrons; and others with 57th Wing USAF Weapons School at Nellis AFB, Nevada; 90th FS of 3rd Wing at Elmendorf, Alaska, received first F-15E on 29 May 1991; 391st FS, sole F-15E squadron in 366th Fighter Wing at Mountain Home AFB, Idaho, received first aircraft (reallocated from early production) 6 November 1991; 492nd and 494th FS of 48th FW at Lakenheath, UK, received first aircraft on 21 February 1992. Deliveries of Lot 7 began to 48th FW on 13 April 1994 and 209th USAF F-15E (92-0366) to 57th Wing on 11 July 1994. First aircraft from Lot 9 flown on 1 April 1999 and delivered to 57th Wing on 7 June; remaining five F-15Es from this batch all assigned to 48th Fighter Wing by November 1999; subsequent deliveries to 48th FW comprised all Lot 10 and Lot 11 aircraft, with final pair arriving on 26 August 2000. First Lot 12 aircraft (00-3000) delivered 21 June 2002; subsequently assigned to 48th FW; four more Lot 12 aircraft all to 48th FW by third quarter of 2003, along with first Lot 13 machine (01-2000). USAF received last of 236 F-15Es when final two aircraft joined 48th FW in December 2004.

Initial contract placed with McDonnell Douglas by US government on 18 December 1992 for 72 Saudi aircraft; project name, Peace Sun IX.

COSTS: USD35 million, flyaway; USD2,000 million for 21 F-15Is (1993), Israel; US$288.5 million appropriation for five F-15Es in FY00. Total cost of South Korean purchase expected to be USD4.2 billion. Estimated cost to procure two attrition reserve F-15E for USAF quoted as USD240 million according to FY06 budget documentation.

DESIGN FEATURES: Conceived as uncompromised air superiority fighter, but further developed for strike/attack mission, with provision for increased weight of ordnance. Typical 1970s fighter configuration, with twin fins positioned to receive vortex flow off wing and maintain directional stability at high angles of attack. Straight two-dimensional external compression engine air inlet each side of fuselage. High-mounted cockpit for all-round vision

Mission includes approach and attack at night and in all weathers; main systems of F-15E include high-resolution, synthetic aperture Raytheon AN/APG-70 radar, wide field of view FLIR, Lockheed Martin LANTIRN navigation (AN/AAQ-13) and targeting (AN/AAQ-14) pods beneath starboard and port air intakes respectively; air-to-air capability with AIM-7 Sparrow, AIM-9 Sidewinder and AIM-120 AMRAAM retained; rear cockpit has four multipurpose CRT displays for radar, weapon selection, and monitoring enemy tracking systems; front cockpit modifications include redesigned up-front controls, wide field of view HUD, colour CRT multifunction displays for navigation, weapon delivery, moving map, precision radar mapping and terrain-following. Engines have digital electronic control, engine trimming and monitoring; fuel tanks are foam-filled; more powerful generators; better environmental control.

NACA 64A aerofoil section with conical camber on leading-edge; sweepback 38° 42′ at quarter-chord; thickness/chord ratio 6.6 per cent at root, 3 per cent at tip; anhedral 1°; incidence 0°.

FLYING CONTROLS: Powered. Plain ailerons and all-moving tailplane with dog-tooth extensions, both powered by National Water Lift hydraulic actuators; rudders have Ronson Hydraulic Units actuators; no spoilers or trim tabs; Moog boost and pitch compensator for control column; plain flaps; upward-opening airbrake panel in upper fuselage between fins and cockpit. Digital triple-redundant BAE Systems flight control system capable of automatic coupled terrain-following.

STRUCTURE: Wing based on torque box with integrally machined skins and ribs of light alloy and titanium; aluminium honeycomb wingtips, flaps and ailerons; airbrake panel of titanium, aluminium honeycomb and graphite/epoxy composites skin. F-15E version includes 60 per cent of earlier F-15 structure redesigned to allow 9 *g* and 16,000 hours fatigue life; superplastic forming/diffusion bonding used for upper rear fuselage, rear fuselage keel, main landing gear doors, and some fuselage fairings, plus engine bay structure.

LANDING GEAR: Hydraulically retractable tricycle type, with single wheel on each unit. All units retract forward. Cleveland nose and main units, each incorporating an oleo-pneumatic shock-absorber. Honeywell wheels and Michelin AIR X radial tyres on all units. Nosewheel tyre size 22×7.75–9 or 22×7.75R9 (26 ply) tubeless; mainwheel tyres size 36×11–18 or 36×11R18 (30 ply) tubeless; tyre pressure 21.03 bar (305 lb/sq in) on all units. Honeywell five-rotor carbon disc brakes.

POWER PLANT: Initially, two Pratt & Whitney F100-PW-220 turbofans, each rated for take-off at 104.3 kN (23,450 lb st), installed, with afterburning. USAF aircraft 135 onwards (90-0233), built from August 1991, have 129.4 kN (29,100 lb st) Pratt & Whitney F100-PW-229s, which also ordered for Saudi F-15S and Israeli F-15I. F-15K for South Korea fitted with General Electric F110-GE-129 turbofans. Air inlet controllers by Hamilton Sundstrand. Air inlet actuators by National Water Lift.

Internal fuel in foam-filled structural wing tanks and six Goodyear fuselage tanks, total capacity 7,643 litres (2,019 US gallons; 1,681 Imp gallons). Simmonds fuel gauge system. Optional conformal fuel tanks (CFT) attached to side of engine air intakes, beneath wing, each containing 2,737 litres (723 US gallons; 602 Imp gallons). Provision for up to three additional 2,309 litre (610 US gallon; 508 Imp gallon) external fuel tanks. Maximum total internal and external fuel capacity 20,044 litres (5,295 US gallons; 4,409 Imp gallons).

ACCOMMODATION: Two crew, pilot and weapon systems officer, in tandem on Boeing ACES II zero/zero ejection seats. Single-piece, upward-hinged, bird-resistant canopy; in-service modification undertaken by USAF replaced original windscreen with laminated polycarbonate material.

SYSTEMS: Lucas Aerospace generating system for electrical power, with Hamilton Sundstrand 60/75/90 kVA constant-speed drive units. Litton molecular sieve oxygen generating system (MSOGS) introduced in 1991 to replace liquid oxygen system. Honeywell air conditioning system. Three independent hydraulic systems (each 207 bar; 3,000 lb/sq in) powered by Abex engine-driven pumps; modular hydraulic packages by Hydraulic Research and Manufacturing Company. AlliedSignal APU for engine starting, and for provision of limited electrical or hydraulic power on the ground independently of main engines.

AVIONICS: *Comms:* Raytheon AN/ARC-164 UHF transceiver and UHF auxiliary transceiver with cryptographic capability; Honeywell AN/APX-101 IFF transponder; BAE Systems AN/APX-76 IFF interrogator with Litton reply evaluator. Some aircraft have AN/ARC-190 HF radio for very long-range communications. F-15K fitted with BAE Systems AN/APX-113 combined interrogator transponder (CIT) unit and Link 16 MIDS (Multifunctional Information Distribution System).

Radar: Raytheon AN/APG-70 I-band pulse Doppler radar provides air-to-air capability equal to F-15C, plus high-resolution synthetic aperture mode for air-to-ground. AN/APG-70 due to be replaced on entire USAF fleet (currently numbering around 220 aircraft) by Raytheon AN/APG-63(V)4 active electronically scanned array (AESA) radar from 2008. AESA also expected to be installed on F-15SG aircraft for Singapore.

Flight: Triple redundant BAE Systems digital flight control system with automatic terrain-following standard. IBM CP-1075C very high-speed integrated circuit (VHSIC) central computer introduced in 1992 (replacing CP-1075). Honeywell AN/ASK-6 air data computer. Honeywell AN/ASN-108 AHRS. Honeywell CN-1655A/ASN ring laser gyro INS providing basic navigation data and serving as primary attitude reference system. Rockwell Collins AN/ARN-118 Tacan. Rockwell Collins HSI presenting aircraft navigation information on a symbolic pictorial display. Rockwell Collins AN/ARN-112 ILS receiver. Rockwell Collins ADF receiver. Dorne& Margolin glideslope localiser antenna and

US F-15 PRODUCTION

	F-15A	F-15B	F-15C	F-15D	F-15DJ	F-15E	F-15I	F-15J	F-15K	F-15S	Total
Israel	19	2	18	13			25				77
Japan					12			10[1]			22
Saudi Arabia			55	19						72	146
South Korea									40[4]		40
USA	365[2]	59[3]	409	61		236					1,130
Total	384	61	482	93	12	236	25	10	40	72	1,415

Notes: Mitsubishi of Japan also produced 155 F-15Js and 36 F-15DJs to complete total JASDF procurement of 165 and 48, respectively

[1] Including eight kits to Mitsubishi
[2] Including 10 YF-15As
[3] Including two YF-15Bs, of which one converted to F-15E prototype
[4] Delivery in progress.

Teledyne Avionics angle of attack sensors. Rockwell Collins Miniaturised Airborne GPS Receiver installed from 1995. Latest aircraft to join USAF (FY96 and subsequent production) feature new embedded GPS/INS.

Instrumentation: FLIR imagery displayed on Kaiser IR-2394/A wide field of view HUD; Honeywell vertical situation display set using CRT to present radar, electro-optical identification and attitude director indicator formats to pilot under all light conditions; moving map display by Honeywell RP-341/A remote map reader. Honeywell digital map system intended to replace remote map reader from 1996. F-15I has Elbit helmet-mounted sight and other cockpit displays. Final 10 aircraft for USAF have Kaiser 125× 125 mm (5 × 5 in) flat panel colour display (FPCD) instead of CRT; Rockwell Collins awarded USD14 million contract in late 2003 for supply of 178 FPCDs that will be retrofitted to earlier F-15Es. F-15K features four 152 × 152 mm (6 × 6 in) Multipurpose Displays (MPDs) and three 127 × 127 mm (5 × 5 in) FPCDs; all produced by Kaiser Electronics and all incorporating AMLCD technology.

Mission: Lockheed Martin LANTIRN externally mounted sensor package comprising AN/AAQ-13 navigation pod and AN/AAQ-14 targeting pod. Lockheed Martin Sniper XR advanced targeting pod is now being installed on USAF F-15E, with operational deployment beginning with 48th FW in January 2005. As interim solution, following hurried integration and evaluation in latter half of 2002, Rafael/Northrop Grumman Litening Extended Range (ER) system installed on some USAF aircraft; batch of 24 pod systems ordered in early 2003 at cost of USD32.6 million, with deliveries completed in April 2003. Lockheed Martin TIGER Eyes sensor suite on aircraft for Republic of Korea.

In July 1998, Boeing began flight test of commercial computing technology in F-15E as part of Phantom Works Bold Stroke project, whereby commercial technology is being used to provide non-proprietary computer systems for installation on military aircraft. F-15E installation embodied advanced display core processor (ADCP) using PowerPC hardware to replace existing central computer and multipurpose display processor; initial trial demonstrated same capabilities as current military hardware. More recent development concerns Suite 5E upgrade, which will involve provision of a new Honeywell ADCP and associated software by Boeing; fielding of this upgrade is expected in April 2006, with fleet-wide modification to be completed in 2010.

Self-defence: Northrop Grumman Enhanced AN/ALQ-135(V) internal countermeasures set provides automatic jamming of enemy radar signals; BAE Systems AN/ALR-56C RWR, Raytheon AN/ALQ-128 EW warning set, (initially) BAE Systems AN/ALE-45 chaff dispenser. Unique SPS-2100 EW system developed by Elisra and Rokar for Israeli F-15I. Sanders and ITT Avionics AN/ALQ-214 Integrated Defensive Electronic CounterMeasures (IDECM) under development and will be installed on F-15E; IDECM package incorporates Sanders AN/ALE-55 fibre optic towed decoy (FOTD). Saab BOL chaff dispensers to be adopted universally, with first contract awarded to BAE Systems in fourth quarter of 2001. F-15K has BAE Systems AN/ALR-56C(V)1 RWR and AN/ALE-47 countermeasures dispenser system, plus Northrop Grumman AN/ALQ-135 internally mounted jamming system. Wideband digital RWR expected to be installed on all F-15Es following technology survey to be completed in late FY06 or early FY07, with laboratory trials of competing systems set to begin in last quarter of FY07 and system development and demonstration phase commencing in FY08.

ARMAMENT: 20 mm M61A1 six-barrel gun in starboard wing-root, with 512 rounds. General Electric lead computing gyro. Provision on underwing (one per wing) and centreline pylons for air-to-air and air-to-ground weapons and external fuel tanks. Wing pylons use standard rail and launchers for AIM-9 Sidewinder (Israeli F-15I also compatible with Rafael Python 4) and AIM-120 AMRAAM air-to-air missiles; AIM-7 Sparrow and AIM-120 AMRAAM can be carried on ejection launchers on the fuselage or on tangential stores carriers on CFTs. Maximum aircraft load (with or without CFTs) is four each AIM-7 and AIM-9, or up to eight AIM-120. Single or triple rail launchers for AGM-65 Maverick air-to-ground missiles can be fitted to wing stations only.

Tangential carriage on CFTs provides for up to six bomb racks on each tank, with provision for multiple ejector racks on wing and centreline stations. Edo BRU-46/A and BRU-47/A adaptors throughout, plus two LAU-106A/As each side of lower fuselage. F-15E can carry a wide variety and quantity of guided and unguided air-to-ground weapons, including Mk 20 Rockeye (26), Mk 82 (26), Mk 84 (seven), BSU-49 (26), BSU-50 (seven), GBU-10 (seven), GBU-12 (15), GBU-15 (two), GBU-24 (five), CBU-52 (25), CBU-58 (25), CBU-71 (25), CBU-87 (25) or CBU-89 (25) bombs; JDAM, JSOW and WCMD weapons; SUU-20 training weapons (three); A/A-37 U-33 tow target (one); and B57 and B61 series nuclear weapons (five). Is only USAF strike aircraft able to carry GBU-28 and will be first to have the GBU-39 Small Diameter Bomb. An AN/AXQ-14 datalink pod is used in conjunction with the GBU-15; LANTIRN pod illumination is used to designate targets for laser-guided bombs; AGM-130 powered standoff bomb integrated in 1993; AGM-88 HARM capability added in 1996. AN/AWG-27 armament control system; Programmable Armaments Control Set adopted by final 10 new-build USAF aircraft and likely to be retrofitted to most earlier aircraft.

Pneumatic weapon ejection system under development in early 2000; makes use of compressed air for weapons separation from aircraft.

DIMENSIONS, EXTERNAL:
- Wing span ..... 13.05 m (42 ft 9¾ in)
- Wing aspect ratio 3.0
- Length overall ..... 19.43 m (63 ft 9 in)
- Height overall ..... 5.63 m (18 ft 5½ in)
- Tailplane span ..... 8.61 m (28 ft 3 in)
- Wheel track ..... 2.75 m (9 ft 0¼ in)
- Wheelbase ..... 5.42 m (17 ft 9½ in)

AREAS:
- Wings, gross ..... 56.49 m² (608.0 sq ft)
- Ailerons (total) ..... 2.46 m² (26.48 sq ft)
- Flaps (total) ..... 3.33 m² (35.84 sq ft)
- Fins (total) ..... 9.78 m² (105.28 sq ft)
- Rudders (total) ..... 1.85 m² (19.94 sq ft)
- Tailplanes (total) ..... 10.34 m² (111.36 sq ft)

WEIGHTS AND LOADINGS (F100-PW-220 engines):
- Operating weight empty (no fuel, ammunition, pylons or external stores) ..... 14,515 kg (32,000 lb)
- Max weapon load ..... 11,113 kg (24,500 lb)
- Max fuel weight: internal (JP4) ..... 5,952 kg (13,123 lb)
  - CFTs (two, total) ..... 4,265 kg (9,402 lb)
  - external tanks (three, total) ..... 5,396 kg (11,895 lb)
  - max internal and external ..... 15,613 kg (34,420 lb)
- Max T-O weight ..... 36,741 kg (81,000 lb)
- Max landing weight:
  - unrestricted ..... 20,094 kg (44,300 lb)
  - at reduced sink rates ..... 36,741 kg (81,000 lb)
- Max zero-fuel weight ..... 28,440 kg (62,700 lb)
- Max wing loading ..... 650.5 kg/m² (133.22 lb/sq ft)
- Max power loading ..... 176 kg/kN (1.73 lb/lb st)

PERFORMANCE:
- Max level speed at height M2.5
- Max combat radius ..... 685 n miles (1,270 km; 790 miles)
- Max range ..... 2,400 n miles (4,445 km; 2,762 miles)

BOEING F/A-18 SUPER HORNET

US Navy designations: F/A-18E, F/A-18F and EA-18G Growler

TYPE: Multirole fighter.

PROGRAMME:

DEVELOPMENT MILESTONES

Requirement issued	1991
First order (EMD contract)	June 1992
Rolled out	18 Sep 1995
First flight	29 Nov 1995
Production go-ahead	26 Mar 1997
First flight, production	6 Nov 1998
First delivery	18 Dec 1998
Entered service (VFA-122)	17 Nov 1999

Proposed 1991 as replacement for cancelled GD/MDC A-12 and follow-on for early F/A-18As and other USN/MC tactical aircraft as they phase out; based on earlier versions of Hornet; development funding approved by Congress for FY92; USD4.88 billion engineering and manufacturing development contract awarded June 1992, covering seven flight test aircraft (five Es; two Fs) and three ground test articles, plus associated 7½-year test programme; USD754 million award in 1992 to GE for F414 engine development.

Critical design review (CDR) undertaken 13 to 17 June 1994 at St Louis by team of independent government evaluators; successfully negotiated, with F/A-18E/F satisfying or surpassing all timescale, cost, technical, reliability and maintainability requirements.

Principal subcontractor Northrop Grumman launched assembly of first aircraft on 24 May 1994 with start of work on centre/aft fuselage section at Hawthorne, California. First forward fuselage section followed suit on new assembly line at St Louis, Missouri, 23 September 1994; completed 12 January 1995, except for wiring; mating with centre/aft section from Hawthorne effected 8 May 1995. Roll-out of prototype (E1/165164) on 18 September 1995; first flight 29 November 1995.

Prototype delivered to Naval Air Warfare Center at Patuxent River, Maryland, on 14 February 1996 for start of three year flight test programme involving seven aircraft; initial flight from Patuxent River made by E1 on 4 March 1996. Second F/A-18E prototype (E2/165165) made first flight on 26 December 1995 and first F/A-18F (F1/165166) on 1 April 1996. Supersonic speed exceeded for first time on 12 April 1996 when E1 achieved M1.1. Carrier suitability trials began mid-1996 and F1 completed three successful catapult launches at Patuxent River on 6 August that year.

By 1 February 1997, when the last development aircraft was delivered to Patuxent River, test fleet had flown 390 sorties, for total of 631 flight hours. Subsequent milestones were passed on 13 May 1997 (1,000th flight hour); 9 September 1997 (1,500th flight hour); 24 September 1997 (1,000th sortie); 11 December 1997 (2,000th flight hour and 1,300th sortie); 1 July 1998 (3,000th hour) and 12 January 1999 (4,000th hour). First missile launch (an AIM-9 Sidewinder) accomplished by aircraft F2 on 5 April 1997; other weapons expended by mid-May 1997 included AIM-7 Sparrow, AIM-120 AMRAAM,

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Boeing F/A-18F Super Hornet of VFA-103 launching from USS *Dwight D Eisenhower (PMA Kathleen Gorby, USN)* 1128916

Trials Boeing F/A-18F Super Hornet of VX-9 (squadron), China Lake *(Cdr Ian C Anderson, USN)* 1128917

SLAM/SLAM-ER, AGM-84 Harpoon, Mk 82 and Mk 83 bombs plus Rockeye CBUs. Successful deployment of AN/ALE-50 towed radar decoy also accomplished by mid-May 1997.

Flight test programme briefly halted in October 1997 for engine inspection after discovery of cracks in stator vanes. More intractable problem concerned wing-drop, with uncommanded departures from controlled flight evident as early as the seventh sortie in March 1996. Boeing and US Navy considered three solutions to eradicate this in January 1998, including fitting stall strips on upper surface; adding a chord-wise fence just inboard of the hinge fairing; and switching to a porous hinge fairing with slots that allow air to flow in both directions through wing fold fairing. Last-mentioned option selected in early 1998; subsequent flight testing confirmed efficacy of solution, but this was only a short-term palliative, with continued investigations into wing-drop eventually resulting in more permanent solution that underwent testing from August 2003 and is now being installed on new-build aircraft and retrofitted to earlier machines. This package of improvements includes saw-tooth leading-edge flaps, re-sealing of wing-fold hinge doors and addition of 127 mm (5 in) high, full-chord wing fences; latter alter airflow and eliminate wing-drop phenomenon, while simultaneously reducing intensity of, and delaying onset of, buffet.

EMD phase of test programme completed end April 1999, by which time seven aircraft had accumulated 4,673 flight hours in 3,172 sorties; in the process, over 15,000 test points completed and 29 weapons configurations cleared for flight. By mid-2000, follow-on testing had increased totals to more than 5,500 flight hours in 3,800 flights.

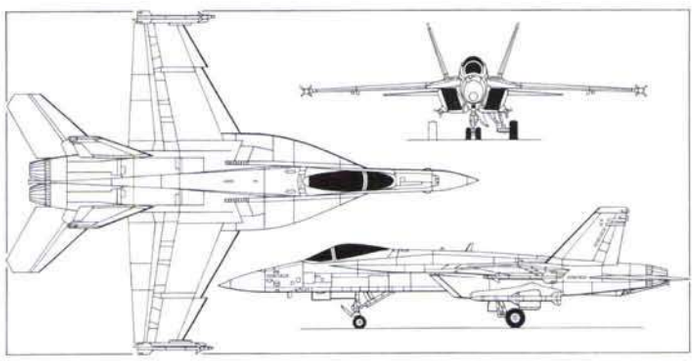
Static testing began in August 1995 with airframe ST50; shock loading assessment from February 1996 with DT50; fatigue testing from 30 June 1997 with FT50, which completed first lifetime (6,000 hours) one month ahead of schedule, on 27 August 1998. ST50 transferred to Lakehurst, New Jersey, for series of six emergency barricade engagements; first successfully completed on 3 September 1997, but ST50 damaged during third test on 23 September when restraint cable failed. ST50 subsequently repaired and returned to test duty, for live-fire testing at China Lake, California; trials included firing large armour-piercing incendiary projectile through inlet duct into aft fuel tank, with resultant hole showing little evidence of leakage.

Approval for low-rate initial production (LRIP) of 62 aircraft in three lots given on 26 March 1997; first lot composed of eight F/A-18Es and four F/A-18Fs. Assembly of first LRIP F/A-18E (165533) started at Northrop Grumman in May 1997 and at Boeing in September 1997; final assembly began at St Louis on 19 June 1998, with mating of centre/aft and forward fuselage sections; first flight 6 November 1998, six weeks ahead of schedule; this aircraft officially accepted by US Navy on 18 December 1998 and flown to Patuxent River to join flight test programme before attachment to VX-9 squadron at China Lake, California, for operational evaluation. Latter programme began 27 May 1999 and involved total of 1,233 flight hours in 866 sorties by seven LRIP aircraft (three F/A-18Es and four F/A-18Fs) in six-month period, including testing of all mission capabilities in varying climates as well as operations at sea aboard USS *John C Stennis* and participation in 'Red Flag' exercise at Nellis AFB, Nevada. Results of operational evaluation announced 15 February 2000, with report stating aircraft to be "operationally effective and operationally suitable" and recommending fleet introduction with the US Navy.

First USN squadron was VFA-122, at Lemoore, California, as specialist FRS (Fleet Replacement Squadron), training pilots and ground crew; received first seven aircraft (of eventual 34) 17 November 1999. First operational squadron was VFA-115, which began transition from F/A-18C to F/A-18E in third quarter 2000; made first deployment in USS *Abraham Lincoln* from 24 July 2002 and recorded combat debut on 6 November 2002 when VFA-115 aircraft dropped four GPS-guided JDAMs on SAM sites in southern Iraq. See table for further details of transition programme.

CURRENT VERSIONS: **F/A-18E**: Single-seat. Initial aircraft (all LRIP examples plus those purchased in FY00 and FY01) to so-called Block 1 standard, with AN/APG-73 and introducing other items of equipment as they became available; subsequent aircraft

VFA-11 (squadron) Boeing F/A-18F Super Hornet turning tightly *(Paul Jackson)* 1128950



Boeing F/A-18E Super Hornet *(Mike Keep)* 0507282

(beginning with Lot 26) to so-called Block 2 standard, incorporating revised forward fuselage as part of ECP 6038, with fibre optic data network and advanced crew station, including 205 × 255 mm (8 × 10 in) display from Lot 28 onward, for NFO among other improvements. Will also eventually feature AN/APG-79 AESA, evaluation of which begun by VX-31 at China Lake, California, in July 2003; one F/A-18E (166423) and two F/A-18F (166450 and 166451) fitted with development radars and allocated to trials, which have demonstrated levels of reliability five times greater than those of AN/APG-73 radar. Initial quantity of eight radars subject of first contract (LRIP 1), with planned delivery between January and June 2005; Lot 2 LRIP contract worth USD61.8 million awarded 5 February 2004 for 12 radars to be delivered between July 2005 and June 2006; Lot 3 LRIP batch expected to comprise 22 radars, with subsequent procurement of 42 units per year until total of 415 delivered (280 for new-build aircraft and 135 for retrofit in place of AN/APG-73). AN/APG-79 installed on eight aircraft from Lot 27 and Lot 28 production for operational evaluation by VX-9 squadron beginning February 2006, with IOC due late September 2006; first of these (226th Super Hornet, believed to be 166638) rolled out 21 April 2005 and delivered to VX-9 on 5 May. Lot 28 aircraft will feature full provisions for AN/APG-79. Raytheon AN/ASQ-228 ATFLIR pod also among Block 2 enhancements and completed operational evaluation in third quarter of 2003, with IOC achieved in September of that year, followed by active service in Afghanistan and Iraq during 2004. ATFLIR has demonstrated detection and recognition ranges up to five times greater than those achieved by earlier pod systems.

F/A-18F: Two-seat. Also produced in Block 1 and Block 2 versions as detailed above. First operational deployment of F/A-18F version made by VFA-41 in USS *Nimitz* between March and November 2003.

EA-18G Growler: Programme launched as private venture, two-seat electronic warfare dedicated derivative of F/A-18F. Initially known by manufacturer as the **F/A-18 C^2W**; announcement of development made 7 August 1995. Name 'Growler' was initially unofficial but was formally adopted by US Navy in October 2005. Boeing is prime contractor, with Northrop Grumman as principal subcontractor with special responsibility for integration of electronic warfare suite; minimal structural changes; wideband receiver pods will replace wingtip AIM-9 Sidewinder AAMs; other pods and antennae to be carried on weapon pylons; satcom receiver positioned behind cockpit. Empty weight of EA-18G is 815 kg (1,797 lb) greater than F/A-18F, with carrier landing weight increased by 1,360 kg (2,998 lb).

US Navy requirement called for new EW aircraft to replace Grumman EA-6B Prowler from 2009 onwards; existing EA-6B equipment such as AN/ALQ-99 jamming system pods to migrate to **EA-18G**, with US Navy seeking to acquire about 90 aircraft by 2012. Second multiyear procurement batch expected to include 128 two-seaters, of which 56 should emerge as EA-18G EW aircraft, with first four LRIP examples funded in FY06, followed by 12 more in FY07, 18 in FY08 and 22 in FY09. IOC target date in 2009.

Initial flight demonstration of first EMD F/A-18F, configured with three AN/ALQ-99 jamming pods and two fuel tanks, accomplished in November 2001; further trials in 2002 expanded performance envelope and provided data on noise and vibration characteristics. These initial evaluations confirmed suitability of Super Hornet for EW mission and paved way for award, on 29 December 2003, of USD979 million contract to cover five-year SDD (system development and demonstration) programme. Majority of SDD testing to be undertaken by two F/A-18Fs that will be modified to pre-production EA-18G configuration; assembly of first components begun by Northrop Grumman at El Segundo on 1 July 2004, with Boeing following suit at St Louis on 22 October. Aft fuselage section of first EA-18G (166641) delivered to St Louis by Northrop Grumman in March 2005; this aircraft essentially complete by 28 April 2005, when rolled off production line to begin year-long modification into EA-18G configuration. Second aircraft (166642) followed suit in late May. Previously, eight-month wind tunnel test programme concluded in January 2005, data gathered being used to complete detailed design in time for critical design review in April 2005. Process of weapon system integration began January 2006, following two test readiness reviews conducted by US Navy in November 2005 and January 2006; over 2,400

CURRENT AND PLANNED US NAVY SUPER HORNET SQUADRONS

Squadron number	Variant	FY of conversion	Previous equipment	Remarks
VFA-2	F/A-18F	03	F-14D	
VFA-11	F/A-18F	05	F-14B	
VFA-14	F/A-18E	01	F-14A	
VFA-15	F/A-18E	06	F/A-18C	
VFA-22	F/A-18E	03	F/A-18C	
VFA-27	F/A-18E	04	F/A-18C	
VFA-31	F/A-18F	06	F-14D	
VFA-32	F/A-18F	06	F-14B	
VFA-41	F/A-18F	01	F-14A	
VFA-81	F/A-18E	08	F/A-18C	
VFA-102	F/A-18F	02	F-14B	
VFA-103	F/A-18F	04	F-14B	
VFA-105	F/A-18E	08	F/A-18C	
VFA-106	F/A-18E/F	04	—	Atlantic Fleet training unit
VFA-115	F/A-18E	00	F/A-18C	First squadron to deploy
VFA-122	F/A-18E/F	00	—	Pacific Fleet training unit
VFA-137	F/A-18E	03	F/A-18C	
VFA-143	F/A-18E	04	F-14B	
VFA-146	F/A-18E	08	F/A-18C	
VFA-154	F/A-18F	04	F-14A	
VFA-211	F/A-18F	05	F-14A	
VFA-213	F/A-18F	06	F-14D	

SUPER HORNET PROCUREMENT

FY	Lot	Batch	Block	F/A-18E	F/A-18F	EA-18G	Total	First Aircraft
-	-	Prototypes	-	5	2		7	165164
97	21	LRIP 1	52	8	4		12	165533
98	22	LRIP 2	53	8	12		20	165660
99	23	LRIP 3	54	14	16		30	165779
00	24	MYP1	55	15	21		36	165860
01	25	MYP1	56	14	25		39	165896
02	26	MYP1	57	29	19		48	166420
03	27	MYP1	58	12	33		45	166598
04	28	MYP1	59	15	27		42	166643
05	29	MYP2	60	15	27		42	
06	30	MYP2	61	25	13	4	42	
07	31	MYP2	62	14	16	12	42	
08	32	MYP2	63	14	10	18	42	
09	33	MYP2	64	14	6	22	42	
Total				**202**	231	**56**	**489**	

Notes: MYP2 contract includes option to increase number by up to six per year. FY03 F/A-18F quantity includes two EMD EA-18Gs. Figures shown for F/A-18E and F/A-18F procurement in FY08 and FY09 are not confirmed and could be subject to change.

test points to be verified in Boeing's Electronic Systems Integration Laboratory before avionics suite is installed in first EA-18G. First aircraft due to make maiden flight in September 2006.

Multimission capability will be retained by EA-18G, which will feature Improved Capability 3 (ICAP 3) EW suite, comprising AN/ALQ-99 jamming pods and AN/ALQ-218(V)2 digital receiver system. So-called Block 1 EA-18G will carry EW avionics in gun bay, with associated AN/ALQ-218 receivers in wingtip pods and up to five AN/ALQ-99F jamming pods plus USQ-113 communications countermeasures system; armament will include pairs of AGM-88 HARM for attack and AIM-120C AMRAAM for self-defence. Enhanced Block 2/3 versions expected to use New Technology (NT) jamming pod, for which it is hoped to secure development funds in 2006, although upgrading existing AN/ALQ-99 is reportedly still under consideration. Other Block 2/3 enhancements could include additional precision weapons, IDECM, new communications countermeasures system and Joint Tactical Radio System.

CUSTOMERS: US Navy. Seven prototypes; approval for 12 LRIP aircraft in FY97. See table for details of prototypes, three LRIP batches and two multiyear procurement (MYP) batches; contract for first MYP batch (eventually totalling 210 aircraft) signed on 15 June 2000, with second MYP contract (also of 210 aircraft) awarded on 29 December 2003. All 62 LRIP aircraft delivered by end of third quarter of 2001, with first full-rate production Super Hornet (an F/A-18F) handed over in late September; 100th Super Hornet (an F/A-18F) delivered 14 June 2002; 200th Super Hornet (F/A-18F 166615) delivered 30 August 2004; total of 215 (including prototypes) had been accepted by US Navy at end of 2004, thought to comprise 99 F/A-18Es and 116 F/A-18Fs; further 42 accepted in 2005, increasing total to 257, probably consisting of 113 F/A-18Es and 144 F/A-18Fs. Broad requirement originally identified for over 1,000 by FY15, but Quadrennial Defense Review reduced this to minimum of 548 and maximum of 785; defence guidance planning proposal in first quarter of 2002 advocated further reduction to 460. Latest procurement plans (early 2004) anticipate purchase of 550 Super Hornets, including 90 EA-18Gs. Boeing seeking export sales, following approval by US government and in late 2004 it was revealed that initial batch of 12 aircraft (four F/A-18F and eight F/A-18E) could be ready for delivery to export customer in 2007 at approximate cost of USD53 million to USD55 million per aircraft. Super Hornet could be among competitors for order for 126 fighter aircraft to satisfy Indian Air Force requirement revealed in 2005.

COSTS: Development estimated USD4.8 billion (1992); USD1,089 million in FY92 budget; USD943 million in FY93; approximately USD1,500 million in FY94 and USD1,348 million requested for FY95. USD2,600 million in provisional FY97 budget for first 12 aircraft; with USD2,100 million requested for FY98 procurement of 20 aircraft. US GAO estimated flyaway unit cost as being of the order of USD43.6 million in 1996, based on original planned procurement of 1,000. Most recent figures, for second MYP batch, put total cost at USD8.6 billion for 210 aircraft. Unit cost quoted as USD48 million in mid-2000, when Boeing pursuing measures to drive cost down to around USD40 million by 2005. Estimated unit cost of EA-18G approximately USD66 million. US Navy quotes USD57 million unit cost for F/A-18E and F/A-18F (2005).

DESIGN FEATURES: Generally as for first-generation Hornet. Stretched versions of F/A-18C/D; gross landing weight increased by 4,536 kg (10,000 lb); 0.86 m (2 ft 10 in) fuselage plug; wings photometrically increased in size to provide 9.29 m^2 (100.0 sq ft) extra area and 1.31 m (4 ft 3½ in) span increase; control surfaces disproportionately enlarged and dogtooth added to leading-edge for increased aileron authority. Wings 2.5 cm (1 in) deeper at root; larger horizontal tail surfaces; LEX size substantially increased in early 1993 (from total 5.8 m^2; 62.4 sq ft to 7.0 m^2; 75.3 sq ft, compared with 5.2 m^2; 56.0 sq ft on F/A-18C/D), ensuring full manoeuvre capability at beyond 40° AoA; also incorporates spoilers on upper surface of LEX as speedbrake and to increase nose-down control authority. Nevertheless, has 42 per cent fewer parts than immediate predecessor.

Additional 1,637 kg (3,600 lb) of internal and 1,406 kg (3,100 lb) of external fuel; 40 per cent extra range; further two (making 11) weapon hardpoints (stations 2 and 10, inboard of wingtips, for AAMs and ASMs of up to 520 kg; 1,146 lb); 'bring-back' weapons load increased to 4,082 kg (9,000 lb); additional survivability measures; air intakes redesigned and slewed to increase mass flow to more powerful F414-GE-400 engines and also changed to 'caret' shape to reduce radar signature. Incorporates several other 'affordable' stealth features to reduce radar cross-section, including saw-toothed doors and panels, realigned joints and edges and angled antennas.

FLYING CONTROLS: Full digital fly-by-wire controls using ailerons and tailerons for lateral control, plus flaps in flaperon form at low airspeeds; leading- and trailing-edge flaps scheduled automatically for high manoeuvrability, fast cruise and slow approach speed; horizontal stabilisers automatically assume neutral position if one is damaged, with pitch control then being passed to other surfaces; both rudders turned in at take-off and landing to provide extra nose-up trim effort; fly-by-wire returns towards 1 *g* flight if pilot releases controls; lateral and then directional control progressively washed out as angle of attack reaches extreme values; height, heading and airspeed holds provided in fly-by-wire system; aircraft can land automatically using carrier-based guidance system. Bertea hydraulic actuators for trailing-edge flaps; Hydraulic Research actuators for ailerons; National Water Lift actuators for tailerons.

STRUCTURE: Multispar wing mainly of light alloy, with graphite/epoxy inter-spar skin panels and trailing-edge flaps; tail surfaces mainly graphite/epoxy skins over aluminium honeycomb core; graphite/epoxy fuselage panels and doors; titanium engine firewall. Northrop Grumman responsible for rear and centre fuselages; assembly and test at St Louis factory; CASA produces horizontal tail surfaces, flaps, leading-edge extensions, speedbrakes, rudders and rear side panels for all F/A-18s.

LANDING GEAR: Retractable tricycle type, with Messier-Dowty twin-wheel nose and Menasco single-wheel main units. Nose unit retracts forward, mainwheels rearward, turning 90° to stow horizontally inside the lower surface of the engine air ducts. AlliedSignal wheels and brakes. Nosewheel tyres size 22×6.6–10 (20 ply) tubeless, pressure 24.13 bar (350 lb/sq in) for carrier operations, 10.34 bar (150 lb/sq in) for land operations. Mainwheel tyres size 30×11.5–14.5 (24/26 ply) tubeless, pressure 24.13 bar (350 lb/sq in) for carrier operations, 13.79 bar (200 lb/sq in) for land operations. Ozone nosewheel steering unit. Nose unit towbar for catapult launch. Arrester hook, for carrier landings, under rear fuselage.

POWER PLANT: Two General Electric F414-GE-400 turbofans, each rated at approximately 97.9 kN (22,000 lb st) with afterburning. Internal fuel contained within four bladder-type fuselage fuel cells and wing cells, giving total capacity (F/A-18F: JP-5 fuel) of 7,798 litres (2,060 US gallons; 1,715 Imp gallons). Wing tanks protected from combat damage by low-density foam. Provision for five 1,250 litre (330 US gallon; 275 Imp gallon) or Lincoln Composites 1,817 litre (480 US gallon; 400 Imp gallon) external tanks, giving F/A-18F maximum fuel capacity of 16,883 litres (4,460 US gallons; 3,714 Imp gallons) and ability to operate in air refuelling role using hose drum unit on centreline station. Normal operational fit anticipated as three external tanks of either size.

ACCOMMODATION: Pilot only in F/A-18E, on Martin-Baker SJU-5/6 NACES zero/zero ejection seat, in pressurised, heated and air conditioned cockpit. Upward-opening canopy, with separate windscreen, on all versions. Two pilots or pilot and Naval Flight Officer in F/A-18F. Pilot and Electronic Countermeasures Officer in EA-18G.

SYSTEMS: High commonality with F/A-18C/D, incorporating two separate and independent hydraulic systems, each at 207 bar (3,000 lb/sq in), but with more powerful actuators to accommodate enlarged control surfaces with increased deflections. Leland Electrosystems power generating system; provides 60 per cent more electrical power than in F/A-18C. Hamilton Sundstrand air conditioning; Vickers hydraulic pumps; oxygen system; fire detection and extinguishing systems. Honeywell GTC36-200 APU.

AVIONICS: Over 90 per cent commonality with F/A-18C, but differences include following:

Comms: Rockwell Collins AN/ARC-210 secure UHF/VHF radio. Multifunction information distribution system (MIDS) datalink, Rockwell Collins digital communication system and Hazeltine combined interrogator transponder to be installed as part of upgrade package; IOC of MIDS-configured aircraft occurred in late 2003.

Radar: Raytheon AN/APG-73 multimode, digital air-to-air and air-to-ground radar as standard. Raytheon AN/APG-79 active electronically scanned array (AESA) X-band radar under development for use on Super Hornet from 2006; first radar unit formally rolled out by Raytheon on 21 November 2002. Current plans anticipate procurement of 415 AESA radars, comprising 280 for new-build aircraft and 135 for retrofit to existing F/A-18E/Fs. First AN/APG-79-equipped aircraft (from Lot 27 production) rolled out 21 April 2005 and delivered to VX-9 squadron on 5 May for trials and operational evaluation. Operational deployment with fleet unit set for September 2006.

Flight: Litton embedded GPS; Smiths/Harris tactical aircraft moving map capability (TAMMAC); DRS Technologies deployable flight incident recorder set (DFIRS).

Instrumentation: Cockpit has 76 × 127 mm (3 × 5 in) touch-panel LCD upfront display and 159 mm (6¼ in) square colour LCD tactical situation display; also two 127 mm (5 in) square monochrome displays and will have monochrome programmable LCD in place of F/A-18C engine/fuel display; Kaiser AN/AVQ-28 HUD. Planar Advance/dpiX awarded joint development contract for Eagle-6 multifunction AMLCD in first half of 1998. Aft cockpit 'missionised' for strike operations, including 205 × 255 mm (8 × 10 in) AMLCD, two 127 mm (5 in) square multifunction LCDs and two hand controllers for use by NFO. Elbit Systems subsidiary EFW awarded initial contract in second quarter of 2004 to develop new cockpit displays; eventual deal could be worth USD45 million and involve installation of displays in some 360 aircraft.

TEAC solid-state recorders being installed. These capture screenshot of target imagery which can be downlinked to ground unit that can annotate image and return it to cockpit. Increment two allows aircraft to send imagery to a combined air operations centre for comparison with previous imagery to refine target co-ordinates.

Mission: Raytheon AN/ASQ-228 advanced targeting forward-looking infra-red (ATFLIR) targeting and navigation system subject of USD900 million EMD contract in March 1998. Low-rate initial production authorised in March 2001 with first units delivered 21 May 2002; operational evaluation completed in third quarter of 2003, with IOC attained in September of that year. Full rate production go-ahead on 17 December 2003, when Raytheon awarded USD298 million contract for initial 88 pods, delivery of which began in first quarter of 2005. Total purchase then expected to be about 530 pods, down from original planned 574. Raytheon Shared Reconnaissance Pod (SHARP) system, incorporating Recon/Optical CA-279 digital reconnaissance sensor system, under development. Initial deployment by VFA-14 and VFA-41 in USS *Nimitz* in early 2003, albeit with some key elements, such as high-resolution electro-optical/infra-red sensor and datalink, omitted. DRS Technologies WRR-818 cockpit video recording system.

Advanced mission computers based on commercial hardware and software and colour flat panel LCD displays in development for incorporation in FY05, with DY4 Systems awarded USD1 million order to upgrade existing system which relies on Control Data Corporation AN/AYK-14 digital computers; upgrade will involve replacement of AN/AYK-14 by DMV-179 single board computers and PMC-642 fibre channel network interface module. Vision Systems International joint helmet-mounted cueing system (JHMCS) installed to target the AIM-9X high off-boresight missile; testing of JHMCS on Super Hornet began at China Lake, California, in 2001, with delivery of production articles beginning in 2002.

Self-defence: Management by BAE Systems (formerly Sanders) AN/ALQ-214(V)2 integrated defensive electronic countermeasures suite (IDECM); interfaces with Raytheon

AN/ALR-67(V)3 radar warning receiver, BAE Systems (formerly Sanders) AN/ALE-55 fibre optic towed radar decoy (with triple dispenser stowed between jetpipes); and four BAE Systems AN/ALE-47 chaff/flare dispensers. However, delay and cost growth of IDECM resulted in first three operational squadrons having aircraft with less sophisticated Raytheon AN/ALE-50 towed decoy in conjunction with AN/ALQ-165 ASPJ, AN/ALQ-214 RF countermeasures system was expected to achieve IOC in July 2004, with AN/ALE-55 FOTD to begin operational evaluation in December 2005.

ARMAMENT: Full range of USN offensive and defensive ordnance can be employed, with new weapons added as they become available. Integration of Joint Air-to-Surface Stand-Off Missile (JASSM) now under way and should be completed by December 2007. At least 29 weapons combinations cleared before service entry. M61A2 20 mm cannon with 400 rounds; compatible with AIM-9X Advanced Sidewinder missile.

US Navy ordnance list for F/A-18E/F comprises Mk 56 mine; Mk 62, 63, 65, 82, 83 bombs; GBU-12, 16, 24; CBU-59, 72 and Mk 20 cluster bombs; LAU-68 rocket launcher; JSOW; JDAM; Mk 77 napalm bomb; Walleye ER/DL and Walleye I; AGM-84D, AGM-45, AGM-65 ASMs; AIM-120, AIM-9, AIM-7 AAMs; and TALD decoy launcher.

DIMENSIONS, EXTERNAL (approx):

Wing span over missiles	13.68 m (44 ft 10½ in)
Wing aspect ratio	4.0
Width, wings folded	9.94 m (32 ft 7¼ in)
Length overall	18.38 m (60 ft 3½ in)
Height overall	4.88 m (16 ft 0 in)

AREAS:

Wings, gross	46.45 m² (500.0 sq ft)

WEIGHTS AND LOADINGS:

Operating weight empty: F/A-18E	14,552 kg (32,082 lb)
F/A-18F	14,875 kg (32,794 lb)
Max fuel weight (JP-5): internal	6,354 kg (14,008 lb)
external	7,381 kg (16,272 lb)
Max external stores load: T-O	8,028 kg (17,700 lb)
landing: F/A-18F	4,082 kg (9,000 lb)
F/A-18E	4,491 kg (9,900 lb)
T-O weight, attack mission: catapult	29,937 kg (66,000 lb)
land	30,209 kg (66,600 lb)
Max landing weight (carrier)	19,958 kg (44,000 lb)
Max wing loading	644.5 kg/m² (132.00 lb/sq ft)
Max power loading	153 kg/kN (1.50 lb/lb st)

PERFORMANCE (estimated):

Max level speed at altitude	M1.6
Approach speed	125 kt (232 km/h; 144 mph)
Combat ceiling	more than 15,240 m (50,000 ft)
Min wind over deck:	
launching	30 kt (56 km/h; 34.5 mph)
recovery	15 kt (28 km/h; 17.5 mph)
Range:	
clean with two AIM-9 Sidewinder AAMs	1,275 n miles (2,361 km; 1,467 miles)
ferry with two AIM-9s and three 480 US gallon tanks	1,660 n miles (3,074 km; 1,910 miles)
Combat radius:	
interdiction with two SLAM-ER, two AMRAAMs, two Sidewinders and three 1,817 litre (480 US gallon; 400 Imp gallon) external tanks, hi-hi-hi (including flight of SLAM-ER)	945 n miles (1,750 km; 1,087 miles)
fighter escort with four AMRAAMs, two Sidewinders and three 1,817 litre (480 US gallon; 400 Imp gallon) external tanks	795 n miles (1,472 km; 914 miles)
Combat endurance	
maritime air superiority, six AAMs, three 1,818 litre (480 US gallon; 400 Imp gallon) external tanks, 150 n miles (278 km; 173 miles) from aircraft carrier	2 h 15 min
g limit	+7.6

BOEING C-17A GLOBEMASTER III

TYPE: Medium transport multirole.

PROGRAMME:

DEVELOPMENT MILESTONES

Programme launched	28 Aug 1981
First order (development)	31 Dec 1985
First prototype material cut	2 Nov 1987
First flight	15 Sep 1991
Production go-ahead	20 Jan 1988
First flight, production	18 May 1992
First delivery	14 Jun 1993
Entered service (IOC)	17 Jan 1995

US Air Force selected McDonnell Douglas to develop C-X cargo aircraft 28 August 1981; full-scale development called off January 1982 and replaced on 26 July 1982 by slow-paced preliminary development order; development and three prototypes (one flying) ordered 31 December 1985; fabrication of prototype C-17A (T1/87-0025) began 2 November 1987; first production C-17A contract 20 January 1988; assembly started at Long Beach 24 August 1988; assembly of prototype completed 21 December 1990. Programme transferred from Douglas Aircraft Company to McDonnell Douglas Aerospace in 1992; to McDonnell Douglas Military Transport Aircraft in 1996 and to Boeing following merger of August 1997.

First flight (T1/87-0025) 15 September 1991 – also delivery to Edwards AFB; first flight of initial production aircraft (P1/88-0265) 18 May 1992; first delivery to operational unit (P6/89-1192) 14 June 1993. First overseas service flight (P11/92-3291) to Mildenhall, UK, 25 May 1994.

C-17 was named Globemaster III on 5 February 1993; peak production rate 15 per year; assembly in 102,200 m² (1.1 million sq ft) facility at Long Beach, California.

Development flight testing completed 15 December 1994, by which time 16 production aircraft delivered and 22nd record set (further 13 world records set by 71st production aircraft during testing at Edwards in November 2001). Initial AMC squadron (17th AS) received its 12th C-17A 22 December 1994; achieved IOC 17 January 1995 with acceptance of 13th (nominal spare) aircraft. Second squadron (14th AS) received its first aircraft 17 February 1995. Air Education and Training Command's 97th AMW at Altus AFB, Oklahoma, subsequently took delivery of eight aircraft between March 1996 and November 1997, all of which had previously been assigned to the 437th AW. Deliveries to 7th AS of 62nd AW at McChord AFB, Washington, began at end of July 1999. First C-17 for Air National Guard (02-1112) handed over at Long Beach on 17 December 2003 and allocated to 172nd AW at Jackson, Mississippi. C-17 fleet passed 500,000 flying hours in 2003, excluding more than 1,000 hours accumulated by the test-dedicated prototype aircraft; total flight time by August 2005 exceeded 850,000 hours, with USAF reporting 84 per cent operational readiness rate at same time. Fleet passed 1 million flight hour milestone on 20 March 2006.

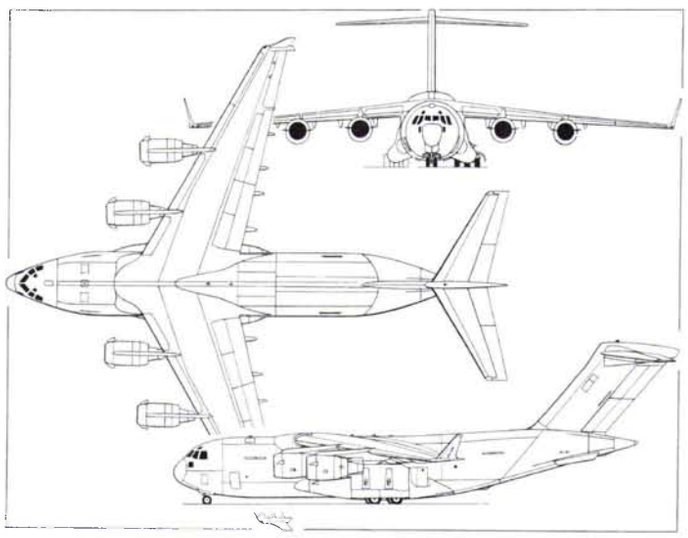
Possible new role emerged on 29 September 2005, when C-17A used for drop test of mock-up of 24,950 kg (55,000 lb), 20 m (65 ft), QuickReach booster rocket at Edwards AFB, California; further drop tests are planned, leading eventually to test with live rocket. Further proposal, revealed October 2005, envisages use of C-17 to carry and deliver air-to-ground weapons such as Boeing Dominator loitering missile; in this role, C-17 could carry weapons on pallets for launch from cargo hold in so-called JITSA (Just-In-Time Strike Augmentation) concept. Air Combat Command has reportedly expressed interest in JITSA, but no funds have been appropriated for demonstration programme.

CURRENT VERSIONS: **C-17A:** Basic standard. Has been progressively refined since service entry, with several further upgrades already under way or in prospect; these include provision of combat lighting system, which is expected to be fielded by FY13; adoption of formation flight system (FY11); installation of LAIRCM (large aircraft infra-red countermeasures) now in process of fielding; fitment of LOX bottle armour (FY17); substitution of enhanced OBIGGS II for present OBIGGS (FY14); provision of Secure Enroute Communications Package-Improved (SECOMP-I) by FY10; and development of performance data allowing expanded operations from unimproved airstrips, for completion in FY06.

Detailed description applies to C-17A.

Boeing C-17A Globemaster III training exercise over Virginia's Blue Ridge Mountains in December 2005, flown by Charleston AFB's 437th and 315th Airlift Wings
(SSgt Jacob N Bailey, USAF) 1128918

62nd/446th Airlift Wing Boeing C-17A Globemaster III *(Paul Jackson)* 1128951



Boeing C-17A Globemaster III long-range heavy cargo transport
(Dennis Punnett) 1158083

C-17A+: Boeing proposal, revealed in June 2005, for a revised configuration with more powerful engines, redesigned flaps and additional centreline landing gear; these changes would give ability to operate in tactical role from shorter unimproved and austere airfields. C-17A+ could be available from 2012, but future of this proposal appears uncertain, in absence of follow-on purchase by USAF to sustain production line in meantime.

C-17B: Not assigned. Used unofficially (along with C-17ER) to identify aircraft with extended-range fuel tanks (Lot 12 and upwards).

KC-17: Private venture tanker/transport project, offered unsuccessfully as replacement for USAF KC-135R/T Stratotanker.

BC-17X: Projected civil cargo version, known until 2000 as MD-17. Little interest shown then, but new proposal emerged in mid-2004, whereby US airfreight companies could acquire 22 oldest C-17s from the USAF, which would in turn replace them with newer aircraft to latest configuration. Commercial operators appear well disposed to this proposal, which would also provide extra airlift capacity should that be required by the US armed forces; in mid-2004, Boeing forecasting that up to 30 BC-17X aircraft could be required, but no apparent movement on this proposal by start of 2006.

CUSTOMERS: US Air Force; original requirement 210; cut to 120 by 1991; capped at 40 in January 1994 for two year probationary period, during which contractor to achieve performance, cost and delivery targets; decision taken on 3 November 1995 to acquire the balance of 80 C-17s. Multiyear procurement contract signed 31 May 1996 for production through 2004; first aircraft from this contract (P41/97-0041) delivered 10 August 1998; last (P120/03-3120) due to have been handed over on 30 November 2004, but actually delivered almost six months ahead of schedule.

Second multiyear procurement contract valued at USD9,7 billion for additional 60 aircraft announced on 15 August 2002, raising total USAF buy to 180. Negotiations between Boeing and the USAF for further 42 C-17s that could be purchased with FY08-10 funds now appear unlikely to result in firm order, although a small number (possibly seven) of additional aircraft now likely to be acquired; in conjunction with recent order from Australia, this should sustain production line until about 2010.

Basing plans were revealed soon after the decision to procure 120 in all, when the USAF announced that the 437th AW at Charleston AFB, South Carolina, and the 62nd AW at McChord AFB, Washington, would each receive 48 Globemaster IIIs, with these respectively being supported by Air Force Reserve Command personnel of the 315th AW and 446th AW. A further eight C-17As went to the 97th Air Mobility Wing at Altus AFB, Oklahoma, for training duties. Finally, of the original 120, eight have been assigned to the Air National Guard's 172nd AW at Jackson, Mississippi, the first of which (P112/02-1112) was handed over 17 December 2003. Delivery of aircraft from the 60 ordered in 2002 began on 7 July 2004, with the first example (P121/03-3121) assigned to the 418th Flight Test Squadron at Edwards AFB. First of 13 aircraft (P125/03-3125) for 305th Air Mobility Wing at McGuire AFB, New Jersey, accepted at Long Beach 23 September 2004. Air Force Reserve Command's 452nd Air Mobility Wing at March ARB, California, received first of eight aircraft (04-4138) in August 2005 and was fully equipped with the delivery of last aircraft (05-5145) in mid-January 2006. First aircraft for joint USAF/ANG unit at Hickam AFB, Hawaii, was 05-5146, which was ferried to Hawaii on 7 February 2006 and officially accepted on the following day; seven more will follow in 2006, with delivery of eight aircraft to Elmendorf AFB, Alaska, beginning in 2007.

The first C-17A to be handed over to Air Mobility Command was the final aircraft from Lot 2 (P6/89-1192), which made its first flight on 8 May 1993 and was ferried to Charleston AFB for the 437th AW on 14 June 1993. By end of 2002, more than 90 C-17As had been received by the USAF; 100th C-17 (including three prototypes and four for UK) delivered on 8 November 2002, this being 93rd production aircraft for USAF (01-0193); 125th USAF aircraft handed over at Long Beach 23 September 2004. Total of 145 delivered to USAF by end of January 2006. Last two of 180 aircraft currently on order due for delivery to USAF in March 2008.

In early 1997, UK Ministry of Defence reportedly considering acquisition of a small number of C-17s for service with RAF in strategic airlift role; no formal requirement then existed, but cost data were received from the USA. Invitation to submit bids for supply on lease basis of up to four 'C-17 equivalent' Short Term Strategic Airlift aircraft issued September 1998, but subsequent criticism by other potential bidders that requirement was weighted in favour of C-17 prompted UK MoD to waive some requirements. Submissions made in early 1999, but competition then suspended in August 1999, when none of competing bids proved acceptable. Restarted, late 1999; announced that C-17 selected on 16 May 2000, with total of four aircraft to be acquired for No. 99 Squadron. These taken from Lot 12 production; assembly of first officially begun 28 June 2000, although lease agreement with Chase Manhattan Bank not signed until 12 January 2001. Lease duration set at seven years, with options for two one-year extensions; on termination of lease arrangement, UK has announced intent to purchase all four aircraft and add a fifth in 2010-11, although this dependent upon continued production. Each initial aircraft valued at £197 million.

First aircraft (UK1/ZZ171/00-0201) accepted by RAF on 17 May 2001 at Long Beach; ferried to UK via Charleston AFB and arrived at Brize Norton 23 May. Final aircraft (UK4/ZZ174/00-0204) accepted 24 August 2001 and at Brize Norton by end of August; first operational sortie in early June; fleet in-service date officially 30 September 2001.

Third confirmed customer will be Australia, which announced intent in December 2005 to obtain total of four aircraft at reported total cost of about USD2 billion.

Canada has requirement for new strategic transport and is believed to be examining several options, including lease or outright purchase of up to three C-17s. Version of the C-17 to be offered for Japanese C-X requirement, while Sweden reported in early 2006 to be considering lease or purchase of two aircraft. On 19 July 2006, Denmark became first NATO member to sign letter of intent for establishment of C-17 pool available to members.

COSTS: Multiyear procurement contract for 80 aircraft signed in May 1996 worth USD14,2 billion; separate USD1,6 billion contract followed in December 1996 for 320 F117 engines. Unit price proposed in November 1995 was USD190 million; recent figures (April 2006) refer to unit cost for foreign customers of USD220 million. Second multiyear procurement contract for 60 aircraft valued at USD9,7 billion.

DESIGN FEATURES: Typical T tail, upswept rear fuselage, high-wing, podded-engine transport, deriving much detail, including externally blown flap system, from McDonnell Douglas YC-15 medium STOL transport prototypes, which involves extended flaps being in exhaust flow from engines during take-off and landing. Combines load-carrying capacity of Lockheed C-5 with STOL performance of Lockheed Martin C-130; required to operate routinely from 915 m (3,000 ft) long and 27,45 m (90 ft) wide runways, complete 180° three-point turn in 25 m (82 ft) and back-taxi up 1 in 50 gradient when fully loaded using thrust reversers. Structure designed to survive battle damage and protect crew; rear-loading ramp.

Supercritical wing with 25° sweepback; 2,72 m (8,9 ft) high NASA winglets, angled at 15° from vertical and with 30° sweep.

FLYING CONTROLS: First military transport with all-digital FBW control system and two-crew cockpit with central stick controllers; outboard ailerons and four spoilers per wing; four elevator sections; two-surface rudder split into upper and lower segments; full-span leading-edge slats; two-slot, fixed-vane, simple hinged flaps over about two-thirds of trailing-edge; small strakes under tail. Quadruple-redundant BAE Systems digital fly-by-wire flight control system, with mechanical back-up; redesign of FCS initiated in 2002, with BAE Systems selected in October to upgrade with CsLEOS real-time operating system (RTOS) as part of package of improvements to autopilot flight control system. This installed on new-build C-17s beginning with P121/03-3121, delivered in mid-2004.

STRUCTURE: Major subassemblies produced in factory at Macon, Georgia; some 50 subcontractors, of which 21 for airframe; subcontractors include Vought (composites ailerons, rudder, elevators, vertical and horizontal stabilisers, engine nacelles and thrust reversers), McCoak Metals (wing skins), Contour Aerospace (wing spars and stringers), Kaman Aerospace (wing ribs and bulkheads), Hitco Technologies (tailcone), Heath Tecna (wing-to-fuselage fillet), Aerostructures Hamble (composites flap hinge fairings and trailing-edge panels) and Northwest Composites (main landing gear pod panels). Raytheon was original supplier of composites winglets and landing gear doors, but replaced by Marion Composites with effect from 41st aircraft; Marion Composites also fabricates nose and tail radomes for last 80 aircraft of USAF order. C-17A structure is 69,3 per cent aluminium; 12,3 per cent steel alloys; 10,3 per cent titanium and 8,1 per cent composites. Wings of

C-17 PROCUREMENT

FY	Lot	Qty	Cum	Line Numbers	First aircraft	First Delivery
	Prototype	1	(1)	T1	87-0025	15 Sep 1991
88	1	2	2	P1-P2	88-0265	18 May 1992
89	2	4	6	P3-P6	89-1189	7 Sep 1992
90	3	4	10	P7-P10	90-0532	26 Aug 1993
92	4	4	14	P11-P14	92-3291	8 Apr 1994
93	5	6	20	P15-P20	93-0599	29 Sep 1994
94	6	6	26	P21-P26	94-0065	31 Jul 1995
95	7	6	32	P27-P32	95-0102	3 Jul 1996
96	8	8	40	P33-P40	96-0001	28 Aug 1997
97	9	8	48	P41-P48	97-0041	10 Aug 1998
98	10	9	57	P49-P57	98-0049	22 April 1999
99	11	13	70	P58-P70	99-0058	17 March 2000
00	12	15	85	P71-P85	00-0171	8 Feb 2001
00	12	4 (RAF)	89	UK1-UK4	00-0201/ZZ171	17 May 2001
01	13	12	101	P86-P97	01-0186	May 2002
02	14	15	116	P98-P112	02-1098	Early 2003
03	15[1]	15	131	P113-P127	03-3113	Early 2004
04	16	11	142	P128-P138	04-4128	Late 2004
05	17	15	157	P139-P153	05-5139	Late 2005
06	18	15	172	P154-P168	06-6154[2]	
07	19	12	184	P169-P180	07-7169[2]	
Total		**184 + 1**				

[1] Includes first seven aircraft from follow-on batch of 60 C-17s
[2] Unconfirmed

P1-P10 underwent local strengthening as consequence of load test of 1 October 1992; first rework to P8/90-0533 at McDonnell Douglas, Tulsa, between 3 January and 9 April 1994

Proposal, early 1994, to design all-composites horizontal tail surfaces for weight-saving resulted in McDonnell Douglas (later Boeing) securing a US$40.7 million contract to build new unit; revised tail manufactured by Northrop Grumman (now Vought) using AS-4 carbon fibre for spars and skins and machined 7075 aluminium for ribs, resulting in assembly said to be 50 per cent cheaper and 20 per cent lighter than existing tail. Incorporates 2,000 fewer components and 42,000 fewer fasteners. Following testing on prototype, completed April 1999, it was incorporated on production aircraft beginning with P51/98-0051

Landing gear pod entirely redesigned in 1995, drastically reducing number of parts and fasteners and simplifying process of attachment to aircraft; introduced on first Lot 8 aircraft (P33/96-0001) and then expected to save US$88 million over remainder of production programme for USAF. New, lighter and less costly engine nacelle, saving 113 kg (250 lb) per unit, flight tested at Edwards AFB between December 1997 and February 1998; first production aircraft with new nacelles (P41/97-0041) delivered to USAF on 10 August 1998

LANDING GEAR: Hydraulically retractable tricycle type, with free-fall emergency extension; designed for sink rate of 3.81 m (12 ft 6 in)/s and suitable for operation from paved runways or unpaved strips. Mainwheel units, each consisting of two legs in tandem with three wheels on each leg, rotate 90° to retract into fairings on lower fuselage sides; tyre size 50×21.0-20 (30 ply) tubeless; pressure 9.52 bar (138 lb/sq in). Menasco (Goodrich from 41st aircraft) twin-wheel nose leg retracts forwards; tyre size 40×16–14 (26 ply) tubeless; pressure 10.69 bar (155 lb/sq in). Honeywell wheels and carbon brakes initially fitted; with effect from aircraft P90/01-0190, Messier-Bugatti wheels, tyres and brakes fitted as standard. Permitting C-17 to be certified to 278,959 kg (615,000 lb) MTOW, these subsequently retrofitted to entire fleet. Minimum ground turning radius at outside mainwheels 17.37 m (57 ft 0 in); minimum taxiway width for three-point turn 27.43 m (90 ft 0 in); wingtip/tailplane clearance 74.24 m (237 ft 0 in).

POWER PLANT: Four Pratt & Whitney F117-PW-100 (PW2040) turbofans, with maximum flat rating of 179.9 kN (40,440 lb st), pylon-mounted in individual underwing pods and each fitted with a directed-flow thrust reverser deployable both in flight and on the ground. With effect from the 20th production aircraft, an improved version of the F117 was adopted, this embodying single-crystal turbine blade technology, a supercharged compressor and enhanced thermal barrier coatings; benefits include a 20 per cent reduction in cost of maintenance, increased reliability and slightly better sfc. Pratt & Whitney, Boeing and USAF seeking in late 2003 to improve engine reliability in wake of increase in unplanned removals and concerns over durability that emerged during Afghan and Iraq operations. Provision for in-flight refuelling. Two outboard wing fuel tanks of 21,210 litres (5,603 US gallons; 4,665 Imp gallons) each; two inboard wing fuel tanks of 30,056 litres (7,940 US gallons; 6,611 Imp gallons) each; total capacity 102,532 litres (27,086 US gallons; 22,554 Imp gallons). BAE Systems fuel pumps. With effect from the 71st (first Lot 12) aircraft, an extended-range fuel tank containment system (ERFCS) was adopted; this converts wing dry bay into additional fuel tank containing approximately 36,339 litres (9,600 US gallons; 7,994 Imp gallons) of fuel, thus increasing range with 18,144 kg (40,000 lb) payload by 900 n miles (1,667 km; 1,036 miles). ERFCS also installed on four UK aircraft.

ACCOMMODATION: Normal flight crew of pilot and co-pilot side by side and two observer positions on flight deck, plus loadmaster station at forward end of main floor; access to flight deck via downward-opening airstair door on port side of lower forward fuselage. Bunks for crew immediately aft of flight deck area; crew comfort station at forward end of cargo hold

Main cargo hold able to accommodate US Army wheeled and tracked vehicles up to M1 main battle tank, including 5 ton expandable vans in two rows, or up to three AH-64 Apache attack helicopters, with loading via hydraulically actuated rear ramp which forms underside of aft fuselage when retracted. Aircraft fitted with 27 stowable tip-up seats along each sidewall and another 48 seats carried on board which can be erected along the centreline; optionally up to 36 litters for medical evacuation mission or up to 90 passengers on 10-passenger pallets in addition to 54 sidewall seats. Air delivery system capability for nine 463L pallets plus two on ramp in single row; or logistics handling system for 18 463L pallets in double row. Airdrop capability includes single platforms of up to 27,215 kg (60,000 lb), multiple platforms of up to 54,430 kg (120,000 lb), container delivery system (CDS) for up to 40 CDS bundles or 40 Tri-wall Aerial Delivery System (TRIADS) containers, or up to 102 paratroops; aircraft originally configured for single-row airdrop, but dual-row capability operationally certified in 1998 and is standard feature of 51st and subsequent C-17s, as well as being retrofitted to earlier aircraft. Equipped for low-altitude parachute extraction system (LAPES) delivery.

Cargo handling system includes rails for airdrops and rails/rollers for normal cargo handling, plus Goodrich winch. Each row of rails/rollers can be converted quickly by a single loadmaster from one configuration to the other. Total of 295 cargo tiedown rings, each stressed for 11,340 kg (25,000 lb), all over cargo floor forming grid averaging 74 cm (29 in) square. Three quick-erecting litter stanchions, each supporting three litters, permanently carried. Main access to cargo hold is via rear-loading ramp, which is itself stressed for 18,145 kg (40,000 lb) of cargo in flight. Underfuselage door aft of ramp moves upward inside fuselage to facilitate loading and unloading. Paratroop door at rear on each side; four overhead FEDS (flotation equipment deployment system) escape hatches, three of which are equipped with a liferaft

SYSTEMS: Include Honeywell computer-controlled integrated environmental control system and cabin pressure control system; 2,440 m (8,000 ft) equivalent cabin pressure up to 11,280 m (37,000 ft); quad-redundant flight control and four independent 276 bar (4,000 lb/sq in) hydraulic systems; independent fuel feed systems; electrical system; Honeywell GTCP331-250G APU (at front of starboard landing gear pod), provides auxiliary power for environmental control system, engine starting, and on-ground electronics requirements; onboard inert gas generating system (OBIGGS) for the explosion protection system, pressurised by engine bleed air at 4.14 bar (60 lb/sq in) to produce NEA (nitrogen-enriched air) and governed by a Parker-Gull system controller; fire suppression system; smoke detection systems. Separate OBIGGS for ERFCS-configured aircraft. Next-generation OBIGGS under development and will be installed on all aircraft from about FY14. All phases of cargo operation and configuration change capable of being handled by one loadmaster.

Electrical system includes single 90 kVA generator per engine and an APU, providing 115/200 V, three-phase, 400 Hz AC power; four 200 A transformer-rectifiers providing 28 V DC; single-phase, 1,000 VA inverter for ground refuelling and emergency AC; and two 40 Ah Ni/Cd batteries for APU starting and emergency DC. Aeromedical equipment provided with 60 Hz power.

AVIONICS: *Comms:* Telephonics Corporation IRMS open architecture integrated radio management system; Rockwell Collins AN/ARC-210 secure radio (from P50/98-0050, replacing Raytheon AN/ARC-187 plus Honeywell KY 58 encoder); satcom; VHF-AM/FM; HF; secure voice and jam-resistant UHF/VHF-FM intercom; IFF/SIF; en route army/marine UHF LOS and satcom hook-up; cockpit voice recorder; crash position indicator. Automatic communications processor and multiband radio in new-build aircraft starting with P50/98-0050 and retrofitted to earlier C-17As. In December 1998, Rockwell Collins selected by Boeing to provide SAT-2000 Aero-I satcom systems and CMU-900 communication management units for future global air traffic management (GATM) environment; initial order for support and preproduction hardware, with options to install equipment on all 120 aircraft. Production line GATM introduction at P71/00-0171, involving TCAS, Mode S IFF, ADS-A (automatic dependent surveillance) and Inmarsat Aero I satcom, plus liquid crystal displays replacing all head-down CRTs. GATM augmented from P97 by HF datalink and RNP 4 (required navigation performance) measures. Under development in 1999 were two SOLL II (special operations low-level) roll-on/roll-off communications suites for use on specific missions; and carry-on radio suite for use on special forces flights, beginning in 2002; SOLL II configured C-17 made combat debut in Iraq war of 2003.

Radar: Honeywell AN/APS-133(V) weather/mapping radar initially installed. Honeywell RDR-4000M radar fitted from outset to all aircraft of follow-on order (P121 onward) and retrospectively installed on older C-17s as their existing systems become inoperative

Flight: Three Delco Electronics mission computers with MDC software and electronic control system on P1 to P40; beginning with P41/97-0041, two Lockheed Martin core integrated processors (CIPs) replaced Delco Electronics equipment and retrofitted on earlier aircraft by September 1998; additional memory added from P50/98-0050 onwards. Hamilton Sundstrand aircraft and propulsion data management computer; Honeywell dual air data computers; Litton warning and caution system; master warning system provides aural and voice alerts plus visual alerts on glareshields; General Dynamics automatic test equipment, and support equipment data acquisition and control system; GPS and four Honeywell inertial reference units, although new, embedded GPS INS introduced from P50/98-0050; VOR/DME; Tacan; ILS/marker beacon; UHF-DF; ground proximity warning system; radar altimeter; flight data recorder; flight plan entry manually or via laptop computer. BAE Systems terrain awareness warning system (TAWS) installed in conjunction with Lockheed Martin Control Systems video integrated processor (VIP), from P86/01-0186 onwards; TAWS underwent flight testing at Edwards AFB in 2001–02. New BAE Systems modernised electronic flight control system (MEFCS) entered development in 2003, with initial airborne test of new flight control computer accomplished in mid-2005. Trials of new spoiler control electronic flap computer also begun in June 2005; these two new systems respectively first installed on C-17As P138/04-4138 and P145/05-5145.

Instrumentation: Advanced digital avionics and four Honeywell full-colour cathode ray tube (CRT) displays; new Honeywell 152 × 152 mm (6 × 6 in) AMLCD colour multifunction displays (MFDs) in 71st and subsequent production aircraft; two BAE Systems full flight regime foldable head-up displays.

Mission: Litton integrated mission and communications keyboards (MCKs) and displays (MCDs); Sierra Technologies AN/APN-243A(V) station-keeping equipment (SKE 2000) fitted as standard commencing with P33/96-0001, retrofitted to earlier aircraft and upgraded from P86/01-0186 onwards to increase capacity from 17 to 100 aircraft. Loadmaster's laptop computer from P41/97-0041 onwards; this replaced from P58/99-0058 by Dolch aircrew data device

Self-defence: Development of defensive electronic systems completed in 1994. AN/AAR-47 missile approach warning system and associated BAE Systems AN/ALE-47 automatic flare dispenser initially installed on five aircraft; USAF subsequently adopted this equipment across the fleet. Software changes affecting pilot/vehicle interface subject of accelerated test programme at Edwards AFB in November 2004 that cleared the way for operational fielding. Northrop Grumman laser-based large aircraft infrared countermeasures system (LAIRCM) currently being installed on C-17, with total of 56 systems contracted for by USAF by July 2005; LAIRCM also to be fitted to those aircraft delivered to the UK. Initial installation of single turret on batch 12 aircraft from third quarter 2003, with definitive LAIRCM (including three laser transmitters) following in FY05.

EQUIPMENT: Removable crew armour can be fitted around flight deck and loadmaster's area.

DIMENSIONS, EXTERNAL:

Wing span: wings only	50.29 m (165 ft 0 in)
at winglet tips	51.74 m (169 ft 9 in)
Wing aspect ratio	7.2
Length: overall	53.04 m (174 ft 0 in)
fuselage	48.49 m (159 ft 1¼ in)
Height: to flight deck roof	7.34 m (24 ft 1 in)
to winglet tips	6.93 m (22 ft 9 in)
overall	16.79 m (55 ft 1 in)
Fuselage diameter	6.85 m (22 ft 6 in)
Tailplane span	19.81 m (65 ft 0 in)
Wheel track	10.26 m (33 ft 8 in)
Wheelbase: to front mainwheel	17.60 m (57 ft 8¾ in)
to rear mainwheel	20.05 m (65 ft 9½ in)
Ground clearance under engine pods:	
inboard	2.71 m (8 ft 10½ in)
outboard	2.35 m (7 ft 8½ in)
Distance between fuselage centreline and engine centreline: inboard	7.44 m (24 ft 5 in)
outboard	13.94 m (45 ft 9 in)
Height of winglets	2.72 m (8 ft 11 in)

DIMENSIONS, INTERNAL:

Cargo compartment:	
Length, incl 6.05 m (19 ft 10 in) rear-loading ramp	26.82 m (88 ft 0 in)
Loadable width	5.49 m (18 ft 0 in)
Max height: under wing	3.96 m (13 ft 0 in)
aft of wing	4.50 m (14 ft 9 in)
Height to sill	1.63 m (5 ft 4 in)
Volume	591.8 m^3 (20,900 cu ft)

AREAS:

Wings, gross	353.03 m^2 (3,800.0 sq ft)
Winglets (total)	3.33 m^2 (35.85 sq ft)
Ailerons (total)	11.83 m^2 (127.34 sq ft)
Tailplane	78.50 m^2 (845.00 sq ft)

WEIGHTS AND LOADINGS:

Operating weight empty:	
non-ERFCS aircraft	125,645 kg (277,000 lb)
ERFCS aircraft	127,685 kg (281,500 lb)
Max payload (2.5 *g* load factor):	
non-ERFCS aircraft	76,655 kg (169,000 lb)
ERFCS aircraft	75,250 kg (165,900 lb)
Max weight on rear-loading ramp	18,143 kg (40,000 lb)
Max usable fuel weight:	
non-ERFCS aircraft	82,125 kg (181,054 lb)
ERFCS aircraft	110,990 kg (244,688 lb)
Max T-O weight: ERFCS aircraft	278,959 kg (615,000 lb)
Max wing loading: ERFCS aircraft	790.2 kg/m^2 (161.84 lb/sq ft)
Max power loading: ERFCS aircraft	388 kg/kN (3.80 lb/lb st)

PERFORMANCE:

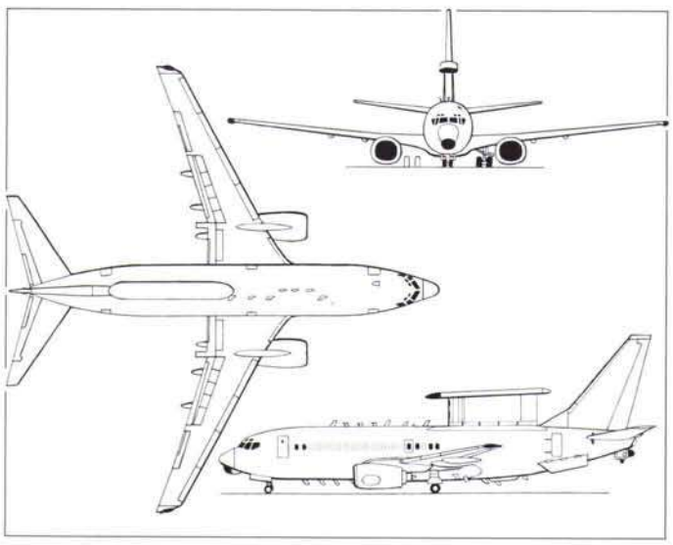
Normal cruising speed at 8,535 m (28,000 ft)	M0.74–0.77
Max cruising speed at low altitude	350 kt (648 km/h; 403 mph) CAS
Airdrop speed: at S/L	115–250 kt (213–463 km/h; 132–288 mph) CAS
at 7,620 m (25,000 ft)	130–250 kt (241–463 km/h; 150–288 mph) CAS
Approach speed with max payload	115 kt (213 km/h; 132 mph) CAS
Service ceiling	13,715 m (45,000 ft)
Runway LCN (paved surface)	better than 49
T-O field length at MTOW	2,360 m (7,740 ft)
Landing field length with 72,575 kg (160,000 lb) payload, using thrust reversal	915 m (3,000 ft)
Range with payloads indicated, with no in-flight refuelling:	
18,144 kg (40,000 lb) payload:	
non-ERFCS aircraft	4,400 n miles (8,148 km; 5,063 miles)
ERFCS aircraft	5,300 n miles (9,815 km; 6,099 miles)
72,575 kg (160,000 lb), T-O in 2,286 m (7,500 ft), land in 915 m (3,000 ft), load factor of 2.25 *g*:	
both:	2,400 n miles (4,444 km; 2,761 miles)
self-ferry (zero payload), T-O in 1,128 m (3,700 ft), land in 701 m (2,300 ft), load factor of 2.5 *g*:	
non-ERFCS aircraft	4,700 n miles (8,704 km; 5,408 miles)
ERFCS aircraft	6,250 n miles (11,575 km; 7,192 miles)

BOEING 737 AEW&C

TYPE: Airborne early warning and control system.

PROGRAMME: Adaptation of Boeing Business Jet (BBJ, which combines 737-700 fuselage with strengthened wing and landing gear of 737-800). Additional features include extra fuel tanks in former baggage hold. Proposed for Australian Project Air 5077 Wedgetail by Boeing, Northrop Grumman Electronic Sensor Systems Division (ESSD) and BAE Australia. Competed against proposals from Lockheed Martin and Raytheon. Secured initial design activity contract worth about USD6 million in December 1997, paving way for submission of full tender in early 1999. Selection of Boeing submission officially announced on 21 July 1999. RAAF initially planned to acquire seven aircraft for USD1.32 billion; cost concerns resulted in reduction to six plus one option in May 2000, but when contract signed on 20 December, this further reduced to four and three options, at reported cost of USD1.65 billion. Delivery of first two aircraft scheduled for November 2006, with operating unit to be No. 2 Squadron. Second pair to be handed over at end of 2007. Main base at Williamtown, New South Wales, with two aircraft permanently deployed to forward operating location at Tindal, Northern Territories; IOC to be achieved in mid-2008. Decision on exercising option for two additional aircraft was due 30 June 2003, but then extended to 30 June 2004; on 11 May 2004, it was announced that this would be converted to firm order, valued at USD224.25 million, for delivery by 2008. Contract signed on 3 June 2004. Seventh aircraft remains on option. Preliminary design review of radar and IFF systems successfully completed in September 2001; further reviews of navigation system, mission computing hardware and other airborne mission systems undertaken by January 2002, with ground-based elements following in 2004. Modification of first two aircraft undertaken by Boeing in US, with remainder accomplished in Australia at Amberley.

First RAAF Boeing 737 AEW&C Wedgetail *(Paul Jackson)* 1037928



Boeing 737 AEW&C *(James Goulding)* 1158081

ESSD L-band multirole electronically scanned array (MESA) radar mounted above rear fuselage ('top hat' configuration) providing 360° coverage from stationary antenna 10.8 m (35 ft 6 in) long that weighs 2,948 kg (6,500 lb). Operating modes will include acute long-range or broad short-range scanning and track-while-scan; maximum detection range said to exceed 216 n miles (400 km; 249 miles). In late 1998, demonstrator BBJ temporarily fitted with full-scale replica of MESA radar, six operator consoles and equipment cabinets for inspection by Australian defence department officials; mockup also featured in-flight refuelling probe above cockpit and EW/ECM sensors. Definitive aircraft will, however, feature 10 operator consoles initially, with potential to add further two. Aerodynamic effects of MESA offset by two large strakes below rear fuselage. Electronic warfare self-protection (EWSP) system will include Northrop Grumman AN/AAQ-24(V) directed infra-red countermeasures system, plus chaff and flares; Elta providing advanced ESM/elint systems; these will be controlled by the ALR-2001 computer. Other mission equipment to include Link 11, JTIDS, Mode S IFF and satcom; flight deck tactical displays, three HF and eight VHF/UHF radios. Patrol endurance of 9 hours at 300 n miles (555 km; 345 miles) from base can be extended by airborne refuelling, with modification to include installation of flying boom receptacle and a removable probe. Maximum T-O weight 77,565 kg (171,000 lb); service ceiling 12,500 m (41,000 ft).

First Australian aircraft rolled out at Seattle on 31 October 2002; subsequently, flown to Georgetown, Delaware, on 4 January 2003 for installation of auxiliary fuel system and tanks. Latter procedure took about three months to complete, whereupon aircraft returned to Boeing for structural modifications associated with installation of radar and mission systems. First MESA radar rolled out at beginning of November 2002 and installed on test range by Northrop Grumman; unit subsequently to Boeing for installation on 737, which took place on 22 October 2003. First flight of first aircraft (A30-001/N378BC) accomplished on 20 May 2004; subsequently used for 27-week aerodynamic test phase, with second aircraft (A30-002) earmarked for test and evaluation of radar from May 2005. However, in late 2004 it was established that 'top hat' antenna would need additional height above the fuselage for improved radar coverage; modification involved raising upper surface of antenna by about 100 mm (4 in) and required one month to accomplish, with airworthiness tests resuming 26 January 2005. These revealed no significant impact on cruise performance and were due for completion by end March 2005 (although interrupted for public debut at Australian International Air Show, Avalon, Victoria, 15 to 20 March); aircraft then to Victorville, California, for high-power electromagnetic interference testing in April 2005. Performance and flight handling test programme completed by early July 2005 and involved almost 250 sorties and about 500 flight hours; trials included simulated air-to-air refuelling. Mission system testing began in latter half of 2005, with responsibility for radar flight trials mostly being assigned to the second aircraft which was scheduled to make maiden flight in May 2005; installation of full mission hardware and operating software to be undertaken in January 2006, followed by further test programme between March and August 2006. This expected to involve about 80 flights and will entail evaluation of radar and electronic warfare system performance as well as air-to-air refuelling. Completion of these trials will clear way for delivery of first two Wedgetail aircraft to Australia. First aircraft to undergo modification in Australia (actually third Wedgetail) arrived at Boeing Australia's Amberley facility on 15 January 2006; completion of this aircraft scheduled for March 2007, with remaining three to follow suit at four-month intervals.

Participating local companies comprise BAE Systems Australia (including ESM; EW design development, integration and testing; design development and manufacture of radar components; manufacture of radar aperture and IFF cabinet sub-elements); Tenix Defence Pty Ltd (electronic components and software); Hawker de Havilland Aerospace

Boeing 737 AEW&C Wedgetail demonstrating a firm landing *(Paul Jackson)* 1037929

Technologies (design and fabrication of aircraft components); Cablex Pty Ltd (radar cables and RF cable production); Amphenol (fibre optic cables); Thycon Industries (power supplies); Thales Training & Simulation (operational flight trainer); Qantas Defence Services Pty Ltd (aircraft depot maintenance) and DoD Defence Science & Technology Organisation (technical assistance).

Republic of Korea interested in AEW-configured 737 as less costly solution to E-X requirement in lieu of Boeing 767, which considered too expensive; programme relaunched on 4 February 2004, after being suspended in 2002. Boeing proposal in competition with rival offerings from IAI/Elta (combination of Ilyushin Il-76 and Gulfstream G-550 platforms), L-3 Communications (Airbus A321) and Thales (Airbus A320). Total of four aircraft required by Korea, which is expected to take delivery of first two aircraft in 2009, with second pair following in 2011. Bids were due for submission in June/July 2004, with selection in November, followed by contract award in 2005. 737 AEW&C evaluated by Korea in September 2004, as was IAI/Elta G 550 proposal, these being only remaining contenders. Decision subsequently slipped to early 2005, with Boeing proposal apparently favoured on grounds of superior capability; by mid-March 2005, no announcement forthcoming, but anticipated cost then exceeded USD1.9 billion budget provision, with Boeing offering alternative less costly configuration said to be similar to Australian version. This evidently rejected in favour of fresh attempt to satisfy E-X requirements. Programme relaunched 24 June 2005, when South Korean ministry of defence issued statement saying that release of request for proposals tentatively expected on 14 July; decision reportedly due to be taken by end of 2005, but announcement still awaited in mid-May 2006.

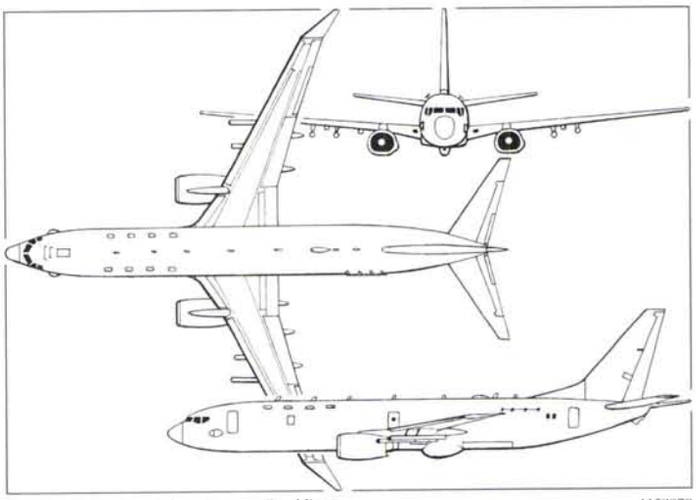
After studying proposals for AEW aircraft involving Airbus A310/Phalcon and Boeing 737/MESA combinations, in early December 2000 Turkey announced selection of latter and revealed intent to obtain total of six aircraft (with option on two more) at cost of USD1.5 billion under 'Peace Eagle' programme; these will include some indigenous equipment. Contract signature was expected in early 2001, but negotiations continued throughout remainder of 2001 and 2002; contract finally signed in May 2003, at which time the number of aircraft to be purchased had been reduced to four (with two on option). First aircraft to be supplied by Boeing; remaining three will be fitted out by Turkish Aerospace Industries. Initial delivery target date is July 2007, with final aircraft going to TAI in June 2008. First Turkish aircraft rolled out at Renton 11 November 2004, being flown to Georgetown, Delaware, for installation of auxiliary fuel tanks in December 2004. Installation of radar and mission systems to be undertaken in Seattle, with post modification first flight to take place in late 2006. Konya has been announced as the main operating base.

Boeing originally forecasting potential sales of up to 50 737 AEW&C aircraft, with other possible customers including Italy, Singapore and Spain; by the beginning of 2002, this had fallen to 30 over next 10 years.

BOEING P-8A POSEIDON

TYPE: Maritime surveillance twin-jet.

PROGRAMME: Design study for 737 MMA (Multi-mission Maritime Aircraft) revealed 18 April 2000 as potential replacement for Lockheed Martin P-3C Orion and EP-3E Aries II. Based on C-40A, combining 737-900 wing featuring raked wing extensions instead of standard blended winglets to address concerns over icing at normal operating altitude with 120 kN (27,000 lb st) CFM56-7B engines and 737-800 fuselage, latter with internal weapons bay beneath forward section and former with hardpoints for air-to-surface missiles. Full range of maritime patrol equipment envisaged, including enlarged nose accommodating Raytheon AN/APY-10 maritime surveillance radar, Northrop Grumman electro-optical/infrared sensor systems, electronic support measures (ESM) system and DIRCM missile defence system, Smiths Aerospace flight management and digital stores management systems, up to seven operators' consoles (US Navy requires five and P-8A will normally operate with crew of nine) and three in-flight reloadable rotary sonobuoy launchers, with total capacity of 120 sonobuoys, plus additional fuel in aft baggage hold. Magnetic anomaly detector (MAD) by CAE. Boeing currently developing UAV control software. Further refinement of design has seen internal weapons bay moved to new location aft of wing; 3.63 m (11 ft 11 in) long weapons bay can accommodate maximum of six stores, further weapons being carried on two stations beneath each wing and two stations below forward fuselage. Model number 737-800ERX assigned by Boeing.



Boeing P-8A Poseidon *(James Goulding)* 1158978

Maximum T-O weight 85,139 kg (187,700 lb); maximum zero-fuel weight 66,497 kg (146,000 lb); weapons payload 5,670 kg (12,500 lb); fuel capacity 42,681 litres (11,275 US gallons; 9,389 Imp gallons); maximum transit speed 490 kt (907 km/h; 564 mph); cruising speed for max range 440 kt (815 km/h; 506 mph); range with four hours on station 1,200+

Model of Boeing P-8A Poseidon shown in 2006, including interior detail and deletion of winglets fitted to previous depictions *(Paul Jackson)* 1040494

n miles (2,222 km; 1,380 miles). US Navy awarded USD493,000 concept exploration study contract to Boeing in July 2000; this followed in September 2002 by USD7 million contract for Phase 1 of component advanced development (CAD), during which air vehicle performance validated and mission system parameters were developed and analysed. Subsequently, in February 2003, a further contract, worth USD20.5 million, was awarded for Phase 2 of CAD, including additional performance analysis and continuing development of the associated mission system. Similar contracts to Lockheed Martin, which proposed an Orion derivative for the MMA.

On completion of Phase 2, Navy released draft request for proposals to industry on 15 July 2003, with definitive RFP following in late September; final bids were due for submission by 29 December 2003, with US Navy planning to award contract for the system development and demonstration (SDD) programme on 9 June 2004; in the event, announcement that Boeing proposal selected delayed until 14 June, at which time contract valued at USD3.89 billion awarded for SDD. Subsequent developments include successful completion of full-systems requirements review on 30 September 2004; conclusion of first series of low-speed wind tunnel tests on 5 November 2004; conclusion of initial high speed wind tunnel tests in December 2004; total of about 4,000 hours of wind tunnel testing planned; and completion of systems functional review in April 2005. Second major programme review completed by US Navy in second quarter 2005, allowing preliminary design phase to begin; preliminary design review completed in fourth quarter of 2005, with critical design review scheduled for third quarter of 2007 and flight testing to begin in final quarter of 2009.

SDD phase will entail manufacture of five airframes: one for airworthiness test, two for testing of mission systems and single examples for static and fatigue test purposes. SDD will continue until final quarter of FY08, with IOC expected in December 2012; key programme milestones include decision to begin low-rate initial production of 34 aircraft over four years, which is due to be taken by 2008. Responsibility for production to be shared between Boeing facilities at Renton, Washington, and Wichita, Kansas; latter to build fuselage, which will be transferred by train to Renton for mating with wing; on completion, aircraft flown to Boeing Field for testing before delivery. First development aircraft due to be completed as bare airframe in January 2008. Full-rate production not expected to begin until 2012 and will involve from 15 to 18 aircraft per year; total of 108 MMAs to be procured by US Navy. Service designation announced 22 March 2005 as P-8A. Target unit flyaway cost is USD126 million in 2004 dollars.

Boeing also offered a version of the 737 for the joint German-Italian MPA-R programme, which could have resulted in a contract for a total of 24 aircraft. Selection of winner was set for 2003, with contract award in 2004. Joint German Italian programme abandoned, however, following German purchase of surplus P-3C Orions from Netherlands. Boeing still confident of securing export orders and US Navy had sought international partners to share development of P-8A; potential buyers include Australia, Canada and Italy, which were expected to begin negotiations in early 2005 concerning cost and work-sharing aspects of collaborative venture. In November 2004, it was hoped negotiations could be concluded before third quarter of 2005, allowing time for bids to be submitted before P-8A design frozen in September 2005; in the event, these three countries all withdrew by mid-2005 and emphasis shifted to search for co-operative opportunities that might emerge in later stages of programme.

First overseas customer could be Indian Navy, which has requirement for eight long range maritime patrol/ASW aircraft. Boeing submitted P-8I (International) proposal on 13 April 2006 and is competing against new production Ilyushin Il-38 and refurbished Lockheed P-3C Orion turboprops; contract award now expected in 2007-08, with first deliveries to follow four years later.

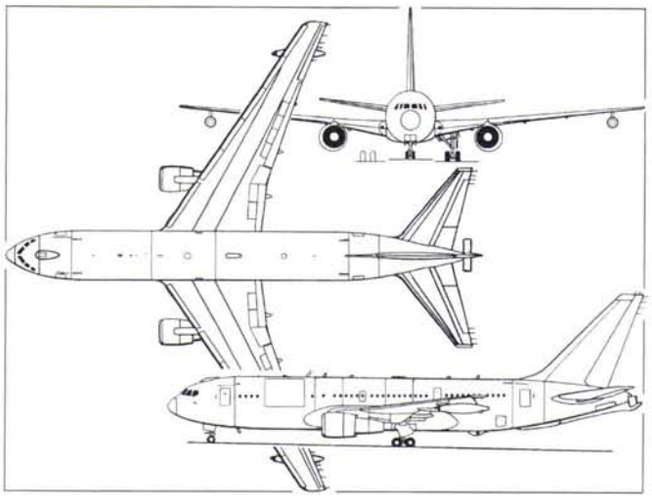
Weapons options could include new winged version of Raytheon Mk54 torpedo that would be dropped at altitude and then glide down to within close proximity to target before entering water for terminal phase of attack. Deployment of this presently expected in 2013. Pneumatic ejector bomb racks by EDO. P-8A will also be able to accommodate naval mines, AGM-84 Harpoon anti-ship attack missiles, SLAM-ER and depth bombs.

On 24 January 2006, Boeing revealed that it was working on a new variant of the P-8A to satisfy an existing US Navy requirement for a new signals intelligence (sigint) platform to replace the EP-3E Aries II aircraft that currently performs this role. This proposal emerged in the aftermath of cancellation of the Lockheed Martin Aerial Common Sensor (ACS) programme that was expected to meet US Navy and US Army sigint needs and basically envisages adapting the P-8A by deleting sonobuoy launchers and other specialised ASW mission equipment and substituting new hardware and software tailored for the sigint role, possibly including an active electronically scanned array (AESA) radar and as many as 14 workstations for crew engaged in acquisition and analysis of intelligence. As well as removal of ASW equipment, it is also proposed to seal the weapons bay and use this space to accommodate additional antennas and associated electronics.

As of 9 January 2007 Boeing P-8A has now been allocated the name Poseidon.

BOEING 767 MILITARY VERSIONS

TYPE: Tanker-transport; airborne ground surveillance system.



Boeing KC-767 Tanker-Transport *(Paul Jackson)* 1159814

PROGRAMME: Variants of Boeing 767 twin-turbofan airliner (which see under Boeing Commercial Airplanes for technical description).

CURRENT VERSIONS: **767 AWACS**: Production complete.

KC-767 Global Tanker Transport Aircraft (GTTA): Tanker-transport version announced by Boeing, February 1995, in anticipation of Japanese order; Boeing in discussions with Kawasaki by mid-1996, concerning co-operative venture to offer tanker version of the 767 to Japan ASDF. Kawasaki involvement then expected to take form of post-production work (including fitment of boom refuelling gear, extra tanks and associated plumbing) on 767-300 derivative. JASDF intended to request funding from FY99, but economic downturn and reductions in defence budget caused delay. Purchase intention reaffirmed 14 December 2001, by Japanese government, which announced plan to buy four aircraft. On 4 April 2003, Boeing announced signature of contract for first of planned four tanker-transports; initial aircraft (a 767-2FK subvariant) flown to Wichita, Kansas, on 31 May 2005 for modification to tanker configuration; this due for delivery in December 2006, for service entry in first quarter of 2007. The remaining three aircraft will be delivered at a rate of one per year during 2008-10 after conversion by Aeronavali in Italy. In late 2004, Japan revealed intent to obtain additional four KC-767s to facilitate overseas deployment in support of international co-operation taskings.

Version of 767 with three hose drum units offered unsuccessfully to UK Royal Air Force, which selected Airbus A330 derivative in late 2003.

Tanker-transport proposals currently based on 767-200ER (see Boeing Commercial Airplanes entry); fuel dispensed through Boeing 'flying boom' capable of maximum transfer rate of 3,407 litres (900 US gallons; 749 Imp gallons) per minute and two Smiths Aerospace underwing pods; boom remotely controlled from cabin, assisted by CCTV and/or three-dimensional helmet mounted display; proximity trials at Patuxent River NAS in June 2000 showed 767 to be stable refuelling platform. Fuel capacity 90,774 litres (23,980 US gallons; 19,967 Imp gallons), in standard (wing) tanks, plus 23,394 litres (6,180 US gallons; 5,146 Imp gallons) in supplementary underfloor tanks; total 114,168 litres (30,160 US gallons; 25,113 Imp gallons). As freighter (side cargo door and reinforced floor), can carry up to 18 463L pallets on main deck or 216 passengers, with additional cargo capacity on lower deck dependent upon auxiliary tank configuration.

First Boeing 767 tankers will be flown by Italian Air Force, which revealed intention in July 2001 to purchase four new-build aircraft as replacements for Boeing 707 tankers. Signature of final contract took place in early December 2002; total cost, including option on two additional aircraft, is about USD618 million. Based on the 767-200ER commercial transport, it is powered by CF6-80C2B6F turbofans and features a Boeing air-refuelling boom, a RARO II remote air-refuelling operator station, wing pods containing hose and drogue refuelling apparatus and a centreline hose and drogue system. It also has a refuelling receptacle fitted as standard. Has standard 767 fuel tankage of 73 tonnes to permit use of underfloor baggage hold when employed as personnel transport.

First aircraft rolled out 3 July 2003 as Boeing 767-2EY subvariant and subsequently flown to Wichita, Kansas, on 16 July for installation of refuelling equipment and operator's station; following this, officially rolled out 24 February 2005 and first flew (N767TT/MM62226) 21 May 2005. Refuelling trials undertaken in 2005, culminating in certification due in February 2006, before this aircraft handed over to Italian personnel, in April 2006, for acceptance testing in USA. Conversion of final three aircraft being

First Boeing KC-767 for Italy, shown at Paris in June 2005 1129035

undertaken by Aeronavali at Naples, Italy; first of these aircraft delivered to Naples 6 May 2005, with last example due for delivery to 8° Gruppo of 14° Stormo, Italian Air Force, in July 2008.

Two different configurations were offered to Australia, to satisfy Project Air 5402 requirement. EADS also in contention, with RAAF selecting Airbus A330 proposal on 15 April 2004.

In 2001, USAF unveiled proposal to lease 100 examples of a derivative of the Boeing 767 to begin process of replacing the KC-135 Stratotanker. This anticipated a 10-year lease agreement, possibly to be followed by outright purchase. In April 2002, USAF formally notified Congress of intention to begin negotiations immediately. On 23 May 2003, US Department of Defense announced approval of USD16 billion lease arrangement programme; lease then said to be for "six years starting in 2006", at unit cost of USD131 million, plus USD7 million in lease-unique costs per aircraft. USAF anticipated accepting first aircraft in FY06 and had longer-term goal to acquire up to 500 new tankers, as replacements for veteran KC-135. Bases at Fairchild, Washington; Grand Forks, North Dakota; and MacDill, Florida, identified as future operating locations for initial 100 KC-767s, each with total of 32 aircraft. In anticipation of deal being finalised, Boeing began manufacture of first KC-767 at Everett.

Lease deal subsequently came under scrutiny, with ensuing controversy leading to dismissal of Boeing's chief financial officer Michael Sears and resignation of chief executive Philip Condit in November 2003. In combination with Congressional opposition, this resulted in revised deal made public on 6 November 2003. Under this, USAF would lease first 20 aircraft from 2006 and purchase further 80, for delivery in 2008-14, with total cost expected to be USD27.6 billion up to and including FY17. However, on 26 May 2004, US Defense Secretary Donald Rumsfeld announced that no decision would be taken on acquisition of new tanker aircraft until fresh studies completed in November 2004. Subsequently, it was decided to abandon lease/purchase and initiate competitive KC-X procurement programme, with EADS thereafter indicating intent to offer version of Airbus A330, initially known as KC-330 and now referred to as KC-30, as rival contender to KC-767. Selection of a winning proposal not now expected to occur before 2007 at the earliest. Boeing still optimistic of success, but work on first KC-767 has been suspended and this is currently stored engineless at Everett.

Boeing formed 767 Tanker Programs office in March 2001 and subsequently selected Wichita, Kansas as the centre for tanker modification work.

Multimission Command and Control Aircraft (MC2A): Now designated Northrop Grumman E-10.

CUSTOMERS: KC-767 tanker-transport ordered by Italy (four) and Japan (four, with additional four in prospect); United Arab Emirates Air Force reported in early 2005 to be considering purchase of up to three aircraft. USAF may eventually acquire substantial number, but future of programme currently in doubt in wake of scandal surrounding controversial lease/purchase arrangement proposed in 2001.

COSTS: Estimated USD216 million for Japanese 767 tanker (2001). Boeing price varies from USD150 million to USD225 million, according to quantity procured.

AVIONICS: Rockwell Collins selected by Boeing to provide avionics and support for KC-767. This will include communications and navigation equipment, as well as modification of commercial 767-400 large format display system (LFDS) and 767-200 electronic flight instrument system (EFIS) and engine indication and crew alert system (EICAS) to incorporate military mission requirements.

Comms: ACSS MASS traffic surveillance/rendezvous/station-keeping system and Mode S/IFF transponder. Rockwell Collins Link-16 and SATCOM terminal. UHF and VHF radio. Military TCAS. Boom interphone for secure communication with receiver aircraft.

Flight: Includes modified AN/ARN-153 Tacan.

Instrumentation: KC-767 will have Kaiser Electro-Optics HUD for remote aerial refuelling operator.

Data follow for tanker-transport.

WEIGHTS AND LOADINGS (estimated):

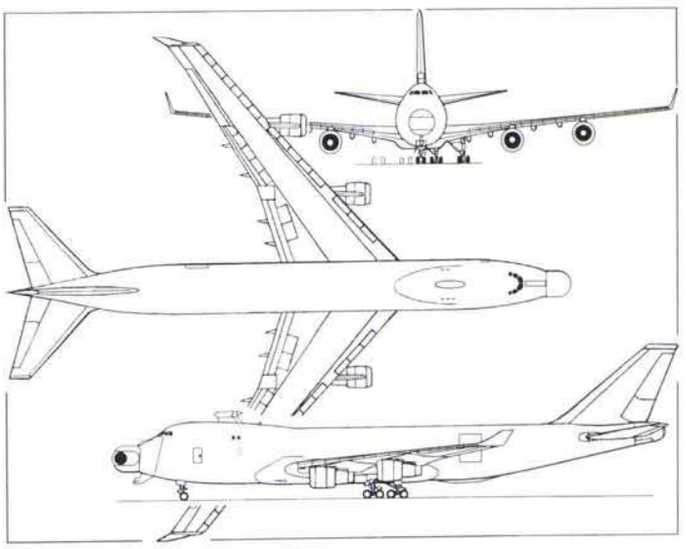
Operational weight, empty	90,720 kg (200,000 lb)
Max T-O weight	179,170 kg (395,000 lb)
Max ramp weight	179,625 kg (396,000 lb)
Max zero-fuel weight	127,006 kg (280,000 lb)

BOEING AL-1A

TYPE: Missile defence system.

PROGRAMME: Prototype YAL-1A (USAF serial number 00-0001) ordered on 12 November 1996; purchase of 747-400F airframe from Boeing confirmed on 30 January 1998. Formal authority to proceed received on 26 June 1998, after TRW (now Northrop Grumman Space Technologies) successfully demonstrated laser firing and missile tracking. First metal cut on YAL-1A on 10 August 1999; rolled out at Everett on 12 December 1999; first flight 6 January 2000; delivered to Boeing Wichita on 21 January 2000 for outfitting with strengthened floor and modifications to take nose-mounted laser turret; subsequent critical design review completed in late April. Programme responsibility and oversight initially assigned to USAF, but transferred to Missile Defense Agency in October 2001.

Nose laser and sensors of Boeing AL-1A *(Jim Shryne, USAF)* 1040474



Boeing AL-1A *(Paul Jackson)* 1158977

On completion of 1.6 million man-hours of work at Wichita, aircraft flew again on 18 July 2002 and was ferried to Edwards AFB, California, on 19 December 2002. Original plan envisaged trials against various missiles, culminating with demonstration against a ballistic missile fired from Vandenberg AFB, California, in September 2003. Subsequent programme slippage arising from budgetary constraints, technical issues and changing defence priorities means that shoot-down demonstration now unlikely before 2008.

Prototype YAL-1A completed short evaluation of aircraft performance and system operation from Wichita before delivery to Edwards AFB. Initial evaluation revealed problems with buffet and lateral acceleration forces acting on pylon for active ranging system pod located above flight deck; this was sufficiently severe to necessitate removal of pylon and pod after third flight and forced redesign of this unit. Installation of integrated battle management and beam control/fire control (BC/FC) systems undertaken in 2004, with YAL-1A returning to flight status on 3 December 2004; programme of about 20 flights followed, to test BC/FC systems and achieve flight certification by about April 2005. YAL-1A then grounded again in August 2005 for further modifications; participation in series of trials in June 2006 with surrogate lasers to verify proper alignment of optical beam train equipment; and eventual installation of tracking illuminator (TILL) and beacon illuminator (BILL) lasers.

Responsibility for initial trials at Edwards entrusted to 452nd Flight Test Squadron (FTS); however, this subsequently assigned to 417th FTS, which activated 16 March 2006 with 750 personnel, including government and contractor representatives. Flight trials planned to resume in late 2006, with BILL and TILL lasers to be directed at missile-shaped image painted on 'Big Crow' NKC-135B test aircraft.

Preliminary testing of laser unit conducted on ground in Systems Integration Laboratory (SIL), using an 'ironbird' 747 fuselage. Initial batch of chemicals for laser delivered to Edwards AFB on 4 December 2003, when 16,656 litres (4,400 US gallons; 3,664 Imp gallons) of hydrogen peroxide arrived; at that time, it was hoped to accomplish first laser 'light' in second quarter of 2004, but this not achieved until 10 November 2004, when 'First

Boeing AL-1A airborne laser platform *(Jim Shryne, USAF)* 1040473

Light' trial took place, with all six modules successfully fired for first time. Successful completion of 70 megawatt-class COIL tests in SIL announced 12 December 2005; laser then removed for refurbishing before being installed in YAL-1A during 2007.

Design work on second aircraft had begun by beginning of 2004, but firm order still awaited by Boeing and appears unlikely until after successful shoot-down demonstration. USAF intent to acquire as many as seven AL-1As will almost certainly not be satisfied and programme may ultimately be limited to just two aircraft. IOC was planned for late 2007, but achievement of even limited contingency capability had been indefinitely postponed by February 2004.

CUSTOMERS: US Air Force.

COSTS: Programme cost (1997, estimated) USD5 billion for one concept prototype and one EMD (both eventually to be fully upgraded) and five production aircraft. Initial programme definition and risk reduction (PDRR) contract of November 1996 valued at USD1.1 billion. USD603 million requested for FY04 and USD474 million for FY05.

DESIGN FEATURES: Based on airframe of Boeing 747-400F (which see under Boeing Commercial Airplanes). Equipped with Northrop Grumman Space Technologies (formerly TRW) multihundred kW chemical oxygen iodine laser (COIL) and Lockheed Martin beam control/fire-control system, for target acquisition, plus aiming and firing of laser. Active ranging system housed in pod sited above forward fuselage section. Intended to destroy ballistic missiles during boost phase, but with additional capability to gather intelligence data concerning hostile missile sites and radar control systems; and command and control through search/detection of infra-red signatures to aid cueing of other weapons. Laser able to fire 20 to 30 times per mission; titanium used in certain areas to protect against heat damage to undersides caused by laser exhaust gases. Mission crew expected to comprise four specialists at individual consoles at rear of forward compartment, specifically the mission crew commander, airborne surveillance officer, weapon system operator and special equipment operator; standard flight deck crew of two could be augmented for long missions.

BOEING 114 and 414 CHINOOK

US Army designations: CH-47 and MH-47 Chinook
Royal Air Force designations: Chinook HC. Mk 2, HC. Mk 2A and HC. Mk 3
South Korean Air Force designation: HH-47D
Spanish Army designation: HT.17
JASDF and JGSDF designations: CH-47J and CH-47JA

TYPE: Medium lift helicopter.

PROGRAMME:

DEVELOPMENT MILESTONES

CH-47D	
Programme launched	1976
First flight	11 May 1979
First order	Oct 1980
First flight, production	26 Feb 1982
First delivery	31 Mar 1982
Entered service (US Army IOC)	28 Feb 1984

Design of all-weather medium transport helicopter for US Army began 1956; first flight of YCH-47A 21 September 1961, initial production concerned CH-47A and CH-47B. Performance increased in CH-47C by uprated transmissions and 2,796 kW (3,750 shp) T55-L-11A; internal fuel capacity increased; first flight 14 October 1967; delivered to US Army from 1968. Since entering service, Chinook variants have accumulated more than 3.5 million flight hours.

CURRENT VERSIONS: **CH-47D**: US Army contract to modify one each of CH-47A, B and C to prototype Ds placed 1976; first flight 11 May 1979; first production contract October 1980; first flight of production aircraft 26 February 1982; first delivery 31 March 1982; initial operational capability (IOC) achieved 28 February 1984 with 101st Airborne Division; first multiyear production contract for 240 CH-47Ds awarded 8 April 1985; second multiyear production contract for 144 CH-47Ds (including 25 MH-47Es) awarded 13 January 1989, bringing total CH-47D (and MH-47E) ordered to 472; two Gulf War attrition replacements authorised August 1992 (these new-build); seven ex-Australian rebuilds funded June 1993 for delivery January to November 1995. Additional new-build CH-47D ordered for US Army in June 1999 was delivered to Fort Hood, Texas, on 26 June 2002. Further 81 remanufactured for overseas operators, plus 97 new-build examples produced for export, raising total number of CH-47Ds to 660 (including 25 MH-47E).

CH-47D update included strip down to bare airframe, repair and refurbish, fit Honeywell T55-L-712 turboshafts, uprated transmissions with integral lubrication and cooling, composite rotor blades, new flight deck compatible with night vision goggles (NVG), new redundant electrical system, modular hydraulic system, advanced automatic flight control system, improved avionics and survivability equipment, Solar T62-T-2B APU operating hydraulic and electrical systems through accessory gear drive, single-point pressure refuelling, and triple external cargo hooks. Principal external change is large, rectangular air intake in leading-edge of rear sail. Composites account for 10 to 15 per cent of structure. About 300 suppliers involved.

At maximum gross weight of 22,680 kg (50,000 lb), CH-47D has more than double useful load of CH-47A. Sample loads include M198 towed 155 mm howitzer, 32 rounds of ammunition and 11-man crew, making internal/external load of 9,980 kg (22,000 lb); D5 caterpillar bulldozer weighing 11,225 kg (24,750 lb) on centre cargo hook; US Army Milvan supply containers carried at up to 130 kt (256 km/h; 159 mph); up to seven 1,893 litre (500 US gallon, 416 Imp gallon), 1,587 kg (3,500 lb) rubber fuel blivets carried on three hooks.

MH-47D Special Operations Aircraft: Element of 160th Special Operations Aviation Regiment (at Hunter AAF, Georgia) equipped with 11 CH-47Ds modified to **MH-47D SOA** standard with refuelling probes (first refuelling July 1988), thermal imagers, Honeywell RDR-1300 weather radar, Rockwell Collins 'glass cockpits', improved communications and navigation equipment, and two pintle-mounted 7.62 mm six-barrel miniguns. Navigator/commander's station also fitted. It is eventually intended to update all MH-47Ds to MH-47G configuration, incorporating technology improvements developed for the CH-47F.

GCH-47D: Limited number of non-flying Chinooks used for maintenance training at Fort Eustis, Virginia.

HH-47D: South Korean Air Force's 235 Squadron received six International Chinooks with this local designation for SAR.

JCH-47D: At least two aircraft (84-24159 and 90-0180) modified for temporary test tasks.

US ARMY CH-47D PROCUREMENT

FY	Quantity	First aircraft	Remarks
81	9	81-23381	
82	19	82-23762	
83	24	83-24102	
84	36[1]	84-24152	
85	48	85-24322	MYP1
86	48	86-1635	MYP1
87	48	87-0069	MYP1
88	48[2]	88-0062	MYP1
89	48	89-0130	MYP2
90	48[3]	90-0180	MYP2
91	48[4]	91-0230	MYP2
92	48[5]	92-0280	MYP2
	2[6]	92-0367	
93	7[7]	93-0928	
98	1[8]	98-2000	
Total	**482**		

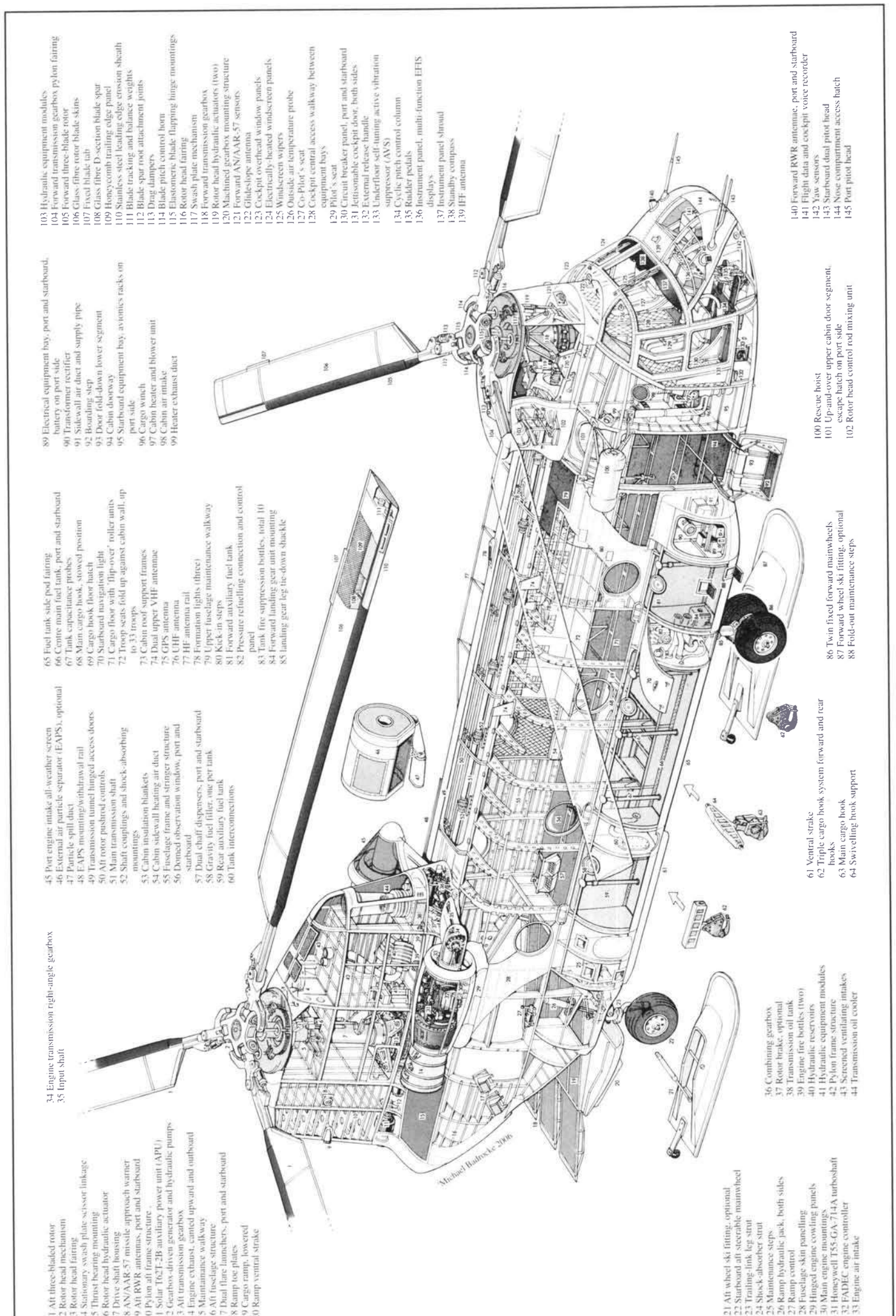
Notes: Excludes three prototypes, of which two were issued with new serial numbers on remanufacture to definitive CH-47D standard
MYP1 First multiyear procurement contract, 8 April 1985
MYP2 Second MYP, 13 January 1989

[1] One crashed on test
[2] One to YMH-47E
[3] This batch includes one aircraft subsequently further modified to MH-47E configuration under separate contract
[4] Total includes six which were further modified to MH-47E under separate contract
[5] This batch includes two of original three prototypes (remaining prototype used as maintenance trainer at Fort Eustis, Virginia) and 11 from Italian production; total includes 18 which were further modified to MH-47E under separate contract
[6] New-build Gulf War attrition replacements, authorised 2 August 1992
[7] Former Australian Air Force CH-47Cs; contract 2 June 1993
[8] New-build aircraft; delivered 26 June 2002

Royal Air Force Boeing Chinook HC. Mk 2 on a supply mission in Afghanistan
(Patrick Allen) 1179943

MH-47E: Special Forces variant with US Army Special Operations Command (USASOC); planned procurement 51, all originally to be deducted from CH-47D conversions, but only 25 received, plus prototype. Prototype development contract 2 December 1987; long-lead items for next 11 helicopters authorised 14 July 1989; firm order for 11, plus option on next 14, awarded 30 June 1991; Lot 2 (14 helicopters) confirmed 23 June 1992. Prototype (88-0267) flew 1 June 1990; delivered 10 May 1991; initial production aircraft (90-0414) flown 1992; originally due to be delivered from November 1992 to 2 Battalion of 160th Special Operations Aviation Regiment at Fort Campbell, Kentucky. Following mission software problems, deliveries delayed until January 1994 when 91-0498 was flown to Fort Campbell; last of original 26 (including prototype) received at Fort Campbell April 1995.

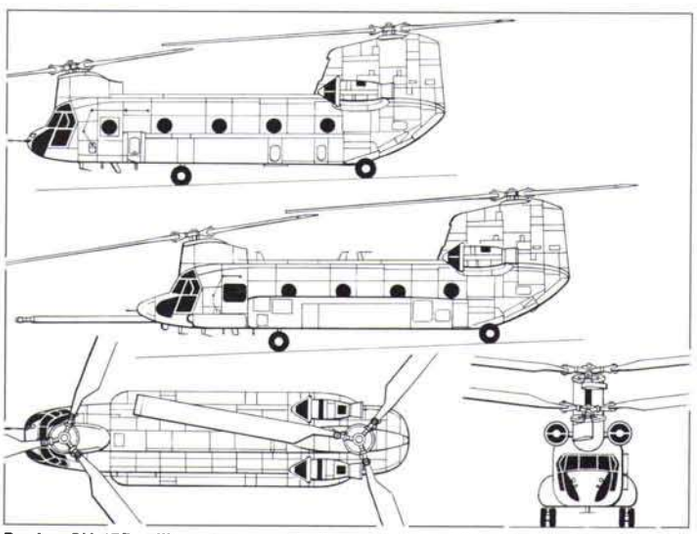
Mission profile 5½ hour covert deep penetration over 300 n mile (560 km; 345 mile) radius in adverse weather, day or night, all terrain with 90 per cent success probability. Equipment includes IBM-Honeywell integrated avionics with four-screen NVG-compatible EFIS; dual MIL-STD-1553B digital databusses; AN/ASN-145 AHRS; jamming-resistant radios; Rockwell Collins CP1516-ASQ automatic target handoff system; inertial AN/ASN-137 Doppler, Rockwell Collins AN/ASN-149(V)2 GPS receiver and terrain-referenced positioning navigation systems; Rockwell Collins ADF-149; laser (Raytheon AN/AVR-2), radar (Lockheed Martin AN/APR-39A) and missile (Honeywell AN/AAR-47) warning systems; ITT AN/ALQ-136(V) pulse jammer and Northrop Grumman AN/ALQ-162 CW jammer; BAE Systems M-130 chaff/flare dispensers; Raytheon AN/APQ-174A radar with modes for terrain-following down to 30 m (100 ft), terrain-avoidance, air-to-ground ranging and ground-mapping; Raytheon AN/AAQ-16 FLIR in chin turret; digital moving map display; Elbit ANVIS-7 night vision goggles; uprated T55-L-714 turboshafts with FADEC; increased fuel capacity; additional troop seating (44 maximum); OBOGS; rotor brake; 272 kg (600 lb) rescue hoist with 61 m (200 ft) usable cable; two six-barrel miniguns in forward port and starboard positions (also on MH-47D); provisions for Stinger AAMs using FLIR for sighting. This system largely common with equivalent Sikorsky MH-60K (which see). In November 2002, Smiths Aerospace received contract for more than USD3 million to demonstrate maintenance, analysis, safety and training (MAST) programme, incorporating integrated HUMS; contract for two systems to be installed on MH-47 in second quarter of 2003, with further systems subject to option.



Boeing CH-47F Chinook, cutaway drawing key *(Michael Badrocke)*

1151683

Boeing CH-47D Chinook of US Army flying earthquake relief missions in Pakistan *(1 Lt Chad Leisenring, USAF)* 1158642



Boeing CH-47D military transport helicopter with additional side view (lower) of MH-47E special forces' variant *(James Goulding)* 0507658

MH-47E has nose of Commercial Chinook to allow for weather radar, if needed; forward landing gear moved 1.02 m (3 ft 4 in) forward to allow for all-composites external fuel pods (also from Commercial Chinook) that double fuel capacity; Brooks & Perkins internal cargo handling system. Upgrade programme will transform 23 surviving MH-47Es to MH-47G configuration by 2011 to improve performance and extend service life. See also Chinook HC. Mk 3, below.

US ARMY MH-47E PROCUREMENT

FY	Quantity	First aircraft
90	1	90-0414
91	6	91-0496
92	4	92-0400
	14	92-0464
Total	**25**	

Notes: Excludes prototype (88-0267).

Chinook HC. Mk 2/2A: RAF version; Mk 1 designation CH47-352; all survivors of original 41 HC. Mk 1s upgraded to HC. Mk 1B; UK MoD authorised Boeing to update 33 (later reduced to 32) Mk 1Bs to Mk 2, equivalent to CH-47D, October 1989; changes include new automatic flight control system, updated modular hydraulics, T55-L-712F power plants with FADEC, stronger transmission, improved Solar 71 kW (95 shp) T62-T-2B APU, airframe reinforcements, low IR paint scheme, fuel system and standardisation of defensive aids package (IR jammers, chaff/flare dispensers, missile approach warning and machine gun mountings). Smiths Industries Health and Usage Monitoring System (HUMS) installed on fleet-wide basis at cost of about £100 million during 1997 to 2000.

Conversion continued from 1991 to July 1995. Chinook HC. Mk 1B ZA718 began flight testing Chandler Evans/Hawker Siddeley dual-channel FADEC system for Mk 2 in October 1989. Same helicopter to Boeing, March 1991; rolled out as first Mk 2 19 January 1993; arrived RAF Odiham 20 May 1993; C(A) clearance November 1993. Initial deliveries pooled at Odiham by Nos 7 and 27 (Reserve) Squadrons — latter for training; first delivery to No 18 Squadron at Laarbruch, Germany, 1 February 1994; to No 78 Squadron, Falkland Islands, February 1994. Final Mk 1 withdrawn from service, May 1994, at which time 11 Mk 2s received. Further three new-build Mk 2s ordered 1993 (as Lot 2), for delivery from late 1995; decision to order further 14 Mks 2A/3 for delivery 1997–2000 at cost of US$365 million announced March 1995; these comprise Lots 3 and 4, respectively; Mk 2A has dynamically tuned fuselage. Latest purchase raised total RAF procurement to 58. First Lot 3 HC. Mk 2A (ZH891) handed over in USA 6 December 1997; shipped to UK and arrived Boscombe Down for clearance trials 18 December 1997. Rest of Lot 3 delivered by end 1998. Retrofits announced in 1996 comprise Smiths HUMS and Thales Avionics RA 800 secure communications control system, with latter to be replaced by RA800M unit during 2003–05 in conjunction with Bowman radios. Thales also prime contractor for Chinook Night Enhancement Package (NEP) which was declared operational on 26 August 2002; this intended to improve capability at night by integrating optical and navigation sensors; improving NVG imagery and providing secure communications suite, with entire package incorporating provision of MIL-STD-1553 databus. Some equipment purchased for HC.Mk 3 version also used, including BAE Systems FLIR; mounted below nose section, sensor imagery is presented on two screens (at pilot and co-pilot positions). Thales AMS 2000 control display navigation unit also subject to upgrade and now incorporates combined GPS and INS, with extra display screen in main cabin that allows third member of crew to assist with navigation. Total of 27 (of 40) RAF Chinook HC. Mk 2/2As configured with NEP cockpit capability, although not all fully equipped. Current squadron dispositions are Nos. 7, 18 and 27 at Odiham; and No. 78 in Falkland Islands.

Chinook also candidate to satisfy at least part of UK Support Amphibious Battlefield Rotorcraft (SABR) requirement; this could lead to additional purchase of more than 20 to complement a smaller number of AgustaWestland Merlins, but consideration also being given to modifying a similar number of existing HC. Mk 2/2As, for which Boeing originally expected to receive contract in closing stages of 2004 to undertake risk-reduction and preliminary design work. This expected to occupy three years, with key features including design, development and production of folding rotor blades to permit stowage in hangar deck of amphibious vessels.

Chinook HC. Mk 3: Eight of 14 additional RAF Chinooks, announced March 1995, assigned to Special Forces; build standard as CH-47SD, but with MH-47E's large fuel panniers, weather radar and refuelling probes. First flight of initial aircraft (ZH897, as N2045G) in mid-October 1998. Following flight test, all transferred to temporary store at Shreveport, Louisiana, for six to eight months, pending fitment of avionics (including Sky Guardian RWR) which form subject of separate contract; delivery was expected to begin in February 2000, but UK refused to accept initial aircraft, citing software problems as cause. First example eventually accepted in December 2000; initial deliveries to UK were ZH898 and ZH899 to Bristol by sea, arriving 15 July 2001, with remainder following by December 2001 (apart from one retained by Boeing for trials); by mid-2002, two flying on Military Aircraft Release trials, one with RAF at Odiham for ground training and four in storage; RAF service entry with Joint Helicopter Command further delayed by UK Audit Office report of 7 April 2004, citing £260 million programme as "one of the most incompetent procurements of all time". Mk 3s restricted to heights above 152 m (500 ft) and flight only in cloudless weather because of lack of fully digital cockpit. Fleet requires further £127 million upgrade before service-entry, with UK Ministry of Defence working with Boeing in late 2005 to find solution that would permit service introduction.

HT.17 Chinook: Spanish Army version.

Boeing 234: Commercial version, currently out of production.

Boeing 414: Export military version. Superseded by CH-47D International Chinook and CH-47SD versions (see below).

CH-47D International Chinook: Boeing 414-100 first sold to Japan; Japan Defence Agency ordered two for JGSDF and one for JASDF in 1984; first flight (N7425H) January 1986 and, with second machine, delivered to Kawasaki April 1986 for fitting out; co-production arrangement (see under Japan: Kawasaki **CH-47J**). International Chinook was available in four versions with combinations of standard or long-range (MH-47E-type) fuel tanks and T55-L-712 SSB or T55-L-714.

CH-47SD 'Super D': Export variant, first flown on 25 August 1999; embodied some improvements first installed on the MH-47E for US special operations forces, including increased max T-O weight. Honeywell T55-GA-714A turboshaft with Coltec Industries FADEC chosen as standard power plant; single-point pressure refuelling and jettison capability on both sides of aircraft, with fuel contained in two ballistic and crash-resistant tanks; total usable capacity 7,828 litres (2,068 US gallons; 1,722 Imp gallons); CH-47SD has Smiths digital fuel quantity gauging system in place of Ragen analogue system.

Simplified structure offers benefits in maintainability and reliability. Specific changes include machined frames instead of standard frames.

CH-47SD also incorporates modernised NVG-compatible cockpit with avionics control management system (ACMS), utilising proven military and commercial off-the-shelf equipment on single console to reduce pilot workload and with provisions for growth ACMS organised into three separate functional groups, specifically air vehicle group (including engines, drive system, fuel, electrics, flight controls and warning indicators); mission group (including communications, navigation and survivability equipment such as INS/GPS, weather radar and digital map display); and pilotage group (including EFIS) Radar nose (but not necessarily radar) fitted as standard

Avionics suite comparable to that of baseline CH-47D, with two embedded INS/GPS units as well as AN/ARN-147 VOR/ILS and AN/ARN-149 ADF, plus space and power provisions for Tacan. AN/ARC-210 frequency-hopping radios installed on CH-47SD for Taiwan

Initial order for 10 from Singapore received shortly before March 1998 announcement of formal SD launch, with first acceptance (in US) in early June 2001. Second customer was Taiwan which, in January 2000, announced purchase of nine CH-47SDs for use by Army; delivery accomplished by October 2002 No further orders received.

CH-47F Improved Cargo Helicopter (ICH): Boeing programme for improved Chinook configuration for US Army involving the development and production of a new version that will remain operational and cost-effective until 2033, when last examples expected to be replaced by a new cargo helicopter to be developed from about 2015. Programme planned to coincide with existing Chinooks beginning to reach planned life cycle limits in 2002 Benefits envisaged include greater airframe and systems reliability arising from lower levels of vibration; reduced operating and support costs; reduced pilot workload; and more efficient cargo handling. Weights unchanged, although US Army aircraft, like CH-47D, will have peacetime MTOW of 22,680 kg (50,000 lb) Key goal of upgrade is ability to airlift 7,257 kg (16,000 lb) load over 50 n miles (92 km; 56 miles) under 35°C (95°F) and 1,220 m (4,000 ft) altitude daytime conditions.

Studies indicated that further remanufacture, rather than new production, offered best degree of affordability, with a key factor being fleet-wide fitment of the T55-GA-714A, an improved variant of the T55-L-714 engine, as installed in the MH-47E and the International Chinook The T55-GA-714A results from a Honeywell (at Greer, South Carolina) kit upgrade programme begun December 1997 and affecting approximately 1,150 existing T55-L-712 engines in the Army inventory; upgrading brings power ratings up to those of the T55-L-714 and adds marinisation features

Increased versatility also derived from replacement of the existing cargo handling system by integral flip-over roller panels in the cargo deck

Cockpit modernisation by Rockwell Collins originally to include two dual-redundant MIL-STD-1553B databusses, four 127 mm (5 in) square MFD 255 EFIS LCDs, two 152 × 203 mm (6 × 8 in) MFD-268E1 situation awareness displays, two CDU 900 controller/processors, DR-200 data loader, moving digital map display, digital communications and electronic instrument displays. This was expected to allow for updated communications and navigation; however, in second quarter of 2004, US Army revealed intent to adopt Rockwell Collins common avionics architecture system (CAAS) cockpit of MH-47G for CH-47F on fleet-wide basis from 2007. Original Rockwell Collins system as proposed for CH-47F said to have insufficient processing capacity to accommodate new interoperability demands and improvements. CH-47F will be first US Army helicopter to incorporate improved data modem (IDM), allowing it to link with digital battlefield and automatically send and receive information concerning targeting and aircraft position

Under terms of Army development contract awarded in late 1997, two Chinooks (83-24107 and 83-24115) refurbished for the engineering and manufacturing development (EMD) phase, for which contract worth USD76 million was awarded to Boeing in May 1998 Initial plan anticipated remanufacture of about 300 helicopters; however, in fourth quarter of 2004, it was reported that US Army considering selling CH-47Ds and using proceeds to fund purchase of new-build CH-47Fs. Approval forthcoming in January 2005, but now appears unlikely to involve many helicopters in view of stated intent to continue with previous plan for entire US Army fleet of 397 CH-47Ds to be upgraded along with acquisition of at least 55 new-build CH-47Fs Both EMD aircraft arrived for conversion on 5 January 1999; first (98-0011/M8001; ex-83-24107) officially rolled out on 11 July 2001, having flown for the first time on 25 June; second (98-0012/M8002; ex-83-24115) completed upgrade in September 2001, with EMD phase planned to end in December 2002; second EMD CH-47F delivered to US Army on 7 May 2002 and flown to Fort Campbell, Kentucky, for further test flights. Operational testing of both EMD aircraft accomplished at Fort Campbell in mid-2004 Low-rate initial production (LRIP) begun in FY03, with seven remanufactured aircraft, six of which to MH-47G standard, with most FY04 funding also directed towards MH-47G; sole CH-47F from Lot 1 delivered to US Army 22 July 2004 Contract for first 17 new-build CH-47Fs signed 21 December 2004, with production of initial example beginning October 2005. This completed and formally rolled out 15 June 2006, subsequently becoming the second CH-47F to be delivered to the US Army Thereafter, delivery of new-build and remanufactured aircraft expected to continue until 2016.

MH-47G: Special operations version embodying improvements developed for the CH-47F. Upgrades include Rockwell Collins common avionics architecture system (CAAS) 'glass cockpit', with five colour MFDs, and MH-47G expected to have enhanced self-protection equipment in the form of a radio frequency jammer and a directed-infra-red countermeasures system. Raytheon ZSQ-1(V) electro-optical sensor system also installed, providing improved navigation, surveillance and targeting capability as well as enhanced mission performance and situational awareness by day and night Some 'new-build' MH-47Gs to be acquired, following decision to increase the number of special operations-configured Chinooks to at least 61. First aircraft (00-02160, previously CH-47D 86-1678) made initial flight on 15 March 2004 and was delivered to US Army on 6 May; this one of three being modernised to replace losses; further six MH-47Gs included in Lot 1 LRIP batch, for delivery between October 2004 and March 2005, followed by 16 more in Lot 2 Programme will involve remanufacture of 11 MH-47Ds and 23 surviving MH-47Es, but not expected to be completed until 2011.

HH-47: Proposal conceived in response to USAF requirement for personnel recovery vehicle (PRV) launched May 2005 and subsequently renamed as CSAR-X programme by end of 2005 CSAR-X calls for acquisition of 145 helicopters (including four for development testing) to replace Sikorsky HH-60G; HH-47 faced competition from Lockheed Martin US101 and Sikorsky HH-92. Boeing proposal based on CH-47F Chinook with new electrical system, a more advanced EW suite and redesigned rotor blades; consideration also given to airframe changes to reduce drag and increase speed. Boeing offer submitted to USAF in November 2005, in advance of air transportability demonstration proving that Chinook could be readied for flight within three hours of being offloaded; Boeing also undertook flight performance and cabin suitability demonstration at Nellis AFB, Nevada, in late 2005 with two leased MH-47Gs. On 9 November 2006, Boeing proposal announced as winner; selection accompanied by award of USD712 million System Development and Demonstration (SDD) contract, with first test aircraft due to be delivered in FY09, followed by IOC in 2012

CH-47X: Proposed follow-on programme to CH-47F in response to diversion of funds from Future Transport Rotorcraft (FTR) MTOW initially projected to be in region of 31 tonnes (68,000 lb), requiring new engine in 4.5 MW (6,000 shp) class, as well as new dynamic components, including four-blade rotor system. Subsequent refinement of design resulted in lower MTOW of about 27,215 kg (60,000 lb); US Army showing interest in proposal, especially as a back-up in event of cancellation of FTR, which has evolved in Joint Heavy Lift (JHL) programme Despite title, JHL appears unlikely to be used by any branch of US armed forces apart from the Army. Decision on future of JHL project anticipated in FY08

CUSTOMERS: US Army received five YCH-47A, 349 CH-47A, 108 CH-47B, 270 CH-47C and three CH-47D as new-build aircraft from US production plus 11 CH-47C from Italian production; further 479 CH-47D/MH-47E obtained from conversion programme involving CH-47A/B/C models as detailed in table elsewhere. CH-47F version also to be acquired in new-build form, with purchase of initial batch of seven authorised in December 2003; contract for these and 10 additional examples signed by Boeing and US Army on 21 December 2004 Delivery to begin September 2006 and continue until late 2008, with further 38 new-build CH-47Fs expected to be acquired by US Army, although number could rise if cargo helicopter alternative procurement strategy (CHAPS) is successful, with around eight to 12 CH-47Ds possibly to be released for export from 2008 onwards and funds used to acquire new CH-47Fs CH-47D, MH-47D and MH-47E inventory was just over 450 in mid-2002

Exports include five CH-47Cs to Argentina (three Air Force; two Army); Australia 12 CH-47Cs with crashworthy fuel system (four refurbished as CH-47D and redelivered in 1995 to C Squadron of Army's 5 Aviation Regiment at Townsville; seven sold to US Army and converted to CH-47D; contract for further two signed 19 June 1998, with delivery to Townsville for modification on 10 March 2000; these accepted by Army in February 2001); Canada nine CH-47Cs designated **CH-147**, delivered from September 1974, but withdrawn from use and seven sold to Netherlands in July 1993; Egypt finalised contract for four CH-47Ds on 20 August 1998, with delivery in mid-1999; Greece ordered seven CH-47Ds in October 1998, deliveries being effected between April and October 2001; Italy (two CH-47Cs, followed by 40 kits for local assembly and delivery to Iran and Italy); Japan (two plus four kits to initiate licensed production, with at least 72 more co-produced by Kawasaki); Netherlands, six ordered in December 1993 for delivery in 1998 (first, D-101, on 12 May 1998), plus seven ex-Canadian CH-147s upgraded to CH-47D (including nose radar) by Boeing and redelivered from August 1995; Spanish Army 19, designated **HT.17**, delivered to 5th Helicopter Transport Battalion (Bheltra-V) at Colmenar Viejo, Madrid (last six have Honeywell RDR-1400 weather radar), total of 17 upgraded by Boeing to CH-47D between August 1990 and November 2002; South Korea, total 30 CH-47D International Chinooks, comprising 24 for Army (deliveries from June 1988 to November 1998); and six (with local designation HH-47D) for Air Force (ordered early 1990; delivered November 1991 to March 1992); Singapore, six ordered April 1994 for delivery in 1996, (training operations conducted in 1996–97 at Grand Prairie, Texas, before transfer to Singapore base) followed by 10 CH-47SDs ordered in 1998 and delivered to 127 Squadron from June 2001 to January 2002; Taiwan (three, notionally civil Boeing 234MLR used by Army until June 2002, when transferred to National Fire Administration; finalised contract for nine CH-47SDs in January 2000; deliveries between November 2001 and October 2002); Thailand, six for Army (three ordered August 1988, three early 1990, deliveries February 1991 to March 1992; all are International Chinook); UK (58, see entries for Chinook HC Mk 2/2A/3); 16 civilian, of which few left operating in original oilfield support role; two for trials; 45 in kits, comprising 40 for assembly in Italy and five for Japan.

Agusta sold licence-built CH-47Cs to Egypt (15, of which 12 upgraded to CH-47D standard by Boeing and redelivered in 2002–04; remaining three expected to follow); Greece (10, of which nine converted to CH-47D by Boeing between March 1992 and 1995; first redelivery in November 1993), Iran (30), plus 38 more from kits supplied by Boeing, Italy (38, comprising 22 CH-47C, 10 CH-47C Plus and six civilian Model 234s for Civil Protection Agency; latter operated by Italian Army), Libya (20, of which 12 passed on to United Arab Emirates in 2003), Morocco (nine) and US Army National Guard (11). Kawasaki (which see) has firm orders for at least 72, with production continuing.

Several countries reportedly considering acquisition of second-hand or new-build Chinooks in 2005-06, including Argentina, Australia, Brazil, Canada, Chile, Indonesia and Netherlands. Canada has requirement for about 16 helicopters, with delivery to begin within 36 months of contract signature; order for Chinook appears very likely, as Canada has said that CH-47 is only currently available helicopter that satisfies the requirement. Netherlands also requires further Chinooks and has contracted for at least five new CH-47Fs, while also returning existing CH-47Ds tro Boeing for upgrade to CH-47F standard; Netherlands intent was to increase Chinook fleet to about 20, but loss of two CH-47Ds in 2005 means only 11 now available for upgrade. Deliveries expected to begin in 2008. Jordan may also obtain up to four CH-47Cs from Libya to equip special operations force.

Total Chinook orders, including civil and five CH-47Cs that were not delivered to Nigeria, 1,205

COSTS: Unit cost of CH-47SD quoted as USD30-32 million (2002). US Army estimates cost of CH-47F programme, including R&D, production of 55 new helicopters and upgrade of 397 Chinooks, as USD11.4 billion (2004). Procurement of 17 new-build CH-47F valued at USD549 million (December 2004). Contract for 16 MH-47G conversions worth USD278.6 million awarded to Boeing in December 2003.

DESIGN FEATURES: Two three-blade intermeshing contrarotating tandem rotors; front rotor turns anti-clockwise, viewed from above; rotor transmissions driven by connecting shafts from engine gearbox, which is driven by rear-mounted engines; normal rotor speed 225 rpm Classic rotor heads with flapping and drag hinges; manually foldable blades, using Boeing VR7 and VR8 aerofoils with cambered leading-edges; blades can survive hits from 23 mm HEI and API rounds; rotor brake optional.

Development of new, low-maintenance elastomeric rotor hub begun at end August 1999, following signature of contract with US Army; development, testing and installation to be completed over four-year period, with new assembly to be installed on all US Army regular and reserve force Chinooks Also under consideration for CH-47F and is incorporated in CH-47SD Will have longer fatigue life (4,500 hours), 75 per cent fewer parts and offer 70 per cent reduction in requirement for special maintenance tools; will also retain same rotor flight dynamics and be fully interchangeable with existing hub.

Constant cross-section cabin with side door at front; rear-loading ramp that can be opened in flight; underfloor section sealed to give flotation after water landing; access to flight deck from cabin; main cargo hook mounting covered by removable floor panel so that load can be observed in flight.

FLYING CONTROLS: Differential fore and aft cyclic for pitch attitude control; differential lateral cyclic pitch (from rudder pedals) for directional control; automatic control to keep fuselage aligned with line of flight. Dual hydraulic rotor pitch-change actuators; secondary hydraulic actuators in control linkage behind flight deck for autopilot/autostabiliser input; autopilot provides stabilisation, attitude hold and outer-loop holds

STRUCTURE: Blades based on D-shaped glass fibre spar, fairing assembly of Nomex honeycomb core and crossply glass fibre skin

LANDING GEAR: Non-retractable quadricycle type, with twin wheels on each front unit and single wheels on each rear unit Oleo-pneumatic shock-absorbers in all units. Rear units

CHINOOK PRODUCTION

Customer	YCH-47A	CH-47A	CH-47B	CH-47C	Model 234	CH-47D	CH-47F	Agusta	Kawasaki	Total
Argentina				5						5
Australia				12		2				14
Canada				9						9
Egypt						4		15		19
Greece						7		10		17
Iran								30		30
Iran (kits)				38						38
Italy								38		38
Italy (kits)				2						2
Japan				2					72	74
Japan (kits)				4						4
Libya								20		20
Morocco								9		9
Netherlands						6				6
Nigeria				5						5
Singapore						16				16
South Korea						30				30
Spain				19						19
Taiwan				3		9				12
Thailand						6				6
UK				41		17				58
USA	5	349	108	270		3	17	11		763
Civil					10					10
Not known				1						1
Total	5	349	108	411	10	100	17	133	72	1,205

Notes: CH-47Cs for Taiwan were built to notional civilian Model 234MLR standard
CH-47C figures include some helicopters produced as Model 414 International Chinook
Table excludes two airframes completed by Boeing for mock-up purposes
Kits for Iran and Italy were assembled in Italy by Meridionali/Agusta; kits for Japan assembled in Japan by Kawasaki
Nigerian CH-47Cs not delivered; one retained by Boeing as maintenance trainer; fate of others uncertain
CH-47D figures include 19 helicopters produced as CH-47SD for Singapore (10) and Taiwan (9)

fully castoring; power steering on starboard rear unit. All wheels are size 24×7.7, with tyres size 8.50–10, pressure 6.07 bar (88 lb/sq in). Single-disc hydraulic brakes on all six wheels. Provision for fitting detachable wheel/skis.

POWER PLANT: Two Honeywell T55-L-712 turboshafts initially on CH-47D, pod-mounted on sides of the rear pylon, each with a standard power rating of 2,237 kW (3,000 shp) and maximum rating of 2,796 kW (3,750 shp). Honeywell T55-L-712 SSB engine has standard power rating of 2,339 kW (3,137 shp) and maximum of 3,217 kW (4,314 shp). Standard in MH-47E and International Chinook are two Honeywell T55-L-714 turboshafts, each with a standard power rating of 3,108 kW (4,168 shp) continuous and emergency rating of 3,629 kW (4,867 shp). Retrofit programme involving installation of T55-GA-714A engine on US Army CH-47D under way at present time, with just over half of fleet re-engined by third quarter of 2005 and completion anticipated in first quarter of 2009; same engine on CH-47SD and Netherlands CH-47Ds. T55-GA-714A has maximum continuous rating of 3,039 kW (4,075 shp). FADEC installed on late production CH-47Ds and CH-47SD; CH-47F has Goodrich FADEC system. From January 1991, more than 100 CH-47Ds fitted with engine air particle separator (also available for RAF variant). Transmission capacity (CH-47D/SD and MH-47E) 5,617 kW (7,533 shp) on two engines and 3,430 kW (4,600 shp) OEI; rotor rpm 225.

Self-sealing pressure refuelled crashworthy fuel tanks in external fairings on sides of fuselage. Total usable fuel capacity 3,914 litres (1,034 US gallons; 861 Imp gallons) in CH-47D. Provision for up to three additional long-range tanks in cargo area, each of 3,028 litres (800 US gallons; 666 Imp gallons); maximum fuel capacity (fixed and auxiliary) 12,998 litres (3,434 US gallons; 2,859 Imp gallons). Oil capacity 14 litres (3.7 US gallons; 3.1 Imp gallons).

Normal fuel (MH-47E/G, International Chinook and CH-47SD) 7,828 litres (2,068 US gallons; 1,722 Imp gallons) but MH-47E/G can operate with three long-range tanks in cargo area, each containing 3,028 litres (800 US gallons; 666 Imp gallons), raising total fuel capacity to 16,913 litres (4,468 US gallons; 3,720 Imp gallons). MH-47s have 8.97 m (29 ft 5 in) refuelling probe on starboard side of forward fuselage, which extends 5.41 m (17 ft 9 in) forward of the nose. Refuelling probe also an option for International Chinook.

ACCOMMODATION: Two pilots on flight deck, with dual controls. Lighting compatible with pilots' NVGs (Nite-Op in RAF variant). Jump seat for crew chief or combat commander. Jettisonable door on each side of flight deck. Depending on seating arrangement, 33 to 55 troops can be accommodated in main cabin, or 24 litters plus two attendants, or (see under Current Versions) vehicles and freight. Rear-loading ramp can be left completely or partially open, to permit transport of extra-long cargo and in-flight parachute or free-drop delivery of cargo and equipment.

Main cabin door, at front on starboard side, comprises upper hinged section which can be opened in flight, and lower section with integral steps. Upper section has a panel with window that is jettisonable. Triple external Breeze-Eastern C-160 cargo hook system on US Army aircraft, with centre hook rated to carry maximum load of 11,793 kg (26,000 lb) and the forward and rear hooks 7,711 kg (17,000 lb) each, or 10,433 kg (23,000 lb) in unison, while International Chinook and CH-47SD ratings are 12,701 kg (28,000 lb) for centre hook and 9,072 kg (20,000 lb) each for forward and rear hooks, or 11,340 kg (25,000 lb) in unison. Options are available for a power-down ramp and water dam to permit ramp operation on water, internal ferry fuel tanks, external rescue hoist, and windscreen washers.

SYSTEMS: Hydraulic system contains a utility system, a No. 1 flight control system and a No. 2 flight control system. Each includes a separate, variable delivery pump and a reservoir cooler module. Utility system contains a pressure control module and a return control module. Both flight control systems contain a power control module, incorporating pressure and return in one module for each system. Each flight control system can be driven by the utility system for ground checkout through a power transfer unit without intermixing of hydraulic fluids. All hydraulic systems have a pressurised reservoir to prevent pump cavitation and are serviced by a common filter.

The CH-47D has a significant reduction in the number of hydraulic lines and fittings; approximately 200 tubes and hoses eliminated, thereby obviating approximately 700 leak points. Majority of all lines now swaged together for permanent joining; Rosan fluid adaptors for hardpoint connections. All systems capable of being monitored, both in flight and on the ground, for servicing prechecks and fault isolation. Subsystems designed for pressurisation on demand; power transfer units now used for flight control ground system checkout. Electrical system includes two 40 kVA oil-cooled alternators driven by transmission drive system. Solar T62-T-2B APU drives a 20 kVA generator and hydraulic motor pump, providing electrical and hydraulic power for main engine start and system operation on the ground.

AVIONICS: Baseline CH-47D. Specific MH-47E and MH-47G avionics listed under those headings. Netherlands aircraft have Honeywell advanced cockpit management system (ACMS) and EFIS, latter adopted by Boeing as baseline for subsequent sales.

Comms: Honeywell AN/ARC-199 HF com radio, Rockwell Collins AN/ARC-186 VHF/FM-AM, Magnavox AN/ARC-164 UHF/AM com; C-6533 intercom (Netherlands aircraft have Telephonics Corp STARCOM); Honeywell AN/APX-100 IFF. Telephonics supplying secure digital intercom for CH-47F. UK Chinooks currently being fitted with Bowman digital battlefield communications system; entire fleet expected to be converted by end of 2007.

Flight: Honeywell AN/APN-209 radar altimeter; AN/ARN-89B ADF; BAE Systems AN/ASN-128 Doppler; AN/ARN-123 VOR/glideslope/marker beacon receiver; and AN/ASN-43 gyromagnetic compass. AFCS maintains helicopter stability, eliminating the need for constant small correction inputs by the pilot to maintain desired attitude. The AFCS is a redundant system using two identical control units and two sets of stabilisation actuators. BAE Systems developing digital advanced flight control system (DAFCS) for CH-47F; this flown for first time in mid-2005, with production units expected to become available for installation on the CH-47F in 2006. RAF Chinooks have Racal RNS252 Super TANS INS including GPS.

Instrumentation: Flight instruments are standard for IFR, and include an AN/AQU-6A horizontal situation indicator. CH-47F incorporates Integrated Engine Crew Advisory System (IECAS).

Mission: Chelton 19-400 satellite communications antenna on some RAF helicopters.

Self-defence: Provisions for Lockheed Martin AN/APR-39A RWR, Sanders AN/ALQ-156 missile warning equipment and BAE Systems M-130 chaff/flare dispensers. BAE Systems CMWS/ATIRCM (common missile warning system/advanced threat infra-red countermeasures) to be installed on CH-47s of US Army over five-year period following contract agreement in latter half of 2004. RAF Chinooks have BAE Systems M-206/M-1 chaff/flare dispensers, BAE Systems ARI 18228 Sky Guardian RWR and (from 1990)

CHINOOK REMANUFACTURE BY BOEING

	CH-47D	MH-47E	CH-47F	MH-47G	Total
Australia	4				4
Egypt	12				12
Greece	9				9
Netherlands	7				7
Spain	17				17
UK	32				32
USA	454	25	3	13	495
Total	535	25	3	13	576

Notes: US Army CH-47D total excludes three prototypes, but includes one that was further converted as MH-47E prototype
Egyptian and Greek aircraft originally built in Italy; three more Egyptian aircraft expected to undergo remanufacture
CH-47F and MH-47G remanufacture now under way; additional helicopters to be remanufactured

Lockheed Martin AN/ALQ-157 IR jammers and Honeywell AN/AAR-47 missile approach warning equipment; Elisra SPS-65V-3 integrated airborne self-protection system chosen for installation on HC. Mk 3 version. Northrop Grumman AN/AAR-54(V) passive missile approach warning system adopted by Royal Netherlands Air Force, with installation accomplished during 2001–04. Australian Chinooks being upgraded with BAE Systems Australia ALR-2002D RWR and EADS AN/AAR-60 missile launch detection system (MILDS)

EQUIPMENT: Hydraulically powered winch for rescue and cargo handling, rearview mirror, plus integral work stands and step for maintenance.

ARMAMENT: Provision for two machine guns or miniguns in crew door (starboard) and forward hold window (port)

DIMENSIONS, EXTERNAL:

Rotor diameter (each) ..... 18.29 m (60 ft 0 in)
Rotor blade chord (each) ..... 0.81 m (2 ft 8 in)
Distance between rotor centres:
CH-47SD ..... 11 85 m (38 ft 10¾ in)
Length:
overall, rotors turning:
MH-47E and CH-47SD ..... 30 14 m (98 ft 10¾ in)
fuselage: MH-47E and CH-47SD ..... 15.87 m (52 ft 1 in)
MH-47D/E, incl probe ..... 21.08 m (69 ft 2 in)
Width, rotors removed: MH-47E ..... 4.78 m (15 ft 8 in)
Height to top of rear rotor head:
CH-47SD ..... 5 70 m (18 ft 8½ in)
MH-47E ..... 5.59 m (18 ft 4 in)
Ground clearance, rotors turning:
rear approach ..... 5.77 m (18 ft 11 in)
Ground clearance, static:
rear approach:
MH-47E and CH-47SD ..... 4.90 m (16 ft 0¾ in)
forward approach: CH-47SD ..... 2.29 m (7 ft 6 in)
Wheelbase: MH-47E and CH-47SD ..... 7.87 m (25 ft 10 in)
Passenger door (fwd, stbd): Height ..... 1 68 m (5 ft 6 in)
Width ..... 0.91 m (3 ft 0 in)
Height to sill ..... 1.09 m (3 ft 7 in)
Rear-loading ramp entrance: Height ..... 1.98 m (6 ft 6 in)
Width ..... 2.31 m (7 ft 7 in)
Height to sill ..... 0.79 m (2 ft 7 in)

DIMENSIONS, INTERNAL (MH-47E and CH-47SD):

Cabin, excl flight deck: Length ..... 9.19 m (30 ft 2 in)
Width: mean ..... 2 29 m (7 ft 6 in)
at floor ..... 2.51 m (8 ft 3 in)
Height ..... 1.98 m (6 ft 6 in)
Floor area ..... 21 0 m² (226 sq ft)
Usable volume ..... 41 7 m³ (1,474 cu ft)

AREAS:

Rotor blades (each) ..... 7 43 m² (80 0 sq ft)
Rotor discs (total):
MH-47E and CH-47SD ..... 525.3 m² (5,655 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: MH-47E ..... 12,210 kg (26,918 lb)
CH-47SD ..... 11,550 kg (25,463 lb)
Useful load: MH-47E ..... 12,284 kg (27,082 lb)
CH-47SD ..... 12,944 kg (28,537 lb)
Max underslung load: CH-47SD ..... 12,700 kg (28,000 lb)
Max fuel weight:
MH-47E, CH-47SD ..... 6,815 kg (15,025 lb)
Max T-O weight:
MH-47E, CH-47SD ..... 24,494 kg (54,000 lb)
Transmission loading at max T-O weight and power:
MH-47E, CH-47SD ..... 4 36 kg/kW (7.17 lb/shp)

PERFORMANCE (at 22,680 kg; 50,000 lb):

Max level speed: MH-47E ..... 154 kt (285 km/h; 177 mph)
CH-47SD ..... 155 kt (287 km/h; 178 mph)
Max cruising speed at S/L:
MH-47E, CH-47SD ..... 140 kt (259 km/h; 161 mph)
Max rate of climb: MH-47E ..... 561 m (1,840 ft)/min
CH-47SD ..... 563 m (1,846 ft)/min
Service ceiling: MH-47E ..... 3,090 m (10,140 ft)
CH-47SD ..... 3,385 m (11,100 ft)
Hovering ceiling:
IGE: MH-47E ..... 2,985 m (9,800 ft)
CH-47SD ..... 2,835 m (9,300 ft)
IGE, ISA + 20°C (68°F): MH-47E ..... 2,410 m (7,900 ft)
CH-47SD ..... 2,180 m (7,160 ft)
OGE: MH-47E, CH-47SD ..... 1,675 m (5,500 ft)
OGE, ISA + 20°C (68°F):
MH-47E, CH-47SD ..... 1,005 m (3,300 ft)
Radius of action, MH-47E, deploy special forces team (1,814 kg; 4,000 lb) at 1,220 m (4,000 ft), 35°C (95°F) ambient temperature ..... 505 n miles (935 km; 581 miles)
Range:
MH-47E, self-deployment at 24,494 kg (54,000 lb) T-O weight ..... 1,260 n miles (2,333 km; 1,449 miles)
CH-47SD with 12,558 kg (27,686 lb) payload ..... 651 n miles (1,207 km; 750 miles)

BOEING AH-64 APACHE

US Army designations: AH-64A and AH-64D
Japan Self-Defence Forces designation: AH-64DJP
Netherlands designation: AH-64DN
UK British Army designation: Apache AH. Mk 1 (WAH-64D)
Israel Defence Force names: AH-64A Pethen (Cobra); AH-64D Saraf (Serpent)

TYPE: Attack helicopter

PROGRAMME:

DEVELOPMENT MILESTONES

Official go-ahead	Dec 1976
First flight	30 Sep 1975
First delivery (US Army)	26 Jan 1984

Original Hughes Model 77 entered for US Army advanced attack helicopter (AAH) competition; first flights of two development prototype YAH-64s 30 September and 22 November 1975; selected by US Army December 1976; named Apache late 1981.

Deliveries started 26 January 1984; 900th delivered in October 1995, at which time US Army had ordered 821 AH-64As (excluding prototypes) with export contracts totalling 104; latter total increased to 258 (116 AH-64A; 142 AH-64D) by end of 2002. Last of 821 AH-64As delivered to US Army on 30 April 1996; aircraft concerned was production vehicle 915, and manufacture of AH-64A variant terminated with completion of 937th example (for Egypt), in November 1996. Delivery of 1,000th Apache (including AH-64D rebuilds) effected on 30 March 1999. Production of new-build helicopters will total at least 1,133, following 2006 decision by US Army to acquire small number of new-build AH-64Ds as attrition replacements; this total made up of 943 AH-64As (827 US Army, 116 export) and 190 AH-64Ds (27 US Army, 163 export).

Boeing awarded four year, USD15.9 million, contract on 27 May 1998 to design, manufacture and flight test new centre fuselage section incorporating advanced composites materials; Phantom Works responsible for design leadership, with support from Boeing facilities at Long Beach, Philadelphia and St Louis. If successful, new section from rear of aft cockpit to just behind engines will be simpler to manufacture as well as lighter and more durable than existing all-metal structure.

In separate development, on 5 October 1998, a modified AH-64D Apache Longbow prototype made initial flight with Rotorcraft Pilot's Associate (RPA) advanced cockpit management system. Also developed by Phantom Works over 60 month period, under terms of USD80 million advanced technology demonstration contract, this featured updated controls and displays, including Boeing-developed four-axis, full authority, advanced digital flight control system. Flight and mission data presented to pilots on three large multipurpose colour displays; RPA also features advanced data fusion and an advanced pilotage system, as well as the ability to recognise and respond to verbal commands. Company flight trials continued throughout remainder of 1998, with test aircraft then visiting US Army's Yuma Proving Grounds for demonstration flights in January-February 1999.

In 2001, Boeing proposed series of upgrades designed to keep AH-64D in operational force until 2030; these included adoption of new split-face power plant gearbox, new main rotor assembly using composite blades and titanium hub, composites fuselage structure elements for enhanced payload, and open architecture avionics with gradual introduction of Boeing RPA features such as digital navigation and communications equipment. Objective of upgrade package to restore original performance, reduce purchase price by about 30 per cent and cut operating costs by 50 per cent, but US Army not enthusiastic and instead chose to direct available funding towards near-term reliability and sustainability concerns, such as adoption of Lockheed Martin Arrowhead M-TADS/PNVS targeting and navigation sensor system.

Other enhancements, including digital avionics incorporating commercial off-the-shelf (COTS) technology, tested on preproduction AH-64D Apache Longbow first flown 12 July 2001; Boeing introducing some of these during production of the second multiyear batch of helicopters (see **Block II**).

US Army AH-64 fleet passed two million flight hour milestone in final quarter of 2005, comprising 1.6 million hours for AH-64A and 400,000 hours for AH-64D, with combined total of 700,000 hours accumulated since September 2001.

CURRENT VERSIONS: **AH-64A**: Produced for US Army and export; 937 built. First 603 had two 1,265 kW (1,696 shp) T700-GE-701 engines. Total of 597 US Army examples being upgraded to AH-64D. Retrofit from 1993 with SINCGARS secure radios and GPS; first installed in Apaches of 5-501 Aviation Regiment at Camp Eagle, South Korea.

GAH-64A: Designation applies to at least 17 AH-64As that have been grounded and assigned as technical instruction training aids.

JAH-64A: Designation applied to seven AH-64As that have been used for special test duties; at least one has reverted to standard AH-64A.

AH-64B: Cancelled 1992. Was planned near-term upgrade of 254 AH-64As with improvements derived from operating experience in 1991 Gulf War, including GPS, SINCGARS radios, target handover capability, better navigation, and improved reliability.

AH-64C: Previous designation for upgrade of AH-64As to near AH-64D standard, apart from omission of Longbow radar and retention of -701 engines; provisions for optional fitment of both. Army requested draft proposal, August 1991; funding for two prototype conversions awarded in September 1992. Designation abandoned late 1993.

AH-64D Apache Longbow: Current improvement programme involving 501 remanufactured helicopters for US Army and new-build examples for export. Based on Lockheed Martin and Northrop Grumman joint venture development of mast-mounted AN/APG-78 Longbow millimetre-wave radar and Hellfire missile with RF seeker; Northrop Grumman has lead on Longbow with Lockheed Martin taking principal role for Hellfire. Programme also includes more powerful engines, larger generators, MIL-STD-1553B databus allied to dual 1750A processors, and a vapour cycle cooling system for avionics; early user tests completed April 1990. First 284 US Army aircraft to basic **Block I** standard; balance of 313 as Block II, with small number of new-build helicopters to be acquired from FY05 also to emerge in Block II configuration.

Detailed description applies to AH-64D.

Full-scale development programme, lasting 51 months, authorised by Defense Acquisition Board August 1990, but airframe work extended in December 1990 to 70 months to coincide with missile development; supporting modifications being incorporated progressively; first flight of AH-64A (82-23356) with dummy Longbow radome 11 March 1991; first (89-0192) of six AH-64D prototypes flown 15 April 1992; second (89-0228) flew 13 November 1992; fitted with radar in mid-1993 and flown 20 August 1993; No 3 (90-0324) flown 30 June 1993; No 4 (90-0423) on 4 October 1993; No.5 (85-25477; formerly AH-64C No 1) 19 January 1994 (first Apache with new Hamilton Sundstrand lightweight flight management computer); No.6 (85-25408) flown 4 March 1994; last two mentioned lack radar. Following termination of AH-64C in late 1993, original plan was to convert 748 AH-64As to AH-64D, although only 227 (original AH-64D total) to carry Longbow radar; subsequent review, revealed at start of 1999, proposed reducing total number of conversions to 530 and increasing purchase of Longbow radars to 500. To date, US Army has funded total of 501 conversions, with further 96 to come in FY07-09.

Under original programme, AH-64D to equip 26 battalions; three companies, each with eight helicopters, per battalion. Longbow can track flying targets and see through rain, fog and smoke that defeat FLIR and TV. RF Hellfire, delivered to US Army from November 1996, can operate at shorter ranges; it can lock on before launch or launch on co-ordinates and lock on in flight; Longbow scans through 360° for aerial targets or scans over 270° in 90° sectors for ground targets; mast-mounted rotating antenna weighs 113 kg (250 lb). Longbow radar transmitter subject of redesign in late 1997 to overcome poor performance of some electrical components in low temperatures; eliminate lengthy and costly manual integration necessary to achieve required output; and avoid shortages of critical components which suppliers reported in 1995 that they would no longer provide. New transmitter meets or surpasses original specification and is fully interchangeable with original unit.

Further modifications include 'manprint' cockpit with large displays, air-to-air missiles, digital autostabiliser, integrated GPS/Doppler/INS/air data/laser/radar altimeter navigation

Singaporean Boeing AH-64D Apache Longbow immediately after delivery *(Paul Jackson)* 1040489

Netherlands Boeing AH-64DN Apache in Afghanistan *(Jane's/Patrick Allen)* 1209135

system, digital communications, faster target handoff system, and enhanced fault detection with data transfer and recording. Cockpit displays initially monochrome, but these replaced by colour displays with effect from 27th production conversion (97-5027); first flight of AH-64D with colour displays on 12 September 1997. AH-64D No.1 made first Hellfire launch on 21 May 1993; first RF Hellfire launch 4 June 1994 (first combat use of RF Hellfire in opening phase of ground conflict during Gulf War of 2003); first demonstration of digital air-to-ground data communications with Symetrics Industries improved data modem, 8 December 1993.

Advanced acquisition phase contract for remanufacture programme, worth USD279.6 million and covering 18 helicopters (later increased to 24), awarded on 14 December 1995; predated by arrival of first two AH-64As (85-25387 and 85-25394) at Mesa on 27 November 1995 for stripping to basic fuselage in readiness for start of remanufacture in early 1996. First fuselage moved to final assembly area on 15 August 1996; first flight (85-25387 with new identity 96-5001) 17 March 1997; formal roll-out at Mesa on 21 March.

Multiyear contract, worth USD1.87 billion, covering 232 AH-64Ds (retrospectively including advanced acquisition aircraft) over five year period signed 16 August 1996; further 269 conversions acquired in second multiyear contract covering FY01 to FY05, which signed 29 September 2000, at total cost of USD2.3 billion; last of these (501st US Army AH-64D) handed over 9 August 2006.

First of 313 so-called **Block II** aircraft (02-5285) delivered to US Army on 25 February 2003; incorporates advanced avionics, digital enhancements and communications upgrades, permitting secure transfer of digitised battlefield information to air and ground forces. Future **Block III** upgrade progressed from research and development phase to system development and demonstration (SDD) stage following Milestone B approval decision on 10 July 2006, with award of USD619.3 million contract to Boeing on 14 July. Block III will build on existing Block II architecture and feature total of 25 technology insertions dominated by provision of network-centric capability, permitting interface with existing Stryker brigade combat teams and future combat systems. Improvements to be incorporated in staged programme and will include open systems architecture, wideband network communications, Link 16 digital datalink, T700-GE-701D engine, extended range Longbow fire control radar and missile armament, Level IV UAV control capability and data fusion to merge imagery from onboard and remote sensor systems. New composites main rotor to be adopted as part of Block III enhancements. A more durable and uprated 2,530 kW (3,400 shp) gearbox may also be installed. First phase to include installation of T700-GE-701D engine, composite main rotor blades, improved driveshaft and a new radar electronics unit; this will involve aircraft for delivery in 2011-13. Phase two will add Link 16, affecting aircraft delivered in 2014-15, with the final phase featuring cognitive decision aids intended to ease pilot workload, as well as a multimode laser sensor for the gun turret and a maritime mode for the fire control radar. Aircraft with phase three improvements should become available after 2016, with earlier aircraft being progressively brought to this definitive configuration. Upgrade programme will initially involve surviving examples of 284 Block I Apaches, followed by Block II helicopters acquired in FY02 to FY05 and, eventually, the Block IIs obtained in FY07 to FY09; signature of first research, development, test and evaluation contract took place on 28 June 2005. Current planning calls for procurement of 12 Block III upgrades in FY09, followed by 38 in FY10 and 60 in FY11. At beginning of 2005, US Army considering potential upgrades for proposed **Block IV**, which could receive funding in 2010, allowing delivery to start soon after 2015; a new engine is almost certain to be included, with competition to find new powerplant for US Army helicopters expected to have begun in January 2007. Known as the Advanced Affordable Turbine Engine (AATE), this should result in availability of a 2,237 kW (3,000 shp) class engine offering significant improvements in fuel economy.

AH-64D deliveries to US Army began 31 March 1997 and total of 18 handed over by end of 1997. Delivery of 24th and last Lot I aircraft accomplished 4 March 1998, with US Army

Northrop Grumman pod-mounted AN/AAR-54 missile warning and expendables countermeasures system installed on Netherlands Apache deployed in Afghanistan *(Jane's/Patrick Allen)* 1183838

having accepted total of 55 by end of 1998, 102 by end of 1999 and 159 by end of 2000; 100th remanufactured AH-64D delivered to US Army on 9 December 1999; 200th followed on 23 August 2001; 300th in second quarter of 2003; 350th in April 2004. Final example of initial multiyear contract and first helicopter from second multiyear contract both delivered to US Army on 3 April 2002; 500th AH-64D (383rd for US Army) delivered 26 August 2004, with production for US Army originally scheduled to end with acceptance of 501st example in August 2006; however, approval received in November 2004 for another 96 aircraft, which are to be delivered between late 2007 and about May 2010. Remanufacture effort during intervening period focused on aircraft for overseas customers, including 30 for UAE.

Initial AH-64D battalion (1-227 AvRgt) at Fort Hood, Texas fully equipped by end July 1998 and attained combat-ready status on 19 November 1998, after eight month training programme at company and battalion level which included four live fire exercises and more than 2,500 flight hours; at least 12 more battalions had followed suit by late 2005.

AH-64DJP: Designation allocated to Apache Longbow for Japan Ground Self-Defence Force, which received first example in March 2006. Basically similar to standard AH-64D, but with some unique attributes, including Stinger AAM capability, new communications and navigation equipment and option to fit skis for use in snow. Total of 100 originally required to replace AH-1, but Ground Self-Defence Force now appears unlikely to receive more than 60 over 10-year period from 2007 on.

Refer to Fuji in Japanese section of *Jane's All the World's Aircraft*.

AH-64DN: Designation assigned to 30 helicopters delivered to Royal Netherlands Air Force between May 1998 and April 2002.

WAH-64D Apache AH. Mk 1: British Army version with Longbow radar and Rolls-Royce/Turbomeca RTM 322 turboshafts. Westland selected, 13 July 1995, to build McDonnell Douglas (now Boeing) AH-64D Apache for Army Air Corps (AAC) and Royal Marines. Total 67 ordered, although original requirement was 91; contract H12b/400 finalised 25 March 1996; programme involved some 240 UK companies (including 60 direct subcontractors) that received over 50 per cent of UK Apache work. Value increased to some £3,100 million by 1999, in part through addition of Marconi Avionics (later part of BAE Systems) to provide HIDAS self-protection. UK version similar to US Apache, including Longbow radar.

Engine integration trials conducted on leased sixth preproduction AH-64D (85-25408) at Boeing's Mesa, Arizona plant; first engine run 6 April 1998; first flight 29 May 1998. Eight WAH-64Ds built and flown at Mesa; ZJ166/N9219G first flew 25 September 1998 and handed over to GKN Westland 28 September; initial trials and pilot training conducted in US, where four WAH-64s were retained by January 2000; further four supplied, complete, to Westland; remainder followed in kit form from 30 August 1999; first kit (ZJ172) made initial flight after assembly from Yeovil on 18 July 2000 and was delivered to Middle Wallop for Advanced Helicopter Trials Unit (AHTU) on 31 July 2000. Final kit (ZJ233) left Mesa on 27 March 2003; first delivery to AAC 15 March 2000; initial military aircraft release (IMAR) signed 22 December 2000; formal in-service date and release-to-service achieved 16 January 2001; initial weapons clearance planned for July 2001; HIDAS clearance December 2001; cannon and CRV-7 clearance August 2002, allowing full deployment; shipboard clearance 2004, following one-month trial aboard HMS *Ocean* in March 2004; final delivery was formal hand-over of ZJ233 to MoD at Farnborough International on 21 July 2004; IOC with 656 Squadron, August 2004; 664 Squadron next; full environmental clearance in November 2004. First Apache with full suite of mission equipment (including HIDAS, HUMS and low-height warning system) delivered early 2003. Initial 37 aircraft built to interim specification and being upgraded.

Shorts contracted in September 1996 to supply engine nacelles, stub-wings and horizontal stabiliser; heat exchangers manufactured by IMI Marston under Hughes-Treitler licence. UK and Netherlands agreed on 5 September 1996 on joint support of their Apache fleets. US and UK governments signed co-operation agreement 24 May 2000 for future Apache development, operation and support. UK contract also included 68 Longbow radars, 980 Hellfire missiles and 204 launchers.

British Army service allocation comprises 19 for operational evaluation, training (of which eight at Middle Wallop) and attrition replacement, plus 16 for each of three Army Air Corps regiments: No. 9 at Dishforth (656 and 664 Squadrons) and Nos. 3 (654 and 669 Squadrons) and 4 (662 and 663 Squadrons) at Wattisham. Units have additional responsibility for supporting Royal Marines with 'navalised' WAH-64s and integrated (Army/RM) crews. Re-equipment dates not met because of crew shortage, and new aircraft initially delivered to storage at Fleetlands and Shawbury. By mid-2002, AHTU at Middle Wallop had some 12 Apaches for development work, including weapon firing by Attack Helicopter Training Unit. AHTU redesignated 673 Squadron on 1 April 2003. First operational unit, 656 Squadron, began conversion on 1 September 2003, two years later than originally planned, following delivery of aircraft to Dishforth; IOC achieved 15 October 2004, with full operational capability now expected in 2007 for entire force of three regiments.

Major upgrade programme, valued at more than GBP1 billion, to be undertaken in 2012-15; ultimate configuration still to be determined, but will include replacement of current radio installation by new equipment offering compatibility with Bowman digital radio system. Other changes likely to echo those of US Army Block III programme, enabling UK Apache to possess high degree of commonality. Before that, Lockheed Martin Arrowhead M-TADS/PNVS system to be installed during 2007-10 at cost of GBP194 million, with this upgrade project announced in May 2005.

CUSTOMERS: US Army 827 AH-64A (including six prototypes), of which last delivered 30 April 1996; in addition to 597 AH-64As in process of being remanufactured, US Army also to acquire 27 new-build AH-64Ds as war replacement aircraft; delivery of latter to be accomplished between March 2007 and September 2009. Confirmed export orders and firm commitments totalled 279 in late 2004 (excluding remanufactured helicopters). Israel ordered 18 in March 1990; first two delivered 12 September 1990 to 113 Squadron; further 24 ex-US Army AH-64As supplied for 113 and 127 Squadrons at Ramon; deliveries to 190 Squadron at Ramat David, 1995. After rejecting new-build AH-64D Apache Longbow on cost grounds, Israel considered upgrade of existing AH-64A to AH-64D; however, upgrade proposal later abandoned in favour of acquisition of new-build AH-64D; letter of offer and acceptance signed February 2001, covering nine helicopters (of which one was to be a remanufactured AH-64A). Contract for eight new-build AH-64Ds awarded on 29 May 2002, at which time additional three remanufactured helicopters included in overall deal, with contract for upgrade of another six being finalised in December 2004. Further upgrades were expected to follow, but no additional orders have yet been placed. First three new-build AH-64D helicopters formally accepted by Israel at Ramon on 10 April 2005.

Deliveries began in April 1993 to Saudi Arabia (12) and in 1994 to Egypt (24). Further orders from Greece (20) and United Arab Emirates (20), both in December 1991; six handed over to UAE on 30 October 1993; 14 followed in 1994, with 10 more received later; following formal request in August 2002, UAE helicopters currently being upgraded to AH-64D standard, incorporating Lockheed Martin Arrowhead piloting and weapon aiming system, Longbow radar and enhanced AN/ALQ-211 EW suite. Total cost of upgrading 30 UAE helicopters expected to be approximately USD1.5 billion with first batch of six AH-64As returned to Mesa for induction by June 2006; completion of upgrade project on all 30 due by 2010, with first deliveries planned for May 2008. Greek deliveries from February 1995 for training in USA; initial six Apaches ferried to New Orleans, Louisiana, for shipment to Greece on 9 June 1995. Greece subsequently revealed intent in 2002 to purchase 24 AH-64Ds, although eventual deal, finalised on 2 September 2003, covered only 12 helicopters, for delivery from first quarter of 2007. In late 2006, however, it emerged that Greece plans to upgrade original 20 AH-64As to AH-64D standard, but will not exercise option for additional new-build examples. Another 12 AH-64As for Egypt approved early 1995, with Egypt revealing intent in July 2000 to upgrade 35 AH-64A to AH-64D. Contract signed in November 2001, with deliveries beginning in July 2003, although these do not have Longbow radar; by early 2004, eight Egyptian aircraft had been remanufactured, with all 35 completed by late 2006. On 28 July 2006, US Defence Security Co-operation Agency advised US Congress that Saudi Arabia had submitted request for remanufacture and upgrade programme to bring existing fleet of 12 AH-64As to AH-64D Longbow Apache configuration; if approved, cost expected to be around USD400 million.

Version of AH-64D Apache Longbow offered to British Army by consortium of McDonnell Douglas, Westland, Lockheed Martin, Northrop Grumman and Shorts; UK announced order for 67 on 13 July 1995; all except initial eight assembled by Westland (AgustaWestland). Netherlands signed contract on 24 May 1995 for 30 AH-64DN Apaches for Nos. 301 and 302 Squadrons at Gilze-Rijen; radar not required at outset, but formal request made in November 1999 and this will now be installed; US Army provided 12 AH-64As for use by No. 301 Squadron on lease basis for period 1996–99; all delivered 13 November 1996 and since returned. First AH-64DNs accepted by Netherlands at Mesa on 15 May 1998 and 21 had been delivered by late August 2001, with 30th and last handed over on 30 April 2002; No. 302 Squadron first unit to be equipped, with initial deliveries to Gilze-Rijen in mid-May 2000; No. 301 Squadron became operational in 2003, although Netherlands government in late 2003 announced intention to reduce size of fleet to about 24 helicopters. Singapore selected AH-64D on 14 June 1999; total of eight initially acquired, with AGM-114K Hellfire 2 laser-guided missile, but lacking Longbow radar; option on further 12 taken up on 23 August 2001, at which time it was revealed that all 20 will have Longbow radar; first example accepted at Mesa on 17 May 2002. Singaporean examples initially remained in US, for training at Silver Bell Army Heliport, Arizona; first delivery to Singapore took place on 23 January 2006, when three AH-64Ds arrived at Sembawang for No. 120 Squadron, coincident with handover in US of first helicopter from second batch. Kuwait was authorised in late 1997 to receive 16 AH-64Ds under FMS programme; letter of acceptance due for signature in last quarter of 1998, but deal stagnated because of concern over inclusion of Longbow radar. Letter of offer and acceptance finally signed at beginning of September 2002, with package including eight Longbow radars; first example handed over at Mesa, Arizona, in July 2005. On 27 August 2001, Japan announced selection of AH-64DJP to satisfy its AH-X combat helicopter requirement; an initial batch of 10 helicopters is being acquired with FY02 funds, with the total buy likely to number around 50, some of which will be fitted with Longbow radar. First AH-64DJP supplied in kit form in December 2005, for assembly by Fuji Heavy Industries at Utsonomiya; this flown for first time in Japan on 25 January 2006 and delivered to Japanese government on 15 March 2006; second aircraft also received as kit, with total of eight Fuji-assembled examples due for delivery by 2008. Subsequent purchases of small lots expected annually over 10-year period. Future customers could include South Korea, which initially needs 18 combat helicopters, but could eventually purchase 36. Taiwan has indicated desire to obtain at least 30 new combat helicopters and apparently favoured the AH-64D Apache Longbow; a decision was expected in 2004, but has been deferred, with Sikorsky MH-60M emerging as front-runner according to July 2006 report in Taiwanese media.

APACHE PROCUREMENT

	Qty	Remarks
US Army		
FY73	3	Prototypes
FY79	3	Preproduction
FY82	11	
FY83	48	
FY84	112	
FY85	138	
FY86	116	
FY87	101	
FY88	77	
FY89	54	
FY90	132	
FY91	12	
FY92	10	
FY94	10	
FY05	16	
FY06	11	
Subtotal	**854**[1]	

Exports		First aircraft and date	
Israel (Lot 1)	18[2]	801	Sep 1990
Israel (Lot 2)	8[2]	719	Apr 2005
Saudi Arabia	12[4]	90-0291	Apr 1993
Egypt (Lot 1)	24[1]	3701	Feb 1994
Egypt (Lot 2)	12[4]	3725	1996
Greece (Lot 1)	20[3]	E-1001	Feb 1995
Greece (Lot 2)	12[6]	E-1021	2007
UAE (Lot 1)	20[3]	050	Oct 1993
UAE (Lot 2)	10[4]	070	1996
Netherlands	30[4]	Q-01/98-0101	May 1998
UK	67[5]	ZJ166	Sep 1998
Singapore	20[6]	92112	May 2002
Kuwait	16[6]	KAF-001	Jul 2005
Japan	10[8]	74501	Mar 2006
Subtotal	**279**		
Total	**1,133**		

[1] Aircraft acquired in FY73 to FY94 are AH-64A (total 827, of which 597 being remanufactured as AH-64D); aircraft funded in FY05 and FY06 are AH-64D war replacements
[2] AH-64A; further 24 obtained from US Army
[3] AH-64A; majority to be remanufactured as AH-64D for Egypt (35), Saudi Arabia (12) and UAE (30)
[4] Delivered as non-radar AH-64D, but this now to be added; 12 US Army AH-64A operated during 1996–99 on lease pending delivery of AH-64DN
[5] WAH-64D
[6] AH-64D
[7] AH-64D. Israel also to receive 10 remanufactured helicopters
[8] AH-64DJP; Japan has requirement for about 50 to 55

APACHE REMANUFACTURE PROGRAMME

Lot	Year	Qty	First aircraft
	Prototypes	6	89-0192
–	Preproduction	2	
1	FY96	24	96-5001
2	FY97	24	97-5025
3	FY98	44	98-5049
4	FY99	66	99-5093
5	FY00	74	00-5159
6	FY01	52	01-5233
7	FY02	60	02-5285
8	FY03	74	03-5345
9	FY04	64	04-5419
10	FY05	19	05-5483
11	FY07	36	
12	FY08	36	
13	FY09	24	
	Total	**605**[1]	

[1] Total excludes aircraft remanufactured for overseas operators

APACHE PRODUCTION

Lot	FY	Qty		First aircraft
		US	Export	
–	73	3[1]		73-22247
–	79	3[2]		79-23257
1	82	11		82-23355
2	83	48		83-23787
3	84	112		84-24200
4	85	138		85-25351
5	86	116		86-8940
6	87	101		87-0407
7	88	67		88-0197
		10		88-0275
8	89	54	18	89-0192
9	90	60	6	90-0280
10	90	72	36	90-0415
11	91/92	22	34	91-0112
12	94	10	10	94-0328
13	95		12	95-0108
	98 et seq	27[3]	163[3]	98-0101
Subtotals		**854**	**279**	
Total		**1,133**		

[1] Prototypes; 73-22247 was static test airframe
[2] Preproduction
[3] AH-64D/WAH-64D; all other aircraft are AH-64A version

COSTS: Programme cost (807 aircraft at 1991 values) USD1,169 million. Egyptian Lot 2 request costed at USD318 million for 12 Apaches plus four spare Hellfire launchers, thirty-four 70 mm (2.75 in) rocket launchers, six spare T700 engines, one spare TADS/PNVS system and miscellaneous spares. Second multiyear procurement contract valued at USD2,3 billion, including training devices, spares, logistics and support services.

DESIGN FEATURES: Modern, tandem-seat, armoured and damage-resistant combat helicopter; is required to continue flying for 30 minutes after being hit by 12.7 mm bullets coming from anywhere in the lower hemisphere plus 20°; also survives 23 mm hits in many parts; target acquisition and designation sight (TADS) and pilot night vision sensor (PNVS) sensors mounted in nose; low-airspeed sensor above main rotor hub; avionics in lateral containers; chin-mounted Chain Gun fed from ammunition bay in centre-fuselage; four weapon pylons on stub-wings (six when air-to-air capability is installed); engines widely separated, with integral particle separators and built-in exhaust cooling fittings; four-blade main rotor with lifting aerofoil blade section and swept tips; blades can be folded or easily removed; tail rotor consists of two teetering two-blade units crossed at 55° to reduce noise; airframe meets full crash-survival specifications. Six AH-64s will fit in C-5 and three in C-17A.

Main transmission, by Litton Precision Gear Division, can operate for 1 hour without oil; tail rotor drive, by Aircraft Gear Corporation, has grease-lubricated gearboxes with Bendix driveshafts and couplings; gearboxes and shafts can operate for 1 hour after ballistic damage; main rotor shaft runs within airframe-mounted sleeve, relieving transmission of flight loads and allowing removal of transmission without disturbing rotor.

FLYING CONTROLS: Fully powered controls with stabilisation and automatic flight control system; automatic hover hold; tailplane incidence automatically adjusted by Hamilton Sundstrand control to streamline with downwash during hover and to hold best fuselage attitude during climb, cruise, descent and transition.

STRUCTURE: Main rotor blades (by Tool Research and Engineering Corporation, Composite Structures Divisions) tolerant to 23 mm cannon shells, have five U-sections forming spars and skins bonded with structural glass fibre tubes, laminated stainless steel skin and composites rear section; blades attached to hub by stack of laminated steel straps with elastomeric bearings New rotor blades fabricated entirely from composites materials flown on Apache for first time on 6 November 2003. Northrop Grumman produced all fuselages, wings, tail, engine cowlings, canopies and avionics containers until 2003, when production of fuselage transferred to Korea Aerospace Industries; first completed unit accepted by Boeing in South Korea on 19 April 2004, thereafter being shipped to the final assembly facility in Mesa

LANDING GEAR: Menasco trailing arm type, with single mainwheels and fully castoring, self-centring and lockable tailwheel. Mainwheel tyres size 8.50–10 (10 ply) tubeless, tailwheel tyre size 5.00–4 (14 ply) tubeless. Hydraulic brakes on main units. Main gear is non-retractable, but legs fold rearward to reduce overall height for storage and transportation. Energy-absorbing main and tail gears are designed for normal descent rates of up to 3.05 m (10 ft)/s and heavy landings at up to 12.8 m (42 ft)/s. Take-offs and landings can be made at structural design gross weight on terrain slopes of up to 12° (head-on) and 10° (side-on).

POWER PLANT: Two General Electric T700-GE-701C turboshafts, each rated at 1,409 kW (1,890 shp) for 10 minutes, 1,342 kW (1,800 shp) for 30 minutes, 1,238 kW (1,660 shp) maximum continuous and 1,447 kW (1,940 shp) 2½ minutes OEI. Engines mounted one on each side of fuselage, above wings, with key components armour-protected. Upper cowlings let down to serve as maintenance platforms. General Electric and US Army to undertake joint remanufacture programme of existing engines into T700-GE-701D standard from mid-2003; intended to alleviate poor levels of reliability, this will also increase power slightly and be installed as part of Block III upgrade package in conjunction with new composites main rotor blades. Further AH-64 modernisation may ultimately lead to installation of new engine on Block IV helicopters.

UK WAH-64D has two 1,566 kW (2,100 shp) RRTI RTM 322-01/12 turboshaft engines.

Two crash-resistant fuel cells in fuselage, combined capacity 1,421 litres (375 US gallons; 312 Imp gallons). Modifications ordered September 1993 for carriage of four 871 litre (230 US gallon; 192 Imp gallon) Brunswick Corporation external tanks on 437 Apaches. Total internal and external fuel 4,910 litres (1,295 US gallons; 1,078 Imp gallons). New crashworthy, ballistically self-sealing internal auxiliary fuel tank entered evaluation phase in fourth quarter of 1997; tank holds 492 litres (130 US gallons; 108 Imp gallons) and is interchangeable with ammunition storage magazine, enabling all four weapons pylons to carry ordnance on long-range missions. Testing of preproduction system undertaken in 1998 in addition to formal test and qualification programme by US Army; total of 48 units ordered from Robertson Aviation in 1999; smaller 379 litre (100 US gallon; 83.3 Imp gallon) internal tank utilised by AH-64D, this permitting carriage of up to 300 rounds of 30 mm ammunition for Chain Gun. 'Black Hole' IR suppression system protects aircraft from heat-seeking missiles: this eliminates an engine bay cooling fan, by operating from engine exhaust gas through ejector nozzles to lower the gas plume and metal temperatures.

ACCOMMODATION: Crew of two in tandem: co-pilot/gunner (CPG) in front, pilot behind on 48 cm (19 in) elevated seat. Crew seats, by Simula Inc, are of lightweight Kevlar. Northrop Grumman canopy, with PPG transparencies and transparent acrylic blast barrier between cockpits, is designed to provide optimum field of view. Crew stations are protected by Ceradyne Inc lightweight boron armour shields in cockpit floor and sides, and between cockpits, offering protection against 12.7 mm armour-piercing rounds. Sierracin electric heating of windscreen. Seats and structure designed to give crew a 95 per cent chance of surviving ground impacts of up to 12.8 m (42 ft)/s.

SYSTEMS: Honeywell totally integrated pneumatic system includes a shaft-driven compressor, air turbine starters, pneumatic valves, temperature control unit and environmental control unit. Fairchild Controls improved environmental control system comprises a distributed vapour-cycle cooling and heating unit, with two redundant systems incorporating dual-speed compressors, digital databus controllers and multiple heat exchangers, fans and control valves. Parker dual-hydraulic systems, operating at 207 bar (3,000 lb/sq in), with actuators ballistically tolerant to 12.7 mm direct hits. Redundant flight control system for both rotors. In the event of a flying control system failure, the system activates Honeywell secondary fly-by-wire control. Honeywell electrical power system, with two 45 kVA fully redundant engine-driven AC generators, two 300 A transformer-rectifiers, and URDC standby DC battery. Honeywell GTP 36-155(BH) 93 kW (125 shp) APU for engine starting and maintenance checking. DASA (TST) electric rotor blade de-icing. Smiths Aerospace integrated electrical power management system (IEPMS) installed on AH-64D is currently being upgraded to incorporate multichannel remote interface unit (RIU) that will replace core electronics and wiring associated with conventional electrical control systems; improved IEPMS available from 2001 is being installed on approximately 300 Apaches for US Army. Japanese Apaches will have Smiths Aerospace advanced electrical power management system (AEPMS), this to be manufactured under licence by Kanto Aircraft Instruments of Fujisawa, Japan.

AVIONICS: *Comms:* AN/ARC-164 UHF, AN/ARC-222 SINCGARS secure UHF/VHF; AN/ARC-220 UHF to be retrofitted; KY-28/58/TSEC crypto secure voice, C-8157 secure voice control; AN/APX-100 IFF unit with KIT-1A secure encoding; C-10414 Tempest intercom. Mode S IFF on WAH-64D. Elta satcom on Israeli AH-64D.

Radar: Lockheed Martin/Northrop Grumman AN/APG-78 Longbow mast-mounted 360° radar installed on most AH-64Ds, presenting up to 256 targets on tactical situation display;detects air targets in air-to-ground mode; air-to-air mode for flying targets only.

Flight: BAE North America AN/ASN-157 lightweight Doppler navigation system, Litton LR-80 (AN/ASN-143) strapdown AHRS, AN/ARN-89B ADF, GPS, Honeywell digital automatic stabilisation equipment (DASE), Astronautics Corporation HSI, Pacer Systems omnidirectional, low-airspeed air data system, remote magnetic indicator, BITE fault detection and location. Doppler system, with AHRS, permits nap-of-the-earth navigation and provides data for storing target locations. BAE Systems air data system, comprising two omnidirectional airspeed and direction sensors (AADSs) mounted on engine cowlings and a high integration air data computer (HIADC) installed in avionics bay.

Instrumentation: Honeywell all-raster symbology generator processes TV data from IR and other sensors, superimposes symbology, and distributes the combination to CRT and helmet-mounted displays; Honeywell AN/APN-209 radar altimeter video display unit. 'Manprint' (manpower integration) instrumentation including Litton Canada upfront display and two Honeywell 152 × 152 mm (6 × 6 in) monochrome CRT displays in each cockpit of early aircraft; from 27th AH-64D, Honeywell flat-panel, colour, active matrix LCD multipurpose displays (MPDs) installed in both cockpits, as well as in aircraft for UK and Netherlands. AH-64A's 1,200 cockpit switches reduced to approximately 200 on AH-64D.

Avionics: Lockheed Martin target acquisition and designation sight and AN/AAQ-11 pilot's night vision sensor (TADS/PNVS) comprises two independently functioning, fully integrated systems mounted on nose.

TADS consists of a rotating turret (±120° in azimuth, +30/–60° in elevation) housing sensor subsystems, optical relay tube (being replaced under 1998 contract by Planar Advanced/dpiX flat panel display) in the CPG's cockpit, three electronic units in the avionics bay, and cockpit-mounted controls and displays; used principally for target search, detection and laser designation, with CPG as primary operator (can also provide back-up night vision to pilot in event of PNVS failure). Once acquired by TADS, targets can be tracked manually or automatically for autonomous attack with gun, rockets or Hellfire missiles. TADS day/night sensor consists of TV camera with narrow (0.5°) and wide angle (4.0°) fields of view; direct view optics (4° narrow and 18° wide angle); laser spot tracker; and International Laser Systems laser range-finder/designator. New switchable eyesafe laser range-finder designator (SELRD) currently being developed by Kollsman Inc under US$2.8 million contract awarded at start of 2000; to be installed in existing TADS turret on AH-64A and AH-64D and will have 80 per cent commonality with Kiowa Warrior SELRD. Night sensor, in starboard half of turret, incorporates FLIR sight with narrow, medium and wide angle (5.6°, 10.6° and 50.0°) fields of view.

PNVS consists of FLIR sensor (30 × 40° field of view) in rotating turret (±90° in azimuth, +20/–45° in elevation) mounted above TADS, electronic unit in the avionics bay, and pilot's display and controls; provides pilot with thermal imaging for nap-of-the-earth flight to, from and within battle area at night or in adverse daytime weather, at altitudes low enough to avoid detection.

Second-generation FLIR sensor installed on AH-64D as Arrowhead M-TADS/PNVS (Modernised TADS/PNVS), which also to be adopted by UK WAH-64D during 2009-10. Lockheed Martin Arrowhead and Raytheon FIREsight systems conceived to satisfy this requirement. Arrowhead selected in late October 2000 to progress to EMD phase. Production underway, with first delivery of new sensor accomplished in May 2005, allowing it to be fitted to late production AH-64Ds and retrofitted to existing helicopters, and permitting fielding of first US Army unit by mid-2005. Arrowhead also available to overseas operators, with Israeli AH-64Ds known to use this sensor system and those of the British Army to receive it during 2007 to 2010.

PNVS imagery displayed on monocle in front of one of pilot's eyes; flight information including airspeed, altitude and heading is superimposed on this imagery to simplify piloting. Monocle is part of Honeywell integrated helmet and display sighting system (HADSS) worn by both crew members. Symetrics Industries improved data modem for transmission of target data (and eventually real-time imagery) between helicopters, tactical jet, Joint STARS airborne command posts, HQs and ground units at 16,000 bits/s, plus radio frequency interferometer beneath radome for identification of hostile transmitters.

Self-defence: Aircraft survivability equipment (ASE) consists of Litton AN/APR-39 passive RWR, Sanders AN/ALQ-144 IR jammer, Raytheon AN/AVR-2 laser warning receiver, ITT AN/ALQ-136 radar jammer and chaff dispensers and Lockheed Martin AN/APR-48A radar frequency interferometer. Sanders AN/ALQ-212 Advanced Threat Infra-Red Countermeasures (ATIRCM) system and ITT AN/ALQ-211 suite of integrated RF countermeasures (SIRFC) system currently under development. ATIRCM combines next-generation directable IRCM system with Sanders AN/AAR-57 Common Missile Warning System (CMWS); contractor tests of SIRFC undertaken on Apache Longbow in latter half of 1999, followed by operational test and evaluation from early 2000. Elisra began flight test of passive airborne warning system in second half of 1999 and Israel plans to install this on its AH-64 fleet. Israeli Air Force AH-64D uses Elisra-supplied EW equipment, including radar, laser and IR missile warning systems, ECM and chaff and flare dispensers, latter produced by Rokar; system is similar to that installed on F-15I and F-16I and provides audio warning and visual threat indication via 100 × 100 mm (4 × 4 in) display. Laser warning system expected to be LWS-20V-2 unit. Upgraded Egyptian AH-64D fitted with Northrop Grumman AN/ALQ-162(V)6 'Shadowhawk' high-band RF countermeasures system. Greek and Kuwaiti AH-64Ds to be fitted with BAE Systems HIDAS (Helicopter Integrated Defensive Aids System); this also installed on WAH-64D and includes Sky Guardian 2000 RWR, Type 1223 LWR, Thales Optronics Vicon 78 Srs 455 chaff/flare dispenser and BAE Systems AN/AAR-57(V) common missile warning system (CMWS). Netherlands Apaches given upgraded self-protection systems in early 2004 in readiness for deployment to Afghanistan; package comprised Terma AMASE (Apache Modular Aircraft Survivability Equipment), incorporating AN/ALQ-213(V) integrated EW controller, colour threat displays and stub-wing, pod-mounted Northrop Grumman AN/AAR-54 missile warning system and expendables.

EQUIPMENT: Avpro of UK cleared Exint transport pod for use with AH-64 at start of 2000, but certification to carry personnel still required. In special forces insertion role, Apache can carry maximum of four pods, each able to accommodate 226 kg (500 lb) payload.

ARMAMENT: Boeing M230 Chain Gun 30 mm automatic cannon, located between the mainwheel legs in an underfuselage mounting with Smiths Industries electronic controls. Normal rate of fire is 625 rds/min of HE or HEDP (high-explosive dual-purpose) ammunition, which is interoperable with NATO Aden/DEFA 30 mm ammunition. Maximum ammunition load is 1,200 rounds. 'Sidehauler' system installed in starboard forward avionics bay; cut normal loading time of 30 minutes by up to half and reduced number of personnel required from three to one. Gun mounting designed to collapse into fuselage between pilots in the event of a crash landing.

New electric turret under development by Boeing, which received two year, US$5 million contract in first half of 1999; objective is to achieve accuracy of 0.5 mrads compared with current 3.0 mrads. Gun, mount and feed system to be retained in conjunction with redesigned mechanical system featuring electric rather than hydraulic drive as well as digital control; result should be at least 10 per cent lighter and require one instead of two electrical boxes. HR Textron responsible for controls, with Boeing providing the rest.

Four underwing hardpoints, with Aircraft Hydro-Forming pylons and ejector units, on which can be carried up to 16 AGM-114 Hellfire anti-tank missiles or up to 76 2.75 in FFAR (folding fin aerial rockets) in their launchers or a combination of Hellfires and FFAR. New Joint Common Missile (JCM) to be developed as replacement for Hellfire from 2009; weapon will possess tri-mode seeker, combining semi-active laser capability with imaging infra-red and millimetre-wave radar. JCM expected to have 8.6 n mile (16 km; 10 mile) range when launched from helicopter. Compatibility with AAM such as Raytheon Stinger or Thales Starstreak under consideration by US Army, but appears unlikely in near-term future; provision of an AAM will require additional hardpoints if existing weapons capacity not to be compromised. AH-64DJP for Japan will operate with Stinger AAM. Hellfire remote electronics by Rockwell Collins; Honeywell aerial rocket control system; multiplex (MUX) system units by Honeywell. Co-pilot/gunner (CPG) has primary responsibility for firing gun and missiles, but pilot can override his controls to fire gun or launch missiles.

WAH-64D version has additional provisions for Bristol Aerospace CRV-7 70 mm rocket pods and Shorts Starstreak AAM.

DIMENSIONS, EXTERNAL:

Main rotor diameter	14.63 m (48 ft 0 in)
Main rotor blade chord	0.53 m (1 ft 9 in)
Tail rotor diameter	2.79 m (9 ft 2 in)
Length overall: tail rotor turning	15.54 m (51 ft 0 in)
both rotors turning	17.76 m (58 ft 3¼ in)
Wing span: clean	5.23 m (17 ft 2 in)
over empty weapon racks	5.82 m (19 ft 1 in)
Height: over tailfin	3.55 m (11 ft 7½ in)
over tail rotor	4.30 m (14 ft 1¼ in)
to top of rotor head	3.84 m (12 ft 7 in)
overall (top of air data sensor)	4.66 m (15 ft 3½ in)
overall, Longbow radar	4.95 m (16 ft 3 in)
Main rotor ground clearance (turning)	3.59 m (11 ft 9¾ in)
Distance between c/l of pylons:	
inboard pair	3.20 m (10 ft 6 in)
outboard pair	4.72 m (15 ft 6 in)
Tailplane span	3.40 m (11 ft 2 in)
Wheel track	2.03 m (6 ft 8 in)
Wheelbase	10.59 m (34 ft 9 in)

AREAS:

Main rotor disc	168.11 m² (1,809.5 sq ft)
Tail rotor disc	6.13 m² (66.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty:	
without Longbow	approx 5,165 kg (11,387 lb)
with Longbow	5,352 kg (11,800 lb)
Max fuel weight: internal	1,108 kg (2,442 lb)
external (four Brunswick tanks)	2,712 kg (5,980 lb)
Primary mission gross weight	7,480 kg (16,491 lb)
Design mission gross weight	8,006 kg (17,650 lb)
Max T-O weight: -701 engines	9,525 kg (21,000 lb)
-701C engines, ferry mission, full fuel	10,432 kg (23,000 lb)
Max disc loading	62.1 kg/m² (12.71 lb/sq ft)

PERFORMANCE (A, with -701 engines, without Longbow at 6,552 kg; 14,445 lb AUW, L, Apache Longbow at 7,530 kg, 16,601 lb with -701C engines):

Never-exceed speed (VNE)	197 kt (365 km/h; 227 mph)
Max level and max cruising speed:	
A	158 kt (293 km/h; 182 mph)
L	143 kt (265 km/h, 165 mph)
Max rate of climb at S/L: L	736 m (2,415 ft)/min
Max vertical rate of climb at S/L:	
A	762 m (2,500 ft)/min
L	450 m (1,475 ft)/min
Service ceiling: A	6,400 m (21,000 ft)
L	5,915 m (19,400 ft)
Service ceiling, OEI: A	3,290 m (10,800 ft)
Hovering ceiling:	
IGE: A	4,570 m (15,000 ft)
L	4,170 m (13,690 ft)
OGE: A	3,505 m (11,500 ft)
L	2,890 m (9,480 ft)
Max range, internal fuel: 30 min reserves:	
A	260 n miles (482 km; 300 miles)
L	220 n miles (407 km; 253 miles)
no reserves, L	257 n miles (476 km; 295 miles)
Ferry range, max internal and external fuel, still air, 45 min reserves	1,024 n miles (1,899 km; 1,180 miles)
Endurance at 1,220 m (4,000 ft) at 35°C	1 h 50 min
Max endurance, L: internal fuel	2 h 44 min
internal and external fuel	8 h 0 min
g limits at low altitude and airspeeds up to 164 kt (304 km/h; 189 mph)	+3.5/–0.5

WEIGHTS FOR TYPICAL MISSION PERFORMANCE (all without Longbow; A: anti-armour at 1,220 m/4,000 ft and 35°C, four Hellfire and 320 rounds of 30 mm ammunition; B: as A, but with 1,200 rounds; C: as A, but with six Hellfire and 540 rounds; D: anti-armour at 610 m/2,000 ft and 21°C, 16 Hellfire and 1,200 rounds; E: air cover at 1,220 m/4,000 ft and 35°C, four Hellfire and 1,200 rounds; F: as E but at 610 m/2,000 ft and 21°C, four Hellfire, 19 rockets, 1,200 rounds; G: escort at 1,220 m/4,000 ft and 35°C, 19 rockets and 1,200 rounds; H: escort at 610 m/2,000 ft and 21°C, 38 rockets and 1,200 rounds):

Mission fuel: A	727 kg (1,602 lb)
G	741 kg (1,633 lb)
E	745 kg (1,643 lb)
C	902 kg (1,989 lb)
B	1,029 kg (2,269 lb)
D	1,063 kg (2,344 lb)
H	1,077 kg (2,374 lb)
F	1,086 kg (2,394 lb)
Mission gross weight: A	6,552 kg (14,445 lb)
E	6,874 kg (15,154 lb)
G	6,932 kg (15,282 lb)
B, C	7,158 kg (15,780 lb)
D	7,728 kg (17,038 lb)
F	7,813 kg (17,225 lb)
H	7,867 kg (17,343 lb)

TYPICAL MISSION PERFORMANCE (A-H as above):

Cruising speed at intermediate rated power:

C	147 kt (272 km/h; 169 mph)
D	148 kt (274 km/h; 170 mph)
F	150 kt (278 km/h; 173 mph)

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jawa.janes.com

B ..... 151 kt (280 km/h; 174 mph)
E, H ..... 153 kt (283 km/h; 176 mph)
A ..... 154 kt (285 km/h; 177 mph)
G ..... 155 kt (287 km/h; 178 mph)
Max vertical rate of climb at intermediate rated power:
B, C ..... 137 m (450 ft)/min
H ..... 238 m (780 ft)/min
F, G ..... 262 m (860 ft)/min
E ..... 293 m (960 ft)/min
D ..... 301 m (990 ft)/min
A ..... 448 m (1,470 ft)/min
Mission endurance (no reserves): A, E, G ..... 1 h 50 min
C ..... 1 h 47 min
D, F, H ..... 2 h 30 min
B ..... 2 h 40 min

BOEING

BOEING COMMERCIAL AIRPLANES

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VICE-PRESIDENT, COMMUNICATIONS: Tom Downey

Single-aisle aircraft are 717, 737 and 757; twin-aisle are 747, 767, 777 and 787.

BOEING AIRLINER FIVE-YEAR DELIVERIES

Year	717	737	747	757	767	777	MD-11	Total
2001	49	299	31	45	40	61	2	**527**
2002	20	223	27	29	35	47		**381**
2003	12	173	19	14	24	39		**281**
2004	12	202	15	11	9	36		**285**
2005	13	212	13	2	10	40		**290**
1H 2006	5	142	8	0	6	34		**195**

BOEING COMMERCIAL AIRPLANE GROUP ORDERS AND DELIVERIES
(at 30 June 2006)

	Orders Total	Deliveries Total	Orders in 1H 2006	Deliveries in 1H 2006	Backlog
707/720	1,010	1,010	0	0	
Total 707/720	**1,010**	**1,010**	**0**	**0**	**0**
717-200	155	150	0	5	
Total 717	**155**	**155**	**0**	**5**	**0**
727	1,831	1,831	0	0	
Total 727	**1,831**	**1,831**	**0**	**0**	**0**
737-100	30	30	0	0	
737-200	1,114	1,114	0	0	
737-300	1,113	1,113	0	0	
737-400	486	486	0	0	
737-500	389	389	0	0	
737-600	70	64	–5	5	6
737-700/C-40A	1,218	752	146	53	466
737-700BBJ	95	80	5	5	15
737-700C	12	11	1	1	1
737-800	1,815	1,005	194	77	810
737-800BBJ	13	12	0	1	1
737-900	55	52	0	0	3
737-900ER	63	0	33	0	63
Total 737	**6,473**	**5,108**	**374**	**142**	**1,365**
747-100/SP	250	250	0	0	
747-200/E-4	393	393	0	0	
747-300	81	81	0	0	
747-400	446	442	0	0	4
747-400D	19	19	0	0	
747-400ER	6	6	0	0	
747-400ERF	38	16	6	2	22
747-400F	126	106	4	6	20
747-400M	61	61	0	0	
747-8	1	0	1	0	1
747-8F	18	0	0	0	18
Total 747	**1,439**	**1,374**	**11**	**8**	**65**
757-200	913	913	0	2	
757-200M	1	1	0	0	
757-200PF	80	80	0	0	
757-300	55	55	0	0	
Total 757	**1,049**	**1,049**	**0**	**0**	**0**
767-200	128	128	0	0	
767-200ER	121	118	0	2	3
767-300	104	104	0	0	
767-300ER	528	510	6	3	18
767-300F	50	44	–2	1	6
767-400ER	38	37	0	0	1
Total 767	**969**	**941**	**4**	**6**	**28**
777-200	92	87	0	0	5
777-200ER	425	376	–3	13	49
777-200LR	40	2	4	2	38
777-300	60	59	0	0	1
777-300ER	209	49	21	19	160
777F	23	0	0	0	23
Total 777	**849**	**573**	**22**	**34**	**276**
787-3	43	0	0	0	43
787-8	269	0	24	0	269
787-9	48	0	45	0	48
Total 787	**360**	**0**	**69**		**360**
Grand Totals	**14,135**	**12,041**	**480**	195	**2,094**

Notes: Table does not include one each of 727-100, 747-100, 757-200, 767-200 and 777-200 owned by Boeing. Annual order total is net (after deduction of cancellations)

BOEING 737

US Navy designation: C-40A Clipper

TYPE: Twin-jet airliner.

PROGRAMME:

DEVELOPMENT MILESTONES

737-100		
First order		15 Feb 65
Rolled out		17 Jan 67
First flight		9 Apr 67
Certification		15 Dec 67
First Delivery		28 Dec 67
Entered service (Lufthansa)	10 Feb 68	
Subsequent versions		
737-600		
First order		15 Mar 95
Rolled out		8 Dec 97
First flight		22 Jan 98
Certification		18 Aug 98
First delivery		18 Sep 98
Entered service (SAS)	25 Oct 98	
737-700		
Go-ahead		17 Nov 93
First order		17 Nov 93
Rolled out		8 Dec 96
First flight		9 Feb 97
Certification		7 Nov 97
First delivery		17 Dec 97
Entered service (Southwest airlines)	18 Jan 98	
737-800		
First order		5 Sep 94
Rolled out		30 Jun 97
First flight		31 Jul 97
Certification		13 Mar 98
First delivery		22 Apr 98
Entered service (Hapag-Lloyd)	24 Apr 98	
737-900		
First order		10 Nov 97
Rolled out		23 Jul 00
First flight		3 Aug 00
Certification		17 Apr 01
First delivery		16 May 01
Entered service (Alaska Airlines)		27 May 01

Original Boeing 737 first flew 9 April 1967; -100 and -200 with Pratt & Whitney JT8D engines; -300 entered service with CFM56 engines, November 1984, followed by -400 and -500; 3,132nd and last of this generation delivered February 2000. These versions, including military T-43 and Surveiller, described in *Jane's Aircraft Upgrades*.

Current 'Next-Generation' of family (initially 737X) originated in 1991, when Boeing asked more than 30 airlines to help define improved series; company board authorised offer for sale June 1993; Southwest Airlines ordered 63 737-700s (32 converted from options for 737-300s) plus 63 new options (all, and more, taken up) 18 November 1993; roll-out (737-700) 8 December 1996; first flight (N737X) 9 February 1997; certification 7 November 1997, followed by first deliveries. CFM56-7B power plant first flew on Boeing 747 testbed on 16 January 1996. Flight test programme involved 10 aircraft: four 737-700s, three 737-800s and three 737-600s. FAA approval for 180-minute ETOPS granted in September 1999. By January 2000, B737s of all subtypes had flown over 100 million hours. 1,000th NG 737 (N418WN) first flew 1 November 2001 and delivered to Southwest Airlines on 13 November; 5,000th 737 of all versions was 1,868th NG, N230WN, first flown 1 February 2006 and formally handed over to Southwest Airlines on 13 February 2006 as its 447th Boeing 737; 2,000th NG 737 handed over to Southwest Airlines on 26 July 2006.

Further enhancements, incorporated in 737-900 demonstrator, completed in March 2002; features include quiet climb system, GPS landing and synthetic vision system. In 2005, Boeing offered short-field improvement package developed initially for GOL of Brazil. Plan to replace existing spring-loaded seal between outboard section of wing leading-edge Krueger flap and adjacent inboard skin by actuated seal, increasing landing approach lift, proved ineffective and abandoned after testing on 737-800 ('YK721') undertaken between February and May 2006. Features introduced as standard on all subsequent 737-900ERs and optional on 737-800 from late 2006, at which time nine airlines had reserved more than 300 upgrade packages. Measures include two-position tailskid for higher AoA and rotation angle; spoilers Nos. 2, 3, 4, 5, 8, 9, 10 and 11 given increased travel from 33 or 38° to 60°; and, on longer fuselage versions, increase in sealed slat on T-O from up to 25° flap.

Eyebrow windows above windscreen deleted from January 2005 onwards; retro-deletion kit available for earlier aircraft.

CURRENT VERSIONS: **737-600:** Smallest of current 737 family. Known as 737-500X until officially launched 15 March 1995; 110 two-class passengers; final assembly of prototype began at Renton 29 August 1997; roll-out December 1997; first flight 22 January 1998; FAA certification 18 August 1998; first delivery (SE-DNM to launch customer SAS) 18 September 1998.

737-700: First to be ordered and manufactured, mid-size version of family, equivalent to previous ('Classic') 737-300, seating 126 passengers in two-class layout. First aircraft (N737X) rolled out 2 (officially 8) December 1996; first flight 9 February 1997, followed by second aircraft 27 February that year; second aircraft attained maximum certified altitude of 12,500 m (41,000 ft) for the first time on 19 March 1997; FAA certification 7 November 1997, with first delivery (fourth built, N700GS to Southwest Airlines) on 17 December 1997.

737-700IGW: Formerly 737-700X; increased gross weight version, based on Boeing Business Jet airframe, including forward cargo door, port. Available as **737-700C** (Convertible) and **737-700C/QC** (Convertible/Quick change); latter interchangeable between 140 single-class (81 cm; 32 in pitch) passengers and eight 2.24 × 3.18 m (88 × 125 in) pallets within one hour, compared to six hours of standard -700C. Max T-O weight 77,560 kg (171,000 lb); max landing weight 60,780 kg (134,000 lb); max zero-fuel weight 57,155 kg (126,000 lb); operating weight empty: -700C passenger 40,000 kg (88,190 lb), -700C cargo 38,365 kg (84, 580 lb), -700C/QC passenger 41,840 kg (92,240 lb), -700C/QC cargo 38,905 kg (85,770 lb). Fuel capacity 26,025 litres (6,875 US gallons; 5,725 Imp gallons); design range: -700C passenger 3,210 n miles (5,944 km; 3,694 miles), -700C/QC passenger 3,115 n miles (5,769 km; 3,584 miles), cargo (both versions) 2,880 n miles (5,333 km; 3,314 miles). Cargo volume: lower hold 27.4 m^3 (966 cu ft), main deck (cargo conversion only) 99.7 m^3 (3,520 cu ft).

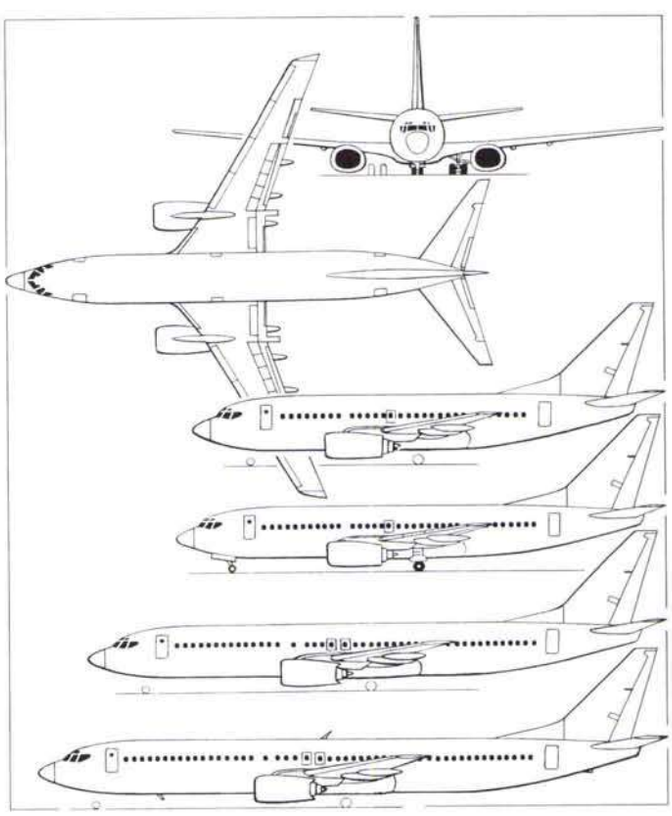
Initial two ordered 29 August 1997 as **C-40A Clipper** to meet US Navy requirement for C-9B Skytrain II replacement. First C-40A flew 17 April 2000; first delivery to US Naval Reserve Fleet Logistics Support Squadron VR-59 at NAS/JRB Fort Worth, Texas 21 April 2001; C-40As also operated by VR-57 at NAS North Island, California, and VR-58 at NAS Jacksonville, Florida; ninth delivered 25 May 2006.

Commercial launch customer for the 737-700C/QC was Saudi Aramco of Saudi Arabia, which took delivery of two in 2001.

First civil equivalent, designated **737-700C**, was N743A, first flown 18 September 2001 and delivered to ARAMCO on 31 October.

737-700ER: Launched 31 January 2006 upon receipt of order from All Nippon Airways for two (originally ordered as 737-700s in June 2003). Up to nine optional auxiliary fuel tanks and optional winglets; range up to 5,510 n miles (10,204 km; 6,340 miles).

737-800: Known as 737-400X Stretch until launched 5 September 1994; seats 162 two-class passengers; roll-out (N737BX) 30 June 1997; first flight 31 July 1997; certified by FAA 13 March and JAA 9 April 1998; first delivery (D-AHFC to launch customer Hapag-Lloyd) 22 April 1998. Hapag-Lloyd became first commercial courier to operate 737-800 fitted with optional winglets in May 2001. Ryanair was recipient of 800th -800 on 1 September 2004.



Boeing 737-700, with additional side views of shorter -600, stretched -800 and further stretched -900 (bottom) *(James Goulding)* 1159813

Boeing 737-600 flown by SAS *(Paul Jackson)* 1159151

Boeing 737-900ER in company colours before delivery to Lion Air 1159796

Boeing 737-700 of Southwest Airlines promoting SeaWorld adventure park 1159152

Boeing 737-800 flying for India's Jet Airways *(Paul Jackson)* 1159153

737-800ERX: Under study in early 2004. Would employ -900X's strengthened wing, plus stronger landing gear. MTOW 83,460 kg (184,000 lb).

737-900: Formerly 737-900X; launched 10 November 1997 with an order for 10, plus 10 options, from Alaska Airlines; largest 737 variant to date, with (compared to -800) stretch by means of 1.57 m (5 ft 2 in) forward plug and 1.07 m (3 ft 6 in) aft plug and strengthened fuselage; seating for 177 two-class passengers; deliveries from early 2001. One prototype/certification aircraft only; rolled out 23 July 2000; first flight (N737X) 3 August 2000; FAA certification achieved 17 April 2001 following 156 hours of ground testing and a two-aircraft flight test programme totalling 649 flight hours in 296 sorties; first delivery (Alaska Airlines) 16 May 2001 and entered service 27 May.

737-900ER: Increased capacity, long-range version under study in 2001, then designated 737-900X; offered from 2002 to compete with Airbus A321 in European charter market. Lauched as 737-900ER on 18 July 2005 following agreement by Lion Air of Indonesia to purchase 30 for delivery from 2007. First aircraft entered final assembly in May 2006; formal rollout 8 August 2006; first flight (N900ER, later PK-LAG) 1 September 2006.

Features include strengthened landing gear; two-position tailskid; heavier gauge wing skins; flat rear pressure bulkhead and additional Type II emergency exits aft of the wing, to increase certification-limited maximum capacity to 215 passengers (180 in two-class); increase in max take-off weight to 85,138 kg (187,700 lb); max zero-fuel weight 67,812 kg (149,500 lb); max landing weight 71,395 kg (157,400 lb); range 3,200 n miles (5,926 km; 3,682 miles) with 180 passengers and two auxiliary tanks for total of 29,665 litres (7,837 US gallons; 6,526 Imp gallons); 121 kN (27,300 lb st) CFM56-7B27/B1F engines; and optional winglets.

Boeing Business Jet: (BBJ) Corporate versions, *described separately*.

Special missions: Military versions, *described separately*.

CUSTOMERS: As per table.

COSTS: List prices (2006; all in millions): 737-600 USD47.0 to USD55.0; 737-700 USD54.0 to USD64.0; 737-800 USD66.0 to USD75.0; 737-900 USD70.0 to 80.5.

DESIGN FEATURES: Conventional, medium-size airliner with podded engines and sweptback wing and tail surfaces. Dihedral 6° at root; sweepback 25° at quarter-chord. Greater range and speed than previous 737s, with less noise and fewer emissions; wing area increased by some 25 per cent by means of 0.43 m (1 ft 5 in) increase in wing chord and about 4.83 m (15 ft 10 in) increase in wing span; new high-lift systems; larger tail surfaces; increased tankage gives US transcontinental range; new aircraft can use same runways, taxiways, ramps and gates as preceding variants; new variant of CFM56 turbofan derated from nominal thrust to suit smaller versions of the family. Noise on ground reduced by approximately 12 dB by new diffuser duct and cooling vent silencer on APU, new ECS fan and duct and new electrical/electronics cooling fan.

FLYING CONTROLS: Conventional and powered. All surfaces actuated by two independent hydraulic systems with manual reversion for ailerons and elevator; elevator servo tabs unlock on manual reversion; rudder has standby hydraulic actuator and system. Variable incidence tailplane has two electric motors and manual standby.

Leading-edge Krueger flaps inboard and four sections of slats outboard of engines; six airbrake/lift dumper panels on each wing, inboard and outboard elements on each wing for ground use only, deflecting 60°, while centre four each side operable in flight and to maximum 33 or 38° on ground, except aircraft with short-field upgrades when 60° possible. Continuous-span, double-slotted trailing-edge flaps inboard and outboard of engines; max deflection 40°.

FAA Cat. II landing minima system standard using SP-300 dual digital integrated flight director/autopilot; Cat. IIIa capability optional.

STRUCTURE: Aluminium alloy dual-path fail-safe two-spar wing structure with corrosion-resistant 7055-T77 upper skin. Aluminium alloy two-spar tailplane. Graphite composites ailerons, elevators and rudder. Aluminium honeycomb spoiler/airbrake panels and trailing-edges of slats and flaps. Fuselage structure fail-safe aluminium. Elevators, rudder and ailerons contain graphite/Kevlar; other, unstressed, components in GFRP and CFRP include nosecone, wing/fuselage fairing, fin fillet, fintip and flap actuator fairings. Rears of engine nacelles are of graphite/Kevlar/glass fibre.

LANDING GEAR: Hydraulically retractable tricycle type, with Boeing oleo-pneumatic shock-absorbers; inward-retracting main units have no doors, wheels forming wheel well seal; nose unit retracts forward; free-fall emergency extension. Twin nosewheels have tyres size 27×7.75. Main units have heavy-duty twin wheels, H40×14.5–19 heavy-duty tyres, and Honeywell or Goodrich heavy-duty wheel brakes as standard. Mainwheel tyre pressure 13.45 to 14.00 bar (195 to 203 lb/sq in). Nosewheel tyre pressure 11.45 to 11.85 bar (166 to 172 lb/sq in).

Ground turning circle (78° nosewheel angle): *737-700* 13.4 m (44 ft) at nosewheel, 21.6 m (71 ft) at winglet tip; *737-800:* 16.5 m (54 ft) at nosewheel, 22.2 m (73 ft) at winglet tip; *737-900:* 18.0 m (59 ft) at nosewheel, 22.6 m (74 ft) at winglet tip.

POWER PLANT: *737-600:* Two CFM International CFM56-7B18 turbofans, each rated at 86.7 kN (19,500 lb st) standard, or two CFM56-7B22s, each rated at 101 kN (22,700 lb st) in high gross weight version.

737-700: Two CFM56-7B20s, each rated at 91.6 kN (20,600 lb st) standard, or two CFM56-7B24s, each rated at 101 kN (22,700 lb st) in high gross weight version.

737-800: Two CFM56-7B24s, each rated at 107.6 kN (24,200 lb st) standard, or two CFM56-7B27s, each rated at 121.4 kN (27,300 lb st) in high gross weight version.

737-900: Two CFM56-7B26s, each rated at 117 kN (26,300 lb st) standard, or two CFM56-7B27s, each rated at 121.4 kN (27,300 lb st) in high gross weight version and 737-900ER.

Fuel capacity 26,025 litres (6,875 US gallons; 5,725 Imp gallons) in all versions except 737-900ER, which increased to 29,665 litres (7,837 US gallons; 6,525 Imp gallons). Pressure refuelling point beneath starboard wing leading-edge, outboard of engine.

ACCOMMODATION: *All:* Crew of two side by side on flight deck. One plug-type door at each corner of cabin, with passenger doors on port side and service doors on starboard side. Airstair for forward cabin door optional. Overwing emergency exit on each side. One or two galleys and one modular vacuum lavatory forward and one or two galleys and lavatories aft; all lavatories interconnected to single waste collection tank at port side rear. Lightweight interior, of crushed core materials, has movable class divider, overnight seating-pitch flexibility and modular passenger service unit (PSU) including fold-down video screen in underside of baggage bin. Centreline stowage bins optional for emergency equipment and crew baggage.

Two underfloor baggage holds, forward and aft of wing. Rear hold has provision for post-delivery installation of telescopic baggage conveyor system (when additional fuel tanks not fitted). One baggage door in starboard side of each hold.

737-600: Alternative cabin layouts seat from 110 to 132 passengers. Typical arrangements offer eight first class seats four-abreast at 91 cm (36 in) pitch and 102 tourist class seats six-abreast at 81 cm (32 in) pitch in mixed class; and 132 all-tourist class at 76 cm (30 in) pitch. Total overhead baggage capacity of 6.1 m^3 (216 cu ft), equivalent to 0.045 m^3 (1.6 cu ft) per passenger.

737-700: Alternative cabin layouts seat from 126 to 149 passengers. Typical arrangements offer eight first class seats four-abreast at 91 cm (36 in) pitch and 118 tourist class seats

BOEING 737 NEXT-GENERATION ORDER BOOK
(at 30 June 2006)

Customer	Variant	First Order	First Delivery	600	700	800	900
Aeromexico	737-700	27 Dec 02	7 Oct 03		27		
	737-800	29 Jul 05	none			6	
Air Algérie	737-600	16 Jul 98	29 Apr 02	5			
	737-800	16 Jul 98	31 Jul 00			10	
Air Berlin	737-800	22 Dec 94	7 May 98			26	
Air China	737-700	31 Jul 01	17 Jun 03		18		
	737-800	30 Oct 97	17 Aug 99			21	
Air Europa	737-800	31 Oct 03	4 Oct 04			41	
Air India	737-800	30 Dec 05	none			18	
Air Pacific	737-700	5 Sep 96	22 Sep 98		1		
	737-800	5 Sep 96	24 May 99			2	
Air Senegal	737-700	27 May 04	7 Jul 05		1		
AirTran	737-700	3 Jul 03	16 Aug 04		78		
Alaska Airlines	737-700	10 Nov 97	28 Jul 99		17		
	737-800	10 Nov 97	2 Feb 05			44	
	737-900	10 Nov 97	15 May 01				12
All Nippon	737-700	27 Jun 03	21 Nov 05		45		
American Airlines	737-800	21 Nov 96	7 Feb 99			124	
American Trans Air	737-800	30 Jun 00	29 Jun 01			13	
Ansett Worldwide	737-700	2 Sep 96	22 Mar 99		4		
Aramco Services Co	737-700	15 Dec 99	15 Sep 00		3		
	737-700C	15 Dec 99	31 Oct 01		2		
Ariana Afghan Airlines	737-700	1 Nov 05	none		4		
Austrian	737-800	5 Mar 03	3 Apr 05			3	
Bavaria	737-700	30 Jan 95	27 Apr 98		10		
	737-800	30 Nov 04	none			2	
Bouillion Aviation	737-700	29 Jul 98	24 Jan 01		14		
	737-800	29 Jul 98	26 Apr 01			18	
Braathens	737-700	3 Feb 97	25 Aug 98		10		
Britannia Airways (Thomson)	737-800	18 Nov 98	6 Apr 00			4	
Buraq Air	737-800	30 Nov 05	none			2	
China Airlines	737-800	22 Dec 95	26 Oct 98			13	
China Eastern	737-700	2 Oct 01	10 Sep 02		13		
	737-800	30 Dec 05	none			1	
China Southern	737-700	2 Oct 01	16 Jan 04		17		
	737-800	2 Oct 01	22 Aug 02			23	
China Southwest	737-800	1 Jun 98	29 Oct 99			3	
China Yunnan	737-700	30 Oct 97	8 Dec 98		4		
CIT Leasing	737-700	14 Jun 99	11 Apr 01		7		
	737-800	14 Jun 99	26 Apr 01			24	
Continental	737-700	25 Jul 96	30 Mar 98		77		
	737-800	25 Jul 96	23 Jun 98			121	
	737-900	18 Mar 98	29 May 01				15
Copa Airlines	737-700	19 Jan 99	21 Jan 00		18		
	737-800	28 Jun 02	6 Oct 03			5	
dba	737-700	28 Dec 05	none		10		
Delta Air Lines	737-800	10 Jun 97	22 Oct 98			132	
Eastwind Airlines	737-700	20 Oct 97	13 May 98		2		
EasyJet	737-700	28 Jul 98	13 Oct 00		32		
Egyptair	737-800	29 Jul 05	none			6	
El Al	737-700	1 Apr 98	11 Aug 99		2		
	737-800	1 Apr 98	24 Feb 99			3	
Ethiopian Airlines	737-700	28 Nov 02	24 Nov 03		3		
Garuda	737-700	15 Dec 99	none		18		
GATX Financial Corp	737-800	31 Jul 96	14 Dec 98			20	
GATX Jet Partners	737-800	31 May 00	29 Jun 00			18	
GECAS	737-600	22 Jan 96	24 Sep 99	7			
	737-700	22 Jan 96	30 Oct 98		101		
	737-800	22 Jan 96	29 Jul 98			124	
Germania	737-700	28 Mar 95	10 Mar 98		12		
GOL Airlines	737-800	17 May 04	none			67	
Hainan Airlines	737-800	30 Oct 97	23 Aug 99			29	
Hapag-Lloyd	737-700	28 Dec 04	none		1		
	737-800	18 Nov 94	22 Apr 98			36	
Icelandair	737-800	26 Jan 05	13 Mar 06			15	
ILFC	737-600	2 Sep 96	17 Oct 03	6			
	737-700	25 Jul 95	25 Mar 98		109		
	737-800	25 Jul 95	10 Jun 98			116	
Itochu AirLease	737-800	11 Jul 96	21 Jan 99			10	
JAL International	737-800	10 May 05	none			30	
Jet Airways	737-700	14 Jun 99	17 May 01		4		
	737-800	11 Dec 96	24 Dec 98			21	
	737-900	14 Jun 99	6 May 03				2
Kenya Airways	737-700	7 Mar 00	11 Dec 02		2		
KLM	737-800	14 Mar 97	25 Feb 99			14	
	737-900	7 Sep 98	29 Jun 01				5
Korean Air	737-800	9 Jun 98	15 Aug 00			6	
	737-900	9 Jun 98	21 Nov 01				16
Lauda Air	737-600	31 Dec 98	4 May 00	2			
	737-700	8 Jan 99	19 Apr 01		2		
	737-800	8 Jan 99	28 Jul 98			4	
Linas Aereas Azteca	737-700	13 Feb 01	29 Jun 01		2		
Lion Air	737-900ER	30 Jun 05	none				30
Luxair	737-700	28 Feb 03	9 Feb 04		3		
Maersk	737-700	16 Jun 94	2 Mar 98		12		
Miami Air	737-800	3 Dec 04	none			1	
Midway Airlines	737-700	14 Jun 99	29 Sep 00		7		
Oman Air	737-700	30 Apr 01	25 Jun 02		1		
	737-800	30 Apr 01	1 Jul 03			2	
Pegasus Airlines	737-800	4 Sep 97	25 Mar 99			7	
Pegasus Finance	737-800	11 Aug 05	none			6	
Pembroke Capital Ltd	737-600	14 Mar 95	27 Apr 99	1			
	737-700	6 Mar 97	15 Dec 98		8		
Qantas	737-800	9 Nov 01	14 Jan 02			33	
RBS Capital	737-800	14 Jun 05	none			20	
Royal Air Maroc	737-700	30 Aug 96	16 Apr 99		6		
	737-800	30 Aug 96	10 Jul 98			25	

Customer	Variant	First Order	First Delivery	600	700	800	900
Ryanair	737-800	9 Mar 98	19 Mar 99			249	
SAS	737-600	14 Mar 95	18 Sep 98	28			
	737-700	14 Mar 95	3 Nov 99		8		
	737-800	14 Mar 95	3 May 00			21	
Shandong Airlines	737-700	12 Nov 03	19 Jul 05		3		
	737-800	12 Nov 03	17 Jun 05			10	
Shanghai Airlines	737-700	30 Oct 97	25 May 00		4		
	737-800	2 Oct 01	14 Aug 02			6	
Shenzhen Airlines	737-700	30 Oct 97	30 Sep 98		6		
	737-800	31 Dec 05	none			5	
	737-900	12 Nov 03	9 Jun 05				5
Singapore Aircraft Leasing	737-800	27 May 05	none			30	
Sky Airlines	737-900ER	30 May 06	none				3
SkyEurope	737-700	20 Jul 05	none		9		
Sonair	737-700	20 Dec 05	none		1		
	737-700C	20 Dec 05	none		1		
South African Airways	737-800	31 May 00	26 Jul 02			5	
Southwest	737-700	17 Nov 93	17 Dec 97		370		
Spice Jet	737-800	9 Feb 05	7 Feb 06			10	
Sumitomo Corp	737-800	11 Jul 96	3 May 99			2	
Sunrock (Sojitz)	737-800	17 Jun 97	20 Apr 00			3	
TAAG	737-800	20 Jul 05	none		4		
Taiwan Air Force	737-800	30 Nov 98	8 Dec 99			1	
TAROM	737-700	17 Jun 99	27 Mar 01		4		
Tombo Aviation	737-700	31 Dec 96	2 Dec 98		7		
	737-800	31 Dec 96	30 Nov 99			8	
Transavia	737-700	15 Nov 01	18 Feb 03		5		
	737-800	6 Nov 95	16 Jun 98			14	
TunisAir	737-600	28 Oct 97	25 May 99	7			
Turkish Airlines	737-800	7 Oct 97	30 Oct 98			49	
Turkmenistan Airlines	737-800	31 Dec 05	none			2	
US Navy	737-700	3 Sep 97	29 Sep 00		9		
	737-800	30 Jun 04	none			5	
Virgin Blue	737-700	30 Jun 04	28 Jul 05		2		
	737-800	31 Dec 02	13 Aug 03			30	
Westjet	737-600	21 May 04	8 Aug 05	14			
	737-700	23 Aug 00	18 Oct 02		40		
	737-800	23 Aug 00	8 Apr 05			6	
Wuhan Airlines	737-800	29 Jun 98	19 Mar 01			2	
Xiamen Airlines	737-700	30 Oct 97	21 Aug 98		11		
	737-800	15 Dec 05	none			16	
Various unidentified	737-700BBJ	22 Jan 96	23 Nov 98		95		
	737-800BBJ	19 Nov 97	28 Feb 01			13	
	737-700				39		
	737-800					72	
	737-900ER	30 Jun 06	none				30
Subtotals				**70**	**1,325**	**1,828**	**118**
Total					**3,341**		

Notes: For deliveries see Group Orders and Deliveries table

six-abreast at 81 cm (32 in) pitch in mixed class; and 149 all-tourist class at 76 cm (30 in) pitch. Total overhead baggage capacity of 7.0 m^3 (248 cu ft), equivalent to 0.05 m^3 (1.8 cu ft) per passenger. C-40A options comprise 121 passengers, all-cargo (eight pallets) and combinations of 70 passengers and three pallets.

737-800: Alternative cabin layouts seat from 162 to 189 passengers. Typical arrangements offer 12 first class seats four-abreast at 91 cm (36 in) pitch and 150 tourist class seats six-abreast at 81 cm (32 in) pitch in mixed class; and 189 all-tourist class at 76 cm (30 in) pitch. Total overhead baggage capacity of 9.3 m^3 (328 cu ft), equivalent to 0.05 m^3 (1.7 cu ft) per passenger.

737-900: Alternative cabin layouts seat from 177 to 189 passengers. Typical arrangements offer 12 first class seats four-abreast at 91 cm (36 in) pitch and 165 tourist class seats six-abreast at 81 cm (32 in) pitch in mixed class; and 189 all-tourist class at 81 cm (32 in) pitch.

737-900ER: Alternative cabin layouts seat from 189 to 215 passengers.

SYSTEMS: Honeywell 131-9(B) APU with air start capability to maximum certified altitude and 90 kVA electrical load capability to 11,278 m (37,000 ft). Three-wheel air cycle environmental control system with optional ozone converter and digital cabin pressure controls.

AVIONICS: *Flight:* Satellite navigation standard. Optional satcom and dual FMS (single standard) integrated with GPS.

Instrumentation: Honeywell Air Transport Systems common display system (CDS) with five-screen flat-panel liquid crystal display (LCD) technology and programmable software, enables operators to emulate previous 737 electronic flight instrument system (EFIS) and 747-400/777 primary flight display-navigation display (PFD-ND) flight deck formats. Optional HUD.

DIMENSIONS, EXTERNAL:

Wing span (all versions): **standard** ..... 34.31 m (112 ft 7 in)
with winglets ..... 35.79 m (117 ft 5 in)
Wing chord: at root ..... 5.71 m (18 ft 9 in)
at tip ..... 1.25 m (4 ft 1¼ in)
Wing aspect ratio, standard 9.4
Length: overall: 600 ..... 31.24 m (102 ft 6 in)
700 ..... 33.63 m (110 ft 4 in)
800 ..... 39.47 m (129 ft 6 in)
900 ..... 42.11 m (138 ft 2 in)
fuselage: 700 ..... 32.18 m (105 ft 7 in)
800 ..... 38.02 m (124 ft 9 in)
900 ..... 40.67 m (133 ft 5 in)
Height overall: 600, 700 ..... 12.57 m (41 ft 3 in)
800, 900 ..... 12.55 m (41 ft 2 in)
Tailplane span: all ..... 14.35 m (47 ft 1 in)
Wheel track (c/l shock-struts): all ..... 5.71 m (18 ft 9 in)
Wheelbase: 700 ..... 12.60 m (41 ft 4 in)
800 ..... 15.60 m (57 ft 2 in)
900 ..... 17.17 m (56 ft 4 in)
Distance between engine centrelines ..... 9.65 m (31 ft 8 in)
Main passenger door (port, fwd), all:
Height ..... 1.83 m (6 ft 0 in)
Width ..... 0.86 m (2 ft 10 in)
Height to sill: at OWE ..... 2.74 m (9 ft 0 in)
at MTOW ..... 2.59 m (8 ft 6 in)
Passenger door (port, rear):
Height: all ..... 1.83 m (6 ft 0 in)
Width: all ..... 0.76 m (2 ft 6 in)
Height to sill: 600, 700: at OWE ..... 3.10 m (10 ft 2 in)
at MTOW ..... 2.95 m (9 ft 8 in)
800, 900: at OWE ..... 3.12 m (10 ft 2 in)
at MTOW ..... 2.97 m (9 ft 9 in)
Emergency exits (overwing, port and stbd, each), all:
Height ..... 0.96 m (3 ft 2 in)
Width ..... 0.51 m (1 ft 8 in)
Service door (stbd, fwd), all:
Height ..... 1.65 m (5 ft 5 in)
Width ..... 0.76 m (2 ft 6 in)
Height to sill: at OWE ..... 2.74 m (9 ft 0 in)
at MTOW ..... 2.59 m (8 ft 6 in)
Service door (stbd, rear):
Height: all ..... 1.65 m (5 ft 5 in)
Width: all ..... 0.76 m (2 ft 6 in)
Height to sill: 600, 700: at OWE ..... 3.10 m (10 ft 2 in)
at MTOW ..... 2.97 m (9 ft 9 in)
800, 900: at OWE ..... 3.12 m (10 ft 3 in)
at MTOW ..... 2.97 m (9 ft 9 in)
Baggage hold door (stbd, fwd), all:
Height: door 1.30 m (4 ft 3 in) clear access ..... 0.89 m (2 ft 11 in)
Width ..... 1.22 m (4 ft 0 in)
Height to sill ..... 1.45 m (4 ft 9 in)
Baggage hold door (stbd, rear), all:
Height: door 1.22 m (4 ft 0 in) clear access ..... 0.84 m (2 ft 9 in)
Width ..... 1.22 m (4 ft 0 in)
Height to sill: 700 ..... 1.78 m (5 ft 10 in)
800, 900 ..... 1.80 m (5 ft 11 in)

DIMENSIONS, INTERNAL:

Cabin, aft of flight deck to rear pressure bulkhead:
Length: 600 ..... 21.79 m (71 ft 6 in)
700 ..... 24.18 m (79 ft 4 in)
800 ..... 30.02 m (98 ft 6 in)
Max height: all ..... 2.13 m (7 ft 0 in)
Floor area: 600 ..... 67.3 m^2 (725 sq ft)
700 ..... 75.1 m^2 (808 sq ft)
800 ..... 94.0 m^2 (1,012 sq ft)

Baggage hold:
- Length: 700: front ... 4.67 m (15 ft 4 in)
- rear ... 8.03 m (26 ft 4 in)
- 800: front ... 7.67 m (25 ft 2 in)
- rear ... 10.87 m (35 ft 8 in)
- 900: front ... 9.25 m (30 ft 4 in)
- rear ... 11.94 m (39 ft 2 in)
- Max width, all: at roof ... 3.15 m (10 ft 4 in)
- at floor ... 1.22 m (4 ft 0 in)
- Min height, all ... 1.13 m (3 ft 8½ in)
- Volume:
- 600: front ... 7.0 m³ (248 cu ft)
- rear ... 13.4 m³ (472 cu ft)
- 700: front ... 11.5 m³ (406 cu ft)
- rear ... 16.9 m³ (596 cu ft)
- 800: front ... 19.6 m³ (692 cu ft)
- rear ... 25.5 m³ (899 cu ft)
- 900: front ... 23.8 m³ (840 cu ft)
- rear ... 28.7 m³ (1,012 cu ft)

AREAS:
- Wings, gross ... 125.00 m² (1,345.5 sq ft)
- Vertical tail surfaces (total) ... 26.40 m² (284.2 sq ft)
- Horizontal tail surfaces (total) ... 32.80 m² (353.1 sq ft)

WEIGHTS AND LOADINGS (600: A: CFM56-7B18 engines, B: CFM56-7B22s; 700: A: CFM56-7B20s, B: CFM56-7B24s; 800: A: CFM56-7B24s, B: CFM56-7B27s; 900: A: CFM56-7B26s, B: CFM56-7B27s):

Operating weight empty:
- 600, 110 passengers: A, B ... 37,104 kg (81,800 lb)
- 700, 126 passengers: A, B ... 38,147 kg (84,100 lb)
- 800, 162 passengers: A, B ... 41,145 kg (90,710 lb)
- 900, 177 passengers: A, B ... 42,493 kg (93,680 lb)

Max T-O weight:
- 600: A ... 56,245 kg (124,000 lb)
- B ... 65,090 kg (143,500 lb)
- 700: A ... 60,330 kg (133,000 lb)
- B ... 70,080 kg (154,500 lb)
- 800: A ... 70,535 kg (155,500 lb)
- B ... 79,015 kg (174,200 lb)
- 900: A ... 74,840 kg (164,000 lb)
- B ... 79,015 kg (174,200 lb)

Max ramp weight:
- 600: A ... 56,470 kg (124,500 lb)
- B ... 65,315 kg (144,000 lb)
- 700: A ... 60,555 kg (133,500 lb)
- B ... 70,305 kg (155,000 lb)
- 800: A ... 70,760 kg (156,000 lb)
- B ... 79,245 kg (174,700 lb)
- 900: A ... 74,615 kg (164,500 lb)
- B ... 79,245 kg (174,700 lb)

Max landing weight:
- 600 A, B ... 54,655 kg (120,500 lb)
- 700: A ... 58,060 kg (128,000 lb)
- B ... 58,605 kg (129,200 lb)
- 800: A ... 65,315 kg (144,000 lb)
- B ... 66,360 kg (146,300 lb)
- 900: A ... 66,360 kg (146,300 lb)
- B ... 66,810 kg (147,300 lb)

Max zero-fuel weight:
- 600: A ... 51,480 kg (113,500 lb)
- B ... 51,710 kg (114,000 lb)
- 700: A ... 54,655 kg (120,500 lb)
- B ... 55,200 kg (121,700 lb)
- 800: A ... 61,690 kg (136,000 lb)
- B ... 62,730 kg (138,300 lb)
- 900: A ... 62,730 kg (138,300 lb)
- B ... 63,640 kg (140,300 lb)

Max wing loading:
- 600: A ... 450.0 kg/m² (92.16 lb/sq ft)
- B ... 520.7 kg/m² (106.65 lb/sq ft)
- 700: A ... 482.6 kg/m² (98.85 lb/sq ft)
- B ... 560.6 kg/m² (114.83 lb/sq ft)
- 800: A ... 564.3 kg/m² (115.57 lb/sq ft)
- B ... 632.1 kg/m² (129.47 lb/sq ft)
- 900: A ... 595.1 kg/m² (121.89 lb/sq ft)
- B ... 632.1 kg/m² (129.47 lb/sq ft)

Max power loading:
- 600: A ... 324 kg/kN (3.18 lb/lb st)
- B ... 322 kg/kN (3.16 lb/lb st)
- 700: A ... 329 kg/kN (3.23 lb/lb st)
- B ... 347 kg/kN (3.40 lb/lb st)
- 800: A ... 327 kg/kN (3.21 lb/lb st)
- B ... 325 kg/kN (3.19 lb/lb st)
- 900: A ... 318 kg/kN (3.12 lb/lb st)
- B ... 325 kg/kN (3.19 lb/lb st)

PERFORMANCE (A, B as above):
- Max operating Mach No. (MMO): all ... 0.82
- Cruising speed: all ... M0.785
- Approach speed:
- 600: A, B ... 125 kt (232 km/h; 144 mph)
- 700: A ... 129 kt (239 km/h; 148 mph)
- B ... 130 kt (241 km/h; 150 mph)
- 800: A ... 141 kt (261 km/h; 162 mph)
- B ... 142 kt (263 km/h; 163 mph)
- 900: A, B ... 141 kt (261 km/h; 162 mph)
- Max certified altitude: all ... 12,500 m (41,000 ft)
- Initial cruising altitude, ISA +10°C:
- 600: A ... 12,500 m (41,000 ft)
- B ... 12,220 m (40,100 ft)
- 700: A ... 12,500 m (41,000 ft)
- B ... 11,700 m (38,400 ft)
- 800: A ... 11,675 m (38,300 ft)
- B ... 10,955 m (35,940 ft)
- 900: A ... 11,215 m (36,800 ft)
- B ... 10,820 m (35,500 ft)

T-O field length, S/L, 30°C:
- 600: A ... 1,616 m (5,300 ft)
- B ... 1,796 m (5,890 ft)
- 700: A ... 1,744 m (5,720 ft)
- B ... 1,677 m (5,500 ft)
- 800: A ... 2,100 m (6,890 ft)
- B ... 2,308 m (7,570 ft)
- 900: A ... 2,591 m (8,500 ft)
- B ... 2,439 m (8,000 ft)

Landing field length at max landing weight:
- 600: A, B ... 1,342 m (4,400 ft)[1]
- 700: A ... 1,418 m (4,650 ft)
- B ... 1,433 m (4,700 ft)[1]
- 800: A ... 1,646 m (5,400 ft)
- B ... 1,646 m (5,400 ft)
- 900: A, B ... 1,662 m (5,450 ft)

Design range:
- 600 with 110 passengers:
- A ... 1,340 n miles (2,481 km; 1,542 miles)
- B ... 3,050 n miles (5,648 km; 3,509 miles)
- 700 with 126 passengers:
- A ... 1,540 n miles (2,852 km; 1,772 miles)
- B[2] ... 3,260 n miles (6,037 km; 3,751 miles)
- 800 with 162 passengers:
- A ... 1,990 n miles (3,685 km; 2,290 miles)
- B[2] ... 2,940 n miles (5,444 km; 3,383 miles)
- 900 with 177 passengers:
- A ... 2,060 n miles (3,815 km; 2,370 miles)
- B[2] ... 2,745 n miles (5,083 km; 3,158 miles)

[1] *Category D Honeywell brakes*
[2] *With optional blended winglets*

BOEING 747-400 and 747-8

TYPE: Wide-bodied airliner.

PROGRAMME:

DEVELOPMENT MILESTONES

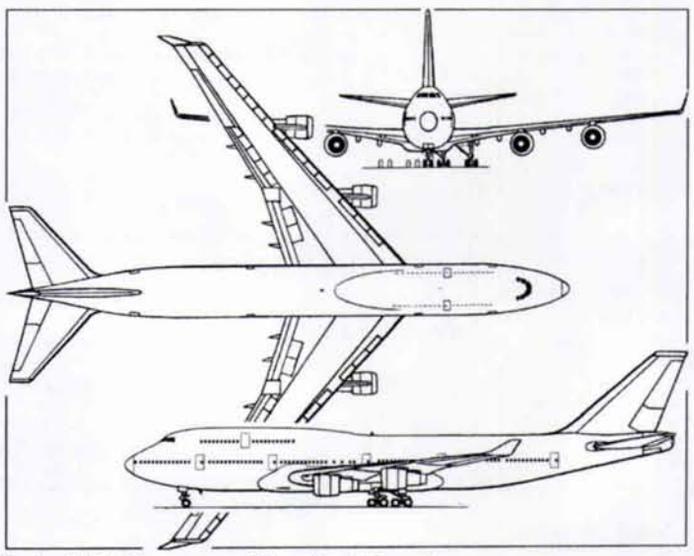
747-100	
First order	13 Apr 66
Rolled out	30 Sep 68
First flight	9 Feb 69
Certification	30 Dec 69
First delivery	12 Dec 69
Entered service (Pan Am)	21 Jan 70
Subsequent versions	
747-400	
First order	22 Oct 85
Rolled out	26 Jan 88
First flight	29 Apr 88
Certification	10 Jan 89
First delivery	26 Jan 89
Entered service (Northwest Airlines)	9 Feb 89
747-400M	
First order	9 Apr 86
Rolled out	23 Mar 89
First flight	30 Jun 89
Certification	1 Oct 89
First delivery	1 Sep 89
Entered service (KLM)	Sep 89
747-400 Domestic	
First order	18 Dec 88
Rolled out	18 Feb 91
First flight	18 Mar 91
Certification	10 Oct 91
First delivery	10 Oct 91
Entered service (Japan Air Lines)	Oct 91
747-400ER	
First delivery	19 Dec 00
Rolled out	17 Jun 02
First flight	31 Jul 02
Certification	29 Oct 02
First delivery	31 Oct 02
Entered service	7 Nov 02
747-8	
First order	30 May 06

World's first wide-body jet airliner; Pan American order for 25 announced 13 April 1966; official programme launch 25 July 1966; first flight 9 February 1969; FAA certification 30 December 1969; first delivery (to Pan Am) 12 December 1969; first route service New York-London flown 21 January 1970. 747-400 announced October 1985. In May 1990, Boeing decided to market only the -400; last -200 (a -200F Freighter for Nippon Cargo Air Lines) delivered 19 November 1991.

For all variants before 747-400, see *Jane's Aircraft Upgrades*. Production of earlier variants totalled 724 (205 -100, 45 SP, 393 -200 and 81 -300). Nineteen Pan American 747s modified as passenger/cargo **C-19As** by Boeing Military Airplanes for Civil Reserve Air Fleet (see 1990–91 edition).

Boeing 747's 35th anniversary of maiden flight occurred 9 February 2004, at which time 1,341 had been delivered, accumulating 35 billion n miles (65 billion km) and carrying 3.6 billion passengers since service entry in 1970.

Take-off from its home base by Singapore Airlines Boeing 747-400 *(Paul Jackson)* 1159155



Boeing 747-400 long-range airliner *(Dennis Punnett)* 1159142

Series 400 announced October 1985 as 747 development with extended capacity and range; design go-ahead July 1985; first order 22 October 1985; roll-out 26 January 1988; first flight 29 April 1988; certified with P&W PW4056 on 10 January 1989; first delivery 26 January 1989; entered service with Northwest Airlines 9 February 1989; certified with GE CF6-80C2B1F on 8 May 1989; R-R RB211-524G on 8 June 1989; R-R RB211-524H on 11 May 1990. Since May 1990, -400 is the only 747 marketed. Final 747-400 due for delivery in September 2009, with change then to 747-8.

CURRENT VERSIONS: **747-400:** Basic passenger version; standard and three optional gross weights (see below).

Detailed description applies to -400, except where indicated.

747-400M Combi: Passenger/freight version; initial order 9 April 1986; rolled out 23 March 1989; first flight 30 June 1989; certified 1 October 1989; first delivery 1 September 1989 to KLM. Maximum 266 three-class passengers with freight, 413 without; port-side rear freight door; main deck limit is seven pallets at 27,215 kg (60,000 lb); underfloor and fuel capacities as for passenger 747; 49 delivered by 31 December 1996. For all gross weights, maximum landing weight 285,763 kg (630,000 lb) and maximum zero-fuel weight 256,280 kg (565,000 lb). All three engine options available.

747-400F: All-freight version. *Described separately.*

747-400 Domestic: Special high-density two-class 568-passenger version; first order 18 December 1988; rolled out 18 February 1991; first flown 18 March 1991; certified 10 October 1991 and delivered same day to Japan Air Lines (first of six) and later to All Nippon (six) and Japan Air System (one). Maximum T-O weight 272,155 kg (600,000 lb) but can be certified to 394,625 kg (870,000 lb). Structurally reinforced; no winglets; lower engine thrust; five more upper deck windows; revised avionics software and cabin pressure schedule; brake cooling fans; five pallets, 14 LD-1 containers and bulk cargo under floor; GE or P&W engines.

747-400 Performance Improvement Package: (PIP) Announced April 1993, and first stage implemented in July 1993. Included gross weight increase of 2,268 kg (5,000 lb). Second stage, implemented in December 1993, included longer-chord dorsal fin made of CFRP, and wing spoilers held down more tightly to reduce profile drag and leakage. These improvements were immediately applied to production aircraft and are retrofittable; PIP flight tested in leased United Airlines 747-400 May 1993.

747-400ER: Offered (as 747-400IGW) from December 1997 in response to Qantas requirement, for which the carrier placed an order for six, with first delivery then scheduled for October 2002. One or two additional fuel tanks in hold. Range 7,500 n miles (13,890 km; 8,630 miles) with one additional tank; 7,700 n miles (14,260 km; 8,861 miles) with two. Structural strengthening around centrebody, wing/fuselage joint, flaps and landing gear.

Prototype N747ER (1,308th B747) rolled out 10 June 2002 (official ceremony on 17th); maiden flight 31 July 2002; became VH-OEE of Qantas.

747-400 ERF: See following entry.

747-400X QLR: Study, since superseded, for developed, Quiet Longer Range version, initially designated 747-400X. Based on 747-400 airframe, but with revised (B777-style) flight deck, crew rest/passenger sleeping area in upper aft fuselage, increased provision for carry-on baggage in cabin, 747-400F's thicker gauge outboard wing with B767-400ER-style raked wingtips (span 68.66 m; 225 ft 3 in) instead of winglets, MD-11-type trailing-edge wedges (of which flight tests began in October 1998), strengthened fuselage sections and landing gear, and modifications to cargo and fuel systems to permit installation of additional fuselage tank forward of centre wing tank, with second additional tank of same capacity optional. Max ramp weight 418,665 kg (923,000 lb); max T-O weight 417,760 kg (921,000 lb); operating weight empty 186,425 kg (411,000 lb), max structural payload 65,315 kg (144,000 lb); fuel load 248,714 litres (65,705 US gallons; 54,710 Imp gallons), giving max range, with 416 passengers in three classes, of 7,980 n miles (14,779 km; 9,183 miles); alternative 396,900 kg (875,000 lb) MTOW and 7,500 n mile (13,890 km; 8,630 mile) range to comply with QC2 noise regulations. Alternative seating up to 524 (including 42 first class). Cruising Mach No is 0.86. By late 2002, QLR had generated little airline interest and Boeing had developed the proposal with greater range and payload, provisionally designating it **747-800X**.

Initial engine planned to be GE CF6-80C2B9F of 282 kN (63,300 lb st). New 'chevron' engine nacelles with serrated rear edges on core and fan nozzles promote mixing of bypass and core flows, and mixing of bypass flow and ambient air; combined with acoustic engine liners, these make QLR some 6 dB quieter (20 per cent on T-O; 40 per cent on approach), enabling it to meet QC2 noise standards.

QLR announced at Asian Aerospace, Singapore, 26 February 2002 (when 'chevron' design revealed). Studies replaced by 747 Advanced.

747-400XF QLR: Study for cargo version of Quiet Longer Range, with simplified and lightened handling system. Launched (then as Longer-Range 747-400 Freighter) April 2001 with order from ILFC. MTOW 417,760 kg (921,000 lb); range 5,150 n miles (9,537 km; 5,926 miles) with 112,810 kg (248,700 lb) payload. Cargo volumes (upper, lower and bulk) as for 747-400F. No extra fuel; capacity as for basic 747-400, GE-engined variant (203,325 litres; 53,765 US gallons; 44,769 Imp gallons). Typical cruising speed M0.845 on GE CF6-80C2B9F engines.

747X and 747X Stretch: Boeing cancelled development of its proposed 747X and 747X Stretch in March 2001.

747-800X: Under consideration by late 2002. Evolved from 747-400X QLR, with 1.98 m (6 ft 6 in) forward fuselage stretch; some 3,785 litres (1,000 US gallons; 833 Imp gallons) of additional fuel in tailplane tanks; between 20 and 40 more seats; and range increased to 8,000 n miles (14,816 km; 9,206 miles). Candidate engines in 276 to 285 kN (62,000 to 64,000 lb st) class. Developed into 747 Advanced.

747-8: Revealed (as 747 Advanced) mid-2003 as further development of 747X QLR (and 747XF QLR) theme, drawing on Boeing 787 Dreamliner technology, including new, General Electric GEnx engines due for certification in April 2008 at 298 kN (67,000 lb st). Formally launched 14 November 2005 on strength of two orders, both for 747-8 Freighter: 10 (plus 10 options) for Cargolux, to be delivered from third quarter of 2009 and eight (plus six options) for Nippon Cargo Airlines, delivery from fourth quarter of 2009. Also available as 747-8 Intercontinental passenger version.

Raked wingtips with overall span of 68.66 m (225 ft 3 in); trailing-edge wedge and fuselage plugs carried forward from previous studies, although last-mentioned to comprise 2.03 m (6 ft 8 in) ahead of wing (4.06 m; 13 ft 4 in for Freighter version) and 1.52 m (5 ft 0 in) behind. Length (Intercontinental) 74.22 m (243 ft 6 in), height overall 19.38 m (63 ft 7 in). Weight empty 198,660 kg (437, 975 lb), max T-O 421,840 kg (930,000 lb), zero-fuel 269,430 kg (594,000 lb), max structural payload 70,770 kg (156,020 lb). Fuel capacity 225,705 litres (59,625 US gallons; 49, 648 Imp gallons); max operating speed M0.86 with 448 passengers (24/85/339) over 8,090 n miles (14,982 km; 9,309 miles). Capacity 560 passengers in two-class layout. Underfloor capacity for 32 LD1 containers. Freighter has 140,000 kg (308,650 lb) payload, equivalent to 36 pallets on main deck, plus 34 LD1 containers below.

747-8 VIP: Announced at NBAA Convention, Orlando, 18 October 2006 with three orders (although passenger 747-8 then still to be officially launched), reportedly including Qatar government, which placed initial contract on 30 May 2006.

Cabin: length 63.25 m (207 ft 6 in); max width 6.12 m (20 ft 1 in); max height 2.39 m (7 ft 10 in); floor area 444.6 m^2 (4,786 sq ft); cargo volume 198.6 m^3 (7,013 cu ft). Weights: empty, operating 234,460 kg (516,900 lb); max T-O 439,980 kg (970,000 lb); max landing 306,175 kg (675,000 lb); max zero-fuel 288,030 kg (635,000 lb). Fuel capacity 243,118 litres (64,225 US gallons; 53,478 Imp gallons). Range: 9,500 n miles (17,594 km; 10,932 miles) with eight passengers; 9,260 n miles (17,149 km; 10,656 miles) with 100 passengers. Operating cost USD9,900 per hour (2006).

CUSTOMERS: As per table. Launch customer Northwest Orient Airlines ordered 10 -400s with PW4000s and 420-passenger interior October 1985; first delivery 26 January 1989.

COSTS: 747-400 USD216 million to USD247.5 million; 747-8 USD272.5 million to USD282.5 million (2006).

DESIGN FEATURES: Wide-bodied extrapolation of Boeing intercontinental jet configuration of low wing and four podded engines, optimised for greater passenger numbers and increased efficiency. Twin-deck forward fuselage; four mainwheel bogies for weight distribution.

According to engine type, fuel burn per seat over 3,000 n mile (5,556 km; 3,452 mile) sector varies between 135.8 kg (299.3 lb) and 138.5 kg (305.4 lb).

Sweepback at quarter-chord 37° 30'; thickness/chord ratio 13.44 per cent inboard, 7.8 per cent at mid-span, 8 per cent outboard; dihedral at rest 7°; incidence 2°; winglets, canted 22° outward and swept 60°, increase range by 3 per cent; upper deck extended rearward by 7.11 m (23 ft 4 in).

FLYING CONTROLS: Conventional and powered.

Elevators: Four elevator sections mechanically linked with breakable shear devices; each elevator has dual hydraulic-powered control units; control feel and three individual autopilot input servos mounted on central elevator quadrant; all surfaces have position transmitters; feel computer-operated by pitot pressure and tailplane angle.

Rudder: Upper rudder surface operated by three hydraulic actuators served by two hydraulic systems, lower surface by two actuators fed by remaining two hydraulic systems; no balance weights; each rudder has separate yaw damper module; left and right digital air data computers provide signals for controlling rudder ratio changer on each rudder surface according to air data and tailplane angle; combined feel actuator, rudder centring and trim actuator in rear servo area; mechanical cable linkage between rudder pedals and aft actuator area; rudder trim control switches on centre console. Maximum rudder deflection ±30°.

Tailplane: Tailplane angle set by hydraulic motor-driven shaft and ball screw with primary and secondary hydraulic brakes; flight control unit and air data computer signals sent to tailplane through dual stabiliser, trim and rudder ratio modules, which automatically apply Mach trim, and by dual-stabiliser control modules; tailplane trim limits computed according to flap positions.

Lateral control: Pilot and co-pilot aileron linkage can be physically separated if necessary; all four ailerons operate at low speeds; outboard ailerons are locked out at cruising speed; the inboard spoiler panel on each wing used on ground only; remainder have variable ratio response and spoiler mixer units; there are trim, centring and feel units.

Leading-edge and trailing-edge devices: Three-section Krueger flaps inboard of engines; variable camber slats between (five-section) and outboard (six-section) of engines lie flat when retracted and adopt camber curvature when extended. Two flap assemblies on each wing, one inboard of engines and the other between engines; three sections, fore flap, mid-flap and aft flap, move rearwards as single flat panel up to 5° deflection; thereafter, three sections separate progressively to form three slots, and camber angles relative to each other increase progressively.

Automatic flight control system: Combines autopilot, flight director and automatic tailplane trim and sends commands through triple independent flight control computers; system automates all flight phases except take-off; dual digital air data computers; pilots' primary flight and navigation displays are large-size cathode-ray tubes; two engine indicating and crew alerting screens, one on main panels, one on console; three multifunction control and display panels control flight management system, navigation and communications; flight control computers (autopilot) and inertial reference units are triplicated; new features include full-time autothrottle and dual-thrust management system included in flight management computer; integrated radio control panels and automatic start and shutdown of APU.

STRUCTURE: Wing and tail surfaces are aluminium alloy dual-path fail-safe structures; advanced aluminium alloys in wing torsion box save 2,721 kg (6,000 lb); advanced aluminium honeycomb spoiler panels; CFRP winglets and main deck floor panels; advanced graphite/phenolic and Kevlar/graphite in cabin fittings and engine nacelles; frame/stringer/stressed skin fuselage with some bonding. Improved corrosion protection and further coverage with compound introduced from 1993.

LANDING GEAR: Twin-wheel nose unit retracts forward; main gear consists of four four-wheel bogies; two, mounted side by side under fuselage at wing trailing-edge, retract forward; two, mounted under wings, retract inward; nosewheel steerable up to 70° left or right from tillers; full rudder pedal travel gives up to 7° for use at high speed; two centre main legs steer up to 13° when nosewheels are steered more than 20° and speed is less than 20 kt (37 km/h; 23 mph); carbon disc brakes on all mainwheels, with individually controlled digital anti-skid units; one of three brake pressure supplies automatically selected; main and nose tyres H49×19.0–20 or -22 (32 ply). Minimum ground turning radius, with body gear steering, is 48.46 m (159 ft 0 in) at wingtip and 27.73 m (91 ft 0 in) at nosewheels.

Boeing 747-8 retains Goodrich as supplier of landing gear, wheels and brakes.

POWER PLANT: Four turbofans for baseline 747-400, these comprise: 252 kN (56,750 lb st) Pratt & Whitney PW4056: 258 kN (57,900 lb st) General Electric CF6-80C2B1F or 276 kN (62,100 lb st) CF6-80C2B5F; or 258 kN (58,000 lb st) Rolls-Royce RB211-524G or 270 kN (60,600 lb st) RB211-524H. Further optional engines (subject to certification) are 267 kN (60,000 lb st) PW4060, 276 kN (62,000 lb st) PW4062 and 274 kN (61,500 lb st) CF6-80C2B1F1. For 747-400ER, initial engine choices are CF6-80C2B5F, PW4062 and RB211-524H8T.

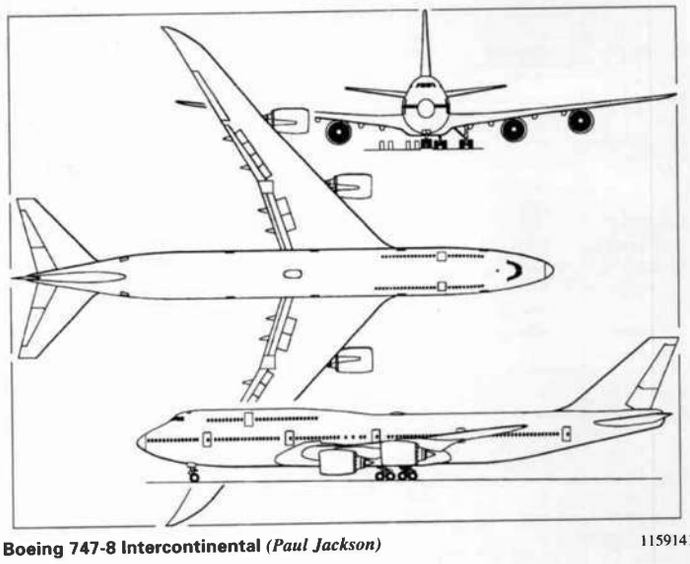
Fuel in four main tanks in wings can feed to any engine; in addition there are a centre-wing tank and reserve tanks in outer wing; optional tailplane tank; vent and surge tanks in outer wings and starboard tailplane; jettison pumps in inner main tanks; APU fed from port inner tank; automatic refuelling through two receptacles under each wing leading-edge between engines; automatic condensate scavenging and flame arresters in vent outlets.

Basic fuel capacity 204,355 litres (53,985 US gallons; 44,952 Imp gallons) with P&W and R-R engines; 203,523 litres (53,765 US gallons; 44,769 Imp gallons) with GE engines. At alternative higher T-O weights above 394,625 kg (870,000 lb) use of 12,492 litre (3,300 US gallon; 2,748 Imp gallon) tailplane/centre section tank is mandatory; fuel capacity including tailplane tank is therefore 216,846 litres (57,285 US gallons; 47,700 Imp gallons) with P&W and R-R engines and 216,013 litres (57,065 US gallons; 47,516 Imp gallons) with GE engines.

Usable fuel in 747-400ER comprises 239,389 litres (63,240 US gallons; 52,658 Imp gallons) with GE engines; 240,222 litres (63,460 US gallons; 52,841 Imp gallons) with P&W and R-R engines. Volumes include two tanks in cargo hold each of 11,583 litres (3,060 US gallons; 2,548 Imp gallons).

Nitrogen-based flammability reduction system (FRS) trials with 747-400 tanks undertaken in 2003 with Honeywell/Parker Aerospace OBNGS; available from late 2006 or early 2007.

ACCOMMODATION: Two-crew flight deck, with seats for two observers; two-bunk crew rest cabin accessible from flight deck. Optional (but currently available on 90 per cent of B747-400 fleet) overhead cabin crew rest compartments above rear of main deck cabin (four bunks, four seats; eight bunks, two seats; two bunks, two seats, five sleeper seats). Typical 416-seat, three-class, long-range configuration accommodates 40 business class on upper deck; 23 first class in front cabin, 38 business class in middle cabin and 315 economy class in rear cabin on main deck. Maximum upper deck capacity 69 economy class. First class seating six abreast with two 86 cm (34 in) aisles, each twin-seat unit 1.45 m (4 ft 9 in) wide. Business passengers four abreast with 72 cm (28½ in) aisle and 1.37 m (4 ft 6 in) wide seat pairs on upper deck or two-three-two on lower deck with two 63 cm (24¾ in) aisles and 2.08 m (6 ft 10 in) triple seat. Economy seating three-four-three, with 49.5 cm (19½ in) aisles, two 1.51 m (4 ft 11½ in) triple seats and 2.07 m (6 ft 9½ in) quad seat. Five passenger doors on each side; upper deck emergency door each side. 747-400ER accommodates, typically, 500 in two-class arrangement (42 first, 458 economy or 416 three-class (as above).



Boeing 747-8 Intercontinental *(Paul Jackson)* 1159141

Centre overhead stowage bins 0.16 m³ (5.7 cu ft) volume per 1.02 m (40 in) long bin; outboard bins 0.45 m³ (15.9 cu ft) volume per 1.52 m (60 in) long bin; 0.083 m³ (2.95 cu ft) bin volume per passenger (three-class). Two modular upper deck lavatories, 14 on main deck, relocatable (six upper deck optional locations; 33 on lower deck) and vacuum-drained into four waste tanks with combined volume of 1,136 litres (300 US gallons; 250 Imp gallons). Single-point drainage. Basic galley configuration, one on upper deck, seven centreline and two sidewall on main deck; lavatories and galleys can be quickly relocated if required fittings are installed; advanced integrated audio/video/announcement system.

Underfloor freight: forward compartment, five 2.44 m (96 in) × 3.18 m (125 in) pallets (totalling 58.8 m³, 2,075 cu ft) or 16 LD-1 containers (totalling 78.4 m³; 2,768 cu ft); aft compartment, 14 LD-1 containers (totalling 68.6 m³; 2,422 cu ft) or four pallets (totalling 47.0 m³; 1,660 cu ft); and bulk storage behind aft compartment 23.6 m³ (835 cu ft). Max capacity of 747-400 (16 LD-1s forward, 14 LD-1s aft and bulk storage in extreme rear) 170.6 m³ (6,025 cu ft). Door to each of three areas, all starboard side. Optional cargo door, port rear, on Combi version. 747-400ER lower deck accommodates 129 m³ (4,550 cu ft) within LD-1 containers, plus 22.3 m³ (789 cu ft) of bulk cargo, when two fuel tanks fitted. Capacity of 747-400X QLR reduced by up to six containers when both additional fuel tanks fitted; capacity 158.5 m³ (5,599 cu ft) with basic fuel; 137.0 m³ (4,837 cu ft) with max fuel.

SYSTEMS: Each engine drives a hydraulic pump feeding an independent system; services are connected to supplies in such a way that loss of one supply cannot disable one system; two hydraulic systems also have air-driven pumps to maintain pressure and two have electric pumps; one electric pump can be run to provide braking when the aircraft is being towed on the ground; all four hydraulic reservoirs can be filled from a single location in the port main landing gear bay.

Hot air bled from the low-pressure and high-pressure compressors of all four engines is precooled by fan exit air and fed via a manifold to the cabin pressurisation and air conditioning system and to provide de-icing of wing leading-edge and engine nose cowling and to pressurise hydraulic tanks. Three conditioning packs in wing/fuselage fairing provide cabin air; five cabin zones, each with digital temperature control.

Each engine drives an integrated drive generator supplying 90 kVA power to respective AC busses; three generators are a dispatch item, but one will supply essential loads; APU drives two further generators; automatic start-up, load transfers and load shedding reduce crew workload; power systems may be isolated from each other for triple-channel Cat. III autoland.

Completely self-contained 1,081 kW (1,450 shp) P&WC PW901A APU, mounted clear of all flight-critical structure and flight controls in the extreme tail, drives two 90 kVA generators that can supply electrical power for whole aircraft; also supplies compressed air to operate pneumatic components; can run at up to 6,100 m (20,000 ft) and supply compressed air below 4,575 m (15,000 ft). Capabilities include maintenance of 24°C (75°F) ground cabin temperature in 38°C (100°F) ambient conditions.

Forward underfloor cargo compartment heated to 5°C by hot air exhausted from flight deck cooling equipment and avionics in main equipment centre, boosted as necessary by two electrical heaters; rear underfloor hold heated to minimum 5°C or 18°C (selected by crew) by engine bleed.

Overheat detection and automatic extinguishing provided in all lavatories; APU automatically shut down and fire extinguisher bottles initiated on detection of fire; each engine has three dual fire detectors in series and a fourth detector for overheating. Underfloor freight compartments and upper deck hold of Combi have smoke detectors and extinguisher systems; wheel wells have overheat detectors.

AVIONICS: Boeing launched development of new Flight Management Computer software in January 1993 to match existing aircraft to international Future Air Navigation System (FANS-1) during 1995. Standard avionics fit as follows:

Comms: Dual VHF and HF transceivers with Selcal; dual transponders; flight intercom with air-to-ground facility, connectable also to satcom system; cabin entertainment and passenger address and service units.

Radar: Colour weather radar transmitting in I- and G-bands.

Flight: Dual VOR; triple ILS receivers with single marker beacon receiver; dual ADF; dual DME; all nav radios automatically tuned by flight management computer system (FMCS). Automatic flight control system (AFCS) integrates autopilot, flight director and automatic stabiliser trim functions; dual digital air data computers with dual selectable pressure sensors, angle of attack sensors and total air temperature probes; FMCS allows crew to preselect flight plan using standard air traffic control language; FMCS incorporates database, updated every 28 days, which includes data on waypoints, airports, standard instrument departures (SIDs), standard terminal arrival routes (STARs), airline routes and information on specific geographic areas; triple ring laser gyro inertial reference units provide navigation input on EFIS, flight management displays or radio magnetic indicators; other systems include ground proximity warning, triple low-range radio altimeters and TCAS.

Central maintenance computer monitors over 75 electrical and electromechanical systems, performs tests and centralises maintenance data; failures are indicated in EICAS displays and stored for future reference for in-flight use or line or hangar maintenance. Satcom datalink allows ground crews to interrogate system for additional information while aircraft in flight.

BOEING 747-400 ORDER BOOK
(at 30 June 2006)

Customer	Variant	First order	First delivery	Engine	400	400D	400ER	400ERF	400F	400M	8F
Air Canada	400M	20 Jan 89	4 Jun 91	PW4056						3	
Air China	400	31 May 90	20 Mar 92	PW4056	6						
	400M	16 May 86	13 Oct 89	PW4056						8	
Air China Cargo	400F	27 Jul 04	16 Dec 05	PW4056					2		
Air France	400	16 Dec 87	28 Feb 91	CF6-80	7						
	400ERF	24 Apr 01	31 Oct 02	CF6-80				2			
	400M	16 Dec 87	17 Sep 91	CF6-80						5	
Air India	400	14 Aug 91	4 Aug 93	PW4056	6						
Air Namibia	400M	21 Apr 99	21 Oct 99	CF6-80						1	
Air New Zealand	400	30 Jul 84	14 Dec 89	RB211-524	3						
	400	1 Mar 91	31 Oct 98	CF6-80	1						
All Nippon Airways	400	21 Oct 86	28 Aug 90	CF6-80	12						
	400D	21 Jan 86	13 Jan 92	CF6-80		11					
Amiri Flight	400	30 Nov 99	30 Nov 99	CF6-80	1						
Asiana Airlines	400	12 Jun 89	24 Jun 93	CF6-80	2						
	400F	3 Sep 90	4 Nov 94	CF6-80					5		
	400M	12 Jun 89	1 Nov 91	CF6-80						6	
Atlas Air	400F	9 Jun 97	29 Jul 98	CF6-80					15		
British Airways	400	15 Aug 86	30 Jun 89	RB211-524	57						
Canadian Airlines Intnl	400	28 Jul 88	11 Dec 90	CF6-80	4						
Cargolux Airlines	400F	6 Dec 90	17 Nov 93	CF6-80					5		
	400F	13 Jun 95	8 Dec 98	RB211-524					11		
	8F	15 Nov 05	none	CF6-80							10
Cathay Pacific	400	3 Jun 86	8 Jun 89	RB211-524	17						
	400F	28 Feb 90	1 Jun 94	RB211-524					6		
	400ERF	22 Jun 06	none					6			
China Airlines	400	21 Jul 87	8 Feb 90	PW4056	13						
	400	28 Nov 02	7 Dec 04	CF6-80	4						
	400F	11 Aug 99	6 Jul 00	PW4056					21		
China Cargo	400ERF	13 Jul 05	none	CF6-80				2			
China Southern	400F	13 Feb 01	19 Jun 02	PW4062					2		
El Al	400	11 Dec 90	27 Apr 94	PW4056	4						
EVA Air	400	6 Oct 89	2 Nov 92	CF6-80	7						
	400F	6 May 99	20 Jul 00	CF6-80					3		
	400M	6 Oct 89	16 Sep 93	CF6-80						8	
GAP	400ERF	23 Jun 05	none	CF6-80				6			
Garuda Indonesia	400	15 Nov 90	14 Jan 94	CF6-80	2						
GE Capital	400	22 Dec 95	18 Jun 99	CF6-80	1						
	400F	15 Dec 99	16 Oct 00	CF6-80					5		
	400ERF	27 Oct 05	none	CF6-80				2			
ILFC	400	16 May 88	31 May 91	CF6-80	12						
	400	16 May 88	25 Sep 91	RB211-524	2						
	400F	30 Jan 90	14 Apr 99	CF6-80					1		
	400ERF	17 Apr 01	17 Oct 02	CF6-80				3			
Jade Cargo Intnl	400 ERF	2 Aug 05	none	CF6-80				6			
Japan Airlines	400	21 Sep 87	25 Jan 90	CF6-80	34						
	400D	30 Jun 88	10 Oct 91	CF6-80		8					
	400F	7 Oct 02	12 Oct 04	CF6-80					2		
Japan Air SDF	400	23 Dec 87	17 Sep 91	CF6-80	2						
KLM	400	9 Apr 86	18 May 89	CF6-80	5						
	400ERF	1 Mar 99	31 Mar 03	CF6-80				3			
	400M	9 Apr 86	1 Sep 89	CF6-80						17	
Korean Air Lines	400	29 Aug 86	13 Jun 89	PW4056	27						
	400F	11 Jun 90	6 Sep 96	PW4056					10		
	400ERF	31 Dec 01	13 Jun 03	PW4056				8			
	400M	14 Apr 88	27 Jun 90	PW4056						1	
Kuwait Airways	400M	12 Apr 92	29 Nov 94	CF6-80						1	
Lufthansa	400	21 May 86	23 May 89	CF6-80	24						
	400M	21 May 86	19 Sep 89	CF6-80						7	
Malaysia Airlines	400	19 Oct 88	27 Sep 90	CF6-80	2						
	400	12 Jan 89	27 Aug 92	PW4056	17						
	400F	8 Jan 96	20 Mar 06	PW4056					2		
	400M	30 Oct 87	6 Oct 89	CF6-80						2	
Mandarin Airlines	400	15 Sep 94	14 Jun 95	PW4056	1						
Nippon Cargo Airlines	400F	30 Jan 04	15 Jun 05	CF6-80					10		
	8F	15 Nov 05	none	CF6-80							8
Northwest Airlines	400	22 Oct 85	26 Jan 89	PW4056	16						
Omani Royal Flight	400	31 Jul 00	14 Dec 01	CF6-80	2						
Philippine Airlines	400	29 Oct 92	19 Nov 93	CF6-80	7						
	400M	18 Jan 96	29 Mar 96	CF6-80						1	
Qantas Airways	400	2 Mar 87	11 Aug 89	RB211-524	21						
	400ER	19 Dec 00	31 Oct 02	CF6-80			6				
Saudia	400	18 Jun 95	24 Dec 97	CF6-80	5						
Singapore Airlines	400	27 Mar 86	18 Mar 89	PW4056	42						
	400F	16 Jan 90	5 Aug 94	PW4056					17		
South African Airways	400	6 May 89	19 Jan 91	RB211-524	6						
	400	30 Dec 98	30 Dec 98	CF6-80	2						
Thai Intnl	400	16 Jun 87	21 Feb 90	CF6-80	18						
United Airlines	400	7 Nov 85	30 Jun 89	PW4056	44						
UPS	400F	16 Aug 05	none	CF6-80					8		
US Air Force (AL-1A)	400F	30 Jan 98	21 Jan 00	CF6-80					1		
UTA	400	3 Jul 86	22 Sep 90	CF6-80	1						

Customer	Variant	First order	First delivery	Engine	400	400D	400ER	400ERF	400F	400M	8F
	400M	3 Jul 86	26 Jul 91	CF6-80						1	
Virgin Atlantic Airways	400	20 Dec 96	17 Jun 97	CF6-80	9						
Unidentified	400-8	30 May 06	none	CF6-80							1
Subtotals					**446**	**19**	**6**	**38**	**126**	**61**	**18**
Total							**715**				

Notes: For deliveries see Group Orders and Deliveries table

Instrumentation: Electronic flight instrument system (EFIS) comprising six (left/right inboard/outboard and central upper/lower) 20.3 × 20.3 cm (8 × 8 in) integrated display units (IDU), two each for primary flight display (PFD), navigation display (ND) and engine indicating and crew alerting (EICAS) functions; all IDUs receive data from all three EFIS/EICAS interface units (EIU), updated via software data loader; PFD and EICAS primary formats automatically switch to inboard and lower IDUs respectively, with facility for manual selection of formats on different IDUs as required. B747-400 has 181 switches, 171 lights and 13 gauges, compared with 284, 555 and 132 of earlier variants; total 365 is below average 450 for typical two-crew jet transport.

DIMENSIONS, EXTERNAL:

- Wing span: normal ..... 64.44 m (211 ft 5 in)
  - with winglets ..... 64.92 m (213 ft 0 in)
- Wing span, fully fuelled ..... 64.92 m (213 ft 0 in)
- Wing chord: at root ..... 14.63 m (48 ft 0 in)
  - at tip ..... 4.06 m (13 ft 4 in)
- Winglet height ..... 0.89 m (2 ft 11 in)
- Wing aspect ratio 7.7
- Length: overall ..... 70.67 m (231 ft 10¾ in)
  - fuselage ..... 68.63 m (225 ft 2 in)
- Max width of fuselage ..... 6.50 m (21 ft 4 in)
- Height overall:
  - at OWE: -400 ..... 19.51 m (64 ft 0 in)
    - -400ER ..... 19.58 m (64 ft 3 in)
  - at MTOW: -400 ..... 18.77 m (61 ft 7 in)
    - -400ER ..... 19.05 m (62 ft 6 in)
- Tailplane span ..... 22.17 m (72 ft 9 in)
- Wheel track (c/l shock-struts):
  - outer pair ..... 11.00 m (36 ft 1 in)
  - inner pair ..... 3.84 m (12 ft 7 in)
- Wheelbase: mean ..... 25.60 m (84 ft 0 in)
  - to forward main bogie ..... 24.07 m (78 ft 11½ in)
  - to rear main bogie ..... 27.14 m (89 ft 0½ in)
- Distance between engine centrelines:
  - outboard ..... 41.66 m (136 ft 8 in)
  - inboard ..... 23.37 m (76 ft 8 in)
- Passenger doors (10, each):
  - Height: door, clear access ..... 1.93 m (6 ft 4 in)
  - Width: door ..... 1.19 m (3 ft 11 in)
    - clear access ..... 1.07 m (3 ft 6 in)
  - Height to sill:
    - at OWE:
      - front: -400 ..... 5.16 m (16 ft 11 in)
        - -400ER ..... 5.21 m (17 ft 1 in)
      - rear: -400 ..... 5.31 m (17 ft 5 in)
        - -400ER ..... 5.38 m (17 ft 8 in)
    - at MTOW:
      - front: -400 ..... 4.72 m (15 ft 6 in)
        - -400ER ..... 4.75 m (15 ft 7 in)
      - rear: 400 ..... 4.80 m (15 ft 9 in)
        - -400ER ..... 4.98 m (16 ft 4 in)
- Upper deck emergency door (two):
  - Height: door ..... 2.01 m (6 ft 7¼ in)
    - clear access ..... 1.83 m (6 ft 0 in)
  - Width ..... 1.07 m (3 ft 6 in)
  - Height to sill:
    - at OWE: -400 ..... 7.90 m (25 ft 11 in)
      - -400ER ..... 7.95 m (26 ft 1 in)
    - at MTOW: -400 ..... 7.52 m (24 ft 8 in)
      - -400ER ..... 7.54 m (24 ft 9 in)
- Baggage door (front hold): Height ..... 1.68 m (5 ft 6 in)
  - Width ..... 2.64 m (8 ft 8 in)
  - Height to sill: at OWE ..... 3.10 m (10 ft 2 in)
    - at MTOW ..... 2.69 m (8 ft 10 in)
- Baggage door (rear hold): Height ..... 1.68 m (5 ft 6 in)
  - Width ..... 2.64 m (8 ft 8 in)
  - Height to sill: at OWE ..... 3.17 m (10 ft 5 in)
    - at MTOW ..... 2.82 m (9 ft 3 in)
- Bulk loading door:
  - Height: max (front) ..... 1.42 m (4 ft 8 in)
    - min (rear) ..... 1.24 m (4 ft 1 in)
  - Width ..... 1.12 m (3 ft 8 in)
  - Mean height to sill: at OWE ..... 3.40 m (11 ft 2 in)
    - at MTOW ..... 3.00 m (9 ft 10 in)
- Combi cargo door (port):
  - Height (clear access) ..... 3.05 m (10 ft 0 in)
  - Width ..... 3.40 m (11 ft 2 in)
  - Height to sill: at OWE ..... 5.26 m (17 ft 3 in)
    - at MTOW ..... 4.87 m (16 ft 0 in)

747-400ER baggage door heights to sill: add 50 to 75 mm (2 to 3 in)

DIMENSIONS, INTERNAL:

- Cabin (main): Max height ..... 2.41 m (7 ft 11 in)
- Passenger cabin volume ..... 885.9 m³ (31,285 cu ft)

AREAS:

- Wings, gross ..... 541.16 m² (5,825.0 sq ft)
- Ailerons (total) ..... 20.90 m² (225.00 sq ft)
- Trailing-edge flaps (total) ..... 78.69 m² (847.00 sq ft)
- Leading-edge flaps (total) ..... 43.85 m² (472.00 sq ft)
- Inboard spoilers (total) ..... 12.78 m² (137.60 sq ft)
- Outboard spoilers (total) ..... 15.46 m² (166.40 sq ft)
- Fin ..... 77.11 m² (830.00 sq ft)
- Rudder ..... 21.37 m² (230.00 sq ft)
- Tailplane ..... 136.57 m² (1,470.00 sq ft)
- Elevators (total, incl tabs) ..... 30.38 m² (327.00 sq ft)

WEIGHTS AND LOADINGS (747-400: GB: CF6-80C2B1F, GM: CF6-80C2B5F, PB: PW4056, PM: PW4062, RB: RB211-524G, RM: 211-524M engines; all 416 passengers, five cargo pallets and 14 containers, 747-400ER: ER GM CF6-80C2B5F, ER PM: PW4062, ER RM: RB211-524H-8T with passengers/cargo as above):

- Operating weight empty: GB ..... 180,485 kg (397,900 lb)
  - GM ..... 180,895 kg (398,800 lb)
  - PB ..... 180,845 kg (398,700 lb)
  - PM ..... 181,255 kg (399,600 lb)
  - RB ..... 181,435 kg (400,000 lb)
  - RM ..... 181,845 kg (400,900 lb)
  - ER GM/PM/RM ..... 184,565 kg (406,900 lb)
- Baggage/freight capacity, all:
  - forward compartment ..... 26,490 kg (58,400 lb)
  - aft compartment ..... 22,938 kg (50,570 lb)
  - bulk compartment ..... 6,749 kg (14,880 lb)
- Max structural payload:
  - ER GM, PM, RM ..... 67,175 kg (148,100 lb)
- Max fuel weight: GB ..... 162,580 kg (358,425 lb)
  - GM ..... 172,560 kg (380,425 lb)
  - PB, RB ..... 163,250 kg (359,900 lb)
  - PM, RM ..... 173,225 kg (381,900 lb)
  - ER, GM ..... 192,190 kg (423,700 lb)
  - ER, PM, ER, RM ..... 192,855 kg (425,175 lb)
- Max T-O weight:
  - GB, PB, RB ..... 362,875 kg (800,000 lb)
  - GM, PM, RM ..... 396,895 kg (875,000 lb)
  - ER GM, PM, RM ..... 412,770 kg (910,000 lb)
- Max ramp weight:
  - GB, PB, RB ..... 364,235 kg (803,000 lb)
  - GM, PM, RM ..... 398,255 kg (878,000 lb)
  - ER, GM, PM, RM ..... 414,130 kg (913,000 lb)
- Max landing weight:
  - GB, PB, RB ..... 260,360 kg (574,000 lb)
  - GM, PM, RM ..... 295,745 kg (652,000 lb)
  - ER, GM, PM, RM ..... 295,745 kg (652,000 lb)
- Max zero-fuel weight:
  - GB, PB, RB ..... 242,670 kg (535,000 lb)
  - GM, PM, RM ..... 251,745 kg (555,000 lb)
  - ER, GM, PM, RM ..... 251,745 kg (555,000 lb)
- Max wing loading:
  - GB, PB, RB ..... 670.5 kg/m² (137.34 lb/sq ft)
  - GM, PM, RM ..... 733.4 kg/m² (150.21 lb/sq ft)
- Max power loading:
  - GB, RB ..... 352 kg/kN (3.45 lb/lb st)
  - GM, PB ..... 359 kg/kN (3.52 lb/lb st)
  - PM ..... 360 kg/kN (3.53 lb/lb st)
  - RM ..... 368 kg/kN (3.61 lb/lb st)

PERFORMANCE (as above; landing at MLW):

- Cruising Mach No. 0.85
- Approach speed:
  - GB, PB, RB ..... 146 kt (270 km/h; 168 mph)
  - GM, PM, RM ..... 157 kt (291 km/h; 181 mph)
- Initial cruising altitude:
  - GB, PB, RB ..... 10,575 m (34,700 ft)
  - GM, PM, RM ..... 10,000 m (32,800 ft)
- T-O field length, 30°C (86°F): GB ..... 2,820 m (9,250 ft)
  - GM ..... 3,033 m (9,950 ft)
  - PB ..... 2,820 m (9,250 ft)
  - PM ..... 2,990 m (9,800 ft)
  - RB ..... 2,850 m (9,350 ft)
  - RM ..... 3,215 m (10,550 ft)
- Landing field length:
  - GB, PB, RB ..... 1,905 m (6,250 ft)
  - GM, PM, RM ..... 2,180 m (7,150 ft)
- Design range:
  - GB ..... 6,185 n miles (11,454 km; 7,117 miles)
  - GM ..... 7,260 n miles (13,445 km; 8,354 miles)[1]
  - PB ..... 6,195 n miles (11,473 km; 7,129 miles)
  - PM ..... 7,325 n miles (13,565 km; 8,429 miles)[1]
  - RB ..... 6,040 n miles (11,186 km; 6,950 miles)
  - RM ..... 7,170 n miles (13,278 km; 8,251 miles)[1]

[1] *Fuel volume limited*

BOEING 747-400F and -8F

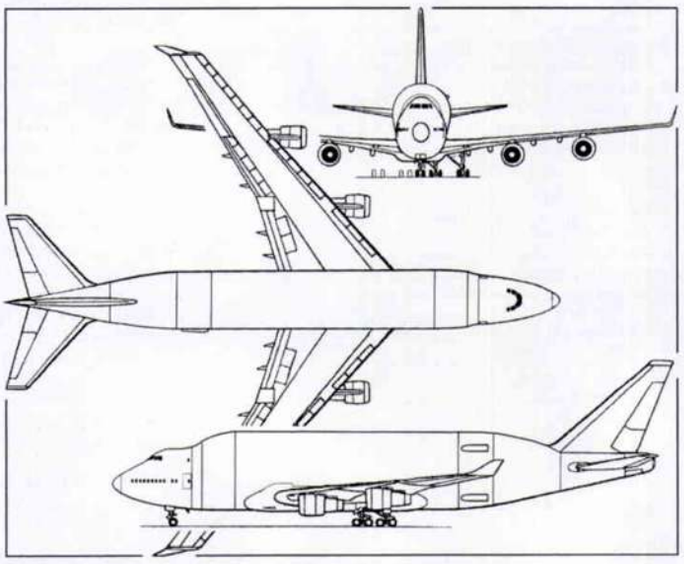
USAF designation: AL-1A

TYPE: Four-jet freighter.

PROGRAMME: Initial order 13 September 1989; rolled out 8 March 1993; first flight (N6005C) 4 May 1993; FAA certification 22 October 1993; JAR certification followed; first delivery (Cargolux) 17 November 1993. During 2000, Boeing began design of a freighter conversion of passenger 747-400s as an eventual partner to the first 747-300F conversion, begun in that year. However, this would differ from new-production -400F in several respects.

CURRENT VERSIONS: **747-400F**: *As described.*

Winglet-equipped Boeing 747-400F delivered to Cargolux in late 2005 *(Paul Jackson)* 1159156



Boeing 747-400 LCF outsize freighter *(Paul Jackson)* 1162422

747-400ERF: Freighter version of 747-400ER; first order placed 17 April 2001; rolled out 5 September 2002; first flight (N5017Q/F-GIUA) 30 September 2002; certified 16 October 2002; deliveries began 17 October (Air France). Ordered by July 2006 by Air France (two), Cathay Pacific (six), China Cargo (two), GAP (six), GE Capital Services (two), ILFC (three), Jade Cargo International (six), KLM (three) and Korean Air Lines (eight); total 38.

Differences from 747-400ER include 302,090 kg (666,000 lb) max landing weight; 277,145 kg (611,000 lb) zero-fuel weight; 164,380 kg (362,400 lb) empty operating weight; 112,765 kg (248,600 lb) structural max payload; 530 m^3 (18,720 cu ft) containerised volume on main deck; 159 m^3 (5,600 cu ft) lower deck containerised volume and 14.7 m^3 (520 cu ft) bulk cargo volume. Usable fuel is 203,523 litres (53,765 US gallons; 44,769 Imp gallons) for GE-engined version and 204,355 litres (53,985 US gallons; 44,952 Imp gallons) for P&W and R-R-engined versions.

747-400XF: Variant of projected 747-400X QLR, now replaced by 747F Advanced.

747-8F Freighter: Counterpart of 747-8 Intercontinental, launched 14 November 2005; orders placed next day by Cargolux (10) and Nippon Cargo Airlines (eight). First flight planned by end of 2008; service entry last quarter of 2009, ahead of passenger version. Shorter upper deck (as -400F) and other 747-8 features, but forward plug of 4.06 m (13 ft 4 in), giving length overall of 76.25 m (250 ft 2 in). Weight empty 182,800 kg (403,000 lb), max T-O 332,940 kg (734,000 lb), zero-fuel 314,790 kg (694,000 lb), max payload 140,000 kg (308,650 lb). Fuel capacity 204,366 litres (53,988 US gallons; 44,954 Imp gallons).

747-400 BCF: Also known as 'Special Freighter' (747-400SF) conversion of former passenger aircraft, retaining enlarged upper floor as crew rest area, but most windows deleted. Freight door, port, rear; integrated flight deck displays. Payload capability 113,400 kg (250,000 lb); typically up to 30 pallets 2.44 × 3.20 m (8 ft × 10 ft 6 in) over 4,100 n miles (7,593 km; 4,718 miles). Launched January 2004, on receipt of initial order from Cathay Pacific for six, plus six options.

747 LCF: Large Cargo Freighter. Conversion of three second-hand Boeing 747s to be operated on behalf of Boeing for transfer of 787 Dreamliner major subassemblies. Distended upper deck (designed by Boeing Moscow); port-hinged swing tail (by Gamesa Aeronautica); fin extended upwards by 1.52 m (5 ft 0 in). Modification by Evergreen Aviation Technologies in Taiwan; rolled out (N747BC) at Taipei 17 August 2006; service entry 2007; final delivery 2009.

AL-1A: Anti-missile defence aircraft. *Described separately.*

CUSTOMERS: See table with main 747-400 entry for full list. First 747-400F delivered to Cargolux 17 November 1993; total 122 -400Fs, 32 -400ERFs and 18 -8Fs ordered by 1 January 2006, of which 100, 14 and nil delivered up to that time. Customers for -400F include China Airlines, which ordered 13 on 11 August 1999, for delivery between 2000 and 2007 (first on 6 July 2000) and later increased to 21; EVA Air, three for delivery from 2000 (first on 20 July); Cathay Pacific Airways, which ordered two in October 1999 (first delivered on 12 September 2000), subsequently increasing its order to six; UPS, which ordered eight in August 2005

COSTS: 747-400F USD219.5 million to USD247 million; 747-8F USD279.5 million to USD283.5 million (2006).

DESIGN FEATURES: 747-200F fuselage (short upper deck) with additional changes combined with stronger and larger 747-400 wing; strengthened floor of short upper deck, as offered for -200F, also integrated into 747-400F; further developed freight handling system; total cargo volume 777.8 m^3 (27,467 cu ft), of which 604.5 m^3 (21,347 cu ft) on main deck, 158.6 m^3 (5,600 cu ft) in lower hold and 48.3 m^3 (520 cu ft) available for bulk cargo. Compared to -200F, empty weight saving of 2,000 kg (4,409 lb) has raised maximum revenue freight load to about 113,000 kg (249,125 lb), at which range is 4,400 n miles (8,149 km; 5,063 miles); fuel consumption more than 15 per cent lower than 747-200F. Same gross weights as passenger 747-400; maximum landing weight at optional T-O weight, 302,090 kg (666,000 lb); maximum zero-fuel weight, 276,690 kg (610,000 lb), can be increased on condition T-O weight is decreased.

ACCOMMODATION: Two-pilot crew, as 747-400. Upward-opening nose cargo door and optional port-side rear cargo door; underfloor cargo doors fore and aft of wing and bulk cargo door aft of rear underfloor door; two crew doors to port. Capacity for 30 pallets on main deck and 32 LD-1 containers plus bulk cargo under floor.

BOEING 767

TYPE: Wide-bodied airliner.

PROGRAMME:

DEVELOPMENT MILESTONES

767-200	
First order	14 Jul 78
Rolled out	4 Aug 81
First flight	26 Sep 81
Certification	30 Jul 82
First delivery	19 Aug 82
Entered service (United Air Lines)	8 Sep 82
Subsequent versions	
767-200ER	
First order (Ethiopian Airlines)	16 Dec 82
Rolled out	14 Feb 84
First flight	6 Mar 84
Certification	Mar 84
First delivery	26 mar 84
Entered service (El Al)	27 Mar 84
767-300	
First order (Japan Airlines)	29 Sep 83
Rolled out	14 Jan 86
First flight	30 Jan 86
Certification	22 Sep 86
First delivery	25 Sep 86
Entered service (Japan Airlines)	20 Oct 86
767-300ER	
Official go-ahead	21 Jul 84
First order (American Airlines)	3 Mar 87
Rolled out	3 Nov 86
First flight	9 Dec 86
Certification	20 Jan 88
First delivery	19 Feb 88
Entered service (American Airlines)	3 Mar 88
767-400ER	
First order (Delta Air Lines)	20 Mar 97
Rolled out	26 Aug 99
First flight	9 Oct 99
Certification	20 Jul 00
First delivery	11 Aug 00
Entered service (Continental Airlines)	14 Sep 00

Launched on receipt of United Air Lines order for 30 on 14 July 1978; construction of basic 220-passenger 767-200 began 6 July 1979; first flight (N767BA) 26 September 1981 with P&W JT9D turbofans; first flight fifth aircraft with GE CF6-80A 19 February 1982; 767 with JT9D-7R4D certified 30 July 1982; with CF6-80A 30 September 1982.

First delivery with JT9D (United Air Lines) 19 August 1982 (initial service 8 September); first delivery with CF6 (Delta) 25 October 1982. ETOPS approval for 767-200 with JT9D-7R4 or CF6-80A or -80A2 granted January 1987; ETOPS approval for 767-200 and-300 with PW4000 obtained April 1990; 180-minute ETOPS approval with PW4000 engines obtained August 1993. Joint 757/767 crew rating approved 22 July 1983. Boeing windshear detection and guidance system FAA approved for 767-200 and -300 February 1987.

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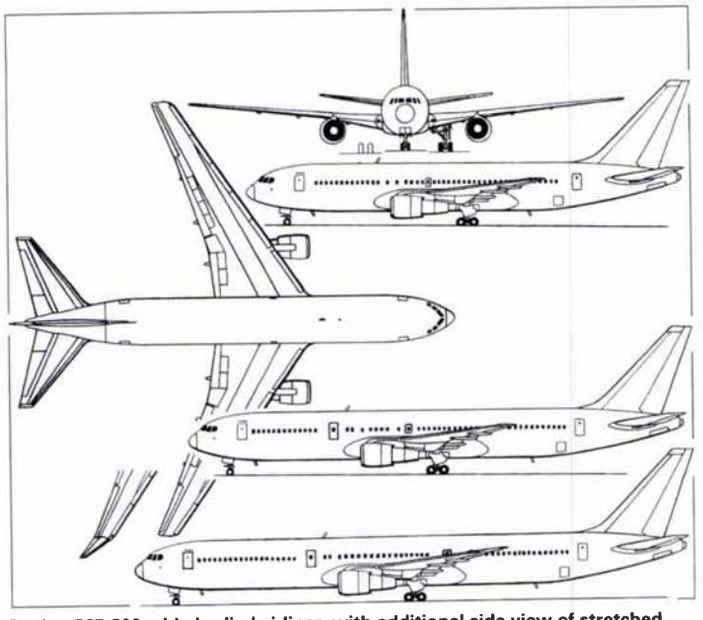
Air China Boeing 767-300 *(Paul Jackson)*



Boeing 767-200 wide-bodied airliner, with additional side view of stretched -300 and further stretched -400, including last mentioned's revised wingtips *(Dennis Punnett)*

1159127

Boeing 767-400 first flew 9 October 1999; FAA certification and 180-minute ETOPS granted 20 July 2000; JAA certification 24 July 2000; FAA common type rating with 767-200/300 and 757-200/300 issued 21 August 2000.

CURRENT VERSIONS: **767-200:** Basic version; no longer available; final delivery 24 February 1994. Medium-range variant (MTOW 136,080 kg; 300,000 lb) has reduced fuel; higher gross weight variant (142,880 kg; 315,000 lb) certified June 1983.

767-200ER: Extended-range version; announced January 1983; first flight 6 March 1984; basic -200ER with centre-section tankage and gross weight increased; first delivered to El Al 26 March 1984.

767-300: Stretched 269-passenger version, with 3.07 m (10 ft 1 in) plug forward of wing and 3.35 m (11 ft) plug aft, and same gross weight as 767-200; strengthened landing gear and thicker metal in parts of fuselage and underwing skin; same flight deck and systems as other 767s; same engine options as 767-200ER; first ordered (by Japan Airlines) 29 September 1983. First flight with JT9D-7R4D engines 30 January 1986; certified with JT9D-7R4D and CF6-80A2 22 September 1986. First delivery (Japan Airlines) 25 September 1986. British Airways ordered 11 in August 1987, later increased to total 25, with Rolls-Royce RB211-524H engines; delivered from 8 February 1990. No longer available.

767-300ER: Extended-range, higher gross weight version; development began January 1985; optional gross weights 172,365 kg (380,000 lb) and, from 1992, 186,880 kg (412,000 lb); further increased centre-section tankage. Engine choice CF6-80C2, PW4000, RB211-524H; structural reinforcement; certified late 1987. Launch customer American Airlines (15), delivered from 19 February 1988. New interior introduced late 2000; based on Boeing 777; first recipient Lauda Air.

767-300ERX: Further range extension, under study from 1998 to 2002, but not proceeded with; addition of tailplane fuel tank, capacity 7,571 litres (2,000 US gallons; 1,665 Imp gallons) would have increased range to 6,695 n miles (12,400 km; 7,705 miles).

767-300X: Proposed early 2002. Main feature would be rapidly changeable 767-400-type wingtip, allowing airlines to customise aircraft to individual routes, according to distance, reverting to standard tips for long range.

767-300 General Market Freighter: Described separately.

767-400ER: Stretched version. Features include strengthened wing with thicker ribs, spars and skin for increased MTOW; updated flight deck based on Boeing 777; fuselage lengthened 6.43 m (21 ft 1 in) by means of plugs forward (3.36 m; 11 ft 0¼ in) and aft (3.07 m; 10 ft 0¾ in) of centre-section; stringerless window belt with elliptical 777-type cabin windows; wing span increased by 4.42 m (14 ft 6 in) with highly sweptback (9° 50') wingtips of composites construction which reduce take-off distance, increase climb rate and improve fuel consumption; redesigned interior; with accommodation for up to 304 passengers; new landing gear with 46 cm (18 in) longer main legs, Boeing 777 brakes and 127 cm (50 in) tyres and revised, hydraulically actuated tail skid. Engine choice of CF6-80C2B7F1 or CF6-80C2B8, with PW4000 series as option; fuel capacity as currently offered on 767-300ER, enabling 767-400ER to operate most existing -300ER routes.

Offered from January 1997; launch customer Delta Air Lines announced intention to order 21 on 20 March 1997; confirmed 28 April 1997; Continental ordered 26 on 10 October 1997. Assembly of first aircraft began at Everett on 9 February 1999; roll-out 26 August 1999; first flight (N76400 No. 1) 9 October 1999. Four aircraft took part in test programme, comprising 1,150 flight hours and 1,200 ground testing hours: prototype used primarily to test and certify basic handling qualities; N76401 served as aerodynamics and avionics certification article; N87402, with full cabin interior used for systems development and certification; N47403 (first flown June 2000) for cabin entertainment and related evaluation. World tour (by N76400 No. 2) in July-August 2000. First delivery (N828MH), to launch customer Delta Air Lines, 11 August 2000; deliveries to Continental Airlines began 30 August 2000 with refurbished second prototype (N76401/N66051). Also on 30 August 2000, Delta received first 767-400ER with Rockwell Collins Large Format Display System, comprising six 203 × 203 mm (8 × 8 in) LCDs.

767-400ER Shrink: Under study in 1999 as alternative to 767-300ERX. Not proceeded with.

Longer Range 767-400ER: Extended-range version; launched (as 767-400ERX) 13 September 2000, but discontinued by 2002.

767 AWACS: Military version. *Described separately.*

KC-767A: Air refuelling tanker; USAF decision announced 23 May 2004 to proceed with lease of 100, but later rescinded and competition opened. *Described separately.*

Northrop Grumman E-10: Ground surveillance version; proposed as successor to E-8C Joint STARS.

767 AST: Boeing contracted by US Army on 11 October 1994 to supply company-owned 767 as Airborne Sensor Testbed for long wavelength infra-red surveillance system; operating contract was extended for 12 months in September 1998 at cost of US$4.1 million.

767 SF: Special Freighter conversion of 767-200 airliner; available from 2000; payload 39,010 kg (86,000 lb); freight door as 767-300F; strengthened floor, main landing gear and forward fuselage.

CUSTOMERS: As per table. Original prototype became 767 Airborne Surveillance Testbed (formerly AOA) for US Army. One reconfigured by E-Systems as medevac aircraft for Civil Reserve Air Fleet.

COSTS: USD118.0 million to USD128.0 million 767-200ER; USD133.0 million to USD149.0 million 767-300ER; USD146.0 million to USD160.5 million 767-400ER (all 2006).

DESIGN FEATURES: Low-wing, wide-bodied airliner with twin, podded turbofans underwing. Boeing aerofoils; quarter-chord sweepback 31° 30'; thickness/chord ratio 15.1 per cent at root, 10.3 per cent at tip; dihedral 6°; incidence 4° 15'.

FLYING CONTROLS: Conventional and hydraulically powered. Inboard, all-speed (between inner and outer flaps) and outboard low-speed ailerons supplemented by flight spoilers (four-section outboard; two-section inboard) also acting as airbrakes and lift dumpers; single-slotted, linkage-supported outboard trailing-edge flaps, double-slotted inboard; track-mounted leading-edge slats; variable incidence tailplane driven by hydraulic screwjack; two-piece elevators each side; no trim tabs; roll and yaw trim through spring feel system; triple digital flight control computers and EFIS; Boeing windshear detection and guidance system optional. Control surface deflections: outboard ailerons +30/–15°, inboard ailerons ±20°, inboard flaps 61° (first element 36°), outboard flaps 36°, spoilers +60°, elevators +28/–20°, rudder ±26°; tailplane incidence +2/–12°.

STRUCTURE: Fail-safe structure. Conventional aluminium structure augmented by graphite ailerons, spoilers, elevators, rudder and floor panels; advanced aluminium alloy keel beam chords and wing skins; composites engine cowlings, wing/fuselage fairing and rear wing panels; CFRP landing gear doors; and aramid flaps and engine pylon fairings.

Subcontractors include Boeing Military Aircraft (wing fixed leading-edges); Northrop Grumman (wing centre-section and adjacent lower fuselage section; fuselage bulkheads); Vought Aircraft (horizontal tail); Canadair (rear fuselage); Alenia (wing control surfaces, flaps and leading-edge slats, wingtips, elevators, fin and rudder, nose radome); Fuji (wing/body fairings and main landing gear doors); Kawasaki (forward and centre fuselage; exit hatches; wing in-spar ribs); Mitsubishi (rear fuselage body panels and rear fuselage doors).

LANDING GEAR: Hydraulically retractable tricycle type; Menasco twin-wheel nose unit retracts forward; Cleveland Pneumatic main gear, with two four-wheel bogies, retracts inward; oleo-pneumatic shock-absorbers; Honeywell wheels and brakes; mainwheel tyres of current production versions H46×18.0–20 (26/28 ply for -200/300; 32 ply for -200ER/300ER); nosewheel tyres size H37×14.0–15 (22/24 ply) for all; steel disc brakes on all mainwheels; electronically controlled anti-skid units. Nosewheel steerable ±16°; ±65° for ground manoeuvring. Min taxiway width for U-turn 50.3 m (165 ft).

POWER PLANT: Two high-bypass turbofans in pods, pylon-mounted on the wing leading-edges.

General Electric options: 225 kN (50,600 lb st) CF6-80C2B2F, 251 kN (56,500 lb st) CF6-80C2B4F, 268 kN (60,200 lb st) CF6-80C2B6F, 276 kN (62,100 lb st) CF6-80C2B7F or F1 and 282 kN (63,500 lb st) CF6-80C2B8F.

Pratt & Whitney options: 233 kN (52,300 lb st) PW4052, 254 kN (57,100 lb st) PW4056, 268 kN (60,200 lb st) PW4060 and 282 kN (63,300 lb st) PW4062. P&W JT9D-7R4D of 213.5 kN (48,000 lb st) no longer offered.

Rolls-Royce options: 251 kN (56,400 lb st) RB211-524G4-T and 265 kN (59,500 lb st) RB211-524H2-T.

Fuel in one integral tank in each wing, and in centre tank, with total capacity of 63,216 litres (16,700 US gallons; 13,905 Imp gallons) in 200/300; 767-200ER and -300ER has additional 27,558 litres (7,280 US gallons; 6,062 Imp gallons) in second centre-section tank, raising total capacity to 90,774 litres (23,980 US gallons; 19,967 Imp gallons). In -400ER, tankage increased to total of 91,377 litres (24,140 US gallons; 20,101 Imp gallons). Refuelling point in port outer wing.

BOEING 767 ORDER BOOK
(at 30 June 2006)

Customer	Variant	Engine	First order	First delivery	200	200ER	300	300ER	300F	400ER
Aeromaritime	200ER	PW	17 Jan 89	26 Jul 90		2				
	300ER	PW	17 Jan 89	22 Aug 91				1		
Air Algérie	300	GE	1 May 89	28 Jun 90			3			
Air Canada	200	PW	11 Jul 79	30 Oct 82	10					
	200ER	PW	11 Jul 79	18 Oct 84		9				
	300ER	PW	31 Aug 89	10 Aug 93				6		
Air China	200ER	PW	23 May 85	9 Oct 85		6				
	300	PW	31 May 90	20 May 92			4			
Air France	300ER	PW	7 Feb 92	14 May 93				3		
Air Mauritius	200ER	GE	19 Jan 87	5 Apr 88		2				
Air New Zealand	200ER	GE	30 Jul 84	3 Sep 85		3				
	300ER	GE	1 Mar 91	11 Aug 93				5		
Airtours International/My Travel	300ER	GE	17 Aug 93	16 Mar 94				3		
Air Zimbabwe	200ER	PW	20 Jul 88	28 Nov 89		2				
All Nippon Airways	200	GE	1 Oct 79	25 Apr 83	25					
	300	GE	26 Dec 85	30 Jun 87			34			
	300ER	GE	26 Dec 85	26 Jun 89				22		
	300F	GE	7 Aug 01	28 Aug 02					4	
American Airlines	200	GE	15 Nov 78	4 Nov 82	13					
	200ER	GE	15 Nov 78	18 Nov 85		17				
	300ER	GE	3 Mar 87	19 Feb 88				58		
Amiri Flight	300ER	GE	30 Nov 99	15 Dec 99				1		
Ansett Australia	200	GE	17 Mar 80	7 Jun 83	5					
Ansett Worldwide	200ER	PW	8 Sep 88	1 May 90		3				
	200ER	GE	28 Sep 93	28 Sep 93		1				
	300ER	PW	16 Nov 88	13 Dec 91				21		
	300ER	GE	24 Jun 94	24 Jun 94				8		
Asiana Airlines	300	GE	23 Dec 88	27 Sep 90			9			
	300ER	GE	3 Sep 90	7 Nov 91				2		
	300F	GE	3 Sep 90	23 Aug 96					1	
Avianca	200ER	PW	24 Dec 80	26 Feb 90		2				
Braathens	200	PW	28 Apr 80	23 Mar 94	2					
Britannia Airways	200	GE	31 Mar 80	6 Feb 84	11					
	300ER	GE	23 Nov 94	15 May 96				7		
British Airways	300ER	RR	14 Aug 87	8 Feb 90				28		
Canadian Airlines Int'l	300ER	GE	7 Apr 87	15 Apr 88				14		
China Airlines	200	PW	20 Mar 80	20 Dec 82	2					
China Yunnan	300ER	RR	10 Jan 95	26 Jul 96				3		
Condor Flugdienst	300ER	PW	16 Nov 88	13 Jul 91				11		
Continental Airlines	200ER	GE	23 Nov 98	9 Nov 00		10				
	400ER	GE	10 Oct 97	30 Aug 00						16
Delta Airlines	200	GE	15 Nov 78	25 Oct 82	15					
	300	GE	15 Nov 78	7 Nov 86			24			
	300	PW	20 Dec 90	17 Jun 93			4			
	300ER	PW	22 Sep 88	9 Jun 90				31		
	300ER	GE	10 Jun 97	18 Jun 98				22		
	400ER	GE	10 Jun 97	11 Aug 00						21
Egyptair	200ER	PW	12 Jan 84	20 Jul 84		3				
	300ER	PW	25 Oct 88	15 Aug 89				2		
El Al Israel Airlines	200	PW	18 Mar 81	12 Jul 83	2					
	200ER	PW	18 Mar 81	26 Mar 84		2				
Ethiopian Airlines	200ER	PW	16 Dec 82	23 May 84		3				
	300ER	PW	28 Nov 02	24 Nov 03				3		
Eva Airways	200	GE	10 Jun 93	13 Jan 94	4					
	300ER	GE	6 Oct 89	30 May 91				4		
Flightlease	300ER	PW	15 Dec 99	4 Apr 00				4		
GATX Capital Corp	200ER	GE	24 May 89	25 Jan 91		1				
GECAS	300ER	GE	30 Aug 95	30 Aug 95				29		
	300F	GE	15 Dec 99	28 Nov 01					1	
GPA Ltd	200ER	PW	18 Apr 89	14 Jan 92		1				
	300ER	GE	18 Apr 89	3 May 93				2		
	300ER	PW	18 Apr 89	28 Feb 01				11		
Gulf Air	300ER	GE	27 Apr 88	14 Jun 88				20		
Hainan Airlines	300ER	PW	21 Aug 02	31 Oct 02				3		
ILFC	200	GE	27 Aug 86	25 Aug 87	1					
	200ER	GE	18 Feb 86	29 May 86		4				
	300ER	GE	16 May 88	14 Jun 91				36		
	300ER	PW	16 May 88	21 Mar 91				16		
Itochu Air Lease Corp	300ER	GE	15 Apr 91	14 Aug 92				3		
Itochu Corp	200ER	GE	4 Nov 93	1 Dec 94		4				
Japan Airlines	200	PW	29 Sep 83	22 Jul 85	3					
	300	PW	29 Sep 83	25 Sep 86			13			
	300	GE	10 Jun 93	1 Aug 94			9			
	300ER	GE	27 Nov 00	19 May 02				18		
	300F	GE	20 Jul 05	none					4	
Khazakstan Airlines	200ER	GE	29 Dec 00	8 Feb 02		1				
Kuwait Airlines	200ER	PW	18 Sep 84	20 Mar 86		3				
LAM Mozambique	200ER	PW	1 Aug 90	24 Aug 93		1				
LAN Chile	300ER	GE	28 May 97	29 Apr 98				15		
	300F	GE	17 Nov 97	23 Sep 98					8	
Lauda Air	300ER	PW	21 Apr 97	29 Apr 88				7		
LOT Polish Airlines	200ER	GE	4 Nov 88	21 Apr 89		2				
	300ER	GE	4 Nov 88	21 Aug 90				3		
LTU	300ER	PW	21 Jan 88	2 Feb 89				5		
Malev Hungarian Airlines	200ER	PW	21 Feb 91	30 Apr 93		2				
Martinair Holland	300ER	PW	11 Mar 88	21 Sep 89				6		
Mid East Jet	200ER	GE	4 Oct 96	4 Oct 96		1				
Pacific Western	200	PW	21 Dec 78	4 Mar 83	2					
Piedmont	200ER	GE	25 Jul 86	21 May 87		6				
Qantas Airways	200ER	PW	7 Sep 83	3 Jul 85		7				
	300ER	GE	24 Apr 87	30 Aug 88				22		
Royal Brunei Airways	300ER	GE	8 Mar 96	8 Mar 96				2		
SAS	200ER	PW	18 Jan 88	11 May 90		2				
	300ER	PW	18 Jan 88	29 Mar 89				14		
Shanghai Airlines	300	PW	14 May 93	22 Jul 94			4			
	767-300ER	PW	18 Jul 05	none				2		

Customer	Variant	Engine	First order	First delivery	200	200ER	300	300ER	300F	400ER
Singapore Lease	300ER	GE	8 Aug 95	4 Aug 95				3		
TACA Int'l Airlines	200	GE	22 May 86	22 May 86	1					
	300ER	GE	27 Aug 91	26 Aug 91				2		
Transbrasil	200	GE	30 Jul 81	23 Jun 83	3					
TWA	200	PW	5 Dec 79	22 Nov 82	10					
Turkmenistan Airlines	300ER	GE	11 Aug 03	21 Oct 04				1		
Unidentified	200ER	GE	15 Apr 02	27 Mar 03		9				
	300ER	PW	25 Sep 01	24 October 02				3		
	300ER	PW	28 Feb 06	none				1		
	400ER	GE	28 Sep 04	none						8
United Airlines	200	PW	14 Jul 78	19 Aug 82	19					
	300ER	PW	19 May 89	18 Apr 91				37		
United Parcel Service	300F	GE	15 Jan 93	12 Oct 95					32	
US Airways	200ER	GE	4 Apr 89	22 May 90		6				
Uzbekistan	300ER	PW	20 Oct 89	27 Nov 96				4		
Varig	200ER	GE	18 Mar 86	2 Jul 87		6				
	300ER	GE	8 Sep 98	21 Dec 89				4		
Subtotals					128	121	104	528	50	38
Total								969		

Notes: For deliveries see Group Orders and Deliveries table

ACCOMMODATION: Operating crew of two on flight deck; observer's seat and optional second observer's seat. Basic accommodation in -200 models for 224 passengers, made up of 18 first class passengers forward in six-abreast seating at 96.5 cm (38 in) pitch, and 206 tourist class in seven-abreast seating at 81 cm (32 in) pitch. Window or aisle seats comprise 86 per cent of total. Type A inward-opening plug doors provided at both front and rear of cabin on each side of fuselage, with options of Type A, I or III emergency exits at various mid-cabin locations on each side. Total of five lavatories installed, two centrally in main cabin, two aft in main cabin, and one forward in first class section. Galleys situated at forward and aft ends of cabin. Alternative single-class layouts provide for 255 tourist passengers seven-abreast (two-three-two) at 81 cm (32 in) pitch (one overwing exit each side) and maximum (requiring two additional overwing emergency exits) 290, mainly eight-abreast (two-four-two), at 76 cm (30 in) pitch. Three-class layout for 181 passengers: 15 first class (two-one-two) at 152 cm (60 in) pitch; 40 business class (two-two-two) at 91 cm (36 in); and 126 tourist class (two-three-two) at 81 cm (32 in).

Basic accommodation in -300 models for 269 passengers, made up of 24 first class passengers forward in six-abreast seating at 96.5 cm (38 in) pitch, 245 tourist class in seven-abreast at 78.7 cm (31 in) pitch, six lavatories and five galleys. Alternatives include 286 in two-three-two seating at 81 cm (32 in) pitch and 218 in three-class layout comprising 18 first, 46 business and 154 tourist class passengers arranged as in -200. Maximum seating capacity in -300 models is 350 passengers at 71 cm (28 in), six lavatories and four galleys; capacities from 291 upwards require standard -300 door configuration (each side) of Type A front and rear and two Type Is overwing to be replaced by two Type As, plus third Type A ahead of wing and Type I adjacent to trailing-edge.

Accommodation in -400ER for 243 passengers in three-class configuration (16/36/189); 296 in two-class (24 first; 272 economy); or 409 in all-economy.

Underfloor cargo holds (forward and rear, combined) of -200 versions can accommodate, typically, up to 22 LD2 or 11 LD1 containers; 767-300 underfloor cargo holds can accommodate 30 LD2 or 15 LD1 containers. Starboard side forward and rear cargo doors of equal size on 767-200 and 767-300, but larger forward door standard on 767-200ER and 767-300ER and optional on 767-200 and 767-300. Bulk cargo door at rear on port side. Overhead stowage for carry-on baggage is 0.08 m^3 (3.0 cu ft) per passenger. Cabin air conditioned, cargo holds heated.

SYSTEMS: Honeywell dual air cycle air conditioning system. Pressure differential 0.59 bar (8.6 lb/sq in). Electrical supply from two engine-driven 90 kVA three-phase 400 Hz constant frequency AC generators (120 kVA in -400ER), 115/200 V output. 90 kVA generator mounted on APU for ground operation or for emergency use in flight. Three hydraulic systems at 207 bar (3,000 lb/sq in), for flight control and utility functions, supplied from engine-driven pumps and a Honeywell bleed air-powered hydraulic pump or from APU. Maximum generating capacity of port and starboard systems is 163 litres (43 US gallons; 35.8 Imp gallons)/min; centre system 185.5 litres (49.0 US gallons; 40.8 Imp gallons)/min, at 196.5 bar (2,850 lb/sq in). Reservoirs pressurised by engine bleed air via pressure regulation module. Reservoir relief valve pressure nominally 4.48 bar (65 lb/sq in). Additional hydraulic motor-driven generator, to provide essential functions for extended-range operations, standard on 767-200ER and 767-300ER and optional on 767-200 and 767-300. Nitrogen chlorate oxygen generators in passenger cabin, plus gaseous oxygen for flight crew. APU in tailcone to provide ground and in-flight electrical power and pressurisation (Honeywell 331-400 of 120 kVA in 767-400ER). Anti-icing for outboard wing leading-edges (none on tail surfaces), engine air inlets, air data sensors and windscreen.

AVIONICS: *Radar:* Honeywell RDR-4A colour weather radar in aircraft for All-Nippon, Britannia and Transbrasil.

Flight: Standard ARINC 700 series equipment, including Honeywell VOR/ILS/marker beacon receivers, ADF, DME, RMI-743 radio magnetic indicator and radio altimeter. Honeywell IRS, FMCS and DADC, as described in Boeing 757 entry; dual digital flight management systems, and triple flight control computers, including FCS-700 flight control system; certified for Cat. IIIb landings; options include Boeing's windshear protection and guidance system.

Instrumentation: Honeywell EFIS-700 electronic flight instrument system.

DIMENSIONS, EXTERNAL:

Wing span: except 400ER	47.57 m (156 ft 1 in)
400ER	51.92 m (170 ft 4 in)
Wing chord: at root	8.57 m (28 ft 1¼ in)
at tip	2.29 m (7 ft 6 in)
Wing aspect ratio: except 400ER	8.0
400ER	9.3
Length:	
overall: 200/200ER	48.51 m (159 ft 2 in)
300/300ER	54.94 m (180 ft 3 in)
400ER	61.37 m (201 ft 4 in)
fuselage: 200/200ER	47.24 m (155 ft 0 in)
300/300ER	53.67 m (176 ft 1 in)
400ER	60.08 m (197 ft 1½ in)
Fuselage max width	5.03 m (16 ft 6 in)
Height overall: 200ER/300 ER	15.85 m (52 ft 0 in)
400 ER: at OWE	17.02 m (55 ft 10 in)
at MTOW	16.69 m (54 ft 9 in)
Tailplane span	18.62 m (61 ft 1 in)
Wheel track (c/l shock absorbers)	9.30 m (30 ft 6 in)
Wheelbase: 200/200ER	19.69 m (64 ft 7 in)
300/300ER	22.76 m (74 ft 8 in)
Turning radius, 400ER: at nosewheel	29.3 m (96 ft)
at mainwheel (outer rims)	17.7 m (58 ft)
at wingtip	39.3 m (129 ft)
Distance between engine centres	15.85 m (52 ft 0 in)
Ground clearance under engine nacelles at MTOW	1.19 m (3 ft 11 in)
Passenger doors, 200ER/300ER (two, fwd and rear, port):	
Height	1.88 m (6 ft 2 in)
Width	1.07 m (3 ft 6 in)
Passenger doors, 400ER (three, port):	
Height, Width	as 200ER/300ER
Height to sill: No. 1: at OWE	4.39 m (14 ft 5 in)
at MTOW	4.14 m (13 ft 7 in)
No 2: at OWE	4.60 m (15 ft 1 in)
at MTOW	4.42 m (14 ft 6 in)
No. 3: at OWE	5.18 m (17 ft 0 in)
at MTOW	4.90 m (16 ft 1 in)
Service door (two/three starboard):	
Height	1.83 m (6 ft 0 in)
Width	1.07 m (3 ft 6 in)
Emergency exits (two, each): Height	0.97 m (3 ft 2 in)
Width	0.51 m (1 ft 8 in)
Cargo door (fwd, stbd):	
Height: door	1.75 m (5 ft 9 in)
Clear access	1.70 m (5 ft 7 in)
Width: door	3.45 m (11 ft 7½ in)
Clear access	3.40 m (11 ft 2 in)
Height to sill, 400ER: at OWE	2.62 m (8 ft 7 in)
at MTOW	2.39 m (7 ft 10 in)
Cargo door (rear, stbd)	
Height: door	1.75 m (5 ft 9 in)
Clear access	1.70 m (5 ft 7 in)
Width: door	1.92 m (6 ft 3½ in)
Clear access	1.78 m (5 ft 10 in)
Height to sill, 400 ER: at OWE	3.20 m (10 ft 6 in)
at MTOW	2.95 m (9 ft 8 in)
Bulk cargo door (port, rear):	
Height: door	1.22 m (4 ft 0 in)
Clear access	1.10 m (3 ft 7½ in)
Width: door	0.96 m (3 ft 2 in)
Clear access	0.96 m (3 ft 2 in)
Height to sill, 400ER: at OWE	3.33 m (10 ft 11 in)
at MTOW	3.07 m (10 ft 1 in)

DIMENSIONS, INTERNAL:

Cabin, excl flight deck:	
Length: 200/200ER	33.93 m (111 ft 4 in)
300/300ER	40.36 m (132 ft 5 in)
Max width	4.72 m (15 ft 6 in)
Height: max	2.87 m (9 ft 5 in)
min under baggage lockers	1.90 m (6 ft 3 in)
Floor area: 200/200ER	155.5 m^2 (1,674 sq ft)
300/300ER	184.7 m^2 (1,988 sq ft)
400ER	213.8 m^2 (2,301 sq ft)
Volume: 200/200ER	428.2 m^3 (15,121 cu ft)
300/300ER	483.9 m^3 (17,088 cu ft)
Volume, flight deck	13.5 m^3 (478 cu ft)
Cargo holds (containerised):	
Length, 400ER: fwd	16.26 m (53 ft 4 in)
rear	14.73 m (48 ft 4 in)
Height above roller floor	1.68 m (5 ft 6 in)
Width at floor	3.66 m (12 ft 0 in)
Volume:	
200/200ER: fwd	40.8 m^3 (1,440 cu ft)
rear	34.0 m^3 (1,200 cu ft)
300/300ER: fwd	54.4 m^3 (1,920 cu ft)
rear	47.6 m^3 (1,680 cu ft)
400ER: fwd	68.0 m^3 (2,400 cu ft)
rear	61.2 m^3 (2,160 cu ft)
Bulk cargo hold volume:	
200ER/300ER	12.2 m^3 (430 cu ft)
400ER	9.8 m^3 (345 cu ft)
Combined baggage hold/bulk cargo hold volume:	
200/200ER	87.0 m^3 (3,070 cu ft)
300/300ER	114.1 m^3 (4,030 cu ft)

Total cargo hold volume:
200/200ER ..... 111.3 m³ (3,930 cu ft)
300/300ER ..... 147.0 m³ (5,190 cu ft)

AREAS:
Wings, gross: except 400ER ..... 283.3 m² (3,050.0 sq ft)
400ER ..... 290.70 m² (3,129.0 sq ft)
Ailerons (total) ..... 11.58 m² (124.60 sq ft)
Trailing-edge flaps (total) ..... 36.88 m² (397.00 sq ft)
Leading-edge slats (total) ..... 28.30 m² (304.60 sq ft)
Spoilers (total) ..... 15.83 m² (170.40 sq ft)
Fin ..... 30.19 m² (325.00 sq ft)
Rudder ..... 15.95 m² (171.70 sq ft)
Tailplane ..... 59.88 m² (644.50 sq ft)
Elevators (total) ..... 17.81 m² (191.70 sq ft)

WEIGHTS AND LOADINGS (767-200ER with 181 (three class) or 224 passengers: 2GB: CF6-80C2B2F engines at basic TOW, 2GM: CF6-80C2B7F engines at max TOW, 2PB: PW4052 engines at basic TOW, 2PM: PW4062 engines at max TOW: 767-300ER with 218 (three class) or 269 passengers: 3GB: CF6-80C2B4F engines at basic TOW, 3GM: CF6-80C2B7F engines at max TOW, 3PB: PW4056 engines at basic TOW, 3PM: PW4062 engines at max TOW, 3RB: RB211-524G4 engines at basic TOW, 3RM: RB211-524H engines at max TOW: 767-400ER with 269 (two class) passengers: 4GB: CF6-80C2B7F1 engines at basic TOW, 4GM: CF6-80C2B8 engines at max TOW, 4PB: PW4056 engines at basic TOW, 4PM: PW4062 engines at max TOW):
(identifiers such as '2GB' are not Boeing designations)
Operating weight empty:
2GB (181), 2GM (181) ..... 84,960 kg (187,300 lb)
2GB (224), 2GM (224) ..... 84,280 kg (185,800 lb)
2PB (181), 2PM (181) ..... 85,005 kg (187,400 lb)
2PB (224), 2PM (224) ..... 84,325 kg (185,900 lb)
3GB (218), 3GM (218) ..... 90,810 kg (200,200 lb)
3GB (269), 3GM (269) ..... 90,130 kg (198,700 lb)
3PB (218), 3PM (218) ..... 90,855 kg (200,300 lb)
3PB (269), 3PM (269) ..... 90,175 kg (198,800 lb)
3RB (218), 3RM (218) ..... 91,625 kg (202,000 lb)
3RB (269), 3RM (269) ..... 90,945 kg (200,500 lb)
4GB, 4GM ..... 103,145 kg (227,400 lb)
4PB, 4PM ..... 103,870 kg (229,000 lb)
Baggage capacity, underfloor:
200ER:
fwd: standard ..... 9,798 kg (21,600 lb)
alternate ..... 15,309 kg (33,750 lb)
rear: standard ..... 8,165 kg (18,000 lb)
alternate ..... 12,247 kg (27,000 lb)
300ER:
fwd: standard ..... 13,063 kg (28,800 lb)
alternate ..... 20,412 kg (45,000 lb)
rear: standard ..... 11,431 kg (25,200 lb)
alternate ..... 17,574 kg (38,745 lb)
Bulk hold capacity (all versions) ..... 2,926 kg (6,450 lb)
Max fuel weight: 200, 300 ..... 51,130 kg (112,725 lb)
200ER, 300ER ..... 73,635 kg (162,340 lb)
400ER ..... 73,365 kg (161,740 lb)
Max T-O weight: 2GB, 2PB ..... 156,490 kg (345,000 lb)
2GM, 2PM ..... 179,170 kg (395,000 lb)
3GB, 3PB, 3RB ..... 172,365 kg (380,000 lb)
3GM, 3PM, 3RM ..... 186,880 kg (412,000 lb)
4GB ..... 181,435 kg (400,000 lb)
4GM, 4PM ..... 204,115 kg (450,000 lb)
Max ramp weight: 2GB, 2PB ..... 156,945 kg (346,000 lb)
2GM, 2PM ..... 179,625 kg (396,000 lb)
3GB, 3PB, 3RB ..... 172,820 kg (381,000 lb)
3GM, 3PM, 3RM ..... 187,335 kg (413,000 lb)
4GB ..... 181,935 kg (401,100 lb)
4GM, 4PM ..... 204,570 kg (451,000 lb)
Max landing weight: 2GB, 2PB ..... 126,100 kg (278,000 lb)
2GM, 2PM ..... 136,080 kg (300,000 lb)
3GB, 3GM, 3PB, 3PM, 3RB, 3RM ..... 145,150 kg (320,000 lb)
4GB, 4GM, 4PB, 4PM ..... 158,760 kg (350,000 lb)
Max zero-fuel weight:
2GB, 2PB ..... 114,755 kg (253,000 lb)
2GM, 2PM ..... 117,935 kg (260,000 lb)
3GB, 3GM, 3PB, 3PM, 3RB, 3RM ..... 133,810 kg (295,000 lb)
4GB, 4GM, 4PM ..... 149,685 kg (330,000 lb)
Max wing loading:
2GB, 2PB ..... 552.3 kg/m² (113.11 lb/sq ft)
2GM, 2PM ..... 632.3 kg/m²(129.51 lb/sq ft)
3GB, 3PB, 3RB ..... 608.3 kg/m² (124.59 lb/sq ft)
3GM, 3PM, 3RM ..... 659.5 kg/m² (135.08 lb/sq ft)
4GB ..... 624.2 kg/m² (127.84 lb/sq ft)
4GM, 4PM ..... 702.2 kg/m² (143.82 lb/sq ft)
Max power loading: 2GB ..... 348 kg/kN (3.41 lb/lb st)
2GM ..... 324 kg/kN (3.18 lb/lb st)
2PB ..... 336 kg/kN (3.30 lb/lb st)
2PM ..... 318 kg/kN (3.12 lb/lb st)
3GB ..... 343 kg/kN (3.36 lb/lb st)
3GM ..... 338 kg/kN (3.32 lb/lb st)
3PB ..... 339 kg/kN (3.33 lb/lb st)
3PM ..... 332 kg/kN (3.25 lb/lb st)
3RB ..... 344 kg/kN (3.37 lb/lb st)
3RM ..... 353 kg/kN (3.46 lb/lb st)
4GB ..... 328 kg/kN (3.22 lb/lb st)
4GM ..... 361 kg/kN (3.54 lb/lb st)
4PM ..... 362 kg/kN (3.55 lb/lb st)

PERFORMANCE:
Normal cruising speed, all versions M0.80
Approach speed at MLW:
2GB, 2PB ..... 137 kt (254 km/h; 158 mph)
2GM, 2PM ..... 142 kt (263 km/h; 163 mph)
3GB, 3GM, 3PB, 3PM ..... 145 kt (269 km/h; 167 mph)
3RB, 3RM ..... 148 kt (275 km/h; 171 mph)
Initial cruising altitude at max T-O weight:
2GB ..... 11,550 m (37,900 ft)
2GM, 2PM ..... 10,670 m (35,000 ft)
2PB ..... 11,310 m (37,100 ft)
3GB ..... 10,700 m (35,100 ft)
3GM, 3PM ..... 10,180 m (33,400 ft)
3PB ..... 10,730 m (35,200 ft)
3RB ..... 10,730 m (35,200 ft)
3RM ..... 10,210 m (33,500 ft)
Service ceiling, OEI: 2GB ..... 5,090 m (16,700 ft)
2GM ..... 4,205 m (13,800 ft)
2PB ..... 5,395 m (17,700 ft)
2PM ..... 4,845 m (15,900 ft)
3GB ..... 4,510 m (14,800 ft)
3GM ..... 3,930 m (12,900 ft)
3PB ..... 4,785 m (15,700 ft)
3PM ..... 4,085 m (13,400 ft)
3RB ..... 3,900 m (12,800 ft)
3RM ..... 3,505 m (11,500 ft)
T-O field length S/L, 86°F: 2GB ..... 2,301 m (7,550 ft)
2GM, 3PB ..... 2,485 m (8,150 ft)
2PB ..... 2,180 m (7,150 ft)
2PM ..... 2,439 m (8,000 ft)
3GB ..... 2,530 m (8,300 ft)
3GM ..... 2,713 m (8,900 ft)
3PM ..... 2,652 m (8,700 ft)
3RB ..... 2,500 m (8,200 ft)
3RM ..... 2,896 m (9,500 ft)
Landing field length at MLW: 2GB ..... 1,524 m (5,000 ft)
2GM ..... 1,555 m (5,100 ft)
2PB ..... 1,509 m (4,950 ft)
2PM ..... 1,540 m (5,050 ft)
3GB, 3GM, 3PB, 3PM ..... 1,677 m (5,500 ft)
3RB, 3RM ..... 1,707 m (5,600 ft)
3RM ..... 2,896 m (9,500 ft)
Design range:
2GB (181) ..... 5,125 n miles (9,491 km; 5,897 miles)
2GB (224) ..... 4,830 n miles (8,945 km; 5,558 miles)
2GM (181) ..... 6,655 n miles (12,325 km; 7,658 miles)
2GM (224) ..... 6,545 n miles (12,121 km; 7,531 miles)
2PB (181) ..... 5,030 n miles (9,315 km; 5,788 miles)
2PB (224) ..... 4,740 n miles (8,778 km; 5,454 miles)
2PM (181) ..... 6,555 n miles (12,139 km; 7,543 miles)
2PM (224) ..... 6,450 n miles (11,945 km; 7,422 miles)
3GB (218) ..... 5,230 n miles (9,686 km; 6,018 miles)
3GB (269) ..... 4,890 n miles (9,056 km; 5,627 miles)
3GM (218) ..... 6,150 n miles (11,389 km; 7,077 miles)
3GM (269) ..... 5,990 n miles (11,093 km; 6,893 miles)
3PB (218) ..... 5,155 n miles (9,547 km; 5,932 miles)
3PB (269) ..... 4,820 n miles (8,926 km; 5,546 miles)
3PM (218) ..... 6,075 n miles (11,250 km; 6,991 miles)
3PM (269) ..... 5,915 n miles (10,954 km; 6,806 miles)
3RB (218) ..... 4,880 n miles (9,037 km; 5,615 miles)
3RB (269) ..... 4,555 n miles (8,435 km; 5,241 miles)
3RM (218) ..... 5,850 n miles (10,834 km; 6,732 miles)
3RM (269) ..... 5,620 n miles (10,408 km; 6,467 miles)
4GB ..... 4,375 n miles (8,102 km; 5,034 miles)
4GM ..... 5,645 n miles (10,454 km; 6,496 miles)

BOEING 767-300 GENERAL MARKET FREIGHTER

TYPE: Twin-jet freighter.

PROGRAMME: First 767 specialised package freighter launched 15 January 1993 by United Parcel Service order; mockup completed early 1994; rolled out 8 May 1995; first flight (N301UP) 20 June 1995; certified 12 October 1995. The 767-300F for general operation was ordered by Asiana in November 1993 and differs from UPS version in having mechanical freight handling on main and lower decks, air conditioning for animals and perishables on main and forward lower decks and more elaborate crew facilities.

CURRENT VERSIONS: **767-300F:** *As described*

767-300BCF: Airliner conversion; programme launched in 2005 with order by All Nippon.

CUSTOMERS: UPS ordered 30 parcel freighters 15 January 1993; first delivery 12 October 1995; entered service 16 October 1995; last delivery on 9 September 1999; two of further 30 options taken up and delivered in October and November 2001. Asiana ordered two 767-300Fs in November 1993; contract reduced to one, which was delivered 23 August 1996. Five to LAN Chile between 23 September 1998 and 9 October 2001, plus further five ordered in 2004-05. All Nippon ordered four between 2001 and 2005, deliveries beginning 28 August 2002; JAL International ordered three in July 2005 increasing to four. One ordered by GECAS; delivered 28 November 2001. Total 52.

COSTS: USD143.0 million to USD155.0 million (2006).

DESIGN FEATURES: Modifications include reinforced landing gear and internal wing structure; main deck floor strengthened to take 24 containers, each 2.24 × 3.18 m (88 × 125 in); no passenger windows; 2.67 × 3.40 m (8 ft 9 in × 11 ft 1¾ in) freight door forward to port; pilot-type rating and extensive component commonality with 757 Freighter.

POWER PLANT: Two General Electric CF6-80C2B6F/B7F, Pratt & Whitney PW4060/4062 or Rolls-Royce RB211-524/H turbofans; 267 kN (60,000 lb st) each.

DIMENSIONS, INTERNAL:
Cabin: Length ..... 39.80 m (130 ft 7 in)
Main deck container capacity ..... 339.5 m³ (11,990 cu ft)
Lower deck cargo capacity ..... 92.9 m³ (3,282 cu ft)

WEIGHTS AND LOADINGS:
Max T-O weight: standard ..... 185,065 kg (408,000 lb)
optional ..... 186,880 kg (412,000 lb)
Max ramp weight ..... 187,335 kg (413,000 lb)
Max zero-fuel weight ..... 140,160 kg (309,000 lb)
Max landing weight ..... 147,871 kg (326,000 lb)
Max wing loading ..... 659.5 kg/m² (135.08 lb/sq ft)
Max power loading ..... 350 kg/kW (3.43 lb/lb st)

PERFORMANCE:
Range: with 40,823 kg (90,000 lb) payload ..... 4,000 n miles (7,408 km; 4,603 miles)
with 50,800 kg (112,000 lb) payload ..... 3,000 n miles (5,556 km; 3,452 miles)

BOEING 777

TYPE: Wide-bodied airliner.

PROGRAMME:

DEVELOPMENT MILESTONES

777-200	
Programme launched	29 Oct 90
First order (United Airlines)	15 Oct 90
Rolled out	9 Apr 94
First flight	12 Jun 94
Certification	19 Apr 95
First delivery	15 May 95
Entered service (United Airlines)	7 Jun 95
Subsequent versions	
777-200ER	
Programme launched	29 Oct 90
First order	14 Jun 91
Rolled out	21 Aug 96
First flight	7 Oct 96
Certification	17 Jan 97
First delivery	6 Feb 97
Entered service (British Airways)	9 Feb 97
777-200LR	
Programme launched	29 Feb 00
First order (EVA Airways)	27 Jun 00
777-300	
Programme launched	26 Jun 95
First order	14 Jun 95
Rolled out	8 Sep 97
First flight	16 Oct 97
Certification	4 May 98
First delivery	22 May 98
Entered service (Cathay Pacific)	27 May 98
777-300ER	
Programme launched	29 Feb 00
First order (Japan Airlines)	31 Mar 00
Rolled out	14 Nov 02
First flight	24 Feb 03
Certification	16 Mar 04
First delivery (Air France)	29 Apr 04

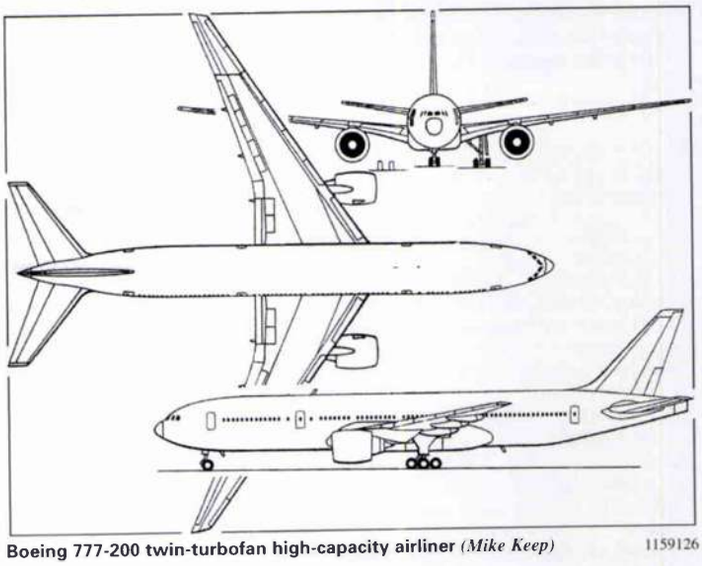
Formerly known as 767-X, initial variant now 777-200; Boeing board authorised firm offer for sale 8 December 1989; launch order by United Airlines 15 October 1990; Boeing launched production programme of initial market and Increased Gross Weight 777s and formed 777 Division 29 October 1990; configuration frozen March 1991; Boeing signed final agreement with Mitsubishi, Kawasaki and Fuji, making them risk-sharing programme partners for about 20 per cent of the 777 structure, on 21 May 1991; roll-out occurred 9 April 1994.

First flight (line no. WA001/N7771 with PW4084 engines), 12 June 1994, WA002 15 July, WA003 2 August, WA004 28 October, WA005 11 November; WA006/G-ZZZA (first with GE90, for British Airways) 2 February 1995, same day as FAA granted engine approval; PW-engined aircraft accumulated some 3,235 hours in 2,340 cycles in test programme, leading to joint FAA/JAA certification on 19 April 1995; FAA awarded 180-minute ETOPS approval 30 May 1995; first delivery, to United Airlines, on 15 May 1995; service entry with United on 7 June 1995 with inaugural revenue flight (by N777NA) from London to Washington, DC. Second GE90 aircraft for British Airways (WA010/G-ZZZB) joined WA006 in 1,750 hour, 1,260 cycle test programme; certification with GE engine 9 November 1995, with deliveries to BA commencing two days later.

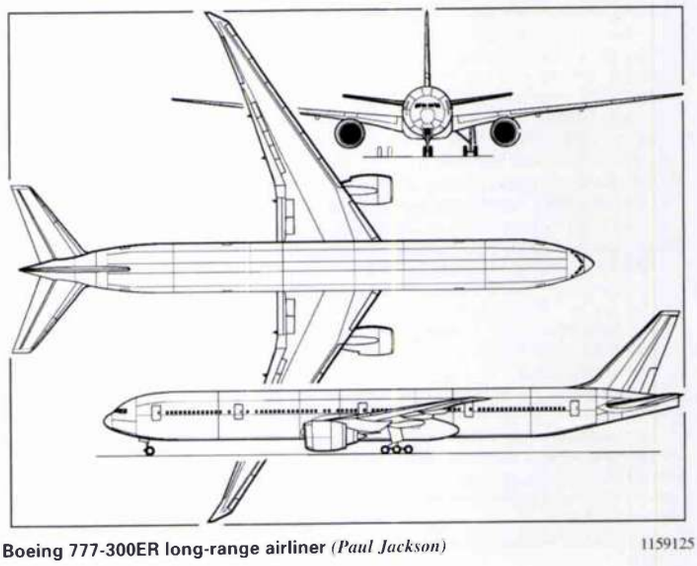
Flight testing of Rolls-Royce Trent 800 on Boeing 747-100 testbed began late March 1995, with first flight of Trent-powered 777 (Boeing test aircraft) 26 May; certification and first delivery (to Thai International) on 3 April 1996 (formal hand-over 31 March), with ETOPS clearance following in October. The US National Aeronautic Association awarded Boeing and the 777 its 1995 Robert J. Collier Trophy for aeronautical achievement. On 2 April 1997, a Trent-powered 777 landed at Boeing Field having captured the eastbound world circumnavigation record in 41 hours 59 minutes with a single stop at Kuala Lumpur, Malaysia, its arrival at the latter also having secured the non-stop great circle distance record of 10,266.9 n miles (19,014.3 km; 11,814.9 miles).

Two new derivatives launched 29 February 2000 as 777-200LR and 777-300ER, both as extended-range versions of current production types. Anticipated market of 500 for these derivatives, 45 per cent of which with Asian operators. Boeing rolled out 500th 777 on 3 December 2004.

CURRENT VERSIONS: **777-100X:** Under study in 2000 to meet Singapore Airlines requirements for shortened, 250-seat version. Not proceeded with.



Boeing 777-200 twin-turbofan high-capacity airliner *(Mike Keep)* 1159126



Boeing 777-300ER long-range airliner *(Paul Jackson)* 1159125

777-200: Initial production version. Maximum T-O weight 247,210 kg (545,000 lb); up to 440 passengers at maximum density.

777-200ER: Formerly -200-IGW (Increased Gross Weight). Maximum T-O weight initially 286,895 kg (632,500 lb); increased to 293,930 kg (648,000 lb) in March 1998 and 297,555 kg (656,000 lb) in January 1999; additional 53,828 litres (14,220 US gallons; 11,840 Imp gallons) of fuel in centre-section tank; same passenger capacity as basic aircraft; configuration frozen January 1994, including strengthened wing, fuselage, empennage, landing gear and engine pylons. First flew (G-VIIA, one of two for British Airways) 7 October 1996 (GE engines); FAA/JAA ETOPS certification 5 February 1997; delivery 6 February. First Trent-powered -200ER (A6-EMI, for Emirates) flew 21 November 1996. January 1999 MTOW increase resulted from fitting 777-300 main landing gear and restricting CG travel to 4 per cent, for increased taxying weight. First flight with GE90-94B engines 12 June 2000; FAA certification 14 November 2000, followed immediately by first delivery (to Air France).

777-200ER VIP: First 777 for private use was -200ER (N777AS) first flown 3 November 1998 and delivered to Raytheon Systems at Waco, Texas, for outfitting; to Middle East Jet September 2003; based at Jeddah, Saudi Arabia. Second, although first in service, was VP-BRH of Saudi Otger construction company, delivered 22 October 1999. Specific executive version announced October 2006, offering cabin 48.36 m (158 ft 8 in) long, 5.87 m (19 ft 3 in) wide, 2.39 m (7 ft 10 in) high and with 278.8 m^2 (3,001 sq ft) floor area. Freight volume 160.0 m^3 (5,650 cu ft). Range 10,000 n miles (18,520 km; 11,507 miles)

Singapore Airlines Boeing 777-200ER *(Paul Jackson)* 1159158

with eight passengers; 9,655 n miles (17,881 km; 11,110 miles) with 100 passengers. Operating cost USD6,980 per hour (2006).

777-200LR Worldliner: Ultra-long-range version (previously 777-200X) powered by two General Electric GE90-110B engines, each rated at 489 kN (110,000 lb st) or GE90-115B1 engines of 513 kN (115,300 lb st); launched 29 February 2000. Maximum T-O weight 347,450 kg (766,000 lb); zero-fuel weight 209,105 kg (461,000 lb); fuel capacity 202,292 litres (53,440 US gallons; 44,498 Imp gallons), with addition of three optional tanks in rear cargo hold; range 9,420 n miles (17,445 km; 10,840 miles) with 301 passengers. Raked wingtips extend total span by 3.86 m (12 ft 8 in). Firm launch order from EVA Airways, 27 June 2000, for three. On 1 October 2001, Boeing announced suspension of development programme for up to 18 months this being resumed in March 2003. Rolled out (504th 777) 25 January 2005; first flight (N60659) 8 March 2005; delivery to Pakistan International Airlines (AP-BGY) scheduled in January 2006. Second development aircraft (N6066Z/AP-BGZ) first flew 24 May 2005.

777-200LR VIP: Announced October 2006. Generally as 777-200ER VIP, but cargo volume of 133.1 m^3 (4,700 cu ft); range 11,100 n miles (20,557 km; 12,773 miles) with eight passengers, 10,725 n miles (19,862 km; 12,342 miles) with 100 passengers. Operating cost USD7,330 per hour (2006).

777-200LRXF: Studies revealed in early 2004 for freighter carrying up to 110 tonnes.

777-250ERX: Under consideration by late 2002; length 68.6 m (225 ft); range 7,500 n miles (13,890 km; 8,630 miles) with up to 330 passengers.

777-300: Initially known as 777 Stretch; revealed at Paris Air Show, 14 June 1995; launched by Boeing board 26 June 1995 when 36 commitments held; configuration frozen October 1995; major assembly started 7 April 1997; roll-out 8 September 1997; first flight (Rolls-Royce engines) 16 October 1997 (N5014K); first with P&W engines (HL-7534 of Korean Air) 4 February 1998; FAA certification achieved 4 May 1998 with 180-minute ETOPS approval; first delivery (B-HNH, 136th 777) to Cathay Pacific 22 May 1998.

Compared with first-generation 747s, 777-300 carries same number of passengers, but at two-thirds of fuel cost and with 40 per cent less maintenance. Features strengthened airframe, inboard wing and landing gear, ground-manoeuvring cameras on horizontal tail surfaces and wing/fuselage fairing; tailskid; Type A emergency door over each wing; and fuselage stretched by 19 frames, 10.13 m (33 ft 3 in) longer (5.33 m; 17 ft 6 in ahead of wing and 4.80 m; 15 ft 9 in aft of wing) than that of 777-200 to increase passenger capacity to 550 in single-class high-density configuration.

777-300ER: Extended range version of 777-300 (previously 777-300X); launched 29 February 2000; launch customer Japan Airlines ordered eight on 31 March 2000 for delivery from October 2003, but first recipient now ILFC/Air France on 29 April 2004 (beginning F-GSQA). Prototype assembly started 20 June 2002; rolled out 6 November 2002; official roll out 14 November 2002; first flight (WD501/N5017V) 24 February 2003; second prototype (WD502/N5016R) flew 6 April 2003; WD501 set twin-jet MTOW record of 351,350 kg (774,600 lb) at Edwards AFB, 19 May 2003 and subsequently exhibited at Paris Air Show, 15 to 22 June 2003. First customer aircraft (466th 777) rolled out 7 December 2003; first flew 10 January 2004; delivered Air France (F-GSQA) 29 April 2004, although owned by ILFC; first owned by Air France (F-GSQC) delivered 1 June 2004. Initial delivery to Japan Airlines was second prototype (429th 777) on 15 June 2004 (as JA731J); first prototype followed.

Both -200LR and -300ER have strengthened horizontal and vertical tail surfaces, strengthened wings with new tips which increase span to 64.80 m (212 ft 7 in) and strengthened landing gear, including semi-levered main gear and extendable (up to 25 cm; 9¾ in) nosewheel leg on -300ER. Modified landing gear permits steeper rotation, and thus operations from shorter runways; anti-tail strike system automatically moves elevator when runway contact is imminent. Early -300ERs temporarily limited to 344,865 kg (760,300 lb) MTOW.

Efficiency package introduced late 2005, initial delivery being to Air France on 29 November (F-GSQK). Fuel efficiency improved 1.4 per cent by combination of modified GE90-115B engines; improvements to air conditioning, air intakes and vortex generators; and lightened internal structure, including main deck floor panels and air conditioning ducts. Retrofit in hand for 27 earlier -300ERs.

777-200ER VIP: Announced October 2006. Generally as 777-200ER VIP, but cabin length 58.50 m (191 ft 11 in) and area 338.3 m^2 (3,641 sq ft). Cargo volume 213.8 m^3 (7,550 cu ft). Range 9,470 n miles (17,538 km; 10,897 miles) with eight passengers, 9,160 n miles (16,964 km; 10,541 miles) with 100 passengers. Operating cost USD7,790 per hour (2006).

777-300ER Stretch: Under study in 1999 as possible replacement for 747-400 with Asian carrier on routes to Europe; fuselage stretch of about 7.9 m (26 ft) to accommodate an additional 60 passengers, but airframe otherwise unchanged; range as for 777-300ER. Also referred to as **777-400X**. Not proceeded with.

777F: Freighter. Officially launched 24 May 2005 with Air France order for five (plus three options), deliveries to begin in fourth quarter of 2008. Based on 777-200LR Worldliner. GE90-110B1L engines; MTOW 347,450 kg (766,000 lb); payload 103,875 kg (229,000 lb); range 4,965 n miles (9,195 km; 5,713 miles). Other changes from -200LR include deletion of all cabin windows and doors except 1L and 1R; revised main deck with strengthened aluminium floor and powered cargo handling system; modified environmental control system; strengthened fuselage and 9g cargo barrier to protect crew; crew rest area with four seats, two bunks, galley and lavatory; and 3.71 × 3.15 m (12 ft 2 in × 10 ft 4 in) cargo door, port, rear.

CUSTOMERS: As per table.

COSTS: Estimated development cost USD4 billion (1990). Unit cost USD178.0 million to USD195.0 million 777-200; USD190.0 million to USD212.5 million 777-200ER; USD219.0 million to USD243.0 million 777-200LR; USD210.0 million to USD234.0 million 777-300; USD237.0 million to USD264.5 million 777-300ER; USD232.5 million to USD240.0 million 777F (all 2006). 777-300 estimated to burn 33 per cent less fuel and have 40 per cent lower maintenance cost than 747-100/200, resulting in direct operating cost savings of around 30 to 35 per cent.

DESIGN FEATURES: Objectives of design included replacement of McDonnell Douglas DC-10 Srs 10 and Lockheed TriStar in regional market, as well as DC-10 Srs 30 and Boeing 747SP in intercontinental service; also is replacement for early 747s. All features required for 180-minute ETOPS incorporated and tested in basic aircraft design. Cylindrical fuselage wider than 767 to allow twin aisle seating for from six- to 10-abreast; lavatories and overhead baggage bins designed to allow rapid change of layout.

Wing, of 31° 30' sweepback at quarter-chord, incorporates new technology to allow minimum M0.83 cruise in combination with high thickness for economical structure and large internal volume, long span for improved take-off and payload/range and large area for high cruise altitude and low approach speed; no winglets. Design included provision for outer 6.48 m (21 ft 3 in) of each wing to be folded to vertical to reduce gate width requirement at airports; this option not proceeded with.

FLYING CONTROLS: Fly-by-wire. Hydraulically actuated, with trim tab in rudder. Six-segment slats in each wing leading-edge. Single-slotted flaps mid-wing, double-slotted flaps inboard; flaperon between inboard and outboard flaps. Five-segment spoilers ahead of single-slotted flaps; two-segment spoilers ahead of double-slotted flaps.

Boeing's first airliner fly-by-wire system; fully powered control surface actuators (31 by Teijin Seiki America) electrically signalled from full FBW system; this signals slats, flaps, spoilers and control feel unit as well as inboard flaperons, outboard ailerons, elevators and rudder; system provides flight envelope protection as well as stabilisation and autopilot inputs, but the normal control columns and rudder pedals in cockpit are back-driven by the system to give the pilots direct appreciation of the activity of the automatic system.

In normal mode, flight guidance commands are generated by Rockwell Collins triple redundant digital autopilot/flight directors and the control laws and envelope protection commands are shaped by the Marconi Avionics triple digital primary flight computers; each of the three primary flight computers contains three 32-bit microprocessors (a Motorola 68040, an Intel 80486 and an AMD 29050), all three programmed in Ada to perform all FBW functions; with power supply and ARINC 629 modules, each microprocessor module constitutes a lane and the three lanes constitute a channel; each lane is compared with the others in its channel; the system not only has high fault tolerance, but allows deferred maintenance, by which failures can be carried over until the next scheduled maintenance.

Commands to the powered control units are produced by three BAE Systems and Teijin Seiki actuator control electronics units, which have a fourth analogue channel directly signalled from the sticks and pedals in the cockpit; normal operating mode is for the aircraft to be flown through autopilots, primary flight computers and actuator control electronics, which simultaneously back-drive the sticks and pedals in the cockpit; first degraded (secondary) mode is used if inertial units and standby attitude sensors all become disabled and the pilots take manual control through the digital primary flight computers; second degraded (direct) mode bypasses the main FBW system with the direct analogue link between cockpit and actuator control electronics; ultimate standby is mechanical control of tailplane incidence for the pitch axis and two wing spoiler panels for lateral control. Some powered control units produced by Parker-Bertea and Moog; tailplane trim module and hydraulic brake by Raytheon Systems.

Pitch axis control law is C* U, effectively tending to make the aircraft hold an airspeed and to respond in pitch attitude to a departure from that airspeed; trim changes due to configuration changes are suppressed; the system returns the bank angle to 35° if that angle is exceeded by the pilots and the controls then released; the system prevents exceeding the limiting airspeed and stalling; asymmetric thrust is automatically countered; the variable feel system adjusts control forces to warn of approach to flight envelope limits in manual flight; the FBW system is linked to the ARINC 629 dual triplex digital databusses (see also aircraft information management system under Avionics heading).

STRUCTURE: Composites of carbon and toughened resin used in skins of tailplane and fin torsion boxes and cabin floor beams; CFRP used for rudder, elevators, ailerons, flaps, engine nacelles and landing gear doors; hybrid composites in wingroot fairing; GFRP in fixed-wing leading-edge, tailplane and fin fore and aft panels, wing aft panels, engine pylon fairings and radome. Toughened materials have high damage resistance and allow simple low-temperature bolted repairs. Metal structure includes thick skins without need for tear straps; no bonding; single-piece fuselage frames; fuselage skin of advanced 2000-series aluminium alloy; wing, empennage and engine nacelle leading edges of 2000-series; wing top skin and stringers made in advanced 7055 aluminium alloy with greater compression strength; tailcone in standard 7000-series; 10 per cent of structure weight is composites.

Fully digital product definition with all parts created by Dassault/IBM CATIA CAD/CAM and communicated to manufacturing and publications; structure and systems integration, tube and cable run design completed before design release; 238 design/build teams have ensured that design, fabrication and test have proceeded concurrently for structure and systems. Whole aircraft defined in computer system; no mockup built.

Centre and rear fuselage barrel sections, tailcone, doors, wingroot fairing and landing gear doors made in Japan. Wing and tail leading-edges and moving wing parts, landing gear, floor beams, nose landing gear doors, wingtips, dorsal fin and nose radome made by Northrop Grumman, Kaman, Alenia (Italy), Embraer (Brazil), Short Brothers (UK), Singapore Aerospace Manufacturing, HDH and ASTA (Australia), Korean Air and other subcontractors. Boeing manufactures flight deck and forward cabin, basic wing and tail structures and engine nacelles; assembles and tests completed aircraft.

LANDING GEAR: Retractable tricycle type (Menasco/Messier-Bugatti joint design for main gear); two main legs carrying six-wheel bogies with steering rear axles automatically engaged by nose gear steering angle; max nosewheel angle ±70°; six-wheel bogies avoid need for third leg in fuselage and simplify braking system; twin-wheel steerable nose gear; mainwheel tyres H49 × 19.0–22 or 50 × 20.0R22 (32 ply); nosewheel tyres 42 × 17.0R18 (26 ply). Honeywell Carbenix 4000 mainwheel brakes arranged so that initial toe-pedal pressure used during taxying applies brakes to alternate sets of three wheels to save brake wear; full toe-pedal pressure applies all six brakes together. Minimum taxiway width for U-turn: 200 srs 48.2 m (158 ft); 300 srs 56.7 m (186 ft).

POWER PLANT: Two turbofans.

777-200: 343 kN (77,000 lb st) General Electric GE90-77B, 331 kN (74,500 lb st) Pratt & Whitney PW4074 or 343 kN (77,200 lb st) PW4077, or 327 kN (73,400 lb st) Rolls-Royce Trent 875 or 338 kN (76,000 lb st) Trent 877.

777-200ER: 377 kN (84,700 lb st) GE90-85B, 400 kN (90,000 lb st) GE90-90B, 417 kN (93,700 lb st) GE90-94B, 376 kN (84,600 lb st) PW4084, 401 kN (90,200 lb st) PW4090, 436 kN (98,000 lb st) PW4098, 372 kN (83,600 lb st) Trent 884, 400 kN (90,000 lb st) Trent 892 or 415 kN (93,400 lb st) Trent 895.

777-200LR: GE90-110B engines, each 489 kN (110,000 lb st), or GE90-115B1s of 513 kN (115,300 lb st).

777-300: PW4090, PW4098 or Trent 884, 892, as above.

777-300ER: GE90-115B1 engines, each 512 kN (115,000 lb st). All fuel of baseline version contained in integral tanks in wing torsion box, with reserve tank, surge tank and fuel vent and jettison pipes all inboard of wing fold; pressure refuelling points in lower wing leading edge, immediately outboard of engine pylons. Combined capacity of main, centre and reserve tanks in 777-200 is 117,348 litres (31,000 US gallons; 25,813 Imp gallons); 777-200ER and 777-300 fuel capacity increased by centre-section tank of 53,829 litres (14,220 US gallons; 11,841 Imp gallons) to maximum of 171,176 litres (45,220 US gallons; 37,653 Imp gallons).

Standard fuel of 777-200LR is 181,283 litres (47,890 US gallons; 39,877 Imp gallons), with provision for up to three 7,003 litre (1,850 US gallon; 1,540 Imp gallon) tanks in rear cargo compartment, increasing capacity to 204,185 litres (53,940 US gallons; 44,914 Imp gallons).

Fuel capacity of 777-300LR in all weight options is 181,283 litres (47,890 US gallons; 39,877 Imp gallons).

ACCOMMODATION: Two-pilot crew; cabin cross-section, which is between that of 747 and 767, chosen to allow widest selection of twin-aisle class and seating layouts ranging from six- to 10-abreast; galleys and lavatories can be located at a selection of fixed points in front and rear cabins or freely positioned within large footprints in which they can be moved in 2.5 cm (1 in) increments and attached to pre-positioned mounting, plumbing and electric fittings; overhead bins open downward and provide each passenger with 0.08 m^3 (3 cu ft) volume;

BOEING 777 ORDER BOOK
(at 30 June 2006)

Customer	Variant	Engine	First Order	First Delivery	200	200ER	200LR	300	300ER	F
Air Canada	777-200LR	GE90	10 Nov 05	none			12			
	777-300ER	GE90	10 Nov 05	none					4	
	777F	GE90	10 Nov 05	none						2
Air China	777-200	PW4000	24 Mar 97	26 Oct 98	10					
Air France	777-200ER	GE90	20 Nov 96	27 Mar 98		18				
	777-300ER	GE90	13 Nov 00	1 Jun 04					19	
	777F	GE90	23 May 05	none						5
Air India	777-200LR	GE90	30 Dec 05	none			8			
	777-300ER	GE90	30 Dec 05	none					15	
Air New Zealand	777-200ER	Trent 800	25 Aug 04	8 Nov 05		4				
Alitalia	777-200ER	GE90	9 Nov 00	23 Aug 02		6				
All Nippon Airways	777-200	PW4000	19 Dec 90	4 Oct 95	20					
	777-200ER	PW4000	19 Dec 90	6 Oct 99		7				
	777-300	PW4000	12 Sep 95	30 Jun 98				7		
	777-300ER	GE90	18 Jul 00	28 Oct 04					10	
American Airlines	777-200ER	Trent 800	21 Nov 96	21 Jan 99		54				
Asiana Airlines	777-200ER	PW4000	20 Dec 96	24 May 02		7				
Austrian Airlines	777-200ER	GE90	30 Sep 05	none		1				
Avion Group	777F	GE90	7 Sep 05	none						8
British Airways	777-200	GE90	21 Aug 91	11 Nov 95	5					
	777-200ER	GE90	21 Aug 91	6 Feb 97		24				
	777-200ER	Trent 800	1 Aug 98	7 Jun 00		16				
Cathay Pacific Airways	777-200	Trent 800	6 May 92	9 May 96	5					
	777-300	Trent 800	6 May 92	22 May 98				12		
	777-300ER	GE90	14 Dec 05	none					14	
China Southern Airlines	777-200	GE90	17 Dec 92	28 Dec 95	4					
	777-200ER	GE90	17 Dec 92	28 Feb 97		2				
Continental Airlines	777-200ER	GE90	12 May 93	28 Sep 98		18				
Delta Air Lines	777-200ER	Trent 800	13 Nov 97	23 Mar 99		13				
Egyptair	777-200ER	PW4090	23 Aug 95	23 May 97		5				
El Al Israel Airlines	777-200ER	Trent 800	14 Dec 99	29 Jan 01		6				
Emirates	777-200	Trent 800	4 Jun 92	5 Jun 96	3					
	777-200ER	Trent 800	4 Jun 92	11 Apr 97		6				
	777-200LR	GE90	21 Nov 05	none			10			
	777-300ER	GE90	19 Jul 04	15 Feb 06					28	
	777F	GE90	21 Nov 05	none						8
Etihad Airways	777-300ER	GE90	30 Nov 04	none					5	
EVA Airways	777-200LR	GE90	27 Jun 00	none			2			
	777-300ER	GE90	27 Jun 00	27 Jul 05					13	
Garuda Indonesian	777-200ER	GE90	25 Jun 96	none		6				
GECAS	777-200ER	GE90	26 Sep 00	10 Oct 03		4				
	777-300ER	GE90	26 Sep 00	30 Mar 05					14	
ILFC	777-200ER	GE90	15 Dec 92	8 Jan 98		33				
	777-200ER	PW4000	15 Dec 92	16 Jul 98		6				
	777-200ER	Trent 800	2 Sep 97	27 Oct 05		4				
	777-300	Trent 800	6 Mar 96	26 Sep 00				8		
	777-300ER	GE90	28 Nov 00	29 Apr 04					25	
Japan Air System	777-200	PW4000	29 Jun 93	3 Dec 96	7					
Japan Airlines	777-200	PW4000	24 Jan 92	15 Feb 96	8					
	777-200ER	GE90	27 Nov 00	11 Jul 02		11				
	777-300	PW4000	22 Dec 95	28 Jul 98				7		
	777-300ER	GE90	31 Mar 00	15 Jun 04					13	
Jet Airways	777-300ER	GE90	29 Sept 05	none					10	
Kenya Airways	777-200ER	Trent 800	22 Mar 02	21 May 04		4				
KLM	777-200ER	GE90	26 Aug 02	23 Oct 03		6				
Korean Air Lines	777-200ER	PW4000	16 Dec 93	21 Mar 97		18				
	777-300	PW4000	16 Dec 93	12 Aug 99				4		
Kuwait Airways	777-200	GE90	10 Jul 96	30 Mar 98		2				
Lauda Air	777-200ER	GE90	13 Dec 91	24 Sep 97		3				
Malaysia Airlines	777-200ER	Trent 800	8 Jan 96	23 Apr 97		15				
Mid East Jet	777-200ER	GE90	1 Oct 97	24 Nov 98		1				
Pakistan International Airlines	777-200ER	GE90	14 Nov 02	29 Jan 04		3				
	777-200LR	GE90	14 Nov 02	24 Feb 06			2			
	777-300ER	GE90	14 Nov 02	none					3	
Saudia	777-200ER	GE90	18 Jun 95	26 Dec 97		23				
Saudi Oger	777-200ER	GE90	30 Nov 98	22 Oct 99		1				
Singapore Aircraft Leasing	777-200ER	Trent 800	22 Dec 95	20 Mar 01		2				
	777-300	Trent 800	22 Dec 95	12 Nov 99				4		
Singapore Airlines	777-200ER	Trent 800	22 Dec 95	5 May 97		46				
	777-300	Trent 800	22 Dec 95	10 Dec 98				12		
	777-300ER	GE90	29 May 01	none					19	
TAAG	777-200ER	GE90	20 Jul 05	none		2				
Thai Airways International	777-200	Trent 800	20 Jun 91	31 Mar 96	8					
	777-200ER	Trent 800	23 Dec 04	none		6				
	777-300	Trent 800	22 Dec 95	23 Dec 98				6		
Unidentified	777-300ER	GE90	30 May 06	none					14	
	777-200LR	GE90	30 May 06	none			6			
	777-300ER	GE90	11 Aug 05	none					3	
United Airlines	777-200	PW4000	15 Oct 90	15 May 95	22					
	777-200ER	PW4000	15 Oct 90	7 Mar 97		38				
Vietnam Airlines	777-200ER	PW4000	31 Jan 02	20 Aug 03		4				
Subtotals					**92**	**425**	**40**	**60**	**209**	**23**
Total							**849**			

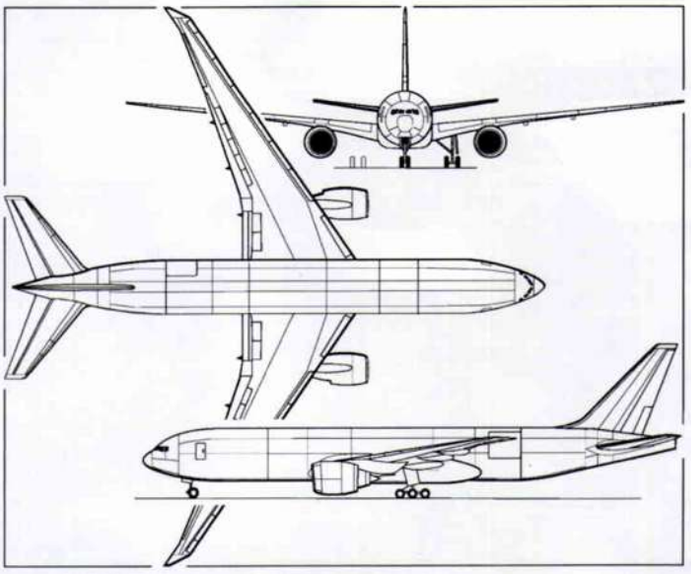
Notes: For delivery totals see Group Orders and Deliveries table
Order dates prior to launch date of specific versions result from renegotiation of earlier contracts
Japan Air System has merged with Japan Airlines
Boeing 777s have also been operated by Air Europe, Aeroflot, Lauda Air and Khalifa Airways

bins can be removed without disturbing ceiling panels, ducts or support structure; advanced cabin management system simplifies cabin management and includes digital sound system of hi-fi quality.

Typical configurations for 200/200ER include 305 passengers in three-class layout: 24 first class (two-two-two-abreast), 54 business class (two-three-two) and 227 economy class (three-three-three); 367 in two classes: 14 business (two-three-two) and 353 economy (three-three-three); 375 in two classes: 30 first class (two-two-two at 97 cm; 38 in pitch) and 345 economy (two-five-two at 79 cm; 31 in or 81 cm; 32 in pitch); 400 in two classes: 30 first class, as immediately previously and 370 economy (three-four-three, pitches as previously); and 440 passengers in single class (three-four-three).

For 777-200LR, typically 279 in two classes (42 first, 237 economy) or 301 in three classes (16 first, 58 business, 227 economy).

For 777-300, options include 368 in three classes: 30 first (two-two-two at 152 cm; 60 in), 84 business (two-three-two at 97 cm; 38 in) and 254 economy (two-five-two at



Boeing 777F freighter, based on 777-200LR *(Paul Jackson)* 1159124

79 cm; 31 in or 81 cm; 32 in); 386 in first (30), business (77) and economy (279) classes, as previously, except last-mentioned at three-four-three, with only four seats at minimum pitch; 451 passengers in two classes: 40 first, as above, and 411 economy (two-five-two, at usual pitches); 479, in first (44) and economy (435) classes, the former with 97 cm; 38 in pitch and latter three-four-three at usual pitches; and ultimate 550 single-class passengers, mostly two-four-two. Underfloor cargo compartments have mechanical handling system and can accommodate all LD formats and 88 in or 96 in width pallets; up to 32 LD-3 containers plus 17.0 m³ (600 cu ft) bulk cargo can be loaded in 777-200, or 44 LD-3s and some bulk cargo in 777-300.

Options for 777-300ER include 339 in two classes (56 first, 283 economy) and 370 in three classes (12/42/316).

Flight crew rest module on flight deck, port, contains two bunks. Optional underfloor crew rest modules available with six, eight or 10 bunks, and stowage space and require only electrical connection and hatch in passenger cabin floor, level with wing trailing-edge. Roof-mounted rest modules optional for ER and LR versions, occupying unused space between rows of baggage bins; first delivery May 2003.

Series 200 has four passenger doors each side; Series 300 has additional pair over wings.

SYSTEMS: Honeywell air drive unit, using bleed air from engines, APU or ground supply, drives central hydraulic system; cabin air supply and pressure control by Honeywell; Hamilton Sundstrand variable-speed, constant frequency AC electrical power generating system, with two 120 kVA integrated drive generators, one APU-driven generator and Honeywell ram air turbine system. Honeywell GTCP331-500 APU; Hamilton Sundstrand air conditioning; Smiths Industries ultrasonic fuel quantity gauging system and electrical load management system; optional wingtip folding by Raytheon Montek Division and Frisby Airborne Hydraulics.

AVIONICS: *Radar:* Honeywell weather radar standard.

Flight: Main navigation system is Honeywell air data and inertial reference (ADIRS) containing the Hexad skewed axis arrangement of six ring laser gyros; standby system is the secondary attitude and air data reference unit (SAARU) containing interferometric fibre optic gyros (using light transmitted in two directions along fibre optic paths), which produces a secondary flight director attitude display, airspeed and altimeter; both are linked to the ARINC 629 digital databus (777 being first aircraft thus equipped); Honeywell TCAS; Honeywell/BAE Systems Canada global navigation satellite sensor with 12-channel receiver; Honeywell/Racal multichannel satcom system optional. New, smaller flight computers installed from October 2003 onwards.

Dual Honeywell aircraft information management system (AIMS) contains the processing equipment required to collect, format and distribute onboard avionic information, including the flight management system (FMS), engine thrust control, digital communications management, operation of flight deck displays and monitoring of aircraft condition; both pilots and ground engineers can assess the condition of all onboard avionics systems.

Instrumentation: Six-screen EFIS using Honeywell 203 mm (18 in) ARINC D-size colour liquid crystal flat panel displays (two primary flight displays, two navigation displays and two engine/EICAS displays); three multipurpose control and colour display units on centre console provide interface with integrated aircraft information management system, which handles flight management, thrust control and communications control as well as all systems information.

Mission: Flight crew's 'electronic flight bag' (EFB) software installed from October 2003 (KLM Royal Dutch Airlines first) as option.

EQUIPMENT: Boeing 777-300 has Ground Maneuver Camera System with TV cameras in leading-edges of both horizontal stabilisers and underside of fuselage.

DIMENSIONS, EXTERNAL:

Wing span: 200, 200ER	60.93 m (199 ft 11 in)
200LR, 300ER	64.80 m (212 ft 7 in)
Wing aspect ratio	8.7
Length: fuselage: 200	62.94 m (206 ft 6 in)
300	73.08 m (239 ft 9 in)
overall: 200	63.73 m (209 ft 1 in)
300, 300ER	73.86 m (242 ft 4 in)
Fuselage: max diameter	6.20 m (20 ft 4 in)
Height overall: 200LR:	
at OWE	18.75 m (61 ft 6 in)
at MTOW	18.49 m (60 ft 8 in)
300LR: at OWE	18.85 m (61 ft 10 in)
at MTOW	18.24 m (59 ft 10 in)
300	18.49 m (60 ft 8 in)
300ER	18.57 m (60 ft 11 in)
Tailplane span	21.52 m (70 ft 7½ in)
Wheel track (c/l shock absorbers)	10.97 m (36 ft 0 in)
Wheelbase: 200 srs	25.88 m (84 ft 11 in)
300 srs	31.22 m (102 ft 5¼ in)
Turning radius: at nosewheel: 200 srs	28.0 m (92 ft)
300 srs	33.8 m (111 ft)
at mainwheel (outer rims): 200 srs	15.5 m (51 ft)
300 srs	17.7 m (58 ft)
at wingtip: 200 srs	43.3 m (142 ft)
300 srs	45.1 m (148 ft)
Distance between engine centres	19.23 m (63 ft 1 in)
Ground clearance under engine nacelles at MTOW	5.13 m (16 ft 10 in)
Passenger doors (four/five each side, according to variant):	
Height	1.88 m (6 ft 2 in)
Width	1.07 m (3 ft 6 in)
Height to sill: 200LR	
No. 1: at OWE	5.05 m (16 ft 7 in)
at MTOW	4.70 m (15 ft 5 in)
No. 2: at OWE	5.13 m (16 ft 10 in)
at MTOW	4.85 m (15 ft 11 in)
No. 3: at OWE	5.31 m (17 ft 5 in)
at MTOW	5.13 m (16 ft 10 in)
No. 4: at OWE	5.51 m (18 ft 1 in)
at MTOW	5.31 m (17 ft 5 in)
300 ER	
No. 1: at OWE	5.13 m (16 ft 10 in)
at MTOW	4.80 m (15 ft 9 in)
No. 2: at OWE	5.21 m (17 ft 1 in)
at MTOW	4.93 m (16 ft 2 in)
Overwing	inaccessible
No. 4: at OWE	5.31 m (17 ft 5 in)
at MTOW	5.11 m (16 ft 9 in)
No. 5: at OWE	5.66 m (18 ft 7 in)
at MTOW	5.18 m (17 ft 0 in)
Forward cargo door, stbd: Height	1.70 m (5 ft 7 in)
Width	2.69 m (8 ft 10 in)
Height to sill: 200LR:	
at OWE	3.10 m (10 ft 2 in)
at MTOW	2.79 m (9 ft 2 in)
300ER: at OWE	3.20 m (10 ft 6 in)
at MTOW	2.87 m (9 ft 5 in)
Rear cargo door, stbd:	
Height	1.70 m (5 ft 7 in)
Width: standard	1.78 m (5 ft 10 in)
optional	2.69 m (8 ft 10 in)
Height to sill: 200LR:	
at OWE	3.40 m (11 ft 2 in)
at MTOW	3.23 m (10 ft 7 in)
300ER: at OWE	3.58 m (11 ft 9 in)
at MTOW	3.20 m (10 ft 6 in)
Bulk cargo door, stbd: Height	0.91 m (3 ft 0 in)
Width	1.14 m (3 ft 9 in)
Height to sill: 200LR:	
at OWE	3.61 m (11 ft 10 in)
at MTOW	3.40 m (11 ft 2 in)
300ER: at OWE	3.76 m (12 ft 4 in)
at MTOW	3.33 m (10 ft 11 in)

DIMENSIONS, INTERNAL:

Cabin: Length	49.10 m (161 ft 1 in)
Max width	5.87 m (19 ft 3 in)
Floor area: 200, 200ER	279.1 m² (3,004 sq ft)
Underfloor baggage hold:	
Forward: Length: 200	14.96 m (49 ft 1 in)
300	20.29 m (66 ft 7 in)
Volume: 200	80.5 m³ (2,844 cu ft)
300	107.4 m³ (3,792 cu ft)
Aft: Length: 200	11.35 m (37 ft 3 in)
300	16.15 m (53 ft 0 in)
Volume: 200	62.6 m³ (2,212 cu ft)
200LR with max fuel	35.8 m³ (1,264 cu ft)
300	89.5 m³ (3,160 cu ft)
Bulk: Length: 200, 300	4.47 m (14 ft 8 in)
Volume: 200, 300	17.0 m³ (600 cu ft)
Height (all)	1.70 m (5 ft 7 in)
Total volume: 200	160.2 m³ (5,656 cu ft)
200LR with max fuel	133.3 m³ (4,708 cu ft)
300	213.8 m³ (7,552 cu ft)

AREAS:

Wings, projected: short span	427.8 m² (4,605.0 sq ft)
extended span	not disclosed
Ailerons (total)	7.11 m² (76.50 sq ft)
Trailing-edge flaps (total)	67.13 m² (722.60 sq ft)
Slats (total)	36.84 m² (396.50 sq ft)
Inboard spoilers (total)	8.67 m² (93.30 sq ft)
Outboard spoilers (total)	14.34 m² (154.40 sq ft)
Flaperons	6.69 m² (72.00 sq ft)
Horizontal tail surfaces, projected	101.26 m² (1,090.0 sq ft)
Vertical tail surfaces, projected	53.23 m² (573.00 sq ft)
Elevators, incl tabs (total)	25.48 m² (274.30 sq ft)
Rudder, incl tab	18.16 m² (195.50 sq ft)

WEIGHTS AND LOADINGS: 777-200 with 305 passengers (24/54/227): 2GB: GE90-77B engines at basic: TOW, 2GM: GE90-77B engines at max TOW, 2PB: PW4074 engines at basic TOW, 2PM: PW4077 engines at max TOW, 2RB: Trent 875 engines at basic TOW, 2RM: Trent 877 engines at max TOW, 777-200ER with 301 passengers (16/58/227): 2ERGB: GE90-85B engines at basic TOW, 2ERGM: GE90-94 engines at max TOW, 2ERPB: PW4084 engines at basic TOW, 2ERPM: PW4090 engines at max TOW, 2ERRB: Trent 884 engines at basic TOW, 2ERRM: Trent 895 engines at max TOW, 777-200LR: 2LRGB: GE90-110B engines at max TOW, 2LRGM: GE90-115B engines at max TOW, 777-300 with 368 passengers (30/84/254): 3PB: PW4090 engines at basic TOW, 3PM: PW4098 engines at max TOW, 3RB: Trent 892 engines at basic TOW, 3RM: Trent 892 engines at max TOW, 777-300ER with 370 passengers (12/42/316): 3ERGB: GE90-115B1 engines at basic TOW, 3ERGM: GE90-115B1 engines at max TOW:

(identifiers such as '2GB' are *not* Boeing designations)

Operating weight empty: 2GB	140,660 kg (310,100 lb)
2GM	140,795 kg (310,400 lb)
2PB	138,890 kg (306,200 lb)

2PM ..... 139,025 kg (306,500 lb)
2RB ..... 141,205 kg (311,300 lb)
2RM ..... 141,385 kg (311,700 lb)
2ERGB ..... 144,830 kg (319,300 lb)
2ERGM ..... 145,015 kg (319,700 lb)
2ERPB ..... 143,065 kg (315,400 lb)
2ERPM ..... 143,835 kg (317,100 lb)
2ERRB ..... 141,205 kg (311,300 lb)
2ERRM ..... 141,385 kg (311,700 lb)
200LR ..... 145,150 kg (320,000 lb)
3PB ..... 158,030 kg (348,400 lb)
3PM ..... 158,485 kg (349,400 lb)
3RB, 3RM ..... 155,540 kg (342,900 lb)
300ER ..... 167,830 kg (370,000 lb)
Max fuel weight: 200 ..... 94,210 kg (207,700 lb)
200ER/300 ..... 135,845 kg (299,490 lb)
200LR: basic ..... 145,540 kg (320,860 lb)
max ..... 162,410 kg (358,050 lb)
300ER ..... 145,540 kg (320,860 lb)
Max T-O weight:
2GB, 2PB, 2RB ..... 229,575 kg (506,000 lb)
2GM, 2PM, 2RM ..... 247,205 kg (545,000 lb)
2ERGB, 2ERPB, 2ERRB, 3PB, 3RB ..... 263,080 kg (580,000 lb)
2ERGM, 2ERPM, 2ERRM ..... 297,555 kg (656,000 lb)
200LR ..... 347,815 kg (766,800 lb)
3PM, 3RM ..... 299,370 kg (660,000 lb)
3ERGB ..... 345,050 kg (760,700 lb)
3ERGM ..... 351,535 kg (775,000 lb)
Max ramp weight allowance:
200, 2ERB, 200LR, 300, 300ER ..... 907 kg (2,000 lb)
2ERM ..... 454 kg (1,000 lb)
Max landing weight: 200 ..... 201,845 kg (445,000 lb)
200ER ..... 213,190 kg (470,000 lb)
200LR ..... 223,170 kg (492,000 lb)
300 ..... 237,680 kg (524,000 lb)
300ER ..... 251,290 kg (554,000 lb)
Max zero-fuel weight: 200 ..... 190,510 kg (420,000 lb)
200ER ..... 199,580 kg (440,000 lb)
200LR ..... 209,105 kg (461,000 lb)
300 ..... 224,525 kg (495,000 lb)
300ER ..... 237,680 kg (524,000 lb)
Max wing loading:
2GB, 3PB, 2RB ..... 536.5 kg/m^2 (109.88 lb/sq ft)
2GM, 3PM, 2RM ..... 577.8 kg/m^2 (118.35 lb/sq ft)
2ERGB, 2ERPB, 2ERRB, 3PB, 3RB ..... 614.9 kg/m^2 (125.95 lb/sq ft)
2ERGM, 2ERPM, 2ERRM ..... 695.5 kg/m^2 (142.45 lb/sq ft)
3PM, 3RM ..... 699.8 kg/m^2 (143.32 lb/sq ft)
Max power loading: 2GB ..... 335 kg/kN (3.29 lb/lb st)
2GM ..... 361 kg/kN (3.54 lb/lb st)
2PB ..... 346 kg/kN (3.40 lb/lb st)
2PM ..... 360 kg/kN (3.53 lb/lb st)
2RB ..... 351 kg/kN (3.45 lb/lb st)
2RM ..... 366 kg/kN (3.59 lb/lb st)
2ERGB ..... 349 kg/kN (3.42 lb/lb st)
2ERGM ..... 357 kg/kN (3.50 lb/lb st)
2ERPB ..... 350 kg/kN (3.43 lb/lb st)
2ERPM ..... 371 kg/kN (3.64 lb/lb st)
2ERRB ..... 354 kg/kN (3.47 lb/lb st)
2ERRM ..... 358 kg/kN (3.51 lb/lb st)
2LRGB ..... 355 kg/kN (3.49 lb/lb st)
2LRGM ..... 340 kg/kN (3.33 lb/lb st)
3PB, 3RB ..... 328 kg/kN (3.22 lb/lb st)
3PM ..... 343 kg/kN (3.37 lb/lb st)
3RM ..... 374 kg/kN (3.67 lb/lb st)
3ERGB ..... 337 kg/kN (3.31 lb/lb st)
3ERGM ..... 344 kg/kN (3.37 lb/lb st)

PERFORMANCE:

Cruising speed: all M0.84
Approach speed: 200 ..... 136 kt (252 km/h; 157 mph)
200ER ..... 138 kt (256 km/h; 159 mph)
300 ..... 149 kt (276 km/h; 171 mph)
300ER ..... 150 kt (278 km/h; 173 mph)
Initial cruising altitude (ISA + 10°C):
2GB ..... 12,010 m (39,400 ft)
2GM, 2PB ..... 11,550 m (37,900 ft)
2PM, 2ERGB ..... 11,155 m (36,600 ft)
2RB ..... 11,645 m (38,200 ft)
2RM ..... 11,370 m (37,300 ft)
2ERGM ..... 10,575 m (34,700 ft)
2ERPB ..... 10,820 m (35,500 ft)
2ERPM ..... 10,270 m (33,700 ft)
2ERRB ..... 11,005 m (36,100 ft)
2ERRM ..... 10,455 m (34,300 ft)
3PB ..... 10,975 m (36,000 ft)
3PM ..... 10,425 m (34,200 ft)
3RB ..... 11,245 m (36,900 ft)
3RM ..... 10,395 m (34,100 ft)
3ERGM ..... 9,845 m (32,300 ft)
Service ceiling, OEI (ISA +10°C):
2GB ..... 5,515 m (18,100 ft)
2GM ..... 4,724 m (15,500 ft)
2PB ..... 4,940 m (16,200 ft)
2PM ..... 4,877 m (16,000 ft)
2RB ..... 4,816 m (15,800 ft)
2RM ..... 5,365 m (17,600 ft)
2ERGB ..... 3,995 m (13,100 ft)
2ERGM ..... 3,719 m (12,200 ft)
2ERPB ..... 4,359 m (14,300 ft)
2ERPM ..... 3,660 m (12,000 ft)
2ERRB ..... 4,755 m (15,600 ft)
2ERRM ..... 3,749 m (12,300 ft)
3PB ..... 4,572 m (15,000 ft)
3PM ..... 3,719 m (12,200 ft)
3RB ..... 4,816 m (15,800 ft)
3RM ..... 3,505 m (11,500 ft)
T-O field length (30° C): 2GB ..... 2,073 m (6,800 ft)
2GM ..... 2,530 m (8,300 ft)
2PB, 2RB ..... 2,164 m (7,100 ft)
2PM, 2RM ..... 2,576 m (8,450 ft)
2ERGB ..... 2,515 m (8,250 ft)
2ERGM ..... 3,033 m (9,950 ft)
2ERPB ..... 2,591 m (8,500 ft)
2ERPM ..... 3,582 m (11,750 ft)
2ERRB ..... 2,545 m (8,350 ft)
2ERRM ..... 3,140 m (10,300 ft)
3PB ..... 2,759 m (9,050 ft)
3PM ..... 3,292 m (10,800 ft)
3RB ..... 2,667 m (8,750 ft)
3RM ..... 3,734 m (12,250 ft)
3ERGM ..... 3,200 m (10,500 ft)
Landing field length: 2GB, 2GM ..... 1,570 m (5,150 ft)
2PB, 2PM, 2RB, 2RM ..... 1,555 m (5,100 ft)
2ERGB, 2ERGM ..... 1,616 m (5,300 ft)
2ERPB, 2ERPM, 2ERRB, 2ERRM ..... 1,601 m (5,250 ft)
300 ..... 1,844 m (6,050 ft)
Design range:
2GB ..... 3,985 n miles (7,380 km; 4,585 miles)
2GM ..... 5,145 n miles (9,528 km; 5,920 miles)
2PB ..... 3,955 n miles (7,324 km; 4,551 miles)
2PM ..... 5,070 n miles (9,389 km; 5,834 miles)
2RB ..... 4,100 n miles (7,593 km; 4,718 miles)
2RM ..... 5,210 n miles (9,648 km; 5,995 miles)
2ERGB ..... 5,810 n miles (10,760 km; 6,686 miles)
2ERGM ..... 7,730 n miles (14,315 km; 8,895 miles)
2ERPB ..... 5,695 n miles (10,547 km; 6,553 miles)
2ERPM ..... 7,410 n miles (13,723 km; 8,527 miles)
2ERRB ..... 5,840 n miles (10,815 km; 6,720 miles)
2ERRM ..... 7,665 n miles (14,195 km; 8,820 miles)
200LR ..... 9,150 n miles (16,945 km; 10,529 miles)
3PB ..... 3,880 n miles (7,185 km; 4,465 miles)
3PM ..... 5,710 n miles (10,574 km; 6,570 miles)
3RB ..... 4,050 n miles (7,500 km; 4,660 miles)
3RM ..... 5,955 n miles (11,028 km; 6,852 miles)
3ERGB ..... 6,240 n miles (11,556 km; 7,180 miles)
3ERGM ..... 7,880 n miles (14,593 km; 9,068 miles)

BOEING 787 DREAMLINER

TYPE: Wide-bodied airliner.

PROGRAMME:

DEVELOPMENT MILESTONES

Programme launched	26 Apr 04
Marketing began	15 Dec 03
First order (All Nippon Airways)	26 Apr 04

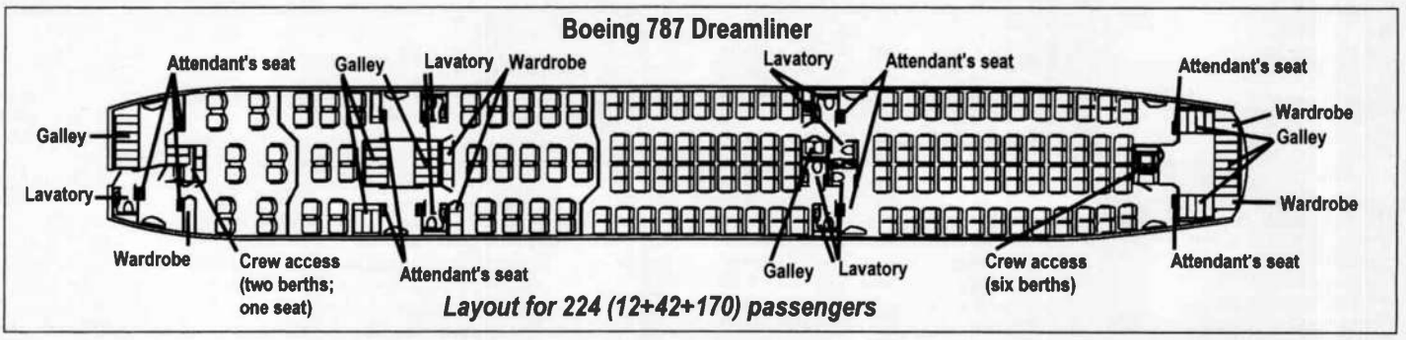
Originated in Super Efficient Airliner studies undertaken in 2001–02 in parallel with (then) higher-profile Sonic Cruiser; assumed prominence when latter abandoned in December 2002. Working designation of 7E7 to indicate 'Efficient'; named Dreamliner on 15 June 2003, following public Internet vote; designation 787 announced 28 January 2005. Programme headquarters at Everett. Development effort will involve 15,000 hours of wind tunnel testing.

Airline commitments sought from early 2004 onwards and launch in latter part of that year; configuration freeze in second quarter of 2005; first flight 2007; service entry 2008.

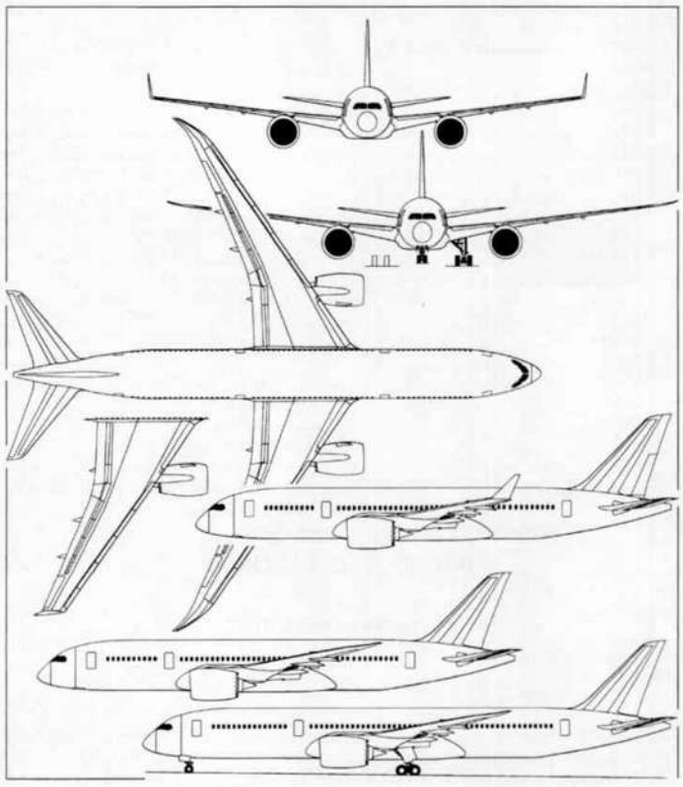
On 15 December 2003, Boeing's Board of Directors approved the start of marketing of the 787 in the expectation of receiving sufficient proposals by airlines to warrant a formal launch to the programme during 2004. Launch customer All Nippon Airways announced order for 50 on 26 April 2004; 787 programme formally launched same day.

For details of the latest updates to *Jane's All the World's Aircraft* online and to discover the additional information available exclusively to online subscribers please visit
jawa.janes.com

Model of Boeing 787 *(Paul Jackson)* 1159171



Typical Boeing 787 interior *(Paul Jackson)* 1159117



Boeing 787-9 Dreamliner; with nose (upper), side (top) and scrap wing plan of 787-3; and side (centre) view of 787-8 *(Paul Jackson)* 1159118

Final configuration, revealed April 2005 omitting characteristic 'shark fin' of initial design. Joint development phase completed 23 September 2005. Flight control laws tested on leased American Airlines Boeing 777 in 2006. First metal cutting for major component (wing centre-section in Japan) celebrated 30 June 2006.

Flight test programme to involve six aircraft (four RR- and two GE-engined) while further two assigned to ground testing (No. 2 ststic tests; No. 4 fatigue tests); eight airframes in total. First flight August 2007 (RR) followed by initial GE-engined aircraft in November 2007.

CURRENT VERSIONS: **787-8:** Baseline version; service entry 2008.

787-8 VIP: Executive transport version formally announced at NBAA Convention, Orlando, Florida, 18 October 2006, when two revealed to be on order. First flight ('green') due 2010. Differences from airliner include cabin max width of 5.46 m (17 ft 11 in); floor area 223.3 m^2 (2,404 sq ft); cargo volume 136.7 m^3 (4,826 cu ft). Range 10,440 n miles (19,334 km; 12,014 miles) with eight passengers; 9,285 n miles (17,195 km; 10,685 miles) with 100 passengers. Empty weight 118,430 kg (261,100 lb), including 18,144 kg (40,000 lb) completion allowance. Operating cost USD5,160 per hour (2006).

787-3: Short range. Length and height as 787-8, but span reduced. Variant-specific weight-saving measures employed. Service entry due with Air New Zealand in December 2010.

787-9: Stretched; span increased some 1.82 m (6 ft) over 787-8, but height unchanged. Service entry late 2010.

787-9 VIP: As 787-8 VIP, with three orders revealed October 2006. Generally as 787-9 airliner, but cabin max width 5.46 m (17 ft 11), floor area 256.6 m^2 (2,762 sq ft), cargo volume 172.4 m^3 (6,090 cu ft). Range 10,250 n miles (18,983 km; 11,795 n miles) with eight passengers; 9,850 n miles (18,242 km; 11,335 miles) with 100 passengers. Empty weight 127,820 kg (281,800 lb), including 20,412 kg (45,000 lb) completion allowance. Operating cost USD5,500 per hour (2006).

787-10X: Design study of 2005 to counter Airbus A350-900; 'double' fuselage stretch to 68.0 m (223 ft), accommodating minimum of 290 passengers; probable adoption of 787-9 wing.

CUSTOMERS: Boeing studies show 20-year market for between 2,000 and 3,000 mid-size airliners of 787 class.

BOEING 787 ORDER BOOK
(at 30 June 2006)

Customer	Variant	Engine	First Order	First Delivery	Qty
Air Canada	787-8	GE	10 Nov 05	none	14
Air China	787-8	TBA	22 Aug 05	none	15
Air India	787-8	GE	30 Dec 05	none	27
Air New Zealand	787-8	RR	25 Aug 04	none	4
Air Pacific	787-9	TBA	19 April 06	none	5
All Nippon Airways	787-3	RR	26 Jul 04	none	30
	787-8	RR	26 Jul 04	none	20
Blue Panorama	787-8	TBA	29 Dec 04	none	4
China Eastern Airlines	787-8	TBA	14 Nov 05	none	15
China Southern Airlines	787-8	TBA	16 Dec 05	none	10
Continental Airlines	787-8	GE	30 Jun 05	none	20
Ethiopian Airlines	787-8	GE	30 Jun 05	none	10
First Choice Airways	787-8	GE	17 Feb 05	none	6
Hainan Airlines	787-8	TBA	28 Nov 05	none	8
Icelandair	787-8	RR	28 Feb 05	none	4
ILFC	787-8	TBA	7 Oct 05	none	20
JAL International	787-8	GE	10 May 05	none	30
Kenya Airways	787-8	TBA	6 Mar 06	none	6
Korean Air	787-8	GE	31 May 05	none	10
Lcal	787-8	RR	16 May 05	none	6
	787-9	TBA	31 Dec 05	none	8
LOT	787-8	RR	Sep 05	none	7
Northwest Airlines	787-8	GE	6 May 05	none	18
Qantas	787-8	TBA	30 Mar 06	none	15
	787-9	TBA	30 Mar 06	none	30
Royal Air Maroc	787-8	GE	29 Nov 05	none	4
Shanghai Airlines	787-8	TBA	22 Aug 05	none	9
Vietnam Airlines	787-8	TBA	16 Nov 05	none	4
Unidentified	787-9	TBA	3 Mar 06	none	1
Total					**360**

COSTS: USD138.0 million to USD143.0 million 787-3; USD148.0 million to USD157.5 million 787-8; USD178.5 million to USD188.0 million 787-9 (all 2006).

DESIGN FEATURES: Intended to replace Boeing 767 and reduce seat/mile costs while providing increased versatility by enabling direct operations into smaller airports, thereby obviating the inconvenience of passenger transfers at hubs.

Efficiency gains of 15 to 20 per cent, compared to Boeing 767, to be achieved by 17 per cent reduction in fuel burn, aerodynamic improvements and airframe weight reduction. Cruising Mach No 0.85. First airliner with all-composites primary structure in fuselage and wing; and first to dispense with engine bleed and pneumatics in favour of increased electronic components.

Low wing configuration with two pylon-mounted turbofans underwing. Sweptback wing with increased sweep at tips, latter partly upturned. Pronounced sweep on fin leading- and trailing-edges.

First airliner application of trailing-edge variable camber (TEVC) which automatically deflects flaps progressively in 30' increments during cruise up to a maximum of 1° 30' either side of a neutral setting (3° movement in total); predicted 0.4 per cent drag reduction; electric actuation via torque tubes; effect maximised by drooped spoilers tailoring airflow between wing and flap.

FLYING CONTROLS: Outboard and inboard ailerons; two-section elevator; single-piece rudder. Three-section spoilers/airbrakes ahead of outboard flaps; two section spoilers/airbrakes ahead of inboard flaps. Trailing-edge variable camber system.

STRUCTURE: Up to 65 per cent of airframe built by external suppliers. Some 35 per cent produced in Japan, with Mitsubishi contributing composites wingbox; Kawasaki the intermediate forward fuselage, main landing gear well and wing fixed trailing edge; Fuji responsible for centre wing box and integration of wheelwells. Vought and Alenia team producing 26 per cent, principally centre and rear fuselage sections and tailplane; Boeing producing almost 40 per cent at Australian, Canadian and US sites (forward fuselage, engine pylons and flight deck at Spirit AeroSystems, the former Boeing Wichita, wing/fuselage fairings at Winnipeg, wing moving leading- and trailing-edges at Tulsa and Hawker de Havilland, Australia, and fin at Frederickson). Composites for "majority" of fuselage and wing, predominantly carbon fibre/epoxy but with titanium-graphite (TiGr) laminate in wings. Toray Industries prepreg carbon fibre/epoxy resin composite (T800S/3900-2B) used for major sections of wing and fuselage. Possible use of new aluminium alloys for smaller structural pieces. Airframe 50 per cent composites by weight; 20 per cent aluminium; 15 per cent titanium; and 10 per cent steel.

BOEING 787 MAJOR SUPPLIERS

Air Cruisers	Escape slides
Alenia Aeronautica	Centre and aft fuselage; tailplane
Boeing (Everett)	Design and final assembly
Boeing (Frederickson)	Fin
Boeing (Tulsa)	Wing leading-edge
Boeing (Winnipeg)	Wing-to-body fairing
Boeing (HdH, Australia)	Wing moving trailing-edges
Boeing (Washington)	Interior; propulsion systems engineering
Bridgestone	Tyres
Dassault Systems	CATIA software
Donaldson Company	Air purification system
FR-HITemp	Fuel pumps and valves
Fuji	Centre wing box and integration of landing gear
General Electric	Engine option
Goodrich	Engine nacelles; fuel controls; electric brakes; exterior lighting; cargo handling
Hamilton Sundstrand	Environmental controls; electrical power; power distribution; APU; nitrogen generation; RAT emergency generator
Honeywell	Navigation systems; health management; flight control electronics
Kaiser Electroprecision	Pilot control system
Kawasaki	Intermediate forward fuselage; mainwheel wells; wing fixed trailing-edges
Kidde Technologies	Fire protection
Korry Electronics	Flight deck control panels
Labinal	Wiring
Latécoère	Passenger doors
Matsushita	Cabin services system
Messier Bugatti	Electric brakes
Messier-Dowty	Landing gear structure
Monogram Systems	Water and waste system
Moog	Flight control actuators
Mitsubishi	Wing box
Parker Hannifin	Hydraulic subsystem
Rockwell Collins	Communications, surveillance and display systems
Rolls-Royce	Engine option
Smiths Aerospace	Common core system; landing gear actuation
Spirit AeroSystems	Nose and forward fuselage; leading edges; engine pylons
Thales	Electrical power conversion; standby flight displays
Toray Industries (Japan)	CFRP
Toray Industries (USA)	CFRP
Ultra Electronics	Ice protection (wing)
Vought Aircraft	(as Alenia Aeronautica)

LANDING GEAR: Tricycle type; retractable. Messier-Dowty design and manufacture. Twin nosewheels and two four-wheel main bogies; increased bogie width on 787-9. Nosewheel tyres 40×16.0P16/26PR, pressure 12.9 bar (187 lb/sq in); mainwheel tyres 50×20.0R22.34PR or (787-9)/36PR); pressure 11.9 bar (173 lb/sq in) on 787-3; 15.2 bar (221 lb/sq in) on 787-8; 14.7 bar (213 lb/sq in) on 787-9. All-electric brakes. Choice of two wheel and brake manufacturers. Nosewheel max steering angle 65°. Taxiway width for U-turn 42 m (138 ft) for 787-3 and -8; 47 m (154 ft) for 787-9.

POWER PLANT: Two turbofans, each in 235 to 311 kN (52,800 to 69,000 lb st) class, with bypass ratio between 9 and 12, pressure ratio 50:1 and fan diameter up to 2.92 m (9 ft 7 in). General Electric Gen X and Rolls-Royce Trent 1000 options. Goodrich fuel management system, nacelles and thrust reverser. Kidde fire protection.

Fuel capacity 126,917 litres (33,528 US gallons; 27,918 Imp gallons) in all versions. Pressure refuelling point below port wing leading-edge, immediately outboard of engine pylon.

ACCOMMODATION: Eight-abreast (two-four-two) seating. Window size 50 per cent larger than competing airliners. Pilot's controls by Kaiser Electroprecision.

787-3: Total 296 passengers in two-class configuration, comprising 20 business class at 91 cm (36 in) pitch and 276 economy class at 81 cm (32 in) pitch. Two business and four economy class lavatories; business galley forward, economy galley at rear. Underfloor capacity for typical load of five pallets (88×125 or 96×125) or 16LD3 forward; plus four 88×125, or three 88×125 and two LD3s, or 12 LD3s in rear hold, plus 11.4 m³ (402 cu ft) in bulk cargo bay at extreme rear.

787-8: Typically 224 passengers in three-class configuration, comprising 12 first class at 155 cm (61 in) pitch, 42 business and 170 economy; plus overhead crew accommodation of two berths and one folding seat forward and six berths at rear; one first, two business and five economy class lavatories; galley in each class. Alternative all-economy capacity of 375 seats; exit - limited maximum of 440. Low density option of 187 passengers (8, 32, 147) plus two crew berths and seats forward, and six berths aft. Underfloor capacity as 787-3.

787-9: Total 259 passengers in three-class configuration, comprising 13 first, 48 business (99 cm; 39 in pitch) and 198 economy; crew accommodation of two berths and one folding seat forward and six berths at rear; two, three and six lavatories; galley in each class. Underfloor capacity for six pallets (88×125 or 96×125) or 20 LD3s forward; five 88×125 pallets or 16 LD3s rear; plus bulk cargo bay as 787-3/-8.

All versions have four equal-size doors each side for passenger access, galley servicing and emergency exit. Normal boarding via port Nos. 1 and 2 doors. Baggage hold doors, starboard, fore and aft of wing; bulk cargo door, port, at rear.

787 VIP: Interiors offered by Lufthansa Technik in collaboration with Andrew Winch Design.

SYSTEMS: Real-time structural monitoring by continuous collection of data from embedded sensors. Variable-frequency electrical system; 350 bar (5,000 lb/sq in) hydraulic system. Hamilton Sundstrand APU, environmental control system, power generating and starting systems.

AVIONICS: Rockwell Collins displays and communications/surveillance systems. Thales integrated flight displays. Five display screens each 305 x 231 mm (12 x 9.1 in); dual HUD and electronic flight bag. Maximum commonality with Boeing 777, although double screen display area. Honeywell crew information system/management system (CIS/MS). Avionics based around Smiths Aerospace common core system (CCS) comprising two dual-redundant common computing resources (CCR) cabinets containing fault-tolerant computing modules, each with ARINC 653 partitioned software operating environment. ARINC 664 deterministic ethernet/advanced communications network connects CCR to several remote data concentrators and avionics and utilities systems.

DIMENSIONS, EXTERNAL (Boeing 787-3, -8 and -9):

Wing span: –3	**51.71 m (169 ft 8 in)**
–8	**60.12 m (197 ft 3 in)**
–9	**61.95 m (203 ft 3 in)**
Length: fuselage: –3, –8	**55.91 m (183 ft 5 in)**
–9	**62.03 m (203 ft 6 in)**
overall: –3, –8	56.72 m (186 ft 1 in)
–9	62.81 m (206 ft 1 in)
Fuselage: Max width	5.74 m (18 ft 10 in)
Max height	5.92 m (19 ft 5 in)
Height: overall: –3, –8	16.92 m (55 ft 6 in)
–9	16.97 m (55 ft 8 in)
Tailplane span	19.81 m (65 ft 0 in)
Wheel track: c/l shock absorbers	9.80 m (32 ft 2 in)
between outboard tyre rims: –3, –8	11.61 m (38 ft 1 in)
–9	11.76 m (38 ft 7 in)
Wheelbase: –3, –8	22.78 m (74 ft 9 in)
–9	25.83 m (84 ft 9 in)
Distance between engine centres: –8	19.46 m (63 ft 10 in)
Ground clearance: under engine nacelles	0.71 m (2 ft 4 in)
under fuselage	1.75 m (5 ft 9 in)
Passenger door, height to sill: –8:	
No. 1	4.32 m (14 ft 2 in)
No. 2	4.44 m (14 ft 7 in)
No. 3	4.67 m (15 ft 4 in)
No. 4	4.83 m (15 ft 10 in)
Baggage door, height to sill: –8:	
fwd (stbd)	2.44 m (8 ft 0 in)
rear (stbd)	2.79 m (9 ft 2 in)
bulk cargo (port)	2.90 m (9 ft 6 in)

DIMENSIONS, INTERNAL:

Length: –8	42.29 m (138 ft 9 in)
–9	48.39 m (158 ft 9 in)
Cabin: Max width	5.74 m (18 ft 10 in)
Max height	2.29 m (7 ft 6 in)
Baggage hold volume: –8	136.7 m³ (4,826 cu ft)

WEIGHTS AND LOADINGS:

Operating weight empty: –3	**101,195 kg (223,100 lb)**
–8	**108,860 kg (240,000 lb)**
–9	115,350 kg (254,300 lb)
Max structural payload: –8	45,359 kg (100,000 lb)
Max fuel weight	101,895 kg (224,640 lb)
Max T-O weight: –3	163,745 kg (361,000 lb)
–8	217,725 kg (480,000 lb)
–9	230,650 kg (508,500 lb)
Max ramp weight: –3	164,650 kg (363,000 lb)
–8	218,630 kg (482,000 lb)
–9	231,560 kg (510,500 lb)
Max landing weight: –8	165,560 kg (365,000 lb)
Max zero-fuel weight: –3	149,685 kg (330,000 lb)
–8	**154,220 kg (340,000 lb)**
–9	**170,550 kg (376,000 lb)**

PERFORMANCE:

Normal cruising Mach No.	**0.85**
Range: –3: with 290 passengers	**3,500 n miles (6,482 km; 4,027 miles)**
with 330 passengers	**3,000 n miles (5,556 km; 3,452 miles)**
–8: with 210 passengers	**8,500 n miles (15,742 km; 9,781 miles)**
with 250 passengers	**8,000 n miles (14,816 km; 9,206 miles)**
–9: with 250 passengers	**8,800 n miles (16,297 km; 10,126 miles)**
with 290 passengers	**8,600 n miles (15,927 km; 9,896 miles)**

DOUGLAS PRODUCTS DIVISION (DIVISION OF BOEING COMMERCIAL AIRPLANE GROUP)

The Douglas Aircraft Company became Douglas Products Division when Boeing absorbed McDonnell Douglas in August 1997. Final MD-80 series, an MD-83, was delivered on 21 December 1999; MD-90 line closed at end of 2000; last MD-11 delivered 22 February 2001. Former MD-95 marketed as Boeing 717. Commercial aircraft production at this Division ended with delivery of last two 717s in May 2006.

BOEING 717

TYPE: Twin-jet airliner.

PROGRAMME:

DEVELOPMENT MILESTONES

Announced	Jun 91
Prototype construction started	(late) 94
Launch order (ValuJet)	19 Oct 95
Rolled out	10 Jun 98
First flight	2 Sep 98
Certification	1 Sep 99
First delivery (AirTran)	23 Sep 99
Entered service	12 Oct 99

Announced at Paris Air Show 1991 as MD-95; potential airline customers briefed and manufacturing partners announced in Berlin, November 1994; modification of former Eastern Airlines DC-9-30 into development prototype began late 1994; design acquired by Boeing in August 1997 and renamed Boeing 717 in January 1998, re-using model number originally allocated to KC-135A tanker vesion of Boeing 707. Three flight test aircraft (T1, T2 and T3); first nose section (built by MDC) delivered to Huntington Beach on 11 December 1996 for T1, which began final assembly in May 1997 and was rolled out on 10 June 1998. BR 715 engine certified 1 September 1998.

First flight of prototype (N717XA; T1) 2 September 1998; second prototype (N717XB; T2) first flew 26 October 1998; third (N717XC; T3) on 16 December 1998, at which time first two had flown 361 hours in 193 sorties. First production aircraft (N717XD; P1) rolled out 23 January 1999; JAA/FAA certification awarded 1 September 1999 at end of five aircraft, 2,000 hour, 1,900 sortie programme; first aircraft (N942AT; third production) delivered to AirTran on 23 September 1999, after demonstration flights; entered service on Atlanta-Washington, DC, route on 12 October 1999. Updated FMS certified 20 October 2000, adding GPS, fuel prediction, vertical guidance and automatic calculation of V-speeds. CIS certification awarded 20 February 2001. Delivery of 100th effected on 18 June 2002 as 37th for AirTran.

Production rate, set at five per month in 2001, had dropped to less than one per month in 2004. Boeing then reported to be considering introducing a winglets option in an effort to boost flagging sales, which seen as due at least in part to competition from company's own 737-600. However, on 14 January 2005 Boeing announced decision to end 717 production in 2006 on completion of current commitments. A backlog of five aircraft remained outstanding at 1 December 2005: three for Midwest (delivered 7 February, 7 March and 23 May 2006) and two for AirTran (delivered 28 April and 23 May 2006). Total production (T2 and T3 having been brought up to production standard), 156 aircraft. Completion marked ending of commercial aircraft manufacture at Long Beach facility, where some 15,000 aircraft had been built since 1941.

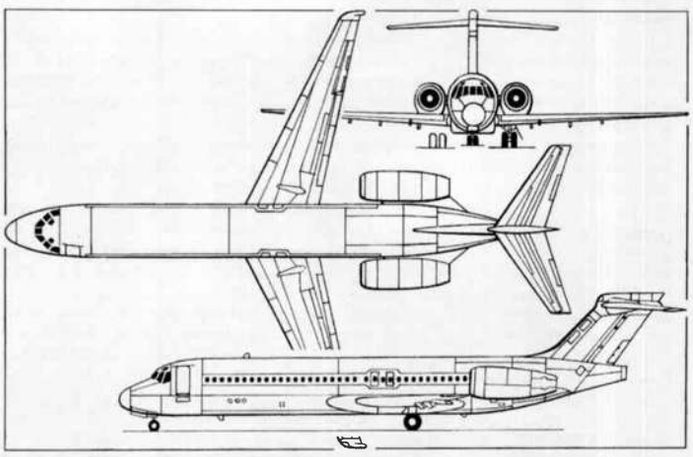
CURRENT VERSIONS: **Boeing 717-200:** Initial (and only) production version, *to which following description applies*. Produced in basic (**BGW**) and high (**HGW**) gross weight versions.

CUSTOMERS: See tables. Launched 19 October 1995 with order for 50, plus 50 options, from ValuJet Airlines (later renamed AirTran).

BOEING 717-200 ANNUAL ORDERS AND DELIVERIES

CY	Ordered	Delivered
1995	42	-
1996	-	-
1997	-	-
1998	41	-
1999	12	12
2000	21	32
2001	5	49
2002	32	20
2003	8	12
2004	8	12
2005	(–14)	13
2006	-	5
Total	**155**	**155**

Midwest Airlines Boeing 717 *(Paul Jackson)* 1158582



Boeing 717-200 airliner (two Rolls-Royce BR 715 turbofans) *(James Goulding)* 1158559

BOEING 717-200 ORDER BOOK

Customer	First Order	First Delivery	Qty
Aerolineas de Baleares	16 May 00	22 Jun 00	3
AirTran	1 Dec 95	23 Sep 99	63
Bavaria International	4 May 98	29 Dec 99	5
Hawaiian Airlines	1 Mar 00	28 Feb 01	13
Jetstar	29 Dec 00	29 Dec 00	3
Midwest Airlines	15 Apr 02	28 Feb 03	25
Pembroke Capital	31 Dec 98	17 Aug 00	12
Turkmenistan Airlines	25 Jul 00	31 Jul 01	7
TWA	31 Dec 98	18 Feb 00	24
Total			**155**

SHARED SERVICES GROUP

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Boeing Shared Services Group provides information management services, personnel management and training, travel services and computing resources to Boeing operating divisions and government customers on a worldwide basis. It has almost 11,000 personnel.

PHANTOM WORKS

St Louis, Missouri
Tel: (+1 562) 797 20 20
PRESIDENT: Robert J Krieger

Tasked with improving Boeing's competitive position through use of innovative technologies, improved processes and creation of new products, the Phantom Works was originally established by McDonnell Douglas at St Louis. Technologies and expertise have expanded in support of company-wide activities, including commercial transport aircraft; this organisation had workforce of about 2,600 in early 2006, with personnel at every major Boeing facility.

Boeing 717 of the type's first and last recipient, AirTran *(Paul Jackson)* 1158585

Close relationship maintained with Advanced Defense and Security Systems Unit, following January 2006 reorganisation of Integrated Defense Systems.

Phantom Works activities are spread over several sites, including: Huntsville (operations analysis, advanced military aircraft and missiles, manufacturing technology & prototyping and advanced support concepts), Mesa (advanced rotorcraft), Philadelphia (advanced rotorcraft), Seattle (advanced commercial aircraft and information & engineering technology), Southern California (advanced tankers and transports; space and communications) and St Louis (computing technology).

In addition to the programmes described in detail, Phantom Works is or has recently been involved with Solar Orbit Transfer Vehicle, X-37 Reusable Spaceplane, X-40 Space Maneuver Vehicle, X-43 Hyper-X and X-45 UCAV programmes.

BOEING BLENDED WING BODY LARGE COMMERCIAL TRANSPORT

Boeing's BWB experiments are described in the International section of *Jane's All the World's Aircraft* under the BWB heading.

BOEING BUSINESS JETS

BOEING BUSINESS JETS

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PARTICIPATING COMPANIES

Boeing Company: see this entry
General Electric Company: see *Jane's Aero Engines*

In July 1996 The Boeing Company and The General Electric Company announced formation of a joint venture, Boeing Business Jets, to develop and market corporate versions of the Next-Generation 737, deliveries of which began in 1998. A third member of the family, the **BBJ 3**, was announced on 21 November 2005 at Dubai Air Show and formally launched at NBAA Convention, Orlando, Florida, in October 2006. Delivery of 100th 'green' BBJ effected on 29 November 2006; of these, 35 for head-of-state use.

VIP versions of other airliners, such as 747 and 787, marketed directly by Boeing.

Company headquarters is at the corporate air services facility of Boeing Field's Flight Center.

BOEING BUSINESS JET (BBJ)

US Air Force designations: C-40B and C-40C

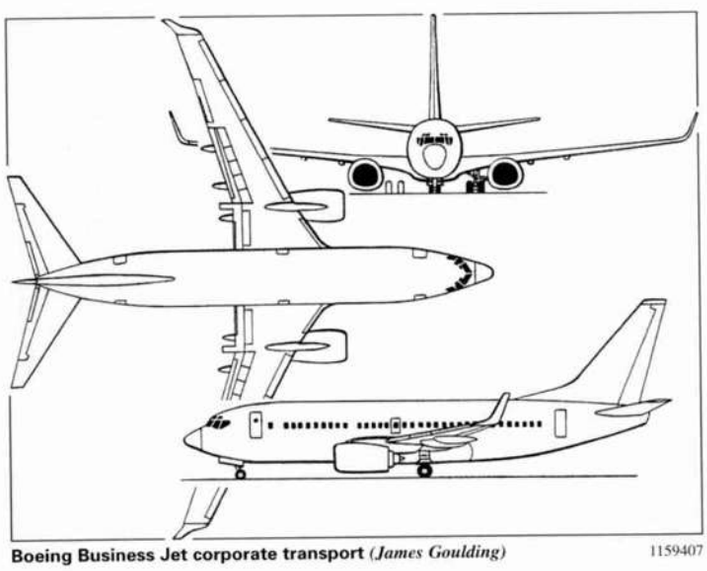
TYPE: Large business jet.

PROGRAMME: Launched July 1996. Aircraft are assembled at Boeing Commercial Airplane Group's Renton facility and supplied to Boeing Business Jets, which hands them over in 'green' condition to customers and delivers them to DeCrane Aircraft at Georgetown, Delaware, for installation of long-range fuel tanks before the aircraft are delivered to the customer's chosen completion centre for interior outfitting and painting; designated completion centres are DeCrane Aircraft and Associated Air Center in Dallas, Texas; Greenpoint Technologies in Seattle, Washington; Arkansas; Lufthansa Technik in Hamburg, Germany; and Jet Aviation in Basle, Switzerland, but other completion centres may be used at the discretion of the customer. After completion, Boeing ferries the aircraft to the customer's base and carries out crew training.

First BBJ (101st N-G 737, N737BZ) rolled out 26 July 1998; first flight 4 September 1998; FAA and JAA certification achieved 29 October 1998; supplementary type certificate for long-range tanks awarded 20 May 1999, following demonstration non-stop flight of 6,252.5 n miles (11,580 km; 7,200.4 miles) in 13 hours 57 minutes 42 seconds. First delivery 23 November 1998.

US Air Force ordered first C-40Bs in February 2001; initial aircraft completed late 2002; two more followed by December 2002 and fourth (02-0042) in June 2005, serving with 1 AS of 89 AW at Andrews AFB, Washington DC (three), and 65 AS of 15 Airlift Wing, Hickam, Hawaii. C-40C designation assigned to two former Ford Air Services BBJs acquired in mid-2002 as (02-0201 and -0202) and issued to 201 AS of District Columbia Air National Guard at Andrews AFB, although nominally operated by BCC Equipment Leasing Corp. Third (02-0203) added in June 2004 from BCC. Further order placed 14 February 2005 for three more C-40Cs to be assigned to the 932nd Airlift Wing of Air Force Reserve Command. C-40B has typical accommodation for 11 crew and 26 passengers.

CUSTOMERS: In October 2006 BBJ sales totalled 114, comprising 99 BBJs, 13 BBJ 2s and two BBJ 3s, of which at least 92 delivered (including some undergoing completion) and 86 in service. Distribution some 40 per cent owned by private individuals; 36 per cent head-of-state; 14 per cent corporate; and 10 per cent charter. Regional distribution 26 per cent Middle East; 18 per cent Europe; 35 per cent North America; 14 per cent Asia and Pacific; 4 per cent Africa; 3 per cent Latin America.



Boeing Business Jet corporate transport *(James Goulding)* 1159407

Boeing Business Jet operated by Southern Air *(Paul Jackson)* 1159374

Launch customer General Electric ordered two in July 1996, of which first (N366G) flew 23 October 1993 and delivered 23 November 1998 for outfitting. First delivery of a completed aircraft to Dubai Air Wing Royal Flight 4 September 1999. Table of customers and deliveries accompanies this entry.

BBJ/BBJ 2 KNOWN ORDERS AND DELIVERIES

Year	BBJ orders	BBJ deliveries	BBJ 2 orders	BBJ 2 deliveries
1996	3			
1997	25		1	
1998	17	7		
1999		25		
2000	6	10	3	6
2001	14	13	4	
2002	6	4		1
2003	4	4	3	3
2004	3	3	1	
2005	12	9	1	1
1H06	5	5		1
Totals	**95**	**80**	**13**	**12**

BBJ/BBJ 2 CUSTOMERS

c/n	Model	Registration	Owner
28579	-75V	N367G	General Electric Company
28581	-75V	N366G	General Electric Company
28976	-75U	VP-BRM	Dobro Ltd
29024	-72T	N50TC	Tracinda Corp
29054	-73T	N500LS	Hayes Productions
29102	-73Q	N737BZ	BCC Equipment Leasing
29135	-74Q	N737CC	Wells Fargo Bank
29136	-74Q	N737GG	Wells Fargo Bank
29139	-74T	VP-BEL	Magenta Aviation
29142	-75T	N737WH	Southern Air
29149	-7H3	TS-IOO	Government of Tunisia
29188	-7P3	HZ-TAA	HRH Talal bin AbdulAziz
29200	-73U	N742PB	Chartwell Partners
29233	-74U	N4AS	BA Leasing & Capital
29251	-7EO	A6-HRS	Dubai Air Wing
29268	-7Z5	A6-AIN	Government of Abu Dhabi
29269	-7Z5	A6-RJZ	Government of Abu Dhabi
29272	-74V	N7378P	Raytheon Company; for Colombian Government
29273	-72U	VP-BBJ	Picton II (Switzerland)
29274	-7H6	M53-01	Malaysian Air Force
29317	-79T	VP-BWR	BEL Air
29441	-79U	N1011N	Aircraft Holdings
29749	-7AH	N134AR	BB Five Inc
29791	-7BH	P4-TBN	Tango Holding
29857	-7Z5	A6-LIW	Government of Abu Dhabi
29858	-7Z5	A6-DAS	Government of Abu Dhabi
29865	-7AK	HB-IIO	Privat Air
29866	-7AK	HB-IIP	Privat Air
29971	-7DM	01-0040	US Air Force (1 AS/89 AW)
29972	-7AN	VP-BYA	Eastern Skies
30031	-7AW	VP-CEC	BB Aviation
30070	-7AV	N889NC	News America
30076	-7BJ	VP-BBW	GAMA Aviation
30327	-7BC	N127QS	Wells Fargo Bank
30328	-7BC	N164RJ	Wells Fargo Bank
30329	-7BC	N129QS	Wells Fargo Bank
30330	-7BC	VP-BJB	Sigair
30496	-7BF	N737AG	Fun Air Corp
30547	-7BQ	HZ-DG5	Dallah al Bakara
30572	-7BC	N171QS	Wells Fargo Bank
30751	-7CG	P4-GJC	GKW Aviation
30752	-7CN	D-ABPA	Privat Air
30753	-7CP	02-0202	US Air National Guard (201 AS/DCANG
30754	-7CJ	N737ER	BBJ One Inc

BBJ/BBJ 2 CUSTOMERS

c/n	Model	Registration	Owner
30755	-7CP	02-0201	US Air National Guard (201 AS/DCANG)
30756	-7BC	N156QS	Wells Fargo Bank
30772	-7CU	N315TS	State Street Bank & Trust
30782	-7BC	N515GM	Kevin Air
30789	-73Q	N349BA	Boeing Aircraft Holding Inc
30790	-7DT	A36-002	Royal Australian Air Force
30791	-7BC	N191QS	BNJ Sales
30829	-7DT	A36-001	Royal Australian Air Force
30884	-7BC	VP-BFA	Jordanian Government
32438	-8AN	VP-BHN	Eastern Skies
32450	-8EC	A6-MRM	Government of Dubai Air Wing
32451	-8DP	HZ-101	Saudi Air Force
32575	-7BC	PP-BSS	Grupo Safra
32627	-7ED	ZS-RSA	South African Government
32628	-7BC	N7600K	SAS Institute
32774	-7EJ	XA-AEX	Omniflys
32775	-7EL	N90R	Swiftlite Aircraft Corp
32777	-8DR	G-OBBJ	Multi Flight Ltd
32805	-7DP	HZ-102	Saudi Air Force
32806	-8AW	VP-CBB	Bosco Aviation
32807	-7EG	HL-7770	Samsung Aerospace Industries
32825	-8AJ	A6-HEH	Duba Air Wing
32915	-8DV	VP-BZL	BZL Ltd
32916	-7DM	01-0015	US Air Force (65 AS/15 ABW)
32970	-7BC	N707BZ	Boeing
32971	-8EF	N371BC	Executive Jets
32082	-7EO	N753JM	Boeing
33010	-7ET	N313P	Premier Executive Transport Services
33036	-7BC	N888YV	Aviation Air
33079	-8EV	EW-001PA	Belarus Government
33080	-7DM	01-0041	US Air Force (1 AS/89 AW)
33102	-7BC	N108MS	Yona Aviation
33361	-8EQ	N7375P	Wells Fargo Bank
33367	-7FB	3C-EGE	Equatorial Guinea Government
33405	-7FG	HZ-MF1	Saudi Ministry of Finance
33434	-7BC	02-0203	US Air Force (201 AS/DCANG)
33473	-8EX	A6-AUH	Amiri Flight Line
33474	-7ES	A30-001	Australian Air Force (AEW&C)
33476	-7ES	A30-	Australian Air Force (AEW&C)
33477	-7ES	A30-	Australian Air Force (AEW&C)
33499	-7AJ	HZ-MF2	Saudi Ministry of Finance
33500	-7FD	02-0042	US Air Force (1 AS/89 AW)
33542	-7AJ	A30-002	Australia Air Force (AEW&C)
33962	-8AJ	1614	Turkish Air Force
33963	-7ES	N360BJ	Turkish AF (AEW&C)
33964	-7ES	N362BJ	Turkish AF (AEW&C)
33965	-7ES	A30-	Australian Air Force (AEW&C)
33986	-7ES	A30-	Australian Air Force (AEW&C)
34260	-7N6	5N-FGT	Nigerian Government
34303	-7AK	HB-JJA	Privatair
34477	-7AU	VT-SRS	Air Sahara
34620	-8GG	N852AK	Sultan Al Kabeer
34622	-7GC	P4-RUS	Vizavi (Russia)
34683	-7EI	N2121	Shangri-la Entertainment
34807	-7DM	N365BJ	US Air Force
34808	-7DM	N366BJ	US Air Force
34809		N368BJ	US Air Force
34865	-7EM	VP-CLR	LUK Aviation
35238	-8EO	A6-MRS	Dubai Air Wing
35478	-8Z6	55-555	R Thai AF

Notes: BBJ 2 model numbers begin -8
Some aircraft have subsequently been sold.
The BBJ has been proposed for USAF's Commander-in-Chief (CINC) support aircraft requirement.

COSTS: USD43 million 'green', estimated USD51 million to 55 million typically equipped (2005). Direct operating cost estimated at USD2,560 per hour (2006).

DESIGN FEATURES: Combines fuselage of 737–700, strengthened in aft section, with centre-section, wing and landing gear of 737–800. Aviation Partners Inc winglets standard, affording 5 to 7 per cent reduction in cruise drag, resulting in four to five per cent increase in range; winglets evaluated in mid-1998 by 737–800 (N737BX), first flown on BBJ prototype (N737BZ) on 20 February 1999, received FAA approval on 6 September 2000 and fitted as standard.

POWER PLANT: Two CFM International CFM56-7 turbofans, each rated at 121.4 kN (27,300 lb st). Standard N-G 737 fuel of 26,025 litres (6,875 US gallons; 5,725 Imp gallons) contained in wing, plus between three and nine belly tanks; maximum combined capacity 40,529 litres (10,707 US gallons; 8,915 Imp gallons).

ACCOMMODATION: To customer's choice; operating weights based on allowance of 5,624 kg (12,400 lb). Typical configuration includes forward lounge and private suite with double bed; mid-section conference room; 12 first class sleeper seats at 152 cm (60 in) pitch in two rows with centre aisle, and galley, lavatory and service area at rear, with crew rest area, galley and lavatory aft of flight deck. Alternative arrangements provide for exercise room/gymnasium, office, 24 first-class sleeper seats or high-density seating for up to 63 passengers, three abreast in two rows. Maximum 149 passengers in airline configuration. Cabin equivalent altitude reduced to 1,980 m (6,500 ft) from 2004, with retrofit available.

AVIONICS: Rockwell Collins Series 90 as core system.

Comms: Triple VHF comm with 8.33 kHz channel spacing; dual HF comm; L-3 Communications 120-minute CVR and Coltech Selcal.

Flight: Dual Rockwell Collins multimode GPS/ILS/VOR/DME receivers; dual ADF; TCAS II; predictive windshear; dual Smiths Industries flight management computers; dual Honeywell ADIRU; Honeywell EGPWS; L-3 Communications FDR and CVR; Flight Dynamics HGS 4000 head-up guidance system; Teledyne airborne navigation data recorder, digital flight data acquisition unit and quick-access recorder; Teledyne Navlink, including two additional navigation computers and electronic standby artificial horizon.

Instrumentation: Honeywell flat-panel LCD displays.

Mission: C-40B equipment includes fibre-optic communications management system; worldwide secure voice and data transmission (UHF, VHF, HF, UHF and commercial satcom, Magnastar airphones, UHF/AM, Boeing Connexion data/video Broadband, secure conferencing and Wideband data and LAN.

DIMENSIONS, EXTERNAL AND AREAS: As for 737-700 except:
- Wing span, incl winglets ..... 35.79 m (117 ft 5 in)

DIMENSIONS, INTERNAL:
- Cabin: Length ..... 24.13 m (79 ft 2 in)
  - Height ..... 2.16 m (7 ft 1 in)
  - Width ..... 3.53 m (11 ft 7 in)
  - Floor area ..... 75.0 m^2 (807 sq ft)
  - Volume ..... 148.7 m^3 (5,250 cu ft)
- Cargo hold volume ..... 4.3 m^3 (151 cu ft)

WEIGHTS AND LOADINGS:
- Operating weight empty, typically equipped ..... 43,526 kg (95,960 lb)
- Interior completion allowance ..... 5,897 kg (13,000 lb)
- Max fuel weight (incl supplementary tanks) ..... 32,825 kg (72,367 lb)
- Max T-O weight ..... 77,565 kg (171,000 lb)
- Max ramp weight ..... 77,790 kg (171,500 lb)
- Max landing weight ..... 60,780 kg (134,000 lb)
- Max zero-fuel weight ..... 57,155 kg (126,000 lb)
- Max wing loading ..... 620.5 kg/m^2 (127.09 lb/sq ft)
- Max power loading ..... 320 kg/kN (3.14 lb/lb st)

PERFORMANCE:
- Max operating Mach No. (MMO) 0.82
- Cruising speed: normal M0.80
  - long range M0.79
- Approach speed ..... 132 kt (244 km/h; 152 mph)
- Max rate of climb ..... 980 m (3,215 ft)/min
- Initial cruising altitude ..... 11,580 m (38,000 ft)
- Max certified altitude ..... 12,500 m (41,000 ft)
- Service ceiling, OEI ..... 7,070 m (23,200 ft)
- T-O field length, S/L:
  - fuel for range of 4,000 n miles (7,408 km; 4,603 miles) ..... 1,369 m (4,490 ft)
  - fuel for range of 5,000 n miles (9,260 km; 5,754 miles) ..... 1,515 m (4,970 ft)
  - fuel for range of 6,000 n miles (11,112 km; 6,905 miles) ..... 1,765 m (5,790 ft)
- Landing run at typical landing weight ..... 706 m (2,315 ft)
- Range (nine belly tanks):
  - with 8 passengers ..... 6,135 n miles (11,362 km; 7,060 miles)
  - with 19 passengers ..... 5,985 n miles (11,084 km; 6,887 miles)
  - with 75 passengers ..... 4,715 n miles (8,732 km; 5,425 miles)
  - with 100 passengers ..... 4,185 n miles (7,750 km; 4,816 miles)

OPERATIONAL NOISE LEVELS (FAR Pt 36 Stage 3):
- T-O ..... 85.6 EPNdB
- Approach ..... 95.9 EPNdB
- Sideline ..... 95.2 EPNdB

BOEING BUSINESS JET 2 (BBJ 2)

TYPE: Large business jet.

PROGRAMME: Launched 11 October 1999; rolled out 30 January 2001; first flight 9 February 2001; first 'green' delivery 3 March 2001 to an undisclosed customer; first service entry was in early 2002; forecast production rate eight per year. Certified by FAA 13 March 1998 and by JAA (EASA) 9 April 1998 (Boeing 737-800).

CUSTOMERS: BBJ 2 expected to account for some 25 per cent of all BBJ sales, but current figure half of that. Total 13 orders by late 2005 and none in first three quarters of 2006. Refer to table in BBJ entry.

COSTS: USD53 million, 'green'; estimated USD63 million to USD68 million, typically equipped (2005). Operating cost USD2,710 per hour (2006).

DESIGN FEATURES: Based on 737–800 airframe (which see), affording 25 per cent more cabin volume and twice the cargo volume of the BBJ; Aviation Partners Inc winglets standard.

POWER PLANT: Two CFM56-7 turbofans, each 121.4 kN (27,300 lb st). Standard 737 'Next-Generation' fuel of 26,025 litres (6,875 US gallons; 5,725 Imp gallons) contained in wing, plus between three and seven belly tanks; maximum combined capacity 39,538 litres (10,445 US gallons; 8,697 Imp gallons).

ACCOMMODATION: Up to 78 passengers, with executive lounge and private suite. Maximum 189 in airliner configuration. Operating weights based on completion allowance of 7,257 kg (16,000 lb).

DIMENSIONS, EXTERNAL: As for BBJ, except:
- Length overall ..... 39.47 m (129 ft 6 in)

DIMENSIONS, INTERNAL:
- Cabin: Length ..... 29.97 m (98 ft 4 in)
  - Floor area ..... 93.27 m^2 (1,004 sq ft)
  - Max cargo volume ..... 21.3 m^3 (753 cu ft)

WEIGHTS AND LOADINGS:
- Operating weight empty, typically equipped ..... 46,820 kg (103,220 lb)
- Interior completion allowance ..... 7,711 kg (17,000 lb)
- Max fuel weight (incl supplementary tanks) ..... 31,922 kg (70,376 lb)
- Max T-O weight ..... 79,015 kg (174,200 lb)
- Max ramp weight ..... 79,245 kg (174,700 lb)
- Max landing weight ..... 66,360 kg (146,300 lb)
- Max zero-fuel weight ..... 62,730 kg (138,300 lb)

PERFORMANCE:
- Max cruising speed M0.82
- Long-range cruising speed M0.79
- Max rate of climb at S/L ..... 948 m (3,110 ft)/min
- Initial cruising altitude ..... 11,505 m (37,750 ft)
- Max certified altitude ..... 12,500 m (41,000 ft)
- Service ceiling, OEI ..... 6,090 m (22,600 ft)
- T-O field length, S/L:
  - fuel for range of 4,000 n miles (7,408 km; 4,603 miles) ..... 1,655 m (5,430 ft)
  - fuel for range of 5,000 n miles (9,260 km; 5,753 miles) ..... 1,915 m (6,280 ft)
  - fuel for range of 5,650 n miles (10,464 km; 6,502 miles) ..... 2,118 m (6,950 ft)

Landing run at typical landing weight ..... 758 m (2,485 ft)
Range (seven belly tanks):
with 8 passengers ..... 5,580 n miles (10,334 km; 6,421 miles)
with 19 passengers ..... 5,335 n miles (9,880 km; 6,139 miles)
with 75 passengers ..... 4,145 n miles (7,676 km; 4,770 miles)
with 100 passengers ..... 3,645 n miles (6,750 km; 4,194 miles)
OPERATIONAL NOISE LEVELS (FAR Pt 36 Stage 3):
T-O ..... 86.0 EPNdB
Approach ..... 96.3 EPNdB
Sideline ..... 94.7 EPNdB

BOEING BUSINESS JET 3 (BBJ 3)

TYPE: Large business jet.
PROGRAMME: Although previously announced, was formally launched on eve of NBAA Convention at Orlando, Florida, 16 October 2006, with first two orders.
CUSTOMERS: First two sales announced 16 October 2006.
COSTS: Operating USD2,880 per hour (2006).
DESIGN FEATURES: Based on 737–900ER airframe (which see), offering same range as BBJ 2, but more cargo volume. Aviation Partners Inc winglets standard.
POWER PLANT: Two CFM56-7 turbofans, each 121.4 kN (27,300 lb st). Standard 737 'Next-Generation' fuel of 26,025 litres (6,875 US gallons; 5,725 Imp gallons) contained in wing, plus between three and eight belly tanks; maximum combined capacity 41,343 litres (10,922 US gallons; 9,094 Imp gallons).
ACCOMMODATION: Up to 100 passengers, with executive lounge and private suite. Operating weights based on completion allowance of 9,072 kg (20,000 lb).
DIMENSIONS, EXTERNAL: As for BBJ, except:
Length overall ..... 42.11 m (138 ft 2 in)
DIMENSIONS, INTERNAL:
Cabin: Length ..... 32.66 m (107 ft 2 in)
Floor area ..... 104.05 m² (1,120 sq ft)
Max cargo volume ..... 26.4 m³ (932 cu ft)
WEIGHTS AND LOADINGS:
Operating weight empty, typically equipped ..... 50,534 kg (111,410 lb)
Max T-O weight ..... 85,138 kg (187,700 lb)
Max landing weight ..... 71,350 kg (157,300 lb)
Max zero-fuel weight ..... 67,720 kg (149,300 lb)
PERFORMANCE:
Range (eight belly tanks):
with 8 passengers ..... 5,475 n miles (10,139 km; 6,300 miles)
with 19 passengers ..... 5,330 n miles (9,871 km; 6,133 miles)
with 75 passengers ..... 4,225 n miles (7,824 km; 4,862 miles)
with 100 passengers ..... 3,755 n miles (6,954 km; 4,321 miles)

BRANTLY

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On 23 December 1994, Brantly International obtained the type certificates for the Brantly B-2B and 305 helicopters from Japanese-American businessman James T Kimura's Brantly Helicopter Industries, which had acquired them in May 1989. In 2002, Brantly employed 40 in its 2,790 m² (30,000 sq ft) facility. Last known B-2B built in 2003. No further reports.

BUSHWHACKER

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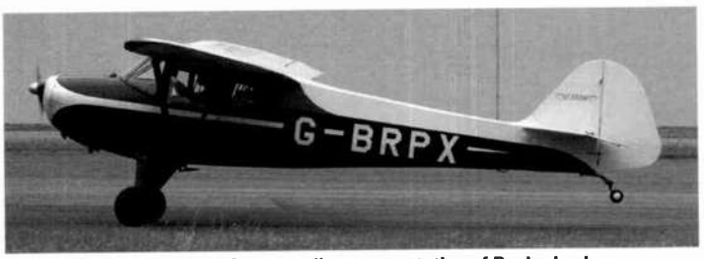
Bushwhacker Aircraft, part of the Bushwhacker Air group of companies, is working on a new sport-based aircraft based on the Taylorcraft BC/F-19 series; this had not flown by September 2006. A further design, the BushCub, was announced in 2006.

Other parts of the parent company include Taylorcraft Classics, YAK North America and Bushwhacker Ridge Runner sales.

BUSHWHACKER BUSHWHACKER

TYPE: Side-by-side kitbuilt.
PROGRAMME: Based on Taylorcraft BC/F-19 series, originating in the 1930s. Announced in 2005, when design of prototype was under way. Construction was still under way in November 2006.
CURRENT VERSIONS: **Bushwhacker R:** Rotec-engined version based on Taylorcraft F-19; *as described.*
Bushwhacker RSP: Rotec-engined version based on Taylorcraft BC-12; intended to be LSA compliant.
Bushwhacker SP: .Lower-powered Aero Vee-engined version based on Taylorcraft BC-12; intended to be LSA compliant.
DESIGN FEATURES: Braced high-wing monoplane with V-struts each side. NACA 23012 aerofoil.
FLYING CONTROLS: Conventional and manual.
STRUCTURE: Fabric-covered welded steel tube fuselage. Wing uses same aluminium spar as PA-18 Super Cub and PA-25 Pawnee. Stainless steel flying wires.
LANDING GEAR: Tailwheel type; fixed. Lightweight spring aluminium mainwheel legs with 15 cm (6 in) main wheels and 15 cm (6 in) or 20 cm (8 in) tyres; Tundra tyre option on R model. Hydraulic disc brakes. Float attachments provided.
POWER PLANT: *R and RSP:* One 82.0 kW (110 hp) Rotec R-2800 seven-cylinder radial engine.
SP: One 59.7 kW (80 hp) Aero Vee.
ACCOMMODATION: Pilot and passenger side by side, with stick controls. Adjustable seats on R model.
SYSTEMS: Full electrical system.
All data provisional.
DIMENSIONS, EXTERNAL:
Wing span ..... 9.75 m (32 ft 0 in)



Original Taylorcraft BC-12D, generally representative of Bushwhacker
(Paul Jackson) 1158790

WEIGHTS AND LOADINGS:
Max baggage weight: R ..... 91 kg (200 lb)
Max T-O weight: R ..... 680 kg (1,500 lb)
Max power loading: R ..... 8.30 kg/kW (13.64 lb/hp)

BUSHWACKER BUSHCUB

TYPE: Two-seat lightplane/kitbuilt.
PROGRAMME: Announced in 2006, when prototype under construction. Based on the Piper Cub family (J3 and PA-18) with modifications.
CURRENT VERSIONS: **BushCub SP:** Basic version, available as ready-to-fly, LSA-compliant version, or as kit; *as described.*
BushCub XP: As BushCub SP, but with higher max T-O weight; kit only.
Clippy: As BushCub SP, but with shorter (9.75 m; 32 ft 0 in) wing span; kit only.
COSTS: BushCub SP: kit USD32,900, ready-to-fly USD69,900; BushCub XP kit USD35,900 (all 2006, kits less engine).
DESIGN FEATURES: High wing, braced by streamlined V-struts and auxiliary struts; rounded fin and tailplane mutually wire braced. Wing section NACA 23012.
FLYING CONTROLS: Conventional and manual; control actuation by cables. BushCub XP has flaps as standard; option on BushCub SP.
STRUCTURE: Welded fuselage of 4130 chromoly. All-aluminium wings; entire structure covered with Superflite fabric except for J3 Cub style engine cowling.
LANDING GEAR: Tailwheel type; fixed. Two faired-in side Vs hinged to lower longerons, with helical spring-damped half-axles attached to compression frame; hydraulic brakes.
POWER PLANT: BushCub SP ready-to-fly has 74.6 kW (100 hp) Teledyne Mattituck TMX-200 engine; BushCub XP will accept engines up to 134 kW (180 hp). Fuel capacity 68 litres (18.0 US gallons; 15.0 Imp gallons) in BushCub SP, with option to raise to 110 litres (29.0 US gallons; 24.1 Imp gallons); BushCub XP capacity 151 litres (40.0 US gallons; 33.3 Imp gallons).
ACCOMMODATION: Two persons in tandem.
SYSTEMS: 12 V battery and electric starter in BushCub SP.
DIMENSIONS, EXTERNAL:
Wing span ..... 10.73 m (35 ft 2½ in)
Wing chord, constant ..... 1.60 m (5 ft 3 in)
Wing aspect ratio 6.7
Length overall ..... 7.01 m (23 ft 0 in)
Height overall ..... 2.07 m (6 ft 9½ in)
Wheelbase ..... 1.90 m (6 ft 3 in)
DIMENSIONS, INTERNAL:
Cabin max width ..... 0.66 m (2 ft 2 in)
AREAS:
Wings, gross ..... 17.17 m² (184.8 sq ft)
WEIGHTS AND LOADINGS (estimated):
Weight empty: SP ..... 371 kg (818 lb)
XP ..... 454 kg (1,000 lb)
Max T-O weight: SP ..... 598 kg (1,320 lb)
XP ..... 771 kg (1,700 lb)
Max wing loading: SP ..... 34.9 kg/m² (7.14 lb/sq ft)
XP ..... 44.9 kg/m² (9.20 lb/sq ft)
Max power loading: SP ..... 8.03 kg/kW (13.2 lb/hp)
XP ..... 5.75 kg/kW (9.44 lb/hp)
PERFORMANCE (estimated):
Normal cruising speed: SP ..... 83 kt (153 km/h; 95 mph)
XP ..... 96 kt (177 km/h; 110 mph)
Stalling speed, power off: SP ..... 30 kt (55 km/h; 34 mph)
XP (flaps down) ..... 31 kt (57 km/h; 35 mph)

Max rate of climb at S/L: SP ..... 305 m (1,000 ft)/min
XP ..... 488 m (1,600 ft)/min
T-O run: SP ..... 77 m (250 ft)
XP ..... 31 m (100 ft)
Landing run: SP ..... 69 m (225 ft)
XP ..... 61 m (200 ft)
Range: SP, standard fuel ..... 216 n miles (400 km; 249 miles)
XP ..... 382 n miles (708 km; 440 miles)

BUTTERFLY

THE BUTTERFLY LLC

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PRESIDENT: Larry Neal

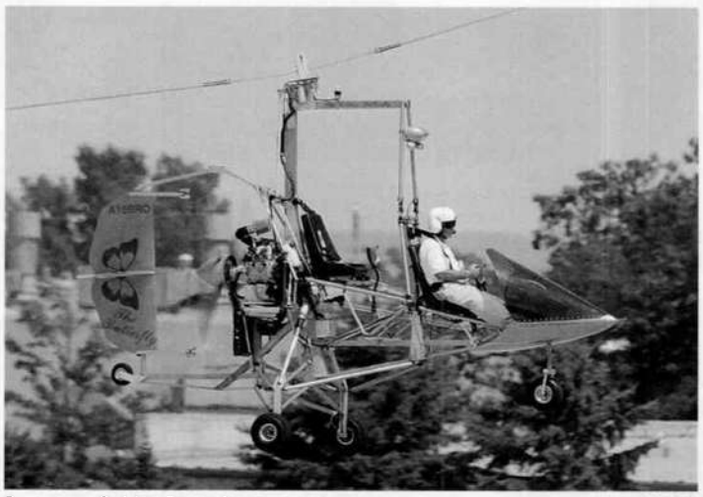
Company markets a range of gyrocopters, including single-seat Butterfly and Monarch Butterfly. Golden Butterfly won award for "outstanding new design" at AirVenture, Oshkosh, 2004. Marketing of an autogyro motorcycle began at Sun 'n' Fun in April 2006.

BUTTERFLY GOLDEN BUTTERFLY

TYPE: Two-seat autogyro kitbuilt.
PROGRAMME: Prototype built 2004 and registered as Ultralight (A10BRO); second aircraft in Experimental category (N8111C) as Turbo Golden Butterfly.
CURRENT VERSIONS: **Golden Butterfly:** *As described.*
Super Sky Car: Road vehicle based on Golden Butterfly airframe, but with (Honda) engine-driven wheels, detachable empennage and rotors and composites enclosure of seats for land travel. First demonstrated in 2005.
COSTS: Kit USD29,995 with 142 kW (190 hp) Subaru flat-four; USD34,995 with 169 kW (227 hp) turbocharged Subaru (2005).
DESIGN FEATURES: Tandem-seat, open configuration with small nosecone. Two-blade rotor with electric pre-rotator. Cruciform empennage on propeller thrust line.
FLYING CONTROLS: Manual. Fin suspended top and bottom, externally mass-balanced and actuated by cables.
STRUCTURE: Rectangular, square and circular metal tube frame.
LANDING GEAR: Tricycle type; fixed. Auxiliary tail 'bumper' wheel. Design by G-Force; mainwheels attached to hinged arms damped by long-stroke oleos braced at mid-fuselage; tyre size 15×6; steerable nosewheel 4.00-6; tailwheel 2.80/2.50-4.
POWER PLANT: One 142 kW (190 hp) Subaru flat-four driving a Warp Drive four-blade, carbon fibre pusher propeller with spinner. Fuel capacity 48 litres (12.7 US gallons; 10.6 Imp gallons).
DIMENSIONS, EXTERNAL:
Rotor diameter ..... 8.84 m (29 ft 0 in)
Length overall ..... 5.31 m (17 ft 5 in)
Height: overall ..... 3.35 m (11 ft 0 in)
folded ..... 2.39 m (7 ft 10 in)
Width overall ..... 2.31 m (7 ft 7 in)
Propeller diameter ..... 1.83 m (6 ft 0 in)
WEIGHTS AND LOADINGS:
Weight empty ..... 408 kg (900 lb)
Max baggage weight ..... 23 kg (50 lb)
Max T-O weight ..... 680 kg (1,500 lb)
PERFORMANCE:
Max level speed ..... 96 kt (177 km/h; 110 mph)
Cruising speed ..... 65 kt (120 km/h; 75 mph)
Max rate of climb at S/L ..... 244 m (800 ft)/min
T-O run ..... 92 m (300 ft)
Landing run ..... 6 m (20 ft)
Range ..... 130 n miles (241 km; 150 miles)

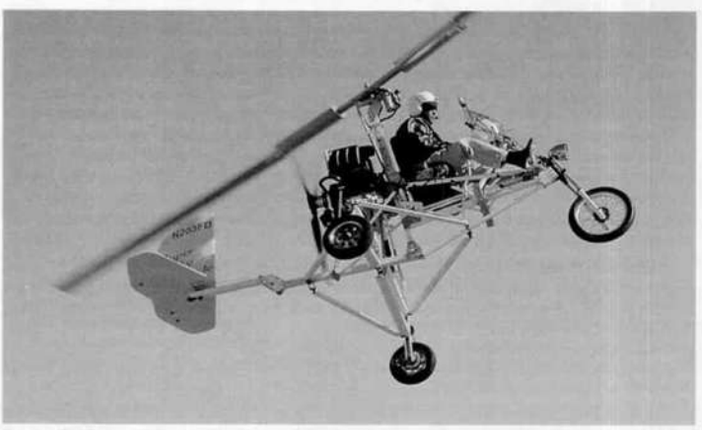
BUTTERFLY SUPER SKY CYCLE

TYPE: Single-seat autogyro ultralight kitbuilt.
PROGRAMME: Prototype (N203FD) exhibited at AirVenture, Oshkosh, in July 2005. US patent 6,978,969 for fly-drive vehicle issued 27 December 2005. Marketing began in 2006.
COSTS: Kit USD24,995 (2006).
DESIGN FEATURES: Combination of autogyro and motorcycle which can be licensed in US as both Experimental aircraft and homebuilt motorcycle. Folding blades; power interchangeable between propeller and road wheels. Adaptation of existing Monarch autogyro.
POWER PLANT: One 48.0 kW (64.4 hp) Rotax 582 two-cylinder, liquid-cooled piston engine. Alternative Aerotwin and Harley Davidson motorcycle engines to be offered.
DIMENSIONS, EXTERNAL:
Height overall: flight condition ..... 2.24 m (7 ft 4 in)
storage condition ..... 2.11 m (6 ft 11 in)
Length overall ..... 4.34 m (14 ft 3 in)
Width over wheels ..... 2.13 m (7 ft 0 in)



Prototype Golden Butterfly *(Paul Jackson)* 1158063

Incomplete prototype of Butterfly Super Sky Car 1037949



Butterfly Super Sky Cycle during flight testing 1037948

CADCOR

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SALES DIRECTOR: Sean Doyle

The company's Chanute sport aircraft first flew in 2004, but no further news has been received.

CAMERON

CAMERON & SONS AIRCRAFT

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Web: www.CameronAircraft.com
CEO: Murdo Cameron

Cameron Aircraft was formed in 1978. Its P-51 Mustang derivative is the company's first product; parts for the North American AT-6 Texan are also marketed. The 4,180 m² (45,000 sq ft) factory is situated on Coeur d'Alene Airport; in 2002 the workforce numbered 22.

Murdo Cameron is working on a lightweight composites air racer variant of the P-51 and in 2006 formed Team 51 Unlimited Air Racing with the intention of racing at Reno in September 2007.

CAMERON P-51G

TYPE: Tandem-seat turboprop sportplane/kitbuilt.

PROGRAMME: Full-size, turbine-powered representation of North American P-51 Mustang. Design began 1988; publicly announced end 1997; first flight 1998 and displayed at Oshkosh in July 1998 as Grand 51; later renamed P-51G.

CUSTOMERS: Two aircraft flying; two production aircraft under construction. Factory capacity for 12 per year; no further information received.

CARTER

CARTERCOPTERS LLC

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CEO: Jay Carter
VICE-PRESIDENT: Paul Redding

Company founded in 1994 by Jay Carter, who previously worked on design of the Bell XV-15 tiltrotor. CarterCopters has produced a flying prototype of what it anticipates will be a family of convertiplanes, although its ultimate purpose is to market the design, not establish a manufacturing programme itself.

In March 2004, company announced that it had been awarded a US$1 million contract from the US Army Research, Development and Engineering Command for research into Slowed-Rotor/Compound (SR/C) technology.

CarterCopters is also working with Butterfly LLC autogyro manufacturer on a new 'smart' landing gear through a patented mechanical valve system that predicts impact energy and adjusts pressure levels accordingly; it is also involved with power plant and rotor blade design and has used a modified Butterfly Monarch Butterfly to develop features of its forthcoming PAV.

Principle of the CarterCopter: Slowed Rotor/Compound principle attempts to overcome high cost (both initial and maintenance) and performance deficiencies of conventional helicopter. An autorotating rotor provides lift for vertical and slow-speed flight, slowing in angular velocity as the wing assumes the lift in forward flight. This angular velocity change improves lift-to-drag ratio, while at aeroplane speeds the rotor is, essentially, unloaded.

Three modes of operation are evident:

Autorotation. Air flows upwards through the rotor, the resultant thrust providing lift. Rotor disc is tilted rearwards by some 10°.

Transition. Progressive transfer of lift from rotor to wing. Rotor disc angle decreases, approaching that of the airstream, the inflow of air through the rotor being reduced, with consequent slowing of rotor angular velocity and shedding of drag. Furthermore, slowed rotation obviates the phenomenon of most other compound helicopters (except Fairey Jet Gyrodyne, Rotodyne and McDonnell XV-1 — all of 1950s vintage) of retreating blade stall and advancing blade compressibility.

High speed. Fixed wing, being optimised for high-speed flight, provides the vast majority of lift. However, the rotor retains a small angle of attack, allowing sufficient through airflow to maintain a minimal angular velocity and so ensure maintenance of the rotor's dynamic stability.

Carter principle relies upon achievement of μ (relationship of aircraft forward speed to blade speed) in excess of 1.0 during the last-mentioned phase. In this hitherto unexplored region, aerodynamic forces vary over the rotor disc. Assuming anticlockwise rotation, forces on the starboard/advancing side drive the rotor in the usual manner.

On the port/retreating side, however, the reverse flow region becomes a dominant factor affecting rotor dynamics. This is a region on the retreating side in which air velocity relative to the blade moves from the trailing- to the leading edge. Traditional helicopters and gyrocopters have a small reverse flow region (typically μ=0.3) within the total disc area. However, at μ=1.0 the full blade length is within the reverse flow area at the moment it passes through the 270° radial (at right angles to the fuselage).

As μ is further increased, the reverse flow region expands. At μ=5.0, for example, the blade is within the reverse flow area throughout almost the entire cycle of retreat.

Other aerodynamic factors requiring investigation by the Carter prototype include unstable blade flapping during slow rotation; and effects of a centre of pressure shift due to the retreating blade being in reverse flow. The latter can cause blade pitching, with consequent rotor destabilisation, vibration and increased control linkage forces.

CARTER CARTERCOPTER CC1

TYPE: Convertiplane.

PROGRAMME: Developed with USD670,000 funding from NASA, the CarterCopter has been conceived as the first in a series of convertiplanes. First flight (N121CC) September 1998; development delayed following damage to prototype during aborted rolling take-off 16 December 1999; flight testing resumed late October 2000 and was interrupted by minor accidents in April 2001. Attempts are planned on rotary-wing world records. On 22 March 2002, the CCTD reached μ 0.87 (relationship between forward speed and blade speed); company hoped to attain μ 1 by early 2003 but prototype again damaged in landing accident on 8 April 2003.

Following repair, a further μ 1 attempt was scheduled for November 2003 but later postponed; it was unofficially achieved on 17 June 2005; however, aircraft was severely damaged during a landing from a later flight that day and further repair was not attempted. By that time, CC1 had demonstrated 150 kt (278 km/h; 173 mph); 3,050 m (10,000 ft) altitude; and rotor speed reduced to 107 rpm.

CURRENT VERSIONS: **CC1 (CarterCopter Technology Demonstrator):** Also referred to as **CCTD:** One prototype version for proof-of-concept; *as described.*

NxCC: Next-generation model announced at Sun 'n' Fun 2003. Improvements include seating for six, fuselage extension of more than 90 cm (3 ft), longer wingspan, wider booms and additional vertical stabiliser. Max T-O weight in STOL mode would be 2,721 kg (6,000 lb) and in VTOL configuration, 2,268 kg (5,000 lb). Power is expected to be provided by a turboprop engine in the 1,491 kW (2,000 shp) class. Discontinued in favour of PAV version.

CarterCopter Technology Demonstrator *(Jason Bynum)* 1133284

CARTER PAV 2+2

TYPE: Convertiplane.

PROGRAMME: Carter and Georgia Institute of Technology awarded NASA contract in April 2004 for "personal air vehicle (PAV) research for rural, regional and intra-urban on-demand transportation". Aims are reduced community noise; simplified pilot's operations; increased safety; and reduced acquisition cost. PAV marketing assumptions based on fast-build kit for home constructor costing USD55,000 (plus engine and avionics) based on annual production of 1,000 and offering 174 kt (322 km/h; 200 mph) cruise over 869 n mile (1,609 km; 1,000 mile) range.

Original PAV studies reflected twin-boom design of CC1 but revised configuration revealed on 2 April 2006, based on single tailboom with cruciform empennage. Further development of concept assisted by CGD/T (CarterGyro Demonstrator/Trainer), which is Butterfly Golden Butterfly autogyro modified initially with Carter propeller. Initial flight (N899CC) January 2006 and first shown at Sun 'n' Fun, Lakeland, Florida, in April 2006. Replacement of original (Rotor Flight Dynamics Dragon Wings) rotor with 7.92 m (26 ft 0 in) Carter unit was due in mid-2006.

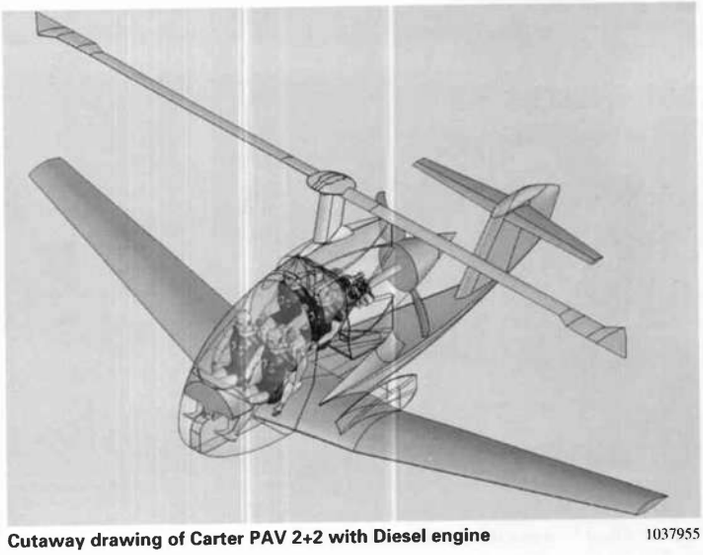
Three PAV 2+2 prototypes to be built, of which third devoted at first to wind tunnel testing, initially without rotor.

CURRENT VERSIONS: **PAV 2+2:** Initial production version for kit assembly. *As described.*

Diesel: Size as 2+2, but powered by 149 kW (200 hp) Delta Hawk Diesel engine. Weight 454 kg (1,000 lb) empty; 1,088 kg (2,400 lb) max T-O. Max level speed 154 kt (285 km/h; 177 mph); max rate of climb 79 m (260 ft)/min; range 784 n miles (1,453 km; 903 miles).

Military: Unmanned air vehicle. Size generally as 2+2, but 13.72 m (45 ft 0 in) rotor and wing span and 895 kW (1,200 shp) turboshaft. Weight 680 kg (1,500 lb) empty; 2,041 kg (4,500 lb) max T-O. Max level speed 278 kt (515 km/h; 320 mph); max rate of climb 143 m (470 ft)/min; range 985 n miles (1,825 km; 1,134 miles).

CGD/T: Demonstrator and trainer, based on Golden Butterfly with changes including 1.52 m (5 ft 0 in) Carter propeller generating 147 kg (325 lb) of thrust from two-cylinder Rotax 582 rated at 44.4 kW (59.6 hp) installed. Fuel capacity increased to 87 litres (23.0 US gallons; 19.2 Imp gallons).

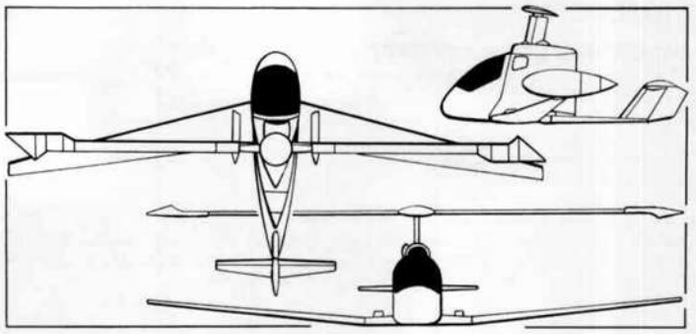


Cutaway drawing of Carter PAV 2+2 with Diesel engine 1037955

Carter CGD/T demonstrator and trainer *(Tyson Rininger, Carter)* 1037967

DESIGN FEATURES: Cabin pod with pusher propeller, narrow tailboom and cruciform empennage; sweptback wing and rotor diameter identical in all versions.

In addition to slow turning qualities, rotor can be spun in neutral pitch to some 500 rpm to store energy for vertical (jump-start) ascent. Propeller controlled by weights which irrevocably change pitch from neutral to thrust at end of jump-start phase.



Carter PAV 2+2 *(James Goulding)* 1158066

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912S flat-four. Fuel capacity 122 litres (32.3 US gallons; 26.9 Imp gallons).

ACCOMMODATION: Four persons in two side-by-side pairs.

DIMENSIONS, EXTERNAL:

Rotor diameter	10.36 m (34 ft 0 in)
Wing span	10.36 m (34 ft 0 in)
Length overall	6.40 m (21 ft 0 in)
Height excl landing gear	3.00 m (9 ft 10 in)

AREAS:

Rotor disc	84.35 m² (907.9 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	363 kg (800 lb)
Max T-O weight	725 kg (1,600 lb)

CESSNA

CESSNA AIRCRAFT COMPANY (SUBSIDIARY OF TEXTRON INC)

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PRESIDENT AND CEO: Jack J Pelton
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SENIOR VICE-PRESIDENT, PRODUCT ENGINEERING: David W Brant
SENIOR VICE-PRESIDENT, SALES AND MARKETING: Roger Whyte
SENIOR VICE-PRESIDENT, FINANCE AND CHIEF FINANCIAL OFFICER: Michael Shonka
VICE-PRESIDENT, PRODUCT ENGINEERING: Andrew H Kasowski
STAFF VICE-PRESIDENT: Marilyn Richwine
VICE-PRESIDENT, MARKETING: Tom Aniello
VICE-PRESIDENT, ADMINISTRATION: Michael Houeskeland
VICE-PRESIDENT, CITATION SALES: Mark Paolucci
VICE-PRESIDENT, COMMUNICATIONS: Robert H Stangarone
VICE-PRESIDENT, QUALITY: Brad Thress
DIRECTOR OF COMMUNICATIONS: Doug Oliver

SINGLE-ENGINE PISTON AIRCRAFT PRODUCTION PLANT:
One Cessna Boulevard, PO Box 1996, Independence, Kansas 67301
Tel: (+1 316) 332 00 00
Fax: (+1 316) 332 03 88
GENERAL MANAGER: Terry Clark

Founded by late Clyde V Cessna 1911; incorporated 7 September 1927; acquired by General Dynamics as wholly owned subsidiary 1985; acquisition by Textron announced February 1992.

Suspended manufacture of some piston-engined light aircraft types in mid-1980s; plans for resumed production of Cessna 172 Skyhawk, 182 Skylane, 206 Stationair and T206 Turbo Stationair announced 1994; 46,450 m² (500,000 sq ft) new factory at Independence Municipal Airport, Montgomery County, Kansas, opened 3 July 1996 to house final assembly, painting, flight test, engineering, finance, marketing and human resource operations for single-engined light aircraft range. First new model 172 rolled out 6 November 1996. On February 2004 Cessna announced that final assembly of the Citation Mustang will take place at Independence; workforce there then stood at 350, and is expected to increase to approximately 1,000 when the Mustang is in full production.

Owned subsidiaries include Cessna Finance Corporation in Wichita and Cessna-Columbus Division in Columbus, Georgia. Sold 49 per cent interest in Reims Aviation of France to Compagnie Française Chaufour Investissement (CFCI) February 1989; Reims continues manufacturing Cessna F406 Caravan II (which see in French section).

Total 187,420 aircraft produced by 30 June 2006. Total of 1,155 delivered in 2005, comprising 822 single-engined piston aircraft, 86 Caravans and 247 Citations. 3,000th piston single from resumed production, a 182T Skylane, delivered in early February 2001; 5,000th following March 2004; 4,000th Citation executive jet delivered 7 October 2003; 150,000th single-engine piston aircraft, a Skyhawk SP, delivered 27 July 2004; 6,000th new-build single-engined piston aircraft, a Skyhawk SP, delivered 30 August 2005. Workforce about 9,900 in May 2003. Order backlog stood at USD6.3 billion at the end of 2005.

CESSNA SPORT

TYPE: Two-seat lightplane.

PROGRAMME: Unflown proof-of-concept aircraft (N158CS) unveiled at AirVenture, Oshkosh, 24 July 2006. First flight 13 October 2006. Total of more than 50 flight testing hours completed by mid-January 2007. Final design and launch dependent upon reaction from potential customers.

DESIGN FEATURES: Company's initial venture into LSA market. High, strut-braced constant-chord wing with inboard leading-edge cutaway for improved up- and sideward visibility; sweptback fin; low, constant-chord tailplane.

FLYING CONTROLS: Conventional and manual. Horn-balanced rudder and elevators. Slotted flaps.

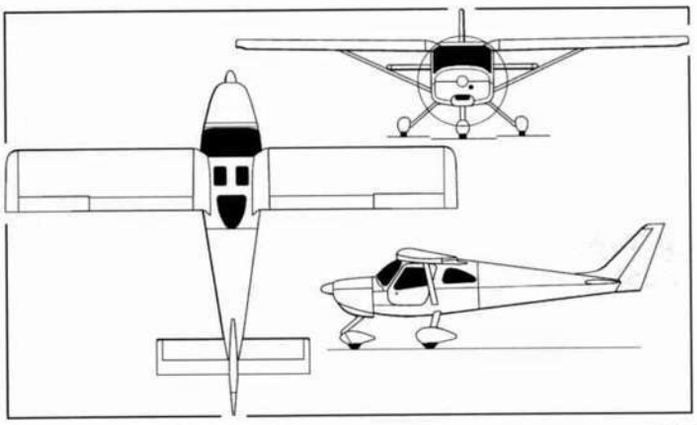
STRUCTURE: Generally of aluminium, with glass fibre engine cowling.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted, spring cantilever mainwheel legs; cantilever, trailing link nosewheel.

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912S flat-four driving a two-blade propeller.

ACCOMMODATION: Two persons, side by side. Upward-hinged door each side. Baggage space at rear.

Cessna Sport LSA proof-of-concept during its maiden flight 1158818



Cessna Sport LSA *(Paul Jackson)* 1159255

DIMENSIONS, EXTERNAL:

Wing span	9.14 m (30 ft 0 in)
Length overall	6.93 m (22 ft 9 in)
Height overall	2.31 m (7 ft 7 in)
Max width of fuselage	1.22 m (4 ft 0 in)

CESSNA 172 SKYHAWK

TYPE: Four-seat lightplane.

PROGRAMME: Development of previous models described in 1985–86 and earlier editions of *Jane's All the World's Aircraft*; total of 35,643 commercial aircraft in the earlier Model 172/Skyhawk series built between 1955 (first flight of prototype, 12 June) and 1985, when production was suspended. Prototype 'Restart 172' (N6786R), modified from 1978 Model 172N with IO-360 engine, made its first flight at Wichita 19 April 1995; certification flight testing began 10 January 1996; three preproduction 172Rs (N172KS, N172SE and N172NU) assembled at East Pawnee, Wichita, plant under single-engine Pilot Program, of which the first flew on 16 April 1996; FAA FAR Pt 23 certification achieved 21 June 1996 after 145 flight test hours; first production aircraft (c/n 80004; N172FN) rolled out at Independence 6 November 1996 and delivered 18 January 1997. First export delivery began on 30 January 1997 when second Independence-built aircraft (c/n 80005; VH-NMN) left US for air ferry to Australia.

CURRENT VERSIONS: **172R Skyhawk:** Standard version. Compared with pre-1986 (172Q) versions, features fuel-injected engine; specially developed McCauley propeller optimised for reduced rpm operation; new Honeywell avionics; metal instrument panel with backlit, non-glare instruments; all-electric engine gauges, dual vacuum system, digital clock, EGT gauge, hour meter and centrally mounted annunciator panel; stainless steel control cables; epoxy corrosion-proofing; cabin improvements as detailed below; steps for visual checking of fuel tanks, which have quick-reference quantity tabs, and consolidation of all primary electrical components into a single junction box on the firewall for simplified servicing.

New standard features announced at the NBAA Convention at New Orleans on 9 October 2000, and introduced on 172R and 172S from 2001 model year, include redesigned wingtips, restyled and reclocked main landing gear fairings, improved nose gear fairing, low-drag wing strut fairings, streamlined refuelling and entrance steps, and improved interiors featuring sculptured composite side panels with integrated cupholders and cushioned armrests, removable overhead panels for simplified maintenance, Rosen sun visors, lightweight door handles and a 12 V electrical port for use with a portable GPS, CD player or laptop computer. New optional avionics include a 12.7 cm (5 in) Honeywell KMD 550 LCD colour MFD with Stormscope that interfaces with the previously available KLN 94 colour IFR GPS.

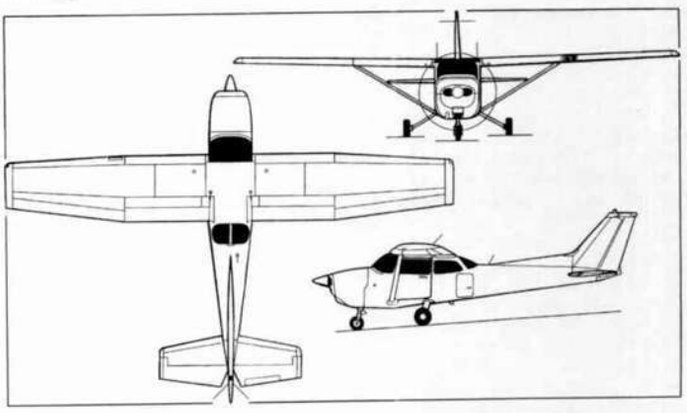
Garmin G1000 integrated glass cockpit announced 27 July 2004 as NAV III package for 172R Skyhawk GA aimed principally at flight training market, and for 172S Skyhawk SP, both available from early 2005.

Amsafe AAIR airbag system introduced as standard on front seats from 2005, optional on rear passenger seats.

Detailed description applies to 172R.

172S Skyhawk SP: Special performance version, announced 19 March 1998; features Textron Lycoming IO-360-L2A engine rated at 134 kW (180 hp) driving a higher-performance McCauley 1A170E/JHA7660 fixed-pitch, 1.93 m (6 ft 4 in) diameter propeller; avionics and equipment as for baseline version except leather seats standard.

Cessna 172S Skyhawk SP *(Paul Jackson)* 1159160



Cessna 172R Skyhawk *(Paul Jackson)* 1159121

Standard empty weight 754 kg (1,663 lb); maximum T-O and landing weight: normal 1,157 kg (2,550 lb), utility 998 kg (2,200 lb); maximum ramp weight: normal 1,160 kg (2,558 lb), utility 1,002 kg (2,208 lb); maximum level speed at S/L 126 kt (233 km/h; 145 mph); cruising speed, 75 per cent power at 2,590 m (8,500 ft) 124 kt (230 km/h; 143 mph); stalling speed, power off: flaps up 53 kt (99 km/h; 61 mph), flaps down 48 kt (89 km/h; 56 mph); maximum rate of climb at S/L 222 m (730 ft)/min; service ceiling 4,270 m (14,000 ft); T-O run 293 m (960 ft); T-O to 15 m (50 ft) 497 m (1,630 ft); landing from 15 m (50 ft) 407 m (1,335 ft); landing run 175 m (575 ft); range with maximum fuel: at 75 per cent power at 2,590 m (8,500 ft), 518 n miles (959 km; 596 miles); at 45 per cent power at 3,050 m (10,000 ft), 638 n miles (1,181 km; 734 miles); endurance 6 h 43 min. First delivery 31 July 1998. Further improvements introduced in October 2000, as noted.

CUSTOMERS: By second quarter 2006, current production series had accounted for 1,353 Cessna 172Rs and 2,257 Cessna 172Ss. Total of 180 172Rs and 279 172Ss delivered in 1999, 150 and 340, respectively in 2000, 107 and 341, respectively in 2001, 57 and 258 respectively in 2002, 58 and 291 respectively in 2003, 32 and 204 respectively 2004, 37 and 314 respectively in 2005, and 65 and 133 respectively in the first six months of 2006. The 1,000th 172R/SP was delivered in October 1999 to North Florida Medical. Customers include Embry-Riddle Aeronautical University (initial batch of 73 172Rs out of 300 piston-engined Cessnas of all models to be ordered over a 12 year period), TAM Training (10), Western Michigan University (38), US AFB Flight Training Centre (22 delivered from 30 March 1998), Civil Air Patrol (42 172Rs/SPs ordered by August 2000, Daniel Webster College of Nashua, New Hampshire (20 172Rs delivered by August 2000, Central Missouri State University (16 172Rs delivered by March 2000), Kansas State University (20 172Rs including five Garmin G1000-equipped aircraft, delivered), Singapore Flying College at Jandakot, Perth, Australia (six 172Rs ordered in February 2000 in addition to five delivered in early 1998), the University of Dubuque (three 172Rs delivered in 2003, bringing fleet total to nine), American Flyers (five 172Rs delivered in 2003, bringing fleet total to 25), Southern Illinois University Carbondale (seven 172Rs delivered in April 2003), Theorie Training Centre of Bonn, Germany, which took delivery of five 172Rs in May 2004, the Civil Aviation Flying University of China (CAFUC), which ordered 42 172Rs, including 22 G1000-equipped, delivery of which began in April 2006, Turkish Airlines which ordered three 172SPs plus seven options for delivery beginning in the first quarter of 2006, Horizon International Flight Academy of the United Arab Emirates, which ordered five 172SPs in November 2005, and Embry-Riddle Aeronautical University, which ordered 16 Skyhawk SPs in April 2006 for delivery in the second and third quarters of the year, and in July 2006

Cessna 172R Skyhawk *(Paul Jackson)* 1159159

ordered a further 29, with Garmin G1000 avionics. 150,000th Cessna single-engine piston aircraft, a 172S, delivered 27 July 2004 at EAA AirVenture Oshkosh, to Sporty's Pilot Shop for its 2005 Super Sweepstakes draw.

COSTS: 172R Skyhawk USD158,000 standard equipped; Skyhawk SP USD165,000. Price including NAV I USD168,150 (172R) and USD175,150 (172S); NAV II USD181,100 (172R) and USD188,100 (172S); NAV III USD199,750 (172R GA) and USD229,750 (172S) (all 2004).

DESIGN FEATURES: Classic, all-metal, braced high-wing, touring lightplane. Tapered, mid-mounted tailplane and wing outer panels; sweptback fin.

NACA 2412 wing section. Dihedral 1° 44'. Incidence 1° 30' at root, −1° 30' at tip; fin sweepback 35° at quarter-chord.

FLYING CONTROLS: Conventional and manual. Actuation by stainless steel cables; modified Frise all-metal ailerons; electrically actuated single-slotted Para Lift flaps; trim tab on elevator.

STRUCTURE: Conventional light alloy, with composites for some non-structural components such as nose-bowl, wing-, tailplane- and fin-caps, and fairings. Epoxy corrosion proofing and polyurethane exterior paint standard.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted Cessna Land-O-Matic spring cantilever tapered steel tube mainwheel legs and oleo-pneumatic nose leg; steerable nosewheel, tyre size 5.00×5, mainwheel tyres size 6.00×6; hydraulic brakes. Wheel fairings optional, but included free when Nav I and II packages are purchased.

POWER PLANT: One 119 kW (160 hp) Textron Lycoming IO-360-L2A flat-four piston engine driving a two-blade, fixed-pitch McCauley 1C235/LFA7570 metal propeller. Fuel contained in two integral wing tanks, combined capacity 212 litres (56.0 US gallons; 46.6 Imp gallons) of which 201 litres (53.0 US gallons; 44.1 Imp gallons) are usable. Refuelling points on upper surface of each wing. Oil capacity 7.6 litres (2.0 US gallons; 1.7 Imp gallons).

ACCOMMODATION: Four persons in two pairs on contoured, energy-absorbing seats dynamically tested to 26 *g*, those for pilot and front seat passenger being vertically adjustable, reclining and mounted on enlarged seat rails with dual locking pins; dual controls standard; rear bench seat with reclining back; door each side of cabin, hinged forward; inertia reel harnesses for all occupants; tinted windows with hinged side windows; ambient noise reduction soundproofing; composites headliner, and double-pin latching system for cabin doors. Baggage compartment to rear of cabin, with access door on port side. Cabin is heated and ventilated. Keith Products air conditioning system optional.

SYSTEMS: Electrical system comprising 28 V 60 A alternator and 24 V 12.75 Ah battery.

AVIONICS: *Comms:* Bendix/King KX 155A nav/com; KI 208 VOR/LOC indicator; KMA 28 audio panel. KT 76C Mode C transponder, and Pointer 3000-11 ELT, all standard.

Flight: Bendix/King KI 208 VOR/LOC standard. Optional NAV I package comprises KLN 94 GPS-IFR, second KX 155A with glideslope, KI 209A VOR/LOC/GS with GPS interface, and MD 41-231 GPS-Nav selector; optional NAV II package adds KAP 140 two-axis autopilot. Optional additions to NAV II include KCS 55 compass, KR 87 ADF, KMD 550 MFD, KDR 510 FIS weather datalink and XM WX satellite weather.

NAV III package for 172R GA features Garmin G1000 fully-integrated system providing all primary flight, navigation, communications, terrain, traffic, weather and engine sensor data on two 10.4 in XGA-resolution PFD/MFD displays, and includes solid-state AHRS; dual VOR/LOC/ILS/GPS; solid-state digital air-data computer; engine-monitoring display; Mode S transponder with Traffic Information Service; dual radio modules that provide WAAS-upgradeable IFR oceanic-approved GPS; VHF navigation with ILS; and VHF communication with 16-watt transceivers and 8.33-kHz channel spacing; EICAS; terrain mapping including topographic and terrain and obstruction clearance mapping; digital audio panel/intercom with ATC playback recording; and three-axis magnetometer that provides full magnetic field information in all flight attitudes. NAV III package for 172S adds to the above an autopilot; high-bandwidth datalink weather system including NEXRAD, METARS, FIS, lightning and up to 14 other weather services (Continental US only); and XM satellite radio entertainment system.

DIMENSIONS, EXTERNAL:

Wing span	11.00 m (36 ft 1 in)
Wing chord: at root	1.63 m (5 ft 4 in)
at tip	1.12 m (3 ft 8½ in)
Wing aspect ratio	7.5
Length overall	8.28 m (27 ft 2 in)
Height overall	2.72 m (8 ft 11 in)
Wheel track	2.53 m (8 ft 3½ in)
Wheelbase	1.63 m (5 ft 4 in)
Propeller diameter	1.90 m (6 ft 3 in)
Cabin doors: Max height	1.02 m (3 ft 4½ in)
Max width	0.94 m (3 ft 1 in)
Baggage door: Max height	0.56 m (1 ft 10 in)
Max width	0.39 m (1 ft 3¼ in)

DIMENSIONS, INTERNAL:

Cabin (firewall to baggage area):	
Length	3.61 m (11 ft 10 in)
Max width	1.00 m (3 ft 3½ in)
Max height	1.22 m (4 ft 0 in)

AREAS:

Wings, gross	16.17 m² (174.0 sq ft)
Ailerons (total)	1.70 m² (18.3 sq ft)
Trailing-edge flaps (total)	1.98 m² (21.26 sq ft)
Fin	1.04 m² (11.24 sq ft)
Rudder, incl tab	0.69 m² (7.43 sq ft)
Tailplane	2.00 m² (21.56 sq ft)
Elevators, incl tab	1.35 m² (14.53 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, standard	743 kg (1,639 lb)
Baggage capacity	54 kg (120 lb)
Max T-O and landing weight:	
Normal	1,111 kg (2,450 lb)
Utility	952 kg (2,100 lb)
Max ramp weight: Normal	1,114 kg (2,457 lb)
Utility	956 kg (2,107 lb)
Max wing loading	68.7 kg/m² (14.08 lb/sq ft)
Max power loading	9.32 kg/kW (15.31 lb/hp)

PERFORMANCE:

Max level speed at S/L	123 kt (227 km/h; 141 mph)
Cruising speed at 80% power at FL80	122 kt (226 km/h; 140 mph)
Stalling speed, power off:	
flaps up	51 kt (95 km/h; 59 mph)
flaps down	47 kt (87 km/h; 54 mph)
Max rate of climb at S/L	219 m (720 ft)/min
Service ceiling	4,115 m (13,500 ft)
T-O run	288 m (945 ft)
T-O to 15 m (50 ft)	514 m (1,685 ft)
Landing from 15 m (50 ft)	395 m (1,295 ft)
Landing run	168 m (550 ft)
Range with max fuel, 45 min reserves:	
at 80% power at FL80	580 n miles (1,074 km; 667 miles)
at 60% power at FL100	687 n miles (1,272 km; 790 miles)
Endurance	6 h 36 min

CESSNA 182 SKYLANE

TYPE: Four-seat lightplane.

PROGRAMME: Development of previous versions, first of which was certified on 2 March 1956; total of 19,773 earlier Model 182/Skylanes were built between 1956 and 1985, when production was suspended. Manufacture resumed when three preproduction 182Ss assembled at East Pawnee, Wichita, plant under single-engine Pilot Program, of which the first (N182NU) flew on 16 July 1996; FAA FAR Pt 23 certification achieved by Model 182S on 3 October 1996 after 164 flight test hours; assembly of first new production aircraft (N182FN) began at Independence 25 September 1996, with delivery 24 April 1997. Cessna 182S supplanted when delivery of improved 182T and T182T versions began in May 2001. Garmin G1000 'glass cokpit' offered from October 2003 and demonstrator shown at Sun 'n' Fun in April 2004.

CURRENT VERSIONS: **182T Skylane:** *As described.* Standard version from 2001 model year, announced at the NBAA Convention at New Orleans on 9 October 2000; FAA certification 23 February 2001. Compared to 182S features redesigned wingtips, restyled and reclocked main landing gear fairings, improved nose gear fairing, low-drag wing strut fairings, streamlined refuelling and entrance steps, and improved interiors featuring sculptured composite side panels with integrated cupholders and cushioned armrests, removable overhead panels for simplified maintenance, Rosen sun visors, lightweight door handles, and a 12 V electrical port for use with a portable GPS, CD player or laptop computer. New optional avionics include a 12.7 cm (5 in) Honeywell KMD 550 LCD colour MFD with Stormscope that interfaces with the previously available KLN 94 colour IFR GPS. Standard empty weight 860 kg (1,897 lb); maximum level speed at S/L 150 kt (278 km/h; 173 mph); cruising speed at 80 per cent power at 2,135 m (7,000 ft), 145 kt (269 km/h; 167 mph); range with maximum fuel, 45 min reserves at 75 per cent power at 2,440 m (8,000 ft), 813 n miles (1,505 km; 935 miles).

Amsafe AAIR airbag system introduced as standard on all seats from 2005.

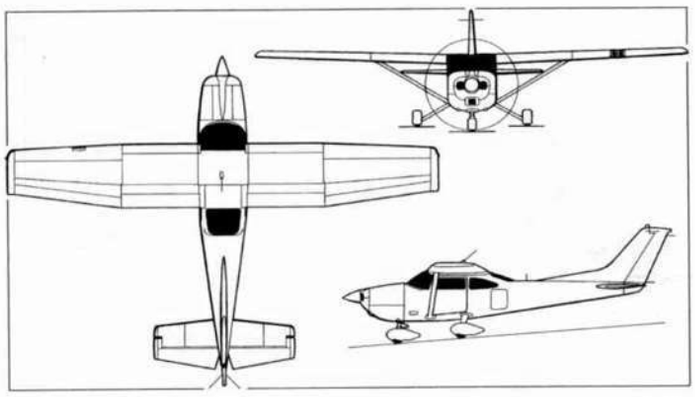
T182T Turbo Skylane: Turbocharged version. Described separately.

CUSTOMERS: Total of 1,795 normally aspirated Model 182s of current series built by 31 March 2006, comprising 944 182Ss and 851 182Ts.

Customers include the Mexican Air Force, which had taken delivery of 76 Skylanes by June 2000, the Louisiana State Department of Agriculture and Forestry, which ordered 18 for delivery in early 2003, and the US Civil Air Patrol, which ordered 15 for delivery in 2003, six for delivery in 2004 and 16 for delivery in 2006. Total of 248 delivered in 1999, 267 in 2000, 142 in 2001, 109 in 2002, 118 in 2003, 196 in 2004, 241 in 2005 and 85 in the first six months of 2006.

COSTS: USD250,000 standard equipped; with NAV I package, USD260,000; with NAV II package, USD278,100; with NAV III package, USD297,500 (all 2004).

Cessna 182T Skylane *(Paul Jackson)* 1159161



Cessna 182T Skylane *(Paul Jackson)* 0568986

DESIGN FEATURES: Generally as for Cessna 172.

Wing section NACA 2412 (modified); incidence 0° 47' at root, –2° 50' at tip; dihedral 1° 44'.

FLYING CONTROLS: Conventional and manual. Actuation by stainless steel control cables; modified Frise ailerons; electrically actuated single-slotted Para Lift flaps; trim tabs on elevator and rudder. Control surface movements: ailerons +20°/–15°; elevator +28°/–21°; rudder ±24°; flaps –38°.

STRUCTURE: Conventional light alloy, with composites for some non-structural components such as nose-bowl, wing-, tailplane- and fin-caps, and fairings. Epoxy corrosion proofing and polyurethane exterior paint standard.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted Cessna Land-O-Matic spring cantilever tapered steel tube mainwheel legs and oleo-pneumatic nose leg; steerable nosewheel, tyre size 5.00×5, mainwheel tyre size 6.00×6; hydraulic brakes. Wheel fairings optional.

POWER PLANT: One 172 kW (230 hp) Textron Lycoming IO-540-AB1A5 flat-six piston engine driving a three-blade, constant-speed McCauley B3D36C431/80VSA-1 metal propeller. Fuel contained in two integral wing tanks, combined capacity 348 litres (92.0 US gallons; 76.6 Imp gallons) of which 329 litres (87.0 US gallons; 72.4 Imp gallons) are usable. Refuelling points on upper surface of each wing. Oil capacity 8.5 litres (2.25 US gallons; 1.9 Imp gallons).

ACCOMMODATION: Four persons in two pairs on contoured, energy-absorbing seats, dynamically tested to 26 *g*, those for pilot and front seat passenger being vertically adjustable, reclining and mounted on enlarged seat rails with dual locking pins; dual controls standard; rear bench seat with reclining back; inertia reel harnesses for all occupants; tinted windows with hinged side windows; ambient noise reduction soundproofing; composites headliner, and double-pin latching system for cabin doors. Baggage compartment to rear of cabin, with access door on port side. Cabin is heated and ventilated. Keith Products air conditioning optional.

SYSTEMS: Electrical system comprising 28 V 60 A alternator and 24 V 12.75 Ah battery.

AVIONICS: *Comms:* Dual Bendix/King KX 155A nav/com glideslope; KMA 28 audio panel with marker beacon receiver, four-position stereo/com voice-activated intercom, ELT and KT 76C Mode C transponder all standard.

Flight: Bendix/King KAP 140 two-axis autopilot and KI 209A VOR/LOC/GS standard. NAV I package adds KI 209A VOR/LOC/GS with GPS interface, KLN 94 colour moving map, KMD 550 MFD and CSE GPS-NAV selector/annunciator KCS 55A HSI, Goodrich WX 500 Stormscope and CSE GPS-NAV/HSI selector/annunciator. Options to NAV II include KR 87 ADF (also with NAV I) KMH 880 traffic and terrain awareness system, and KDR 510 FIS sensor.

NAV III package, announced at the NBAA Convention in Orlando on 7 October 2003 and available as option from second quarter 2004, features Garmin G1000 all-glass integrated cockpit comprising two 264 mm (10.4 in) high-resolution, wide viewing angle XGA screens for PFD and MFD functions; solid-state AHRS and digital air data computer; dual VHF com radios; dual VOR/LOC/ILS receivers; dual GPS receivers with future WAAS upgrade capability; Mode S transponder and Traffic Information System; WX-500 Stormscope displayed on EFIS screens; digital audio panel/intercom with ATC playback recording; XM WX satellite weather; XM satellite Radio entertainment system; turbine-class switch panels with electro-luminescent lighting; and simplified line-replaceable units to minimise down time. FAA approval for G1000 granted 17 June 2004.

DIMENSIONS, EXTERNAL:

Wing span	10.97 m (36 ft 0 in)
Wing chord: at root	1.63 m (5 ft 4 in)
at tip	1.09 m (3 ft 7 in)
Wing aspect ratio	7.4
Length overall	8.84 m (29 ft 0 in)
Height overall	2.84 m (9 ft 4 in)
Wheel track	2.74 m (9 ft 0 in)
Wheelbase	1.69 m (5 ft 6½ in)
Propeller diameter	2.01 m (6 ft 7 in)
Cabin doors: Height	1.04 m (3 ft 5 in)
Max width	0.93 m (3 ft 0½ in)
Baggage door: Height	0.56 m (1 ft 10 in)
Width	0.40 m (1 ft 3¾ in)

DIMENSIONS, INTERNAL:

Cabin (firewall to baggage compartment):	
Length	3.40 m (11 ft 2 in)
Max width	1.07 m (3 ft 6 in)
Max height	1.23 m (4 ft 0½ in)

AREAS:

Wings, gross	16.30 m² (175.50 sq ft)
Ailerons (total)	1.70 m² (18.3 sq ft)
Trailing-edge flaps (total)	1.97 m² (21.20 sq ft)
Fin	1.08 m² (11.62 sq ft)
Rudder	0.65 m² (6.95 sq ft)
Tailplane	2.13 m² (22.96 sq ft)
Elevators	1.54 m² (16.61 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	870 kg (1,918 lb)
Baggage capacity	91 kg (200 lb)
Max T-O weight	1,406 kg (3,100 lb)
Max ramp weight	1,411 kg (3,110 lb)
Max landing weight	1,338 kg (2,950 lb)
Max wing loading	86.2 kg/m² (17.66 lb/sq ft)
Max power loading	8.20 kg/kW (13.48 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	175 kt (324 km/h; 201 mph)
Max level speed at S/L	150 kt (278 km/h; 173 mph)
Cruising speed at 80% power at FL70	145 kt (269 km/h; 167 mph)
Stalling speed, power off:	
flaps up	54 kt (100 km/h; 63 mph)
flaps down	49 kt (91 km/h; 57 mph)
Max rate of climb at S/L	282 m (924 ft)/min
Service ceiling	5,515 m (18,100 ft)
T-O run	242 m (795 ft)
T-O to 15 m (50 ft)	462 m (1,514 ft)
Landing from 15 m (50 ft)	412 m (1,350 ft)
Landing run	180 m (590 ft)
Range with max fuel, 45 min reserves:	
at 80% power at FL70	773 n miles (1,431 km; 889 miles)
at 55% power at FL100	930 n miles (1,722 km; 1,070 miles)

CESSNA T182T TURBO SKYLANE

TYPE: Four-seat lightplane.

PROGRAMME: Announced at NBAA Convention at New Orleans on 9 October 2000. Certified 23 February 2001; deliveries began in May 2001. First four Garmin G1000-equipped Turbo Skylanes delivered 29 June 2004, following FAA certification of new avionics on 7 June. Amsafe AAIR airbag system introduced as standard on all seats from 2005.

Description for Cessna 182S and 182T Skylanes applies also to the T182T Turbo Skylane, except as follows.

CUSTOMERS: Total of 96 delivered in 2001, 79 in 2002, 47 in 2003, 133 in 2004, 118 in 2005, and 88 in the first six months of 2006. Recent customers include the Alabama Department of conservation, wildlife and freshwater Fisheries, which took delivery of one in July 2003 and the Civil Air Patrol, which took delivery of five on 18 November 2003.

COSTS: Standard equipped USD275,000; with NAV I package USD285,000; with NAV II package USD303,100; with NAV III package USD322,500 (all 2004).

POWER PLANT: One 175.2 kW (235 hp) Textron Lycoming TIO-540-AK1A turbocharged flat-six engine, driving a three-blade, constant-speed McCauley B3D76C442-C/80VSB-1 metal propeller.

AVIONICS: As for Skylane. Garmin G1000 avionics fit received FAA approval on 25 June 2004.

WEIGHTS AND LOADINGS:

Standard weight empty	918 kg (2,023 lb)
Max power loading	8.03 kg/kN (13.19 lb/hp)

PERFORMANCE:

Max level speed at FL200	176 kt (326 km/h; 203 mph)
Cruising speed at 88% power at FL125	159 kt (294 km/h; 183 mph)
Max rate of climb at S/L	317 m (1,040 ft)/min
Max operating altitude	6,100 m (20,000 ft)
T-O run	236 m (775 ft)
T-O to 15 m (50 ft)	422 m (1,385 ft)
Max range	615 n miles (1,139 km; 707 miles)

Cessna T182T Turbo Skylane *(Paul Jackson)* 1129396

CESSNA 206 STATIONAIR and T206 TURBO STATIONAIR

TYPE: Six-seat utility transport.

PROGRAMME: Development of previous versions described in 1984–85 and earlier editions of *Jane's All the World's Aircraft*; beginning in 1964, total of 7,556 earlier Model 206/Skywagons/Super Skylanes/Stationairs/Turbo Stationairs had been built when production was suspended in 1985. New model T206H prototype (N732CP) first flown from Wichita 28 August 1996; new model 206H prototype first flown 6 November 1996; assembly of first Pilot Program T206H began 3 December 1996.

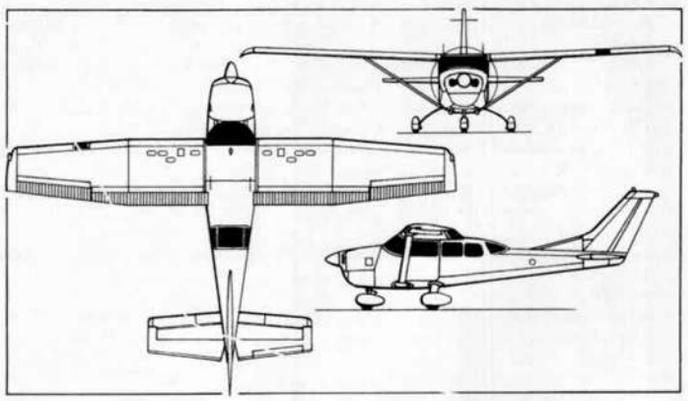
FAA certification of 206H achieved 9 September 1998, followed by approval for T206H on 1 October 1998. First delivery, of 10 206Hs to Uruguayan Air Force, began 8 December 1998. Garmin G1000 'glass cockpit' offered from October 2003 and demonstrator shown at Sun 'n' Fun in April 2004.

CURRENT VERSIONS: **206H Stationair: and T206H Turbo Stationair: (Stationair TC)** Standard versions. New features introduced on 206H and T206H comprise fuel-injected engines; new Honeywell avionics; metal instrument panel with backlit, non-glare instruments plus back-up cold fluorescent light system; all-electric engine gauges; stainless steel control cables; epoxy corrosion-proofing; cabin improvements as detailed below; strobe lights; handles and steps to check fuel levels; static wicks; GPU receptacle; and fire extinguisher.

New standard features announced at the NBAA Convention at New Orleans on 9 October 2000, and introduced on 206H and T206H from 2001 model year, include redesigned wingtips, restyled and reclocked main landing gear fairings, improved nose gear fairing, low-drag wing strut fairings, streamlined refuelling and entrance steps, and improved interiors featuring sculptured composite side panels with integrated cupholders and cushioned armrests, removable overhead panels for simplified maintenance, Rosen sun visors, lightweight door handles, and a 12 V electrical port for use with a portable GPS, CD player or laptop computer. New optional avionics include a 12.7 cm (5 in) Honeywell KMD 550 LCD colour MFD with Stormscope that interfaces with the previously available KLN 94 colour IFR GPS.

Garmin G1000 integrated 'glass cockpit' received FAA approval for T206H on 9 September 2004 and for 206H on 4 October 2004.

Cessna T206H Stationair TC *(Paul Jackson)* 1159162



General arrangement of the Cessna 206H Stationair *(James Goulding)* 1159120

Amsafe AAIR airbag system introduced as standard on forward four seats from 2005, optional on rearmost passenger seats.

Description applies to the above version.

CUSTOMERS: Total of 264 Stationairs and 623 Turbo Stationairs delivered by 30 June 2006, including 16 and 58 respectively in 2003, 22 and 67 respectively in 2004, 29 and 83 respectively in 2005, and seven and 40 respectively in the first six months of 2006. Recent customers include Beijing Sport Aviation School of Beijing, China, which took delivery of one T206H in November 2003, and A&P Light Aircraft Service Company (China) Ltd, which ordered two for delivery in November 2004.

COSTS: Stationair USD351,900 standard equipped; with NAV I package USD370,800; with NAV II package USD394,300; with NAV III package USD413,000; Turbo Stationair USD381,900 standard equipped; with NAV I package USD400,800; with NAV II package USD424,300; with NAV III package USD443,000 (all 2004).

DESIGN FEATURES: Generally as for Cessna 172.

Wing section NACA 2412 (modified). Dihedral 2° 14'; incidence 1° 30' at root, −1° 30' at tip.

FLYING CONTROLS: As Cessna 182.

LANDING GEAR: As Cessna 182. Wipline 3450 floatplane conversion certified April 2000.

POWER PLANT: Stationair has one 224 kW (300 hp) Textron Lycoming IO-540-AC1A flat-six piston engine; Turbo Stationair has one 231 kW (310 hp) Textron Lycoming TIO-540-AJ1A turbocharged flat-six piston engine; each drives a three-blade, constant-speed McCauley B3D36C432/80VSA-1 metal propeller. Total fuel capacity 348 litres (92.0 US gallons; 76.6 Imp gallons), of which 329 litres (87.0 US gallons; 72.4 Imp gallons) are usable. Oil capacity 10.4 litres (2.75 US gallons; 2.3 Imp gallons).

ACCOMMODATION: Forward-hinged door, port side; double cargo doors starboard side, each opening away from centre. Six persons in three pairs on contoured, energy-absorbing seats, dynamically tested to 26 g, those for pilot and front seat passenger being vertically adjustable, reclining and mounted on enlarged seat rails with dual locking pins; other seats have reclining backs; inertia reel harnesses for all occupants; tinted windows; hinged front side windows; composites headliner; multilevel ventilation system; ambient noise reduction soundproofing and double-pin latching system on pilot's door, all standard. Utility interior and Keith Products air conditioning system optional.

AVIONICS: *Comms:* Bendix/King KX 155A nav/com/glideslope, KMA 28 audio panel, with marker beacon receiver, stereo/com splitter and voice-activated intercom. KT 76C Mode C transponder and ELT.

Flight: Bendix/King KI 209 VOR/LOC/GS and KAP 140 two-axis autopilot. Optional NAV I package adds second KX 155A, second KI 209A, plus KLN 94 colour moving map GPS-IFR, KMD 550 MFD and CSE GPS-NAV selector/annunciator. NAV II adds Bendix/King KCS 55A HSI, Goodrich WX 500 Stormscope and CSE GPS-NAV/HSI selector annuciator. KMH 880; traffic and terrain awareness system optional; NAV III package optional, as described in 182 Skylane entry.

EQUIPMENT: Optional equipment includes electric propeller de-icing, 0.45 m^3 (16 cu ft) cargo pod, floatplane provisions kit, oversized rough terrain tyres and wheel fairings and horizontal stabiliser abrasion boots.

DIMENSIONS, EXTERNAL:

Wing span	10.97 m (36 ft 0 in)
Wing chord: at root	1.63 m (5 ft 4 in)
at tip	1.13 m (3 ft 8½ in)
Wing aspect ratio	7.4
Length overall	8.61 m (28 ft 3 in)
Height overall	2.83 m (9 ft 3½ in)
Wheel track	2.46 m (8 ft 1 in)
Wheelbase	1.76 m (5 ft 9¼ in)
Pilot's door (port): Max height	1.04 m (3 ft 5 in)
Max width	0.94 m (3 ft 1 in)
Cargo double door (stbd):	
Max height	1.00 m (3 ft 3¼ in)
Max width	1.09 m (3 ft 7 in)
Height to sill	0.64 m (2 ft 1 in)

DIMENSIONS, INTERNAL:

Cabin: Length	3.68 m (12 ft 1 in)
Max width	1.12 m (3 ft 8 in)
Max height	1.26 m (4 ft 1½ in)
Volume available for payload	2.87 m^3 (101.2 cu ft)

AREAS:

Wings, gross	16.30 m^2 (175.5 sq ft)
Ailerons (total)	1.61 m^2 (17.35 sq ft)
Trailing-edge flaps (total)	2.68 m^2 (28.85 sq ft)
Fin	1.08 m^2 (11.62 sq ft)
Rudder, incl tab	0.65 m^2 (6.95 sq ft)
Tailplane	2.31 m^2 (24.84 sq ft)
Elevators, incl tab	1.86 m^2 (20.08 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, standard: 206H	990 kg (2,182 lb)
T206H	1,043 kg (2,299 lb)
Max baggage	82 kg (180 lb)
Max fuel: 206H, T206H	239 kg (528 lb)
Max T-O and landing weight, 206H, T206H	1,632 kg (3,600 lb)
Max ramp weight: 206H	1,639 kg (3,614 lb)
T206H	1,641 kg (3,617 lb)
Max wing loading:	
206H, T206H	100.2 kg/m^2 (20.51 lb/sq ft)
Max power loading: 206H	7.30 kg/kW (12.00 lb/hp)
T206H	7.07 kg/kW (11.61 lb/hp)

PERFORMANCE:

Max level speed: 206H at S/L	151 kt (280 km/h; 174 mph)
T206H at FL170	178 kt (330 km/h; 205 mph)
Cruising speed at 75% power:	
206H at FL62	142 kt (263 km/h; 163 mph)
T206H at FL200	164 kt (304 km/h; 189 mph)
Stalling speed:	
206H, T206H: flaps up	62 kt (115 km/h; 72 mph)
flaps down	54 kt (100 km/h; 63 mph)
Max rate of climb at S/L: 206H	301 m (988 ft)/min
T206H	320 m (1,050 ft)/min
Service ceiling: 206H	4,785 m (15,700 ft)
T206H	8,230 m (27,000 ft)
T-O run: 206H, T206H	277 m (910 ft)
T-O to 15 m (50 ft): 206H	567 m (1,860 ft)
T206H	530 m (1,740 ft)
Landing from 15 m (50 ft): 206H, T206H	425 m (1,395 ft)
Landing run: 206H, T206H	224 m (735 ft)
Range with max fuel, 45 min reserves:	
206H: at 75% power at FL65	605 n miles (1,120 km; 696 miles)
max range at FL65	721 n miles (1,335 km; 829 miles)
T206H: at 75% power at FL100	541 n miles (1,002 km; 622 miles)
at 75% power at FL200	568 n miles (1,052 km; 653 miles)
max range at FL200	703 n miles (1,302 km; 809 miles)

CESSNA NGP

TYPE: Four-seat lightplane.

PROGRAMME: First reports of Cessna Next Generation Piston (NGP) project emerged in 2005. Initial flight, unannounced, 23 June 2006; public debut at AirVenture, Oshkosh, 24 July 2006 when prototype, N99110—then with some 20 flying hours—made three unheralded flypasts immediately following unveiling of Cessna LSA.

DESIGN FEATURES: Intended to regain ground lost to Cirrus composites four-seat family. Superficial resemblance to Cessna 177 Cardinal, although slightly larger. High, cantilever wing slightly forward-swept, tapered and with inboard leading edge cutaway to give maximum up- and sideward visibility. Trapezoidal tailplane.

Prototype apparently in Cessna 182 class; lower-powered version of some 134 kW (180 hp) expected to be developed as Cessna 172 follow-on; six-seat version could replace Cessna 206.

Cessna NGP prototype at its initial public showing, Oshkosh, 24 July 2006 *(R W Simpson)* 1158506

FLYING CONTROLS: Conventional and manual. Horn-balanced rudder and elevators. Flight-adjustable rim tab in starboard elevator. Slotted laps.

STRUCTURE: Composites fuselage and metal wing, rudder and elevators.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring cantilever mainwheel legs; cantilever trailing link nosewheel. Fairings on all wheels.

POWER PLANT: Not disclosed, but believed to be six-cylinder in 149 to 172 kW (200 to 230 hp) range driving a three-blade propeller.

ACCOMMODATION: Four doors for ease of access; interior trim based on luxury motorcar; cabin has a rear window. Rear baggage compartment with external door; port.

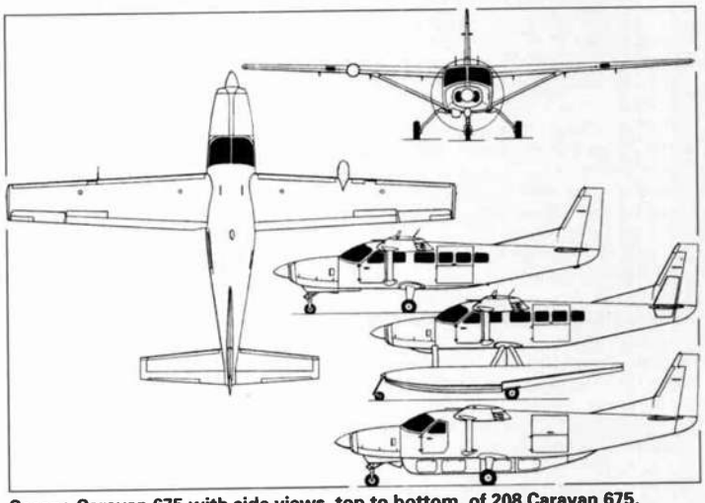
CESSNA 208 CARAVAN

Brazilian Air Force designation: C-98
US DoD designation: U-27A

TYPE: Light utility turboprop.

PROGRAMME: First flight of engineering prototype (N208LP) 9 December 1982; first production Caravan rolled out August 1984; FAA certification 23 October 1984; full production started 1985; wheeled float version certified March 1986. Cessna 208A certified 11 February 1985. First single-engined aircraft to achieve FAA certification for ILS in Cat. II conditions (Federal Express aircraft equipped); approval for IFR cargo operations 1989 made France and Ireland first European countries to allow single-engined public transport day/night IFR operation; also since approved in Canada, Denmark and Sweden. Russian certification of 208 and 208B achieved 4 September 1998.

The 1,000th of the 208B version was delivered on 12 December 2002 to Supap Puranitee of Thailand. 100th Caravan equipped with Wipaire 8000 floats delivered 16 May 2000. 1,500th Caravan delivered in November 2005 to a Polish customer. Total fleet operating time exceeded 8 million hours by November 2005, at which time Caravans were in service in 68 countries, with average fleet utilisation rate of 70,000 hours per month worldwide, and highest utilisation aircraft averaging 220 hours per month. Quoted dispatch reliability rate is 99.9 per cent. Basic utility model for passengers or cargo was Cessna 208. Engine flat rated at 447 kW (600 shp) to 3,800 m (12,500 ft). Federal Express Corporation version was 208A Cargomaster freighter with special features including T-O weight 3,629 kg (8,000 lb), Honeywell avionics, no cabin windows or starboard rear door, more cargo tiedowns, additional cargo net, underfuselage cargo pannier of composites materials, 15.2 cm (6 in) vertical extension of fin/rudder, jetpipe deflected to carry exhaust clear of pannier. These early versions now discontinued; military U-27A no longer promoted.



Cessna Caravan 675 with side views, top to bottom, of 208 Caravan 675, Caravan Amphibian and 208B Super Cargomaster *(Dennis Punnett)* 1159119

CURRENT VERSIONS: **Caravan 675**: Combines airframe of 208 and 208A with fully rated engine of 208B. Announced at NBAA Convention in Dallas, Texas, September 1997; FAA certification achieved in April 1998 with first delivery (N900RG; c/n 00277) 15 April to Riversville Aviation Company of New York in amphibious configuration; production follows on from 208/208A, beginning at c/n 00277.

Detailed description applies to Caravan 675, except where indicated.

208B: Stretched version, lacking cabin windows, and with ventral cargo pod as standard, developed at request of Federal Express. Commissioned by FedEx as **Super Cargomaster**; first flight (N9767F) 3 March 1986; certified 9 October 1986; first delivery to FedEx 31 October 1986. Features include 1.22 m (4 ft) fuselage plug aft of wing, payload of

Cessna 208B Grand Caravan *(Paul Jackson)* 1159163

1,587 kg (3,500 lb) and 12.7 m³ (450 cu ft) of cargo volume; 503 kW (675 shp) P&WC PT6A-114A from 1991.

Grand Caravan: Announced at NBAA Convention 1990; passenger version of 208B, with cabin windows, accommodating up to 14 in quick-change interior.

CUSTOMERS: Federal Express Corporation received 40 208As and 260 208Bs. Recent customers include Ben Air Inc of Stauning, Denmark, which took delivery of five Grand Caravans between 2000–2004 for onward sale to Scandinavian customers; Shandong Airlines of the People's Republic of China, which ordered one Grand Caravan and two Caravan 675s on amphibious floats for delivery in first quarter 2001, plus 37 options, of which two were exercised in 2002; China Northern Airlines of Shenyang, which took delivery of three Grand Caravans in 2002; Van Nuys Flight Center of California, which ordered 10 Grand Caravans for delivery between September 2001 and September 2005, four delivered to undisclosed Russian customers in the first half of 2002, four delivered to three cargo operators in Spain in the first half of 2002; followed by another four in 2005, Pudjiastuti of Indonesia, and Corporate Air of the Philippines, each of which ordered a Grand Caravan for delivery in 2004. Other customers include Royal Canadian Mounted Police (first amphibious version), Brazilian Air Force (eight), Chilean Army (three delivered from 7 February 1998 onwards), Liberian Army (one) and Malaysian Police (six delivered in 1994). 1,500th Caravan delivered 21 April 2005 to GEMI Ltd of Poland.

Total of 1,591 Caravans (all versions) delivered by 30 June 2006, including 102 in 1998; 87 in 1999, 92 in 2000, 75 in 2001, 80 in 2002, 57 in 2003, 64 in 2004, 86 in 2005, and 29 in the first six months of 2006. Out-of-production variants comprised two prototypes, 239 Model 208s and 37 Model 208As

COSTS: Caravan 675 USD1,600,000 (amphibian USD1,800,000); Super Cargomaster USD1,450,000; Grand Caravan USD1,750,000 (all 2004, typically equipped). Direct operating costs per hour: Caravan 675 USD209.95; Grand Caravan USD210.55; Super Cargomaster USD211.30; Amphibian USD226.00 (all 2004).

DESIGN FEATURES: Launched as first all-new single-engined turboprop general aviation aircraft; intention was to replace de Havilland Canada Beavers and Otters, Cessna 180s, 185s and 206s in worldwide utility role. Main qualities advertised are high speed with heavy load, compatibility with unprepared strips, economy and reliability with minimum maintenance; can also carry weather radar, air conditioning and oxygen systems; optional packs for firefighting, photography, spraying, ambulance/hearse, border patrol, parachuting and supply dropping, surveillance and government utility missions; optional wheel or float landing gear.

Braced, high-wing design; tapered wings and tailplane; sweptback fin with dorsal fillet; auxiliary fins on floatplane.

Wing aerofoil NACA 23017.424 at root, 23012 at tip; dihedral 3° from root; incidence 2° 37' at root, –0° 36' at tip.

FLYING CONTROLS: Conventional and manual. Lateral control by small ailerons and slot-lip spoilers ahead of outer section of flaps; aileron trim standard; all tail control surfaces horn balanced; fixed tailplane with upper surface vortex generators ahead of elevator; elevator trim tabs; electrically actuated single-slotted flaps occupy more than 70 per cent of trailing-edge and deflect to maximum 30°. Control surface movements: ailerons +25/–16°; elevator +25/–20°; rudder ±25°.

STRUCTURE: All-metal. Fail-safe two-spar wing; conventional fuselage.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted tubular spring cantilever mainwheel units; oil-damped steerable nosewheel. Mainwheel tyres size 6.50–10 (8 ply); nosewheel 6.50–8 (8 ply). Oversize tyres, optional, mainwheels 8.50–10, nosewheel 22×8.00–8, and extended nosewheel fork, optional. Hydraulically actuated single-disc brake on each mainwheel. Certified with Wipline 8000 floats (with or without retractable land wheels).

POWER PLANT: One 503 kW (675 shp) P&WC PT6A-114A turboprop. McCauley 3GFR34C703/106GA-0 three-blade, constant-speed, reversible-pitch and feathering metal propeller. Alternatively, Hartzell HC-B3MN3/M10083. Integral fuel tanks in wings, total capacity 1,268 litres (335 US gallons; 279 Imp gallons), of which 1,257 litres (332 US gallons; 276.5 Imp gallons) are usable.

ACCOMMODATION: Pilot and up to nine passengers or 1,360 kg (3,000 lb) of cargo. Maximum seating capacity with FAR Pt 23 waiver is 14. Cabin has a flat floor with cargo track attachments for a combination of two- and three-abreast seating, with an aisle between seats. Forward-hinged door for pilot, with direct vision window, on each side of forward fuselage. Airstair door for passengers at rear of cabin on starboard side. Cabin is heated and ventilated. Optional air conditioning. two-section horizontally split cargo door at rear of cabin on port side, flush with floor at bottom and with square corners. Upper portion hinges upward, lower portion forward 180°. Optional electrically operated, flight openable tambour roll-up door with airflow deflecting spoiler. In a cargo role, cabin will accommodate, typically, two D-size cargo containers or up to ten 208 litre (55 US gallon; 45.8 Imp gallon) drums.

Upgraded interior with new colour-co-ordinated fabrics and leather, and new seat design introduced in February 2001.

SYSTEMS: Electrical system is powered by 28 V 200 A starter/generator and 24 V 45 Ah lead-acid battery (24 V 40 Ah Ni/Cd battery optional). Standby electrical system, with 75 A alternator, optional. Hydraulic system for brakes only. Oxygen system, capacity 3,315 litres (117 cu ft), optional. Vacuum system standard. Cabin air conditioning system optional from c/n 208-00030 onwards. de-icing system, comprising electric propeller de-icing boots, pneumatic wing, wing strut and tail surface boots, electrically heated windscreen panel, heated pitot/static probe, ice detector light and standby electrical system, all optional.

AVIONICS: Customers' choice of Bendix/King and Garmin packages introduced in 2001; typical equipment listed below.

Comms: Dual Bendix/King KX 165 nav/com/glideslope, KT70 Mode S transponder, KHF 950 HF transceiver and KMA 24H audio control.

Radar: Honeywell RDR 200 weather radar with vertical profile.

Flight: Bendix/King KFC 225 flight director/autopilot, KLN 90 GPS, dual KR 87 ADF, KN 63 DME and KR 21 MKR. Garmin alternatives include GNS 340 com/nav/GPS; GNS 530 WAAS-upgradable IFR com/nav/GPS, with LOC and glideslope receiver, GMA 240 or GMA 340 audio panel and GTX 327 Mode C digital transponder with LCD display. Bendix/King KDR 510 flight information service and KMH 880 multi-hazard awareness system optional from 2003.

Instrumentation: Sensitive altimeter, electric clock, magnetic compass, attitude and directional gyros, true airspeed indicator, turn and bank indicator, vertical speed indicator, ammeter/voltmeter, fuel flow indicator, ITT indicator, oil pressure and temperature indicator.

EQUIPMENT: Standard equipment includes windscreen defrost, ground service plug receptacle, variable intensity instrument post lighting, map light, overhead courtesy lights (three) and overhead floodlights (pilot and co-pilot), approach plate holder, cargo tiedowns, internal corrosion proofing, vinyl floor covering, emergency locator beacon, partial plumbing for oxygen system, pilot's and co-pilot's adjustable fore/aft/vertical/reclining seats with armrest and five-point restraint harness, tinted windows, control surface bonding straps, heated pitot and stall warning systems, courtesy lights on wing underside, passenger reading lights, retractable crew steps (port side), rudder gust lock, tiedowns and towbar.

Optional equipment includes passenger seats, stowable folding utility seats, digital clock, fuel totaliser, turn co-ordinator, flight hour recorder, fire extinguisher, dual controls, co-pilot flight instruments, floatplane kit (from c/n 208-00030 onwards), hoisting rings (for floatplane), inboard fuel filling provisions (included in floatplane kit), ice detection light, flashing beacon, retractable crew step for starboard side, oversized tyres, electric trim system, oil quick drain valve and fan-driven ventilation system.

DIMENSIONS, EXTERNAL (L: landplane, A: amphibian):

Wing span	15.88 m (52 ft 1 in)
Wing chord: at root	1.98 m (6 ft 6 in)
at tip	1.22 m (4 ft 0 in)
Wing aspect ratio	9.7
Length overall: 675	11.46 m (37 ft 7¼ in)
675 Amphibian	11.86 m (38 ft 10¾ in)
Grand Caravan, Super Cargomaster	12.68 m (41 ft 7¼ in)
Height overall: 675	4.51 m (14 ft 9½ in)
675 Amphibian on land	4.97 m (16 ft 3½ in)
Grand Caravan, Super Cargomaster	4.72 m (15 ft 6 in)
Tailplane span	6.25 m (20 ft 6 in)
Wheel track: L	3.56 m (11 ft 8 in)
A	3.25 m (10 ft 8 in)
Wheelbase: L	3.54 m (11 ft 7½ in)
A	4.44 m (14 ft 7 in)
Propeller diameter	2.69 m (8 ft 10 in)
Airstair door: Height	1.27 m (4 ft 2 in)
Width	0.61 m (2 ft 0 in)
Cargo door: Height	1.27 m (4 ft 2 in)
Width	1.24 m (4 ft 1 in)

DIMENSIONS, INTERNAL (A: 208-675 Caravan; B: Super Cargomaster and Grand Caravan):

Cabin: Length, aft of cockpit: A	3.87 m (12 ft 8½ in)
B	5.09 m (16 ft 8½ in)
Max width: A, B	1.57 m (5 ft 2 in)
Max height: A, B	1.30 m (4 ft 3 in)
Volume: A	7.19 m³ (254 cu ft)
B	9.63 m³ (340 cu ft)
Cargo pannier (675): Length	5.58 m (18 ft 3½ in)
Width	1.28 m (4 ft 2½ in)
Depth	0.50 m (1 ft 7½ in)
Volume: 675	2.4 m³ (83 cu ft)
Grand Caravan, Super Cargomaster	3.27 m³ (115.5 cu ft)

AREAS:

Wings, gross	25.96 m² (279.4 sq ft)
Vertical tail surfaces (total, incl dorsal fin)	3.57 m² (38.41 sq ft)
Horizontal tail surfaces (total)	6.51 m² (70.04 sq ft)

WEIGHTS AND LOADINGS (A: 208–675 Caravan; B: Super Cargomaster; C: Grand Caravan; D: Caravan 675 Amphibian):

Weight empty: A	1,830 kg (4,034 lb)
D	2,259 kg (4,980 lb)
Baggage capacity	147 kg (325 lb)
Cargo pannier capacity	372 kg (820 lb)
Max fuel weight	1,009 kg (2,224 lb)
Max T-O weight: A, D	3,629 kg (8,000 lb)
B, C	3,969 kg (8,750 lb)
Max ramp weight: A, D	3,645 kg (8,035 lb)
B, C	3,985 kg (8,785 lb)
Max landing weight: A, D	3,538 kg (7,800 lb)
B, C	3,855 kg (8,500 lb)
Max wing loading: A, D	139.8 kg/m² (28.63 lb/sq ft)
B, C	152.9 kg/m² (31.32 lb/sq ft)
Max power loading: A, D	7.21 kg/kW (11.85 lb/shp)
B, C	7.89 kg/kW (12.96 lb/shp)

PERFORMANCE (A: 208–675 landplane; D: Caravan Amphibian):

Max operating speed (VMO)	175 kt (325 km/h; 202 mph) IAS
Max cruising speed at FL100:	
A	186 kt (344 km/h; 214 mph)
D	162 kt (300 km/h; 186 mph)
Stalling speed, power off:	
flaps up: A	75 kt (139 km/h; 87 mph) CAS
D	74 kt (137 km/h; 86 mph) CAS
flaps down: A	61 kt (113 km/h; 71 mph) CAS
D	59 kt (110 km/h; 68 mph) CAS
Max rate of climb at S/L: A	376 m (1,234 ft)/min
D	338 m (1,110 ft)/min
Max certified altitude: A	7,620 m (25,000 ft)
D	6,100 m (20,000 ft)
T-O run: A	354 m (1,160 ft)
D: on land	335 m (1,100 ft)
on water	585 m (1,920 ft)
T-O to 15 m (50 ft): A	626 m (2,053 ft)
Landing from 15 m (50 ft) at S/L, without propeller reversal: A	507 m (1,665 ft)
D: on land	454 m (1,490 ft)
on water	590 m (1,935 ft)
Landing run at S/L, without propeller reversal:	
A	227 m (745 ft)
D: on land	224 m (735 ft)
on water	319 m (1,045 ft)
Range with max fuel, at max cruise power, allowances for start, taxi and 45 min reserves:	
A at FL100	932 n miles (1,726 km; 1,072 miles)
A at FL200	1,220 n miles (2,259 km; 1,404 miles)
D at FL100	790 n miles (1,463 km; 909 miles)
g limits	+3.8/–1.52

PERFORMANCE (B: Super Cargomaster; C: Grand Caravan):

Max cruising speed:	
at FL100: B	175 kt (324 km/h; 201 mph)
C	184 kt (341 km/h; 212 mph)
Stalling speed, power off:	
flaps up: B, C	78 kt (145 km/h; 90 mph)
flaps down: B, C	61 kt (113 km/h; 71 mph)
Max rate of climb at S/L: B	282 m (925 ft)/min
C	297 m (975 ft)/min

Service ceiling: B ..... 6,950 m (22,800 ft)
C ..... 7,220 m (23,700 ft)
T-O run: B ..... 428 m (1,405 ft)
C ..... 416 m (1,365 ft)
T-O to 15 m (50 ft): B ..... 762 m (2,500 ft)
C ..... 738 m (2,420 ft)
Landing from 15 m (50 ft), without propeller reversal:
B ..... 530 m (1,740 ft)
C ..... 547 m (1,795 ft)
Landing run, without propeller reversal:
B ..... 279 m (915 ft)
C ..... 290 m (950 ft)
Range with max fuel, max cruise power, allowances for start, taxi, climb and descent, plus 45 min reserves: at FL100:
B ..... 862 n miles (1,596 km; 992 miles)
C ..... 907 n miles (1,679 km; 1,043 miles)
at FL180, conditions as above:
B ..... 1,044 n miles (1,933 km; 1,201 miles)
C ..... 1,109 n miles (2,053 km; 1,276 miles)
Range with max fuel, max range power, allowances for start, taxi, climb and descent, plus 45 min reserves: at FL100:
B ..... 963 n miles (1,783 km; 1,108 miles)
C ..... 1,026 n miles (1,900 km; 1,180 miles)
at FL180, conditions as above:
B ..... 1,076 n miles (1,992 km; 1,238 miles)
C ..... 1,163 n miles (2,153 km; 1,338 miles)

Cessna Citation Mustang flight deck 1040431

CESSNA 510 CITATION MUSTANG

TYPE: Light business jet.

PROGRAMME: Initial design studies, then as turboprop, began in 1996–97; twin-jet configuration chosen in early 2001; announced at NBAA Convention, Orlando, Florida, 10 September 2002, when cabin mockup unveiled. New design but with wing scaled down from Citation Sovereign; smallest of Cessna jet family. First engine runs 22 March 2005; first flight (N27369, c/n 712001) 23 April 2005; certification programme involved the prototype and two production airframes, of which the first (N510CE, c/n 0001) flew on 29 August 2005, followed by the second (N510KS, c/n 0002) on 27 January 2006, plus two static test airframes, last-named to undertake five-lifetime, 75,000-hour test programme. Public debut by prototype at EAA AirVenture at Oshkosh, 26 July 2005.

First Independence-built Mustang, and first Cessna jet manufactured there (N403CM, c/n 0003) rolled out 31 May 2006 and first flown 15 June 2006, to serve as company demonstrator. FAA certification achieved 8 September 2006 following 1,200-hour flight test and certification programme, included approval for single-pilot, day/night, VFR/IFR, RVSM and GPS WAAS operations. Approval for flight into known icing conditions granted 9 November 2006. EASA and Brazilian certifications anticipated in the first and third quarters of 2007 respectively. Production target for 2007 is 40 aircraft.

First customer delivery was N403CM to Mustang Management Group of Fresno, California, 22 November 2006, although aircraft immediately leased back to Cessna (and flew back to Wichita later the same day), for 10 months as demonstrator.

CUSTOMERS: More than 250 firm orders held by October 2006, representing planned production until mid-2009, of which 105 were from European customers, including 25 for UK operators. Announced customers include Formula One Champion Nelson Piquet, who ordered one on 11 September 2002; Delta Aero-Taxi of Florence, Italy, which ordered sevens on 21 October 2002 for its fractional ownership programme; and London Executive Aviation of the UK, which ordered seven for delivery from late 2007.

COSTS: USD2.56 million; estimated direct operating cost USD2.06 per nautical mile (both 2006).

DESIGN FEATURES: Low-wing, T tail and twin, podded, rear-mounted turbofans in usual Cessna business jet configuration, but second type to employ new Sovereign wing planform. Wing sweepback 11° at leading edge; tailplane 27°; fin 52°. Small wing fences inboard of ailerons at trailing-edge. Dual horizontal strokes each side of rear fuselage following flight testing.

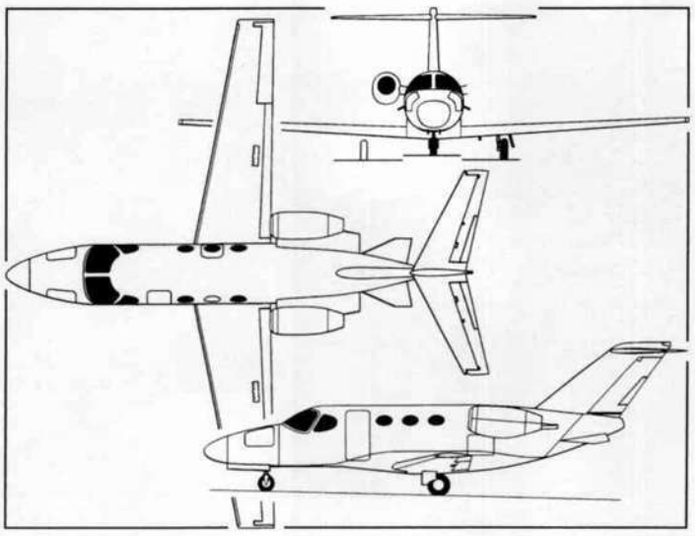
FLYING CONTROLS: Conventional and manual with trim for each axis. Ailerons and elevator horn-balanced. Flight-adjustable tabs in port aileron, rudder and both elevators. Slotted flaps. Speed brakes above and below wings at mid-span. Control surface maximum deflections: elevators up 25°, down 15°; elevator trim tab up 4° 30', down 20°; rudder 35°; rudder trim tab 20°; ailerons deflected 2° up in 'neutral' position, further movement 23° up, 18° 30' down; aileron trim tab +/– 21°; flaps 0°, 15° (for take-off/approach), 30°; speedbrakes up 59° 30', down 62° 30'.

STRUCTURE: Generally of aluminium alloy; riveted and bonded joints, as required. Three-spar wing manufactured at Cessna's Columbus, Georgia, parts fabrication plant; centre-section, including fuel tank, mounted below fuselage to avoid penetration of pressure vessel. Semi-monocoque fuselage of frames and stringers with sheet metal skin; forward and aft pressure bulkheads.

LANDING GEAR: Nosewheel type; retractable. Single wheel on each leg. Trailing-link mainwheels retract inwards, to lie flat; nosewheel forwards; hydraulic actuation. Mainwheel doors cover legs only; wheels exposed in flight. Manually steerable nosewheel. Disc brakes with anti-skid on mainwheels.

POWER PLANT: Two pod-mounted Pratt & Whitney Canada PW615F turbofans, each rated at 6.00 kN (1,350 lb st) at ISA+15°C, with dual-channel FADEC. First PW615F ground run

Second production Cessna 510 Citation Mustang with rear fuselage strakes 1040430



Cessna 510 Citation Mustang light business jet *(Paul Jackson)* 1158964

took place on 9 April 2004, and first flight, installed on Cessna-operated CitationJet testbed, on 27 April 2004. Fuel contained in two wing tanks.

ACCOMMODATION: Two pilots on flight deck; four passengers in club configuration in cabin; rearmost pair of seats have centre console with single 12 V DC power outlet, dual cup holders and storage area. Door port side, ahead of wing; emergency exit, starboard, over wing. Chemical lavatory with privacy curtain opposite door. Recessed central aisle; storage and refreshments cabinets behind each pilot's seat, facing cabin. Nose and tail baggage compartments both unpressurised, with external, access only; nose compartment has door each side; tail compartment has door behind wing, port only. Kollsman Autoschedule KAPS II cabin pressurisation system. Cabin pressurised to 0.57 bar (8.3 lb/sq in), giving 2,440 m (8,000 ft) environment at 12,500 m (41,000 ft). Air conditioning vents in cabin sidewalls.

SYSTEMS: Electrical system supplied by two starter/generators via left and right busses; separate emergency bus. Hydraulic system for landing gear actuation; icing protection for wing, tailplane, windscreen and engine air intakes; certified for flight into known icing. Vapour cycle air conditioning system with distribution via sidewalls and overhead panels. Crew and passenger oxygen system standard.

AVIONICS: Garmin G1000 as core system.

Comms: Dual VHF/COM; GTX 33D Mode S transponder; dual GMA 1347D audio controls. Artex C406-N ELT.

Radar: Garmin GWX 68 weather radar.

Flight: Dual Garmin GDC 74B air data computers, GRS 77 AHRS, GIA 63W integrated avionics units; single Honeywell KN 63 DME, Garmin GCU 475 FMS, GFC 700 AFCS, GDL 69A satellite weather datalink.

Instrumentation: Dual 27.5 cm (10.4 in) GDU 1040A active matrix LCD screens for MFD functions; single GDU 1500 38.1 cm (15 in) MFD for display of navigation, engine indication, weather, traffic and terrain data. SafeTaxi system gives graphical representation of aircraft's position on the ground. Standby instruments.

EQUIPMENT: Control lock; pitot head, engine and pylon inlet, exhaust, generator inlet and static discharge wick covers; tow straps; tailcone baggage restraint strap; emergency escape hatch locking pin; jack pad adapter; fire extinguisher; and overall white exterior base colour with choice of five stripe designs, all standard.

DIMENSIONS, EXTERNAL:

Wing span: incl lights	13.16 m (43 ft 2 in)
excl lights	13.03 m (42 ft 9 in)
Wing aspect ratio	8.7
Length overall	12.37 m (40 ft 7 in)
Height overall	4.09 m (13 ft 5 in)
Tailplane span	5.26 m (17 ft 3 in)
Wheel track	3.61 m (11 ft 10 in)
Wheelbase	4.37 m (14 ft 4 in)
Door (port): Height	1.17 m (3 ft 10 in)
Width	0.61 m (2 ft 0 in)
Emergency exit (starboard): Height	0.61 m (2 ft 0 in)
Width	0.56 m (1 ft 10 in)
Tail baggage door: Height	0.46 m (1 ft 6 in)
Width	0.61 m (2 ft 0 in)

DIMENSIONS, INTERNAL:

Cabin: Length between pressure bulkheads	4.50 m (14 ft 9 in)
Length excl flight deck	2.74 m (9 ft 0 in)
Max width	1.40 m (4 ft 7 in)
Max height	1.37 m (4 ft 6 in)
Door width	0.61 m (2 ft 0 in)
Baggage compartment volume:	
nose	0.57 m^3 (20.0 cu ft)
tail	1.0 m^3 (37 cu ft)

AREAS:

Wings, gross	19.51 m^2 (210.0 sq ft)
Vertical tail	3.48 m^2 (37.50 sq ft)
Horizontal tail	5.25 m^2 (56.50 sq ft)

WEIGHTS AND LOADINGS:

Basic operating weight	2,336 kg (5,150 lb)
Max baggage weight: nose	145 kg (320 lb)
tail	136 kg (300 lb)
Max fuel	1,170 kg (2,580 lb)
Max usable fuel	1,165 kg (2,568 lb)
Payload with max fuel, one pilot	272 kg (600 lb)
Max T-O weight	3,921 kg (8,645 lb)
Max ramp weight	3,960 kg (8,730 lb)
Max landing weight	3,629 kg (8,000 lb)
Max zero-fuel weight	3,062 kg (6,750 lb)

PERFORMANCE:

Max operating Mach No. (MMO)	0.63
Max operating speed (VMO)	250 kt (463 km/h; 287 mph) IAS
Cruising speed at FL350	340 kt (630 km/h; 391 mph)
T-O balanced field length	950 m (3,120 ft)
Landing run	795 m (2,610 ft)
Certified ceiling	12,500 m (41,000 ft)
Range, IFR, 100 nm alternate	1,150 n miles (2,129 km; 1,323 miles)

CESSNA 525 CITATION CJ1 and CJ1+

TYPE: Light business jet.

PROGRAMME: Original CitationJet announced at NBAA Convention 1989 as replacement for Citation 500 and I (production of which stopped 1985); first flight of FJ44 turbofans in Citation 500 April 1990; first flight of CitationJet (N525CJ) 29 April 1991; first flight of second (preproduction) prototype 20 November 1991; FAA certification for single-pilot operation received 15 October 1992; first customer delivery 31 March 1993. Russian certification achieved 4 September 1998. RVSM Group approval granted by FAA in January 2000.

Replacement Citation CJ1 announced at NBAA Convention 19 October 1998; first aircraft (N31CJ) completed late 1999; FAA certification 16 February 2000; first customer delivery 31 March 2000 to the Commercial Envelope Company of Deer Park, New York; 500th Cessna 525 series, a CJ1, rolled out 7 June 2002.

CURRENT VERSIONS: **CJ1:** Original version up to 2006. Williams FJ44-1A turbofans of 8.48 kN (1,900 lb st).

CJ1+: Improved version, *as described*. Announced at NBAA Convention in Las Vegas 11 October 2004. Features 8.63 kN (1,941 lb st) Williams FJ44-1AP turbofans with dual-channel FADEC; increased ramp, maximum take-off and landing weights; improved time-to-climb and cruise performance; upgraded four-seat cabin interior based on those of larger Citations with port side belted flushing toilet, one-piece cockpit headliner, deluxe refreshment centre, and indirect lightning; and Collins Pro Line 21 avionics with three-tube EFIS, dual air data computers, file server system with cursor control panel and enhanced map overlays, Collins FMS-3000 with performance database, and broadcast weather. Optional avionics include Honeywell Mark VIII EGPWS, interactive graphical weather, and electronic charts showing geo-referenced aircraft position on aircraft diagrams. FAA certification achieved 17 June 2005 followed by EASA approval 13 March 2006. Initial production aircraft N52626 (c/n 0601) employed as demonstrator N601CJ and shown at NBAA Convention, Orlando, November 2005; first delivery in fourth quarter 2005.

CUSTOMERS: Total 359 CitationJets, plus three prototypes, delivered up to early 2000, when manufacture turned to CJ1. Total of 259 CJ1s and CJ1+s delivered by 30 September 2006, including 30 delivered in 2002, 22 in 2003, 20 in 2004, 18, including 4 CJ1+s, in 2005, and 21 (all CJ1+s) in the first nine months of 2006. Recent customers include Avemex SA of Toluca, Mexico (one); Taxi Marilia (TAM) of Brazil (three, including c/n 0500); Atlas Air Service GmbH of Germany (four), Cessna's TAG Aviation USA's fractional ownership operation, CitationShares, which has received one, and the Chilean Air Force, which took delivery of three in November 2001.

COSTS: USD181 million, typically equipped (2005).

DESIGN FEATURES: Small business jet of conventional appearance; wings attached below fuselage; T tail; tapered wings and tailplane; podded engines mounted clear of upper rear fuselage. Natural Laminar Flow (NLF) aerofoil section. CJ1 is generally identical to CitationJet; increased maximum T-O, ramp and landing weights to provide improved range/payload; Pro Line 21 avionics. Wing sweepback 0° at 35 per cent chord; tailplane 0° at 70 per cent; fin 49° at 25 per cent.

FLYING CONTROLS: Conventional and manual. Ailerons and elevators horn balanced; trim tab on port aileron; trim tabs on rudder and both elevators; hydraulically actuated single-slotted flaps, deflections 15° for T-O; 35° for landing; and 60° ground use only. Control surface movements: ailerons +23° 30'/–20° 30'; elevators +20°/–15°; rudder ±30°. Speed brake in upper (49°) and lower (68°) surface of each wing. Engine thrust attenuators and max flap deflection provide lift-dump function during landing roll.

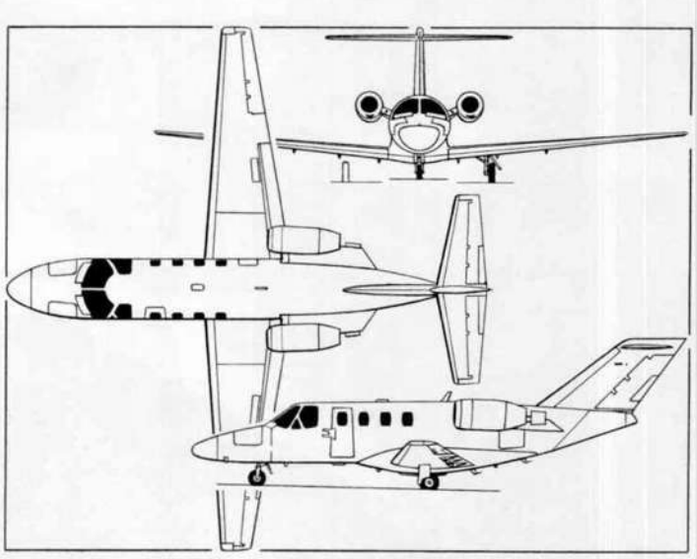
STRUCTURE: All-metal. Three-spar wing.

LANDING GEAR: Hydraulically retractable tricycle type, with single wheel on each unit. Trailing-link main units retract inward into wing; nose gear retracts forward. Main tyres 22×7.75-10 (8 ply) tubeless; nose 18×4.4 (6 ply) tubeless.

POWER PLANT: Two 8.72 kN (1,961 lb st) Williams FJ44-1AP turbofans with FADEC, pod-mounted, with thrust attenuators. Two independent fuel systems, with fuel contained in two integral wing tanks, and single filler port in each wing; see under Weights and Loadings.

ACCOMMODATION: Crew of two on flight deck. Main cabin with standard seating for five passengers, one on sideways-facing seat at front of cabin, with four in club arrangement; tray tables which stow in elbow rails, and individual reading lights and ventilation ducts, standard.

SYSTEMS: Hydraulic system, maximum pressure 103 bar (1,500 lb/sq ft) for operation of landing gear, flaps and speedbrakes. Independent hydraulic system operates brakes and anti-skid system. Electrical system supplied by two 28 V 300 A DC starter/generators, with 24 V 44 Ah Ni/Cd battery. Digitally controlled pressurisation system, maximum differential



Cessna 525 Citation CJ1+ (two Williams FJ44 turbofans) *(Dennis Punnett)* 1158963

1040407

Cessna 525 Citation CJ1+ *(Paul Jackson)*

0.58 bar (8.5 lb/sq in) maintains sea level environment to 6,705 m (22,000 ft) and 2,438 m (8,000 ft) environment to 12,495 m (41,000 ft). Oxygen system, capacity 1.41 m³ (50 cu ft) with quick-donning pressure demand masks for crew and dropout constant-flow masks for passengers. Engine inlets, wing leading-edges, pylon inlet ducts and windscreen supplied by engine bleed air for anti-icing, with back-up alcohol anti-icing for pilot's windscreen; tailplane has de-icer boots; fin unprotected; pitot tubes, static ports and angle of attack sensor electrically anti-iced.

AVIONICS: Rockwell Collins Pro Line 21 as core system.

Comms: Dual Collins VHF-4000 transceivers and TDR-94 Mode S transponders. L-3 Communications FA2100 voice recorder. Artex C406-N ELT.

Radar: Rockwell Collins WXR-800 colour weather radar.

Flight: L-3 Communications Skywatch HP TCAS, LandsMark TAWS 8000 and GH-3000 stand-by instruments. Rockwell Collins GPS-4000A; NAV-4000 and NAV-4500 VOR/LOC/GS and marker beacon receivers; DME-4000; AHC-3000 AHRS.

Instrumentation: Three-tube EFIS with 203 × 253 mm (8 × 10 in) adaptive flight displays.

DIMENSIONS, EXTERNAL:

Wing span: with lights	14.30 m (46 ft 11 in)
without lights	14.20 m (46 ft 7 in)
Wing aspect ratio	9.1
Length overall	12.98 m (42 ft 7 in)
Height overall	4.19 m (13 ft 9 in)
Tailplane span	5.61 m (18 ft 5 in)
Wheel track	3.96 m (13 ft 0 in)
Wheelbase	4.67 m (15 ft 4 in)
Door (port): Height	1.29 m (4 ft 2¾ in)
Max width	0.60 m (1 ft 11½ in)
Emergency exit (starboard): Height	0.74 m (2 ft 5 in)
Width	0.48 m (1 ft 7 in)

DIMENSIONS, INTERNAL:

Cabin:	
Length: between pressure bulkheads	4.80 m (15 ft 9 in)
excl cockpit	3.35 m (11 ft 0 in)
Max width	1.47 m (4 ft 10 in)
Max height	1.45 m (4 ft 9 in)
Baggage compartment volume:	
nose	0.58 m³ (20.4 cu ft)
cabin	0.11 m³ (4.0 cu ft)
tailcone	0.86 m³ (30.2 cu ft)
total	1.55 m³ (54.6 cu ft)

AREAS:

Wings, gross	22.30 m² (240.0 sq ft)
Vertical tail surfaces (total, incl tab)	4.35 m² (46.8 sq ft)
Horizontal tail surfaces (total, incl tabs)	5.64 m² (60.7 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, typically equipped	3,014 kg (6,645 lb)
Max usable fuel weight	1,460 kg (3,220 lb)
Max T-O weight	4,853 kg (10,700 lb)
Max ramp weight	4,899 kg (10,800 lb)
Max landing weight	4,491 kg (9,900 lb)
Max zero-fuel weight	3,810 kg (8,400 lb)
Max wing loading	217.7 kg/m² (44.58 lb/sq ft)
Max power loading	278 kg/kN (2.73 lb/lb st)

PERFORMANCE:

Max operating speed (VMO):	
S/L to FL305	263 kt (487 km/h; 302 mph) IAS
above FL305	M0.71
Max cruising speed at FL310	389 kt (720 km/h; 448 mph)
Stalling speed, landing configuration at max landing weight	83 kt (154 km/h; 96 mph) CAS
Time to FL410	27 min
Max certified altitude	12,500 m (41,000 ft)
FAR Pt 25 T-O field length:	991 m (3,250 ft)
Landing field length	789 m (2,590 ft)
IFR range with 100 n mile (185 km; 115 mile) alternate	1,300 n miles (2,407 km; 1,496 miles)

OPERATIONAL NOISE LEVELS:

T-O	73.5 EPNdB
Approach	88.5 EPNdB
Sideline	85.2 EPNdB

CESSNA 525A CITATION CJ2 and CJ2+

TYPE: Light business jet.

PROGRAMME: Design began 1 May 1998; construction of prototype started August 1998; announced at NBAA Convention at Las Vegas, Nevada, 18 October 1998; first flight of prototype (N2CJ, a rebuilt CitationJet) 27 April 1999, followed by first preproduction aircraft (N525AZ) on 15 October and second (N765CT) in mid-December 1999; total of 1,008 flight test hours accumulated by three aircraft by 9 April 2000; first production aircraft c/n 525A-0003/(N132CJ) rolled out 14 January 2000; FAA FAR Pt 23 certification achieved 21 June 2000; public debut at EAA AirVenture Oshkosh in July 2000; first customer delivery, 30 November 2000, was N200KP to King Pharmaceuticals of Tennessee (second production aircraft). By April 2004 the 200 CJ2s then in service had logged a total of more than 80,000 flight hours. A CJ2+ (N525XD c/n 0337) delivered in January 2007 was 1,000th of CJ series.

CURRENT VERSIONS: **CJ2:** Original version; replaced in 2006. Williams FJ44-2C turbofans of 10.68 kN (2,400 lb st).

CJ2+: Improved version, *as described.* Announced at NBAA Convention in Las Vegas 11 October 2004. Production from c/n 525A-0301. Features 10.68 kN (2,400 lb st) Williams FJ44-3A-24 turbofans with dual-channel FADEC; increased ramp, basic operating, maximum take-off and landing weights; improved time-to-climb and cruise performance; upgraded cabin interior with port side belted flushing toilet, 110 V electrical outlets and indirect LED lighting; and Collins Pro Line 21 avionics with three-tube EFIS, dual air data

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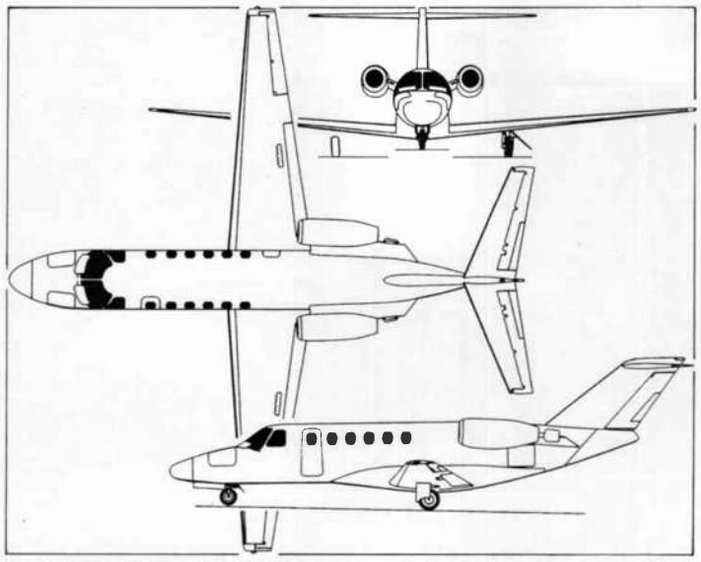
Second production Cessna Citation CJ2+ *(Paul Jackson)*



Cessna 525A Citation CJ2+ (Williams FJ44 turbofans) *(Paul Jackson)* 1158962

computers, file server system with cursor control panel and enhanced map overlays, Collins FMS-3000 with performance database, and broadcast weather showing NEXRAD information, text METARs and text TAFs. Optional avionics include Honeywell Mark VIII EGPWS, interactive graphical weather, and electronic charts showing geo-referenced aircraft position on aircraft diagrams. First flight (N5245D, later N432MA; built from airframe 525A-0232 renumbered as 525A-0300), 2 April 2005. FAA certification granted 3 October 2005 following 80+ sortie, 190 light hour test programme. EASA certification achieved 10 July 2006. Total of 35 orders held at time of launch, including three for Atlas Air Service of Germany for delivery in late 2006 and early 2007.

CUSTOMERS: Total of 76 firm orders held at time of launch; by December 2000 order backlog accounted for planned production until first quarter of 2004. First delivery to overseas customer was D-IBBB, which arrived at Bremen for Atlas Air Service GmbH of Germany on 21 June 2001. 100th production CJ2 (N170TM) delivered to TitleMax Aviation Inc of Savannah, Georgia, on 27 August 2002. 200th production CJ2 delivered to Unijet of France 8 April 2004. Some 262 built by 30 September 2006. Total of 86 delivered in 2002, 56 in 2003, 27 in 2004, 23 in 2005, and 22 (one CJ2 and 21 CJ2+s) in the first nine months of 2006. Recent customers include Jetalliance of Austria, which ordered five in November 2005.

COSTS: USD5.525 million, typically equipped (2004).

DESIGN FEATURES: Development of CitationJet/CJ1 with fuselage stretched by 1.30 m (4 ft 3 in) in cabin and tailcone areas (extra two cabin windows), wing and swept tailplane of greater span and Rockwell Collins Pro Line 21 avionics. Design goals included improvements in cabin room and comfort, speed and range over CitationJet. Common type rating with CJ1.

Description for the Citation CJ1+ applies also to the Citation CJ2+, except as follows:

Wing sweepback 0° at 31 per cent chord; tailplane 20° at 25 per cent; fin 49 degrees at 25 per cent.

FLYING CONTROLS: As CJ1+, except aileron neutral position 2° up. Control surface movements: ailerons flaps and speed brakes as CJ1+; elevators +18° 30'/–15°; rudder ±35°.

STRUCTURE: Primarily metal, with composites in non-critical areas such as fairings, wing and tailplane tips and exhaust nozzles. Three-spar wing.

POWER PLANT: Two pod-mounted Williams FJ44-3A-24 turbofans, each flat rated at 11.08 kN (2,490 lb st) at 22°C (72°F), with thrust attenuators. Integral fuel tank in each wing, total capacity 2,245 litres (593 US gallons; 494 Imp gallons), of which 2,222 litres (587 US gallons; 489 Imp gallons) are usable; overwing gravity refuelling.

ACCOMMODATION: One or two crew on flight deck; six passengers in standard centre club layout with refreshment centre on starboard side; customised interiors to customer's choice. Flight accessible baggage area at rear of cabin; other baggage compartments in nose and tailcone. Cabin is pressurised, heated and air conditioned. Six cabin windows per side. Main door on port side forward of wing; emergency exit starboard aft.

SYSTEMS: Pressurisation system, maximum pressure differential 0.61 bar (8.9 lb/sq in). Open-centre 103.4 bar (1,500 lb/sq in) hydraulic system for operation of landing gear, flaps, speedbrakes and thrust attenuators. Vapour cycle air conditioning system. Electrical system supplied by battery and two engine-driven starter/generators. Oxygen system, capacity 623 litres (22.0 cu ft) standard, 1,417 litres (50.0 cu ft) optional.

AVIONICS: As Citation CJ1+.

DIMENSIONS, EXTERNAL:

Wing span: with lights	15.19 m (49 ft 10 in)
without lights	15.09 m (49 ft 6 in)
Wing aspect ratio	9.4
Length overall	14.53 m (47 ft 8 in)
Height overall	4.27 m (14 ft 0 in)
Tailplane span	6.32 m (20 ft 9 in)
Wheel track	4.85 m (15 ft 11 in)
Wheelbase	5.44 m (17 ft 10 in)

DIMENSIONS, INTERNAL:

Cabin: Length: between bulkheads	5.64 m (18 ft 6 in)
excl cockpit	4.19 m (13 ft 9 in)
Max width	1.47 m (4 ft 10 in)
Max height	1.45 m (4 ft 9 in)
Baggage volume: nose	0.42 m³ (15.0 cu ft)
tailcone	1.4 m³ (50 cu ft)
total	1.8 m³ (65 cu ft)

AREAS:

Wings, gross	24.53 m² (264.0 sq ft)
Vertical tail surfaces	4.35 m² (46.8 sq ft)
Horizontal tail surfaces	6.57 m² (70.7 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, standard	3,468 kg (7,645 lb)
Max usable fuel weight	1,783 kg (3,930 lb)
Max T-O weight	5,670 kg (12,500 lb)
Max landing weight	5,227 kg (11,525 lb)
Max ramp weight	5,726 kg (12,625 lb)
Max zero-fuel weight	4,399 kg (9,700 lb)
Max wing loading	231.2 kg/m² (47.35 lb/sq ft)
Max power loading	256 kg/kN (2.51 lb/lb st)

PERFORMANCE:

Max operating Mach No. (MMO)	0.737
Max operating speed (VMO)	278 kt (514 km/h; 320 mph) IAS
Max cruising speed at FL310	418 kt (774 km/h; 481 mph)
Stalling speed in landing configuration at MLW	86 kt (160 km/h; 99 mph)
Time to: FL450	28 min
max certified altitude	13,715 m (45,000 ft)
FAR Pt 25 T-O balanced field length	1,042 m (3,360 ft)
Landing field length at MLW	908 m (2,980 ft)
Range, NBAA IFR, 100 n mile alternate	1,613 n miles (2,987 km; 1,856 miles)

OPERATIONAL NOISE LEVELS:

T-O	75.5 EPNdB
Approach	89.7 EPNdB
Sideline	86.1 EPNdB

CESSNA 525B CITATION CJ3

TYPE: Light business jet.

PROGRAMME: Announced on eve of NBAA Convention, Orlando, Florida, 9 September 2002; fuselage mockup shown following day. First flight (N3CJ, c/n 711) 17 April 2003, followed by first pre-production aircraft (N753CJ, c/n 525B-0001) 11 August 2003; public debut (N753CJ) at NBAA Convention, Orlando, Florida 7 October 2003; second pre-production aircraft (N763CJ, c/n 525B-0002) flew 6 November 2003; total of 900 hours in 540 sorties completed by all three aircraft by 24 May 2004, at which time the static test article had completed more than 200 test conditions, including 105,000 hours, equivalent to five life cycles, of landing gear testing; first production aircraft rolled-out 13 February 2004; engine certification achieved 31 July 2004; aircraft certification to FAR Pt 23, including single pilot operation and RVSM approval, achieved 15 October 2004; EASA certification achieved 16 June 2006; first delivery 1 December 2004.

DESIGN FEATURES: Further development of CJ1/CJ2 family. Fuselage stretched by 1.00 m (3 ft 31/2 in) (seven windows each side), giving 0.61 m (2 ft 0 in) extra in cabin, and wing span extended by 1.03 m (3 ft 41/4 in). Uprated engines with 14 per cent more T-O thrust and 12 per cent more in cruise. Improved range and passenger comfort.

Description for Citation CJ1/CJ2 applies to CJ3, except as follows:

CUSTOMERS: Orders for more than 100 held by May 2004. Announced customers include Eisele Flugdienst of Germany, which ordered one in October 2004, Jetalliance of Austria, which ordered two in November 2005, and Wallan Aviation, which ordered one in May 2006. The 100th delivery took place on 28 August 2006 to Mark-Taylor Residential Inc of Arizona. Total of six delivered in 2004, 48 in 2005, and 53 in the first nine months of 2006.

COSTS: USD6,425,000 typically equipped (2005).

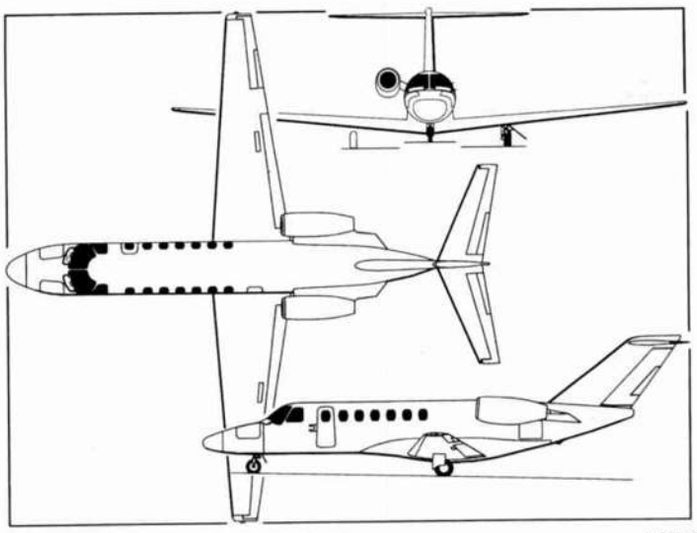
DESIGN FEATURES: Wing dihedral 5° 0'; sweepback 0° at 31 per cent chord; taper ratio 0.30. Tailplane sweepback 20° 0' at 25 per cent chord; no dihedral; taper ratio 0.43. Fin sweepback 49° 0' at 25 per cent chord; taper ratio 0.56.

FLYING CONTROLS: As CJ1/CJ2 except aileron neutral position 0°. Control surface deflections: ailerons +23° 30'/–20° 30'; elevators +20° 30'/–15°; rudder ±27°; flaps 15°, 35° and (ground) 55°; speed brakes as CJ1/CJ2.

POWER PLANT: Two 12.37 kN (2,780 lb st) Williams FJ44-3A turbofans with FADEC. Fuel in two wing tanks, combined usable capacity 2,661 litres (703 US gallons; 585 Imp gallons).

ACCOMMODATION: As CJ2, but chemical lavatory starboard, rear, opposite baggage area.

Cessna 525B Citation CJ3 *(Paul Jackson)* 1040408



Cessna 525B Citation CJ3 *(Paul Jackson)* 1158965

SYSTEMS: Hydraulic system with two engine-driven pumps, pressure 103.5 bar (1,500 lb/sq in). Secondary hydraulic system for mainwheel brakes. Cabin pressurisation as CJ2. Emergency oxygen system reservoir 1,134 litres (40.0 cu ft). Electrical system 28 V DC includes two engine-driven generators and one 44 Ah Ni/Cd battery.

Engine bleed air for anti-icing of wing leading-edges engine air intakes and windscreen, and inflation of de-icing boots on horizontal leading-deges. Backup windscreen alcohol de-icing.

AVIONICS: Rockwell Collins Pro Line 21 suite as core system.

Comms: Dual VHF-4000 transceivers. Dual TDR-94 Mode S transponders. Optional CVR. Artex C-406-2 three-frequency ELT. Provision for CVR.

Radar: As CJ2.

Flight: Collins NAV-4000/NAV-4500 dual VOR, LOC, glideslope and MKR; single (optional second) ADF. DME-4000 DME. AHC-3000 AHRS, ADC-3000 ADC, FMS-3000 FMS with performance database, GPS-4000A GPS, ALT-4000 radio altimeter, Goodrich Skywatch HP TCAS, Goodrich TAWS 8000 Landmark terrain-avoidance, dual airdata computers, standard, and FAA-approved electronic chart system. Maintenance diagnostic system.

Instrumentation: Three-tube EFIS with 203 × 254 mm (8 × 10 in) PFD and MFD active matrix LCDs. Goodrich GH-3000 standby instruments; Smiths standby EHSI.

DIMENSIONS, EXTERNAL:

Wing span	16.26 m (53 ft 4 in)
Wing mean chord	1.90 m (6 ft 2¾ in)
Wing aspect ratio	9.5
Length: overall	15.29 m (50 ft 2 in)
fuselage	13.79 m (45 ft 2¾ in)
Height overall	4.62 m (15 ft 2 in)
Tailplane span	6.35 m (20 ft 10 in)
Tailplane mean chord	1.09 m (3 ft 7 in)
Wheel track	4.88 m (16 ft 0 in)
Wheelbase	6.10 m (20 ft 0 in)
Door:	
Height	1.29 m (4 ft 3 in)
Max width	0.60 m (1 ft 11½ in)
Emergency exit width	0.51 m (1 ft 8 in)

DIMENSIONS, INTERNAL:

Cabin: Length overall excluding cockpit	4.77 m (15 ft 8 in)
Max width	1.45 m (4 ft 9 in)
Max height	1.45 m (4 ft 9 in)
Baggage volume	2.095 m³ (74.0 cu ft)

AREAS:

Wings, gross	27.32 m² (294.1 sq ft)
Vertical tail surfaces (total)	5.23 m² (56.30 sq ft)
Horizontal tail surfaces (total)	6.57 m² (70.68 sq ft)

WEIGHTS AND LOADINGS:

Empty weight	3,738 kg (8,240 lb)
Weight empty, equipped	3,851 kg (8,490 lb)
Max fuel weight	2,136 kg (4,710 lb)
Max baggage weight	as CJ2
Max payload	2,463 kg (5,430 lb)
Payload with max fuel	327 kg (720 lb)
Max ramp weight	6,382 kg (14,070 lb)
Max T-O weight	6,291 kg (13,870 lb)
Max landing weight	5,783 kg (12,750 lb)
Max zero-fuel weight	4,767 kg (10,510 lb)
Max wing loading	230.3 kg/m² (47.16 lb/sq ft)
Max power loading	254 kg/kN (2.49 lb/lb st)

PERFORMANCE:

Max operating speed (VMO): S/L to FL80	260 kt (482 km/h; 299 mph) CAS
FL80 to FL293	278 kt (515 km/h; 320 mph) CAS
above FL293	M0.737
Max cruising speed, at mid-cruise weight: at FL330	417 kt (772 km/h; 480 mph)
at FL390	408 kt (756 km/h; 496 mph)
Stalling speed, landing configuration at MLW	83 kt (154 km/h; 96 mph) CAS
Max rate of climb at S/L	1,365 m (4,478 ft)/min
Time to: FL410	19 min
FL450	27 min
Rate of climb at S/L, OEI	332 m (1,090 ft)/min
Max certified altitude	13,715 m (45,000 ft)
Service ceiling, OEI	8,001 m (26,250 ft)
T-O balanced field length	969 m (3,180 ft)
Landing distance	844 m (2,770 ft)
Range: with max fuel, VFR reserves	1,900 n miles (3,518 km; 2,186 miles)
with four passengers, NBAA IFR reserves	1,875 n miles (3,472 km; 2,157 miles)

CESSNA 525C CITATION CJ4

TYPE: Business jet.

PROGRAMME: Announced, and cabin mock-up unveiled, at NBAA Convention, Orlando, Florida, 17 October 2006, although marketing had begun in August 2006 and over 70 aircraft on order by time of public launch. First flight planned for second quarter of 2008; FAA certification in late 2009; and service entry in second quarter of 2010.

COSTS: USD7.995 million (2006).

DESIGN FEATURES: Launched as 'clean sheet' addition to CJ family, according to manufacturer, although retains '525' designation. Described as having Encore+ cockpit and cabin; Mustang's wide door; Sovereign-style wing; and CJ3's external access baggage capacity.

Advanced, moderately swept, low-mounted wing selected for its low aerodynamic drag and favourable approach and landing characteristics; leading edge sweepback 12° 30' at 25 per cent chord; trailing edge approx 3°. Fin sweepback 49° at 25 per cent chord; T tail; tailplane sweepback 20° at 25 per cent chord. Fuselage has a constant circular cross section and carries two podded engines on rear shoulders.

FLYING CONTROLS: Conventional and manual. Horn balances on ailerons and elevators. Pushrod, bellcrank, sector and cable systems actuate rudder, elevators, and ailerons. Corrosion-resistant stainless steel cables in all primary and secondary systems; rudder cables split through the tail cone for redundancy. Three-position flap on each wing; deflections: up; takeoff/approach (15°); and landing (35°). Electric sensing allows flap position to be displayed on the EFIS. A cable interconnect protects against asymmetric extension.

Three speed brake panels on the upper surface of each wing may be extended in flight at any speed. Centre panel of each set is fully modulating; remaining panel sets extend fully only when the actuating handle is in the aft detent. Flaps and speed brakes are electrically controlled and hydraulically actuated.

Trim in all three axes; tabs in port aileron, both elevators and rudder. For roll and yaw, electric trim switches drive actuators inside the rudder and left aileron. Pitch trim by trim wheel connected to dual trim tabs by cables. Interconnected to these cables is an electric pitch trim servo allowing use of yoke mounted thumb switches for elevator trim. Trim position is shown on the EFIS for all three systems.

Three electric servos installed for autopilot functions; yaw servo also performs yaw damping. Yaw damper system, located in the tail, works with the autopilot to augment stability and is only required at high altitudes. Bleed air sourced bias system incorporated in rudder for improved runway performance and automatic control enhancement during engine-out conditions. Integral control lock.

STRUCTURE: Generally of aluminium alloy. Framing structures surround the main door opening, emergency exit and windshields, providing structural continuity. Glass windscreens and cockpit side windows are surrounded by a stainless steel retainer structure. Composites radome and wing/fuselage fairing. Three-spar wing, with a shallow drop in the centre section to permit attachment of the fuselage without interruption of the cabin cross-section. Windscreens designed to meet bird resistance requirements of 14 CFR Part 25.

LANDING GEAR: Tricycle type; retractable. Single wheel on each leg. Retraction is electrically controlled and hydraulically actuated. Independent electrically powered hydraulic system provides normal power for the brakes with a pneumatic system for backup. Multiple disc brakes on the main wheels are powered by digitally controlled anti-skid system. Each main gear is of trailing link type and retracts inboard into the wing; nose gear retracts forward into the fuselage and, when retracted, is enclosed by doors. Nose tyre is chine type for water and slush deflection. Emergency landing gear extension by single action cable release and pneumatic blow-down system. Nose gear is mechanically steered by the rudder pedals to 20° each side; for ground handling, maximum deflection is 95°.

POWER PLANT: Two Williams FJ44-4A medium bypass, twin-spool turbofans, each 15.12 kN (3,400 lb st) at sea level, flat rated up to 26°C (79°F). Dual channel FADECs. Detents in the throttle quadrant for idle, takeoff , maximum continuous and high speed cruise give pilots optimal power settings for each phase of flight based on ambient conditions. A takeoff/go around button is located on the throttle lever. Electrical power for FADECs comes from engine driven permanent magnet alternators (PMAs) rectified to DC. Two PMAs mounted to each engine. In the event that both PMAs fail on one engine, the FADEC on that side will draw from main DC power. Continuous loop fire detection system monitors engine nacelles;

Computer graphic of proposed Cessna Citation CJ4 1159555

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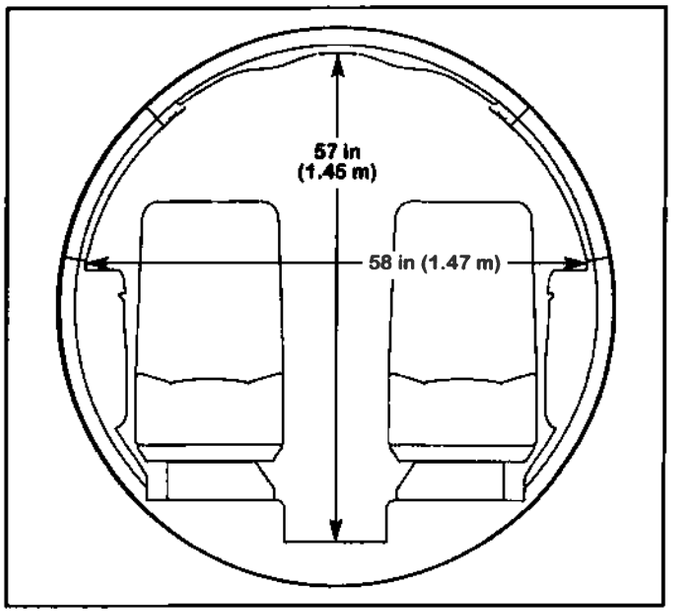
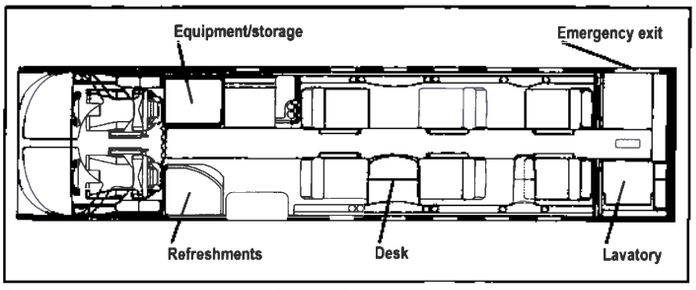
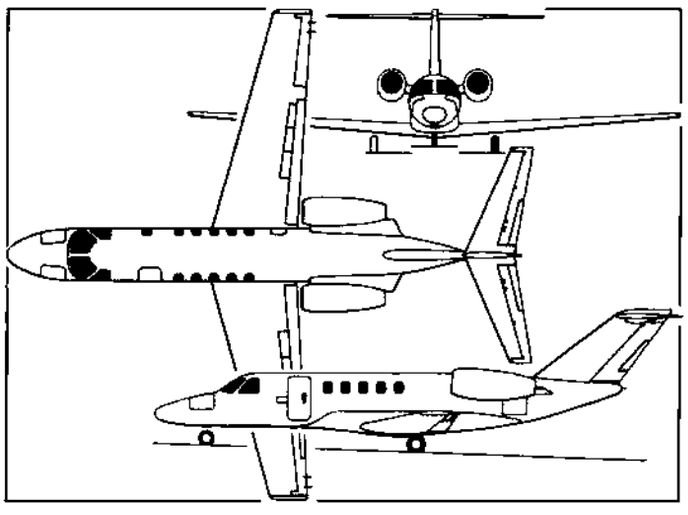


Cessna Citation CJ4 fuselage cross-section 1159562



Standard floor plan of Cessna Citation CJ4 1159561



Cessna Citation CJ4 business jet *(Paul Jackson)* 1159564

two-shot fire extinguishing system.

Integral fuel tank in each wing. System operation is fully automatic throughout the normal flight profile with each engine receiving fuel from its respective wing tank. Electric boost pump in each tank sump delivers fuel during engine start, fuel transfer, and as activated by low fuel pressure. Fuel may be transferred from tank to tank as needed. A vented surge tank is integrated near each wing tip.

Refuelling through over wing filler ports with flush mounted locking caps, or through single point refuelling system, latter incorporating a standard receptacle forward of the right wing in the fairing capable of refuelling at 568 litres (150 US gallons; 125 Imp gallons)/min at 50 psig 3.45 bar (50 lb/sq in). System can also defuel one or both fuel tanks.

ACCOMMODATION: Two, including at least one pilot, in cockpit (seats 1 and 2), plus standard cabin layout featuring six-place centre club (seats 3 and 4 both rear-facing; seats 5, 6, 7 and 8 forward-facing) with a seventh seat facing door; last-mentioned includes armrest storage cabinet. Refreshment centre immediately behind pilot's seat with a heated liquid container, ice chest, LED work surface lighting and other storage places. Behind the co-pilot is equipment/storage cabinet, some of which houses the cabin management and entertainment equipment. Latter includes CD, DVD, and MP3. Both cabinets contain air conditioning equipment in lower levels. Port side belted flushing toilet in aft cabin lavatory offers an approved eighth passenger seat; sliding divider doors provide privacy; centre flush-mounted coat rod is in lavatory. Alternate floorplan is available, offering a two-place side facing couch.

Each pedestal seat tracks forward, aft, and laterally and may be reclined to horizontal depending on its position on the pedestal. (Seats 3, 4, 7, and 8 are partially restricted in recline). The two centre seats (5 and 6) are mounted on floor tracks for greater flexibility. A single inboard armrest folds down when not in use. In the lower sidewall next to seats 5 and 6 are two 110 VAC outlets, one on each side. The VIP seat includes a corded satellite phone with a cockpit intercom call switch. Individual air outlets and reading lights above each passenger. Dropout, constant-flow oxygen masks for emergency use.

Each crew seat is fully adjustable and includes a five-point restraint system. Two complete crew stations are provided with dual controls including control columns, adjustable rudder pedals, and brakes. Electroluminescent panels, instrument floodlights, and blue-white background lighting illuminate all cockpit instruments and switches. Illuminated LED pushbutton switches replace many cockpit toggle switches previously employed in CJ series aircraft.

Dropped aisle (13 cm; 5 in) from immediately behind cockpit through to lavatory. Keyed cabin door, port, forward has eight locking pins and is hinged forward with two passive door seals for pressure and acoustics. Folding airstairs inside entrance; fold-up water barrier in threshold. Plug-type emergency exit starboard, aft, in lavatory. Nose section includes baggage compartment with lockable doors each side, additionally allowing access to avionics bay and oxygen bottle. Tailcone houses major components of hydraulic, environmental, electrical distribution, flight control and engine fire extinguishing systems. Aft baggage compartment accessed via lockable door on the lower port side.

SYSTEMS: Closed-centre, constant pressure 207 bar (3,000 lb/sq in) hydraulic system operates landing gear, speed brakes and flaps. Hydraulic pressure is supplied by two engine-driven pressure compensating pumps. Either pump can supply enough flow to operate the system. Independent, electrically powered hydraulic system in fairing behind wing to operate wheel brakes and anti-skid system, and to accumulator. Ground connections to service each system are located starboard, below engine.

Power generation and distribution system features traditional parallel bus architecture designed to provide 600 A at 28.5 V DC from two engine-driven 300 A starter/generators. Each generator connected to a remote digital generator control unit (DGCU) in tailcone; DGCUs connected to each other to allow proportionate load sharing. If one generator becomes disabled in flight, vapour cycle air conditioning system (if in use) will automatically turn off. All other essential electrical systems are supplied by the remaining generator through the respective main and crossfeed busses.

Each engine also drives an alternator in support of AC system for electrical anti-icing and defogging of glass windscreens and cockpit side windows. System also provides backup to generators in the event of dual generator failure by supplying power through a solid state AC-to-DC converter onto an essential bus. Essential bus powers all components of Pro Line 21 avionics system that are essential for flight, including all four display units and the autopilot. Only one alternator is required to keep the essential bus on line. If all engine driven power sources are lost, 44 Ah nickel cadmium battery, normally used for initial engine starts, is limited backup.

In addition to alternators, each engine also drives a dedicated permanent magnet alternator (PMA) to support its respective FADEC. External power receptacle below port engine pylon. A 500 W static inverter supplies 110 V AC power to four 5 A outlets: two in cockpit sidewalls and two in cabin.

Pressurization and heating is divided into two separate subsystems: cabin and cockpit. High pressure bleed air is drawn from starboard engine for cabin while port engine supplies cockpit. Air is conditioned in two stages: first, by passing through a heat exchanger in the engine pylon and second, through a proprietary cooler. Exhaust from this cooler is used to help draw ambient air across the heat exchanger. Conditioned air then passes through a pressure regulator and muffler before entering the cockpit and cabin. Right engine air is delivered to the cabin through sidewall shoulder and floor vents while air from port engine is routed to cockpit through foot warmers and sidewall shoulder vents. If conditioned air to the cockpit is interrupted a check valve redirects cabin air to the cockpit, eliminating need for a separate emergency pressurization system.

Cooling system is independent of heating and is divided into separate cabin and cockpit zones with cockpit divided for each pilot. A separate cabin controller is provided at the VIP seat. The system consists of a compressor and condenser assembly in the tailcone, three evaporator fan assemblies inside the pressure vessel, and cold air ducting. The cabin evaporator assembly is located on the aft pressure bulkhead. Cockpit evaporator fan assemblies for each side are in the lower part of the refreshment centre and equipment cabinet. Each draws in surrounding air and distributes chilled air through its respective outlets. System may be operated any time, airborne or on ground, when ground power is connected or either engine is running. In flight, vapour cycle compressor automatically shuts down if one generator fails. A fresh air vent with blower and check valve is located in the tailcone and feeds into existing conditioned air ducts to provide outside air to cockpit whenever cabin is not pressurized.

Pressurization control system automatically schedules cabin altitude and change rate while maintaining a nominal maximum pressure differential of 0.62 bar (9.0 lb/sq in), which permits a sea level cabin altitude up to 23,980 feet (7,310 m), increasing to 7,800 feet (2,375 m) equivalent at maximum cruise altitude of 45,000 feet (13,715 m).

Oxygen system includes 50 cubic foot 1.42 m^3 (50 cu ft) oxygen bottle in nose. Quick-donning pressure demand masks with microphones are provided at each crew seat, while automatic dropout constant-flow oxygen masks are provided at each passenger seat and above the toilet.

Engine bleed air is used for anti-ice protection of the engine inlets and the wing leading edges. Horizontal stabilizer leading edges are fitted with pneumatic de-ice boots, inflated by engine bleed air through the service air system. Pitot tubes, static ports, and the AOA sensor are electrically anti-iced. Glass windscreens and cockpit side windows are also electrically heated; however, power is provided by dedicated AC alternators, one on each engine.

Collins maintenance diagnostic system has the ability to collect, store, and display diagnostic data, service, and fault messages for many Collins Pro Line 21 LRUs. The maintenance data can be accessed on the co-pilot's MFD only when on the ground. System can store history for up to 500 faults occurring during the previous 100 flights.

AVIONICS: Collins Pro Line 21 avionics suite designed for single pilot operation.

Comms: Dual Collins VHF-4000 VHF transceivers are compliant with European 8.33 kHz spacing requirements. Dual Collins digital audio control panel amplifiers. Where local rules permit, all audio and aural warnings to the cockpit overhead speakers including TCAS and TAWS can be muted. Dual Collins Mode S transponders include Enhanced Surveillance and ADS-B transmission capability. One transponder is contained within the TSS-41 00 Traffic Surveillance System unit while the stand alone TDR-94D transponder is remotely mounted. Collins TSS-4100 Traffic Surveillance System integrates the TCAS and Mode-S transponder functions into a single LRU. XM WX Satellite Weather Data Service. Artex C406-N ELT. L-3 Communications FA21 00 cockpit voice recorder.

Radar: Collins WXR-800 colour weather avoidance radar.

Flight: Integrated Collins Pro Line 21 Flight Guidance System (FGS) consists of dual flight guidance computers and a single, three-axis autopilot. Emergency descent mode (EDM) activates automatic descent if cabin becomes depressurized at altitude. EDM is automatically armed when the autopilot is engaged and aircraft altitude is above FL300. Dual Collins AHC-3000 solid-state attitude/heading- and ADC-3000 digital air data computers. Pressure altitude information is supplied to each Mode S transponder, as well as to Collins FMS and FGS for vertical mode computations. Third ADC is dedicated to electronic standby instrument system. Collins GPS-4000A GPS. Two Collins NAV-4500

navigation receivers provide integrated ground-based navigation functions. Dual VOR, localizer, glideslope, and marker beacon receivers standard. Single ADF receiver as option. Honeywell Mark VIII EPGWS. Collins DME-4000. Collins AL T-4000 Radio Altimeter system provides height above the terrain from 760 m (2,500 ft) to touchdown.

Instrumentation: Collins IFIS-5000 with four 203 × 254 mm (8 × 10 in) colour, active matrix liquid crystal displays. Dual PFDs and dual enhanced MFDs in each pilot position. All displays are capable of providing compass, radar information, and engine parameters in reversion mode. Two outer displays are PFDs and the two inner are MFDs, including a flexibly displayed EICAS. Because each display is capable of providing critical flight, navigation and engine indications in reversion mode, dispatch is possible with one display inoperative. Second FMS is available as an option. Electronic standby instrument system features solid-state internal sensors for attitude cues and an independent, dedicated air data computer (remotely mounted) for airspeed and altitude information. Flight reference information is presented on a full-colour AMLCD.

Mission: Worldwide electronic charts function allows high resolution Jeppesen SID, STAR, and approach charts, as well as airport taxi diagrams, to display on the MFDs.

EQUIPMENT: The landing lights below fuselage in wing/fuselage composites fairing. Tail flood lights in the horizontal stabilizer illuminate the vertical. Wingtips include LED navigation and anti-collision strobe lights, and static wicks. Pitot-static system includes three heated pitot sources and six heated static sources. Fire extinguisher in cockpit and cabin.

DIMENSIONS, EXTERNAL:

Wing span: incl tip lights	15.49 m (50 ft 10 in)
excl tip lights	15.37 m (50 ft 5 in)
Wing aspect ratio	7.7
Length overall	19.30 m (53 ft 4 in)
Height overall	4.67 m (15 ft 4 in)
Tailplane span	6.73 m (22 ft 1 in)
Wheel track	3.76 m (12 ft 4 in)
Wheelbase	6.45 m (21 ft 2 in)
Passenger door: Height	1.22 m (4 ft 0 in)
Width	0.61 m (2 ft 0 in)
Emergency exit: Height	0.74 m (2 ft 5 in)
Width	0.48 m (1 ft 7 in)

DIMENSIONS, INTERNAL:

Length: between pressure bulkheads	6.81 m (22 ft 4 in)
cockpit	1.52 m (5 ft 0 in)
cabin	4.60 m (15 ft 1 in)
lavatory	0.69 m (2 ft 3 in)
Cabin: Max width	1.47 m (4 ft 10 in)
Max height	1.45 m (4 ft 9 in)
Baggage volume	0.18 m^3 (6.5 cu ft)
External access baggage volume:	
front	0.42 m^3 (15.0 cu ft)
rear	1.42 m^3 (50 cu ft)

AREAS:

Wings, gross	30.66 m^2 (330.0 sq ft)
Vertical tail surfaces	5.51 m^2 (59.30 sq ft)
Horizontal tail surfaces	7.40 m^2 (79.60 sq ft)

WEIGHTS AND LOADINGS:

Max baggage weight: cabin	18 kg (40 lb)
external access: forward	181 kg (400 lb)
rear	272 kg (600 lb)
Payload: max	953 kg (2,100 lb)
with max fuel	454 kg (1,000 lb)

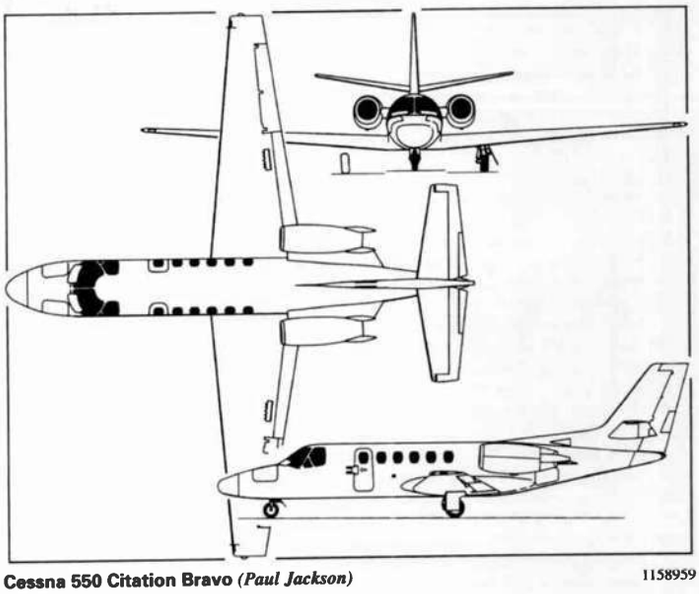
PERFORMANCE:

Max operating speed, FL80 to FL280 (VMO)	305 kt (565 km/h; 351 mph) CAS
Max operating Mach No. above FL280	0.77
Max cruising speed at FL350	435 kt (806 km/h; 501 mph)
Time to FL430	28 min
Max certified altitude	13,715 m (45,000 ft)
T-O balanced field length	1,006 m (3,300 ft)
Landing run	813 m (2,665 ft)
Range: NBAA IFR	1,825 n miles (3,379 km; 2,100 miles)
absolute	1,925 n miles (3,565 km; 2,215 miles)

CESSNA 550 CITATION BRAVO

TYPE: Business jet.

PROGRAMME: Cessna 550 Citation II first flew 31 January 1977; Bravo announced at Farnborough Air Show September 1994; replaced Citation II; prototype (N550BB, c/n 0734) first flight 19 April 1995; initial production aircraft (N801BB, c/n 0801) flew mid-1996; FAA certification in January 1997; first delivery, to Firebond Corporation of Minden, Louisiana, on 25 February 1997. Russian certification achieved 4 September 1998. Certification for operation into London City Airport achieved in May 2002.



Cessna 550 Citation Bravo *(Paul Jackson)* 1158959

CUSTOMERS: First 18 months' production had been sold by time of initial delivery. Earlier production in this series accounted for 621 Model 550 Citation IIs, 97 Model 551 Citation II SPs and 15 Model 552 T-47A Citations, or 733 in all. Bravo deliveries comprised 28 in 1997, 34 in 1998, 36 in 1999, 54 in 2000, 48 in 2001, 41 in 2002, 31 in 2003, 25 in 2004, 21 in 2005, and 16 in the first nine months of 2006. Recent customers include Avemex SA of Toluca, Mexico (two, for delivery from May 2002); Taxi Aereo Marilia (TAM) of Brazil (three, for delivery from April 2002); Flying Partners CV of Antwerp, Belgium, which has ordered two for its shared ownership programme, for delivery from January 2002; Cessna's and TAG Aviation USA's fractional ownership operation, CitationShares, which placed an initial order for six, for delivery before the end of 2000; and The Company Jet of Grand Rapids, Michigan, which has ordered five for delivery in 2003 for its fractional ownership operation.

COSTS: USD5.850 million, typically equipped (2005).

DESIGN FEATURES: Small/mid-size business jet. Based on Citation II airframe; tapered wing; tapered, mid-set tailplane; sweptback fin, sweepback at quarter-chord 33° 0'; podded engines mounted clear of upper rear fuselage; wide track landing gear.

Wing aerofoil NACA 23014 (modified) at centreline, NACA 23012 at wing station 247.95; dihedral 4°; tailplane dihedral 9°.

FLYING CONTROLS: Conventional and manual. Trim tab on port aileron is manually operated; manual rudder trim; electric elevator trim tab with manual standby; electrically actuated single-slotted flaps, maximum deflection 40°; hydraulically actuated airbrake.

STRUCTURE: Two primary, one auxiliary metal wing spars; three fuselage attachment points; conventional ribs and stringers. All-metal pressurised fuselage with fail-safe design providing multiple load paths.

LANDING GEAR: Hydraulically retractable tricycle type with single wheel on each unit. Trailing-link main units retract inward into the wing, nose gear forward. Free-fall and pneumatic emergency extension systems. Steerable nosewheel maximum deflection ±20°, or ±95° for ground handling and towing. Mainwheel tyres H22.0×8.25-10 (14 ply); steerable nosewheel with tyre size 18×4.4DD (10 ply); all tubeless. Toe-actuated multiple disc brakes on mainwheels. Parking brake and pneumatic emergency brake system. Anti-skid system standard.

POWER PLANT: Two 12.84 kN (2,887 lb st) Pratt & Whitney Canada PW530A turbofans; Nordam target-type thrust reversers standard. Two independent fuel systems with integral tank in each wing, with combined usable capacity of 2,725 litres (720 US gallons; 600 Imp gallons).

ACCOMMODATION: Crew of two on separate flight deck, on fully adjustable seats, with seat belts and inertia reel shoulder harness. Sun visors standard. Fully carpeted main cabin equipped with seats for seven to 10 passengers (seven standard, on pedestal-mounted seats). Main baggage areas in nose and tailcone; flight accessible baggage area at rear of cabin. Refreshment centre standard. Cabin is pressurised, heated and air conditioned. Individual reading lights and air inlets for each passenger. Dropout constant-flow oxygen system for emergency use. Cabin door with integral airstair at front on port side and one emergency

1040409

Cessna 550 Citation Bravo *(Paul Jackson)*

exit on starboard side. Doors on each side of nose baggage compartment. Tinted windows, each with curtains. Pilot's storm window, birdproof windscreen with de-fog system, anti-icing, standby alcohol anti-icing and bleed air rain removal system.

SYSTEMS: Pressurisation system supplied with engine bleed air, maximum pressure differential 0.61 bar (8.9 lb/sq in), maintaining a sea level cabin altitude to 7,189 m (23,586 ft), or a 2,440 m (8,000 ft) cabin altitude to 13,715 m (45,000 ft). Hydraulic system, pressure 103.5 bar (1,500 lb/sq in), with two pumps to operate landing gear and speed brakes. Separate hydraulic system for wheel brakes. Electrical system supplied by two 28 V 400 A DC starter/generators, with two 350 VA inverters and 24 V 44 Ah Ni/Cd battery. Oxygen system of 1,814 litre (64 cu ft) capacity includes two crew demand masks and five dropout constant-flow masks for passengers. Engine fire detection and extinguishing systems. Wing leading-edges electrically de-iced ahead of engines; pneumatic de-icing boots on outer wings and on leading-edges of tailplane and fins; engine inlets and windscreen have anti-ice protection via engine bleed air, with back-up alcohol system for windscreen; pitot tubes and static ports have electric anti-icing.

AVIONICS: Honeywell Primus 1000 as core system.

Comms: Dual Honeywell KY-196B VHF transceivers with 25 kHz and 8.33 kHz channel spacing; dual Avtech audio amplifiers; Dual Telex hand microphones, headsets and cockpit speackers; dual Honeywell Mode S transponders; L3 Communications FA2100 CVR with underwater locator beacon; Artex 110-4 ELT.

Radar: Honeywell Primus 660 colour weather radar.

Flight: Honeywell GNS-X_{LS} FMS; three-axis fail-passive autopilot; dual Honeywell navigation systems including VOR/LOC/GS/MKR, DME, digitally tuned ADF. Dual integrated computers combine EFIS display functions with flight guidance function; dual Honeywell VG-14A vertical gyros and C-14D compass systems supply primary heading and attitude information to cockpit displays.

Instrumentation: EFIS with two 178 × 203 mm (7 × 8 in) screens for primary flight display (PFD) and additional multifunction display (MFD) of same size; standby 3 in HSI; Davtron clock.

DIMENSIONS, EXTERNAL:

Wing span	15.75 m (51 ft 8 in)
Wing aspect ratio	8.4
Length overall	14.40 m (47 ft 3 in)
Height overall	4.57 m (15 ft 0 in)
Tailplane span	5.79 m (19 ft 0 in)
Wheel track	3.99 m (13 ft 1 in)
Wheelbase	5.64 m (18 ft 6 in)
Crew/passenger door: Height	1.21 m (3 ft 11½ in)
Width	0.60 m (1 ft 11½ in)

DIMENSIONS, INTERNAL:

Cabin: Length (between pressure bulkheads)	6.37 m (20 ft 11 in)
excl cockpit	4.75 m (15 ft 7 in)
Max width	1.48 m (4 ft 10¼ in)
Max height	1.43 m (4 ft 8¼ in)
Baggage volume: nose	0.44 m^3 (15.6 cu ft)
cabin	0.31 m^3 (10.8 cu ft)
tailcone	0.79 m^3 (28.0 cu ft)

AREAS:

Wings, gross	30.00 m^2 (322.9 sq ft)
Vertical tail surfaces (total)	4.73 m^2 (50.9 sq ft)
Horizontal tail surfaces (total, incl tab)	6.48 m^2 (69.8 sq ft)

WEIGHTS AND LOADINGS:

Standard empty weight	3,992 kg (8,800 lb)
Weight empty, typically equipped	4,073 kg (8,980 lb)
Max fuel weight (usable)	2,188 kg (4,824 lb)
Max baggage weight:	
nose	159 kg (350 lb)
cabin	136 kg (300 lb)
tailcone	227 kg (500 lb)
Payload with max fuel	370 kg (816 lb)
Max T-O weight	6,713 kg (14,800 lb)
Max ramp weight	6,804 kg (15,000 lb)
Max landing weight	6,123 kg (13,500 lb)
Max zero-fuel weight	5,126 kg (11,300 lb)
Max wing loading	223.8 kg/m^2 (45.83 lb/sq ft)
Max power loading	262 kg/kN (2.56 lb/lb st)

PERFORMANCE:

Max operating speed (VMO):	
S/L to FL80	260 kt (481 km/h; 299 mph)
FL80 to FL279	275 kt (509 km/h; 316 mph)
at FL279 and above	M0.70
Max cruising speed at FL330	403 kt (746 km/h; 464 mph)
Stalling speed in landing configuration at MLW	86 kt (160 km/h; 99 mph) CAS
Max rate of climb at S/L	974 m (3,195 ft)/min
Rate of climb at S/L, OEI	345 m (1,133 ft)/min
Max certified altitude	13,715 m (45,000 ft)
Service ceiling, OEI	8,458 m (27,750 ft)
T-O balanced field length	1,098 m (3,600 ft)
FAR Pt 25 landing field length at MLW	970 m (3,180 ft)
NBAA IFR range, 100 n mile (185 km; 115 mile) alternate, plus 45 min reserves	1,744 n miles (3,230 km; 2,007 miles)
Range with max fuel, VFR reserves	2,000 n miles (3,704 km; 2,302 miles)

OPERATIONAL NOISE LEVELS:

T-O	73.7 EPNdB
Approach	91.2 EPNdB
Sideline	85.2 EPNdB

CESSNA 560 CITATION ENCORE

US Army designation: UC-35B
US Marine Corps designation: UC-35D

TYPE: Business jet.

PROGRAMME: Original Cessna 560 was stretched, higher-performance version of Citation S/II, first flown August 1987 and marketed as Citation V; certified 9 December 1988 as extension of Cessna 500/550 certificate; Citation Ultra introduced from c/n 560-0260 (no recertification), but replaced by current Encore.

Prototype Encore, based on rebuilt Citation Ultra, first flown (N560VU) 9 July 1998; announced at NBAA Convention at Las Vegas, Nevada 18 October 1998; first production aircraft (c/n 560-0539) rolled out in early March 2000. FAA certification achieved 26 April 2000; first delivery (N539CE/N5108G) on 29 September 2000 to J R Simplot Company of Boise, Idaho.

CURRENT VERSIONS: **Citation Encore:** Civilian business jet; *as described.*

Encore+: Announced on eve of NBAA Convention at Orlando, Florida, 8 November 2005; deliveries to begin in February 2007. First flight (N560CC c/n 560-0751) 22 March 2006; FAA certification granted 21 December 2006. Pratt & Whitney PW535B engines with FADEC; MTOW increased 91 kg (200 lb). Three-screen Pro Line 21 avionics suite generally as for Citation CJ1+ except dual Rockwell Collins TDR-94D Mode S transponders, TTR-4000 (TCAS II) TCAS and Honeywell Mk VIII EPGWS. New interior styling with LED indirect cabin lighting.

UC-35B: In January 1996, US Army selected Ultra for its C-XX medium-range transport aircraft programme; equipped with 0.90 × 1.15 m (2 ft 11½ in × 3 ft 9 in) upward-opening clamshell cargo door on port forward fuselage; first order was for two UC-35As, of which one (95-0123) was delivered in last quarter of 1996; first two serve with 207 AvnCo at Heidelberg, Germany. Subsequent orders for five in each of FY96, FY97, FY98 and FY99; (last two aircraft of this batch are first UC-35Bs), three in 2000, one in 2001 (delivered December 2001) and one in 2003 (delivered March 2004). Total seven UC-35Bs, plus 20 earlier UC-35As.

UC-35D: Equivalent version to UC-35B for US Marine Corps. Following two UC-35C equivalents of Citation V Ultra with Reserve's MWHS-4 based at New Orleans), USMC purchased five UC-35Ds; first, 165938, delivered to Miramar in August 2001 (subsequently lost on 10 March 2004); others to Washington for VIP transport, Futenma, Japan, and elsewhere.

Citation Excel: Described separately.

CUSTOMERS: Deliveries of Ultra began July 1994; deliveries comprised 24 in 1994, 56 in 1995, 52 in 1996, 47 in 1997, 41 in 1998, 32 in 1999, six in 2000, 37 in 2001, 36 in 2002, 21 in 2003, 24 in 2004, 13 in 2005, and seven in the first nine months of 2006. Announced customers for Encore include J R Simplot Co of Boise, Idaho, which has ordered two; Taxi Aereo Marilia (TAM) of Brazil (one); Flying Partner CV of Antwerp, Belgium (one).

COSTS: USD8.09 million, typically equipped (Encore+, 2006).

DESIGN FEATURES: Stretched version of Citation S/II for full eight-seat cabin and with fully enclosed toilet/vanity area; seventh cabin window each side; two baggage compartments outside main cabin. Rear-engined executive jet with low-mounted wing of tapered planform with root gloves; tapered horizontal tail with sweptback fin and fillet.

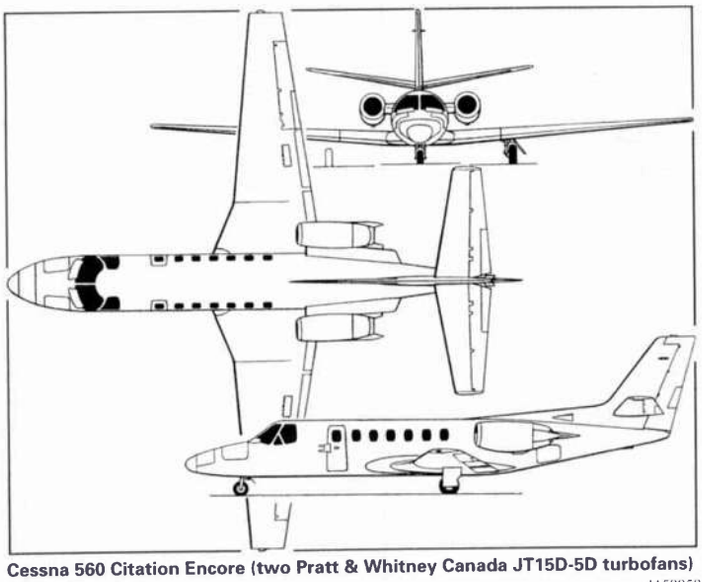
Encore generally as Citation Ultra and Citation Bravo (which see). Compared to Ultra, has increased wing span; bleed air anti-icing for wing leading-edges; boundary layer energisers and stall fences to improve stall characteristics; trailing-link main landing gear with narrower track; decreased fuel capacity; Pratt & Whitney Canada PW535 turbofans offering 10 per cent increase in thrust and 15 per cent improvement in specific fuel consumption; reduced fuel capacity; fuel heaters obviating the need for additives; digital pressurisation system; improved braking system; single level access electrical junction box; and redesigned interior with increased headroom, new passenger service units, pin-mounted seats for easy removal/replacement and increased serviceability.

Wing sweepback 0° at 35 per cent chord; tailplane 0° at 68 per cent; fin 33° at 25 per cent.

Description for Citation Ultra applies also to Citation Encore except as follows:

FLYING CONTROLS: Conventional and manual. Trim tab on port aileron manually actuated; manual rudder trim; electric elevator trim tab with manual standby; hydraulically actuated Fowler flaps, max deflection 35°; hydraulically actuated airbrake on wing upper surfaces, each side, deflection 58°.

Prototype Cessna 560 Citation Encore+ *(Paul Jackson)* 1154691



Cessna 560 Citation Encore (two Pratt & Whitney Canada JT15D-5D turbofans) *(Dennis Punnett)* 1158958

STRUCTURE: Two primary, one auxiliary metal wing spars; four fuselage attachment points, conventional ribs and stringers. All-metal pressurised fuselage with fail-safe design providing multiple load paths.

LANDING GEAR: Hydraulically retractable trailing-link tricycle type with single wheel on each unit. Main units retract inward into the wing, nose gear forward. Free-fall and pneumatic emergency extension systems. Goodyear mainwheels with tubeless tyres size 22×8.0-10 (12 ply), pressure 6.90 bar (100 lb/sq in). Steerable nosewheel (±20°) with Goodyear wheel and tyre size 18×4.4DD (10 ply), pressure 8.27 bar (120 lb/sq in). Goodyear hydraulic brakes. Parking brake and pneumatic emergency brake system. Anti-skid system standard. Minimum ground turning radius about nosewheel 8.38 m (27 ft 6 in).

POWER PLANT: Two Pratt & Whitney Canada PW535A turbofans, each rated at 15.12 kN (3,400 lb st) at 27°C (80°F). Integral fuel tank in each wing, combined usable capacity 3,047 litres (805 US gallons; 670 Imp gallons).

ACCOMMODATION: Standard seating for seven passengers in four forward-facing and three aft-facing seats, or eight passengers in double-club arrangement, on swivelling and fore/aft/inboard-tracking pedestal seats; refreshment centre in forward cabin area; lavatory/vanity centre with sliding doors to rear, metallic plating on cabin fittings, veneer overlay on armrests, optional pleated window shades and cabin divider mirror standard; space in aft section of cabin for 272 kg (600 lb) of baggage, in addition to baggage compartments in nose and rear fuselage.

SYSTEMS: Pressurisation system supplied with engine bleed air, maximum pressure differential 0.69 bar (8.9 lb/sq in), maintaining a sea level cabin altitude to 7,189 m (23,586 ft), or a 2,286 m (7,500 ft) cabin altitude to 13,716 m (45,000 ft). Hydraulic system, pressure 103.5 bar (1,500 lb/sq in), with two pumps to operate flaps landing gear, speed brakes and thrust reversers. Separate hydraulic system for wheel brakes. Electrical system supplied by two 28 V 300 A DC starter/generators, with two 375 VA inverters and 24 V 30 Ah Ni/Cd battery. Oxygen system of 1.90 m^3 (67 cu ft) capacity includes two crew demand masks and dropout constant flow masks for passengers. Engine fire detection and extinguishing system. Bleed air anti-icing system for wing leading-edges and engine inlets; pneumatic de-icing boots on tailplane leading-edges.

AVIONICS: Standard avionics package based on Honeywell Primus 1000 digital flight control system with integrated avionics computer.

Comms: Dual Honeywell TR-833 transceivers, dual TDR-94 transponders, dual altitude reporting systems L-3 Communications FA2100 cockpit voice recorder, Artex ELT-110-4, and dual Telex microphones and headsets, all standard.

Radar: Honeywell Primus 660 colour weather radar standard.

Flight: Dual Honeywell Primus II, single Honeywell ADF, AA-300 radio altimeter, coupled vertical navigation system. Universal Avionics UNS-1Csp navigation management system, including GPS.

Instrumentation: Three-tube EFIS with 203 × 178 mm (8 × 7 in) CRTs comprising pilot's and co-pilot's primary flight displays (PFDs) and centrally mounted multifunction display (MFD); PFDs integrate functions of five flight instruments and several sources of navigation data, and provide trend data for airspeed, altitude and rate of climb. L3 Communications GH-3000 ESIS standby indicator.

DIMENSIONS, EXTERNAL:

Wing span: incl lights	16.69 m (54 ft 9 in)
excl lights	16.48 m (54 ft 1 in)
Wing aspect ratio	9
Length overall	14.91 m (48 ft 11 in)
Height overall	4.62 m (15 ft 2 in)
Tailplane span	6.55 m (21 ft 6 in)
Wheelbase	6.12 m (20 ft 1 in)
Wheel track	4.06 m (13 ft 4 in)
Door (port): Height	1.30 m (4 ft 3 in)
Max width	0.61 m (2 ft 0 in)

DIMENSIONS, INTERNAL:

Cabin:	
Length: between pressure bulkheads	6.81 m (22 ft 4 in)
excl cockpit	5.28 m (17 ft 4 in)
Max width	1.47 m (4 ft 10 in)
Max height	1.43 m (4 ft 8½ in)
Baggage compartment volume	1.95 m^3 (69 cu ft)

AREAS:

Wings, gross	29.94 m^2 (322.3 sq ft)
Vertical tail surfaces (total, incl tab)	4.73 m^2 (50.90 sq ft)
Horizontal tail surfaces (total)	7.88 m^2 (84.80 sq ft)

WEIGHTS AND LOADINGS (E: Encore, P: Encore+):

Standard weight empty: E	4,525 kg (9,977 lb)
P	4,536 kg (10,000 lb)
Max fuel weight: E, P	2,449 kg (5,400 lb)
Fuel with max payload: E	413 kg (910 lb)
Max baggage weight:	
nose	141 kg (310 lb)
aft cabin	272 kg (600 lb)
tailcone	227 kg (500 lb)
Max T-O weight: E	7,543 kg (16,630 lb)
P	7,634 kg (16,830 lb)
Max ramp weight: E	7,634 kg (16,830 lb)
P	7,724 kg (17,030 lb)
Max landing weight: E, P	6,895 kg (15,200 lb)
Max zero-fuel weight: E, P	5,715 kg (12,600 lb)
Max wing loading: E	251.9 kg/m^2 (51.60 lb/sq ft)
P	255.0 kg/m^2 (52.22 lb/sq ft)
Max power loading: E	249 kg/kN (2.45 lb/lb st)
P	252 kg/kN (2.48 lb/lb st)

PERFORMANCE:

Max operating Mach No. (MMO) above FL289	0.755
Max operating speed (VMO): S/L to FL80	261 kt (481 km/h; 299 mph) IAS
above FL80	292 kt (540 km/h; 336 mph) IAS
Max cruising speed at FL350	429 kt (795 km/h; 494 mph)
Stalling speed, flaps down	83 kt (154 km/h; 96 mph)
Max rate of climb at S/L: E	1,445 m (4,740 ft)/min
Time to: FL350: E	12 min
FL450: E	28 min
P	29 min
Rate of climb at S/L, OEI: E	439 m (1,440 ft)/min
Max certified altitude: E, P	13,715 m (45,000 ft)
T-O balanced field length: E	1,064 m (3,490 ft)
P	1,095 m (3,590 ft)
Landing field length at MLW: E, P	844 m (2,770 ft)
NBAA IFR range, 100 n mile (185 km; 115 mile) alternate:	
E	1,778 n miles (3,292 km; 2,046 miles)
P	1,760 n miles (3,259 km; 2,025 miles)
Range with max fuel, VFR reserves: E	1,970 n miles (3,648 km; 2,267 miles)

OPERATIONAL NOISE LEVELS:

T-O	70.0 EPNdB
Approach	90.5 EPNdB
Sideline	89.8 EPNdB

CESSNA 560XL CITATION EXCEL and XLS

TYPE: Business jet.

PROGRAMME: Excel announced at National Business Aircraft Association Convention in New Orleans, October 1994; derivation of Model 560 Citation V/Ultra. Construction of prototype (N560XL) began February 1995; first flight 29 February 1996; public debut at NBAA convention at Orlando, Florida, November 1996, by which time prototype and preproduction aircraft (N561XL, c/n 560-5001) had completed 350 hours of flight testing in 400 sorties; first production aircraft rolled out 21 November 1997; FAA certification achieved 22 April 1998 (on Cessna 500/550/560 certificate); first delivery 2 July 1998 to Swift Transportation Inc of Phoenix, Arizona. First export, September 1998, to Automobilvertriebs AG, Austria; 100th production Excel rolled out 17 April 2000 and delivered in August 2000. Cessna delivered its 4,000th Citation, an Excel, on 7 October 2003.

1040405

Cessna 560 Citation XLS *(Paul Jackson)*

Citation XLS announced at NBAA Convention in Orlando 7 October 2003, where development aircraft (N562XL, c/n 560-5313) was displayed statically. Features 17.75 kN (3,990 lb st) Pratt & Whitney Canada PW545B turbofans providing 4.9 per cent more take-off thrust; and revised flight deck and cabin interior featuring Goodrich Aerospace crew seats, BE Aerospace passenger seats, LED lightning and restyled and upgraded furnishings. FAA certification achieved 23 March 2004; first production aircraft (c/n 560-5501/N633RP) rolled out 17 April 2004; deliveries began August 2004, replacing Excel. Total fleet time stood at nearly one million flight hours in October 2006.

CURRENT VERSION: **Citation Excel:** Initial version.

Citation XLS: Current version, *as described.*

Citation XLS+: Upgraded version; *described separately.*

CUSTOMERS: Total market expected to exceed 1,000. Total of 15 delivered in 1998, 39 in 1999, 79 in 2000, 85 in 2001, 81 in 2002, 48 in 2003, 55 (23 Excel and 32 XLS) in 2004, 64 (all XLS) in 2005, and 53 in the first nine months of 2006. Last of 372 Excels (excluding prototype) delivered to Portuguese customer on 11 August 2004; 500th Excel/XLS delivered 27 June 2006, to European flight Service AB of Sweden. Recent customers include Jetalliance of Austria, which ordered four XLSs in November 2005; Bexair of Bahrain, UAE, which ordered two, with one option, in November 2005; and Gulf Jet-UAE and Wallan Aviation, which ordered three and two, respectively, in May 2006 for delivery in 2007.

COSTS: XLS USD10.136 million (2004); XLS+ USD11.595 million (2006).

DESIGN FEATURES: Combines systems and wing and tail surfaces of Citation Ultra (Encore) with shortened version of Citation X's fuselage, providing eight-seat cabin with stand-up headroom; dual ventral strakes.

FLYING CONTROLS: As Citation Encore.

LANDING GEAR: Hydraulically retractable tricycle type with single wheel on each unit; trailing-link suspension on main legs. Mainwheel tyre size 23.5 x 8.0–10 (12 ply) tubeless, pressure 14 bar (212 lb/sq in); mechanically steerable nosewheel (±20°) with chined tyre, size 18x4.4DD (10 ply) tubeless, pressure 8.96 bar (130 lb/sq in). Hydraulic multiple disc carbon brakes with anti-skid and pneumatic emergency system.

POWER PLANT: Two 17.75 kN (3,990 lb st) Pratt & Whitney Canada PW545B turbofans. Nordam clamshell-type thrust reversers standard. Integral fuel tank in each wing, usable capacity 3,808 litres (1,006 US gallons; 838 Imp gallons) single-point pressure refuelling.

ACCOMMODATION: Typical standard seating for nine passengers includes six-seat centre club arrangement, two-seat couch and single seat on aft port side of cabin; seats recline, swivel and track forward and aft and laterally; forward refreshment centre and cupboard; aft lavatory and centreline cupboard. Airstair door on port side aft of flight deck. Baggage compartment in rear fuselage, capacity 317.5 kg (700 lb), with external access door incorporating integral step.

SYSTEMS: Tailcone mounted Honeywell RE-100(XL) APU optional from c/n 5021 (mid-1999) onwards, and retrofittable to earlier aircraft. Pressurisation system maximum differential 0.64 bar (9.3 lb/sq in), maintaining a sea level cabin altitude to 7,690 m (25,230 ft) or a 2,070 m (6,800 ft) cabin altitude to 13,715 m (45,000 ft). Hydraulic system, pressure 103.5 bar (1,500 lb/sq in), with two engine-driven pumps to operate landing gear, flaps, horizontal stabiliser, speed brakes and thrust reversers; separate hydraulic system for wheel brakes and anti-skid. Electrical system supplied by two 28 V 300 A DC starter/generators, with 24 V 44 Ah Ni/Cd battery. Vapour cycle air conditioning system standard; APU optional. Oxygen system, capacity 2.15 m^3(76 cu ft) with pressure demand masks for crew and dropout constant-flow masks for passengers. Engine inlets and wing leading-edges supplied by engine bleed air for anti-icing; tailplane has de-icer boots; fin unprotected; electrically heated windscreen and cockpit side windows with PPG SurfaceSeal coating for rain dispersal, with electric blower assistance.

AVIONICS: Standard Honeywell Primus 1000 integrated digital avionics suite with IC-600 avionics computer as core system. Rockwell Collins system optional.

Comms: Dual Honeywell TR-850 transceivers, dual XS-852B Mode S transponders, Artex C406-2 ELT, L3 Communications FA2100 CVR, airborne telephone system. Provisions for Honeywell KHF-1050 HF. Max-Viz EVS 1000 enhanced vision system optional from late 2005.

Radar: Honeywell Primus 880 colour weather radar.

Flight: Dual Honeywell NV-850, dual DM-850 DME, single DF-850 ADF, long-range navigation management system incorporating GPS, Honeywell AA-300 radio altimeter, Honeywell Mark V EGPWS and Honeywell TCAS II.

Instrumentation: Three-tube EFIS with 203 x 254 mm (8 x 10 in) CRT screens comprising dual primary flight displays (PFDs) showing attitude/heading and all air data information, and single multifunction display (MFD) for map/plan, weather and checklist data.

DIMENSIONS, EXTERNAL:

Wing span	17.16 m (56 ft 3¾ in)
Wing aspect ratio	8.4
Length: overall	15.79 m (51 ft 9½ in)
Height overall	5.30 m (17 ft 4½ in)
Tailplane span	6.55 m (21 ft 6 in)
Wheelbase	6.67 m (21 ft 10¾ in)
Wheel track	4.54 m (14 ft 10¾ in)

DIMENSIONS, INTERNAL:

Cabin: Length:	
between pressure bulkheads	6.52 m (21 ft 4¾ in)
excl cockpit	5.69 m (18 ft 8 in)
Max width	1.70 m (5 ft 7 in)
Max height	1.73 m (5 ft 8 in)
Baggage capacity (aft)	2.26 m^3 (80 cu ft)

AREAS:

Wings, gross	34.35 m^2 (369.7 sq ft)
Vertical tail surfaces (total, incl tab)	4.73 m^2 (50.9 sq ft)
Horizontal tail surfaces (total, incl tab)	7.88 m^2 (84.8 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, typically equipped	5,520 kg (12,170 lb)
Max fuel weight (usable)	3,057 kg (6,740 lb)
Max T-O weight	9,162 kg (20,200 lb)
Max ramp weight	9,253 kg (20,400 lb)
Max landing weight	8,482 kg (18,700 lb)
Max zero-fuel weight	6,849 kg (15,100 lb)
Max wing loading	266.8 kg/m^2 (54.64 lb/sq ft)
Max power loading	258 kg/kN (2.53 lb/lb st)

PERFORMANCE:

Max operating speed (VMO):	
S/L to FL80	260 kt (481 km/h; 299 mph)
FL80 to FL265	305 kt (564 km/h; 351 mph) CAS
above FL265	M0.75
Max cruising speed at FL350	433 kt (802 km/h; 498 mph)
Stalling speed in landing configuration, at MLW	90 kt (167 km/h; 104 mph)
Max rate of climb at S/L	1,064 m (3,490 ft)/min
Rate of climb at S/L, OEI	259 m (850 ft)/min
Time to climb to FL450	29 min
Max certified altitude	13,715 m (45,000 ft)
Service ceiling, OEI	8,717 m (28,600 ft)
T-O balanced field length	1,095 m (3,590 ft)
Landing field length at MLW	969 m (3,180 ft)
VFR range with max fuel	2,110 n miles (3,907 km; 2,428 miles)

OPERATIONAL NOISE LEVELS:

T-O	72.4 EPNdB
Approach	93.1 EPNdB
Sideline	85.3 EPNdB

CESSNA 560XL CITATION XLS+

TYPE: Business jet.

PROGRAMME: Citation XLS+ announced at NBAA Convention in Orlando, Florida, 16 October 2006, with mockup unveiled following day. Certification expected in first quarter of 2008, with deliveries beginning in last quarter of 2008. Constructor's numbers begin 560XL-6001.

Original Excel announced at NBAA Convention in New Orleans, October 1994; derivation of Model 560 Citation V/Ultra. Construction of prototype (N560XL) began February 1995; first flight 29 February 1996; public debut at NBAA Convention at Orlando, November 1996, by which time prototype and preproduction aircraft (N561XL, c/n 560-5001) had completed 350 hours of flight testing in 400 sorties; first production aircraft rolled out 21 November 1997; FAA certification achieved 22 April 1998 (on Cessna 500/550/560 certificate); first delivery 2 July 1998 to Swift Transportation Inc of Phoenix, Arizona. First export, September 1998, to Automobilvertriebs AG, Austria; 100th production Excel rolled out 17 April 2000 and delivered in August 2000. Cessna delivered its 4,000th Citation, an Excel, on 7 October 2003.

Citation XLS announced at NBAA Convention in Orlando, 7 October 2003, where development aircraft (N562XL, c/n 560-5313) was displayed statically. Featured 17.75 kN (3,990 lb st) Pratt & Whitney Canada PW545B turbofans providing 4.9 per cent more take-off thrust; and revised flight deck and cabin interior with Goodrich Aerospace crew seats, BE Aerospace passenger seats, LED lighting and restyled and upgraded furnishings. FAA certification achieved 23 March 2004; first production aircraft (c/n 560-5501/N633RP) rolled out 17 April 2004; deliveries began August 2004, replacing Excel.

CURRENT VERSIONS: **Citation Excel:** Initial version; discontinued.

Citation XLS: Upgraded version of Excel; *described separately.*

Citation XLS+: As described. Compared with predecessor, has extended nose contour similar to that of Citation Sovereign and Citation X; P&WC PW545C engines with FADEC; Collins Pro Line 21 avionics suite with XM animated broadcast weather and charts; head-up autopilot controls; revised lower instrument panel design; simplified throttle quadrant and pedestal; optional second file server unit for charts and maps, facilitating paperless cockpit; advanced maintenance diagnostic system; revised cabin interior with serpentine side ledges and cabin seats 5 cm (2 in wider).Citation XLS.

CUSTOMERS: Last of 372 (excluding prototype) first-generation Excels delivered on 11 August 2004; 500th Excel/XLS delivered 27 June 2006.

COSTS: USD11.595 million (2008) and USD11.945 million (2009).

DESIGN FEATURES: Baseline Excel produced by combining wing and tail surfaces of Citation Ultra (Encore) with shortened version of Citation X's fuselage, providing eight-seat cabin with stand-up headroom; dual ventral strakes extend aircraft's usable CG range. Low, trapezoidal wing with root rib; cruciform empennage; and two podded engines on rear fuselage sides.

Wing sweepback 0° at 35 per cent chord; dihedral 4°. Tailplane sweepback 0° at 68 per cent chord. Fin sweepback 33° at 25 per cent chord. Tailplane incorporates a 9° dihedral for minimum sonic fatigue and thrust effects.

FLYING CONTROLS: Conventional and manual. Trim tab in port aileron; upper and lower speed brake on each wing. Aileron-, flap- and speed brake gaps sealed to reduce drag. Electrically-actuated trim tab on each elevator; rudder servo/trim tab. Horizontal stabiliser has two position settings: take-off/landing and cruise; position is controlled by flap angle and airspeed. Control actuation by pushrods and cables. Two hydraulically actuated Fowler flaps on each wing. Infinite positioning of flaps, but selector detents at take-off (7°), take-off/approach (15°) and landing (35°) positions. Speed brakes on upper and lower surfaces of each wing; speed brakes electrically controlled and hydraulically actuated. Rudder bias system—employing engine bleed air to power a pneumatic actuator—assists pilot in the event of engine failure and improves balanced field length for wet runways.

STRUCTURE: Circular fuselage section with dropped aisle in cabin to maximise headroom. Nose section includes composites radome, radar and avionics bay. Windscreens meet bird resistance requirements of 14 CFR Part 25. Various systems housed or accessed through the wing/fuselage fairing. Removable or openable panels for single-point refuelling, servicing of the hydraulic and power brake systems, external power, battery and the externally serviceable lavatory. Tailcone contains baggage compartment and equipment bay, including APU, hydraulic, environmental, electrical distribution, flight controls and engine fire extinguishing systems; external access through door on starboard side of tailcone.

Wing of conventional, all metal construction, including control surfaces, although flap panels of graphite composites. Wing structure has a two-cell torque box formed by spars, stringers, ribs and skin; incorporates fuselage attachment points and a dropped carry-through which permits a continuous dropped aisle in the passenger cabin and lavatory. Integral fuel tanks in each wing forward of the aft spar and in the wing carry-through section, which passes under fuselage.

Empennage comprises vertical stabiliser, horizontal stabiliser and a dorsal fin incorporating two ram-air ducts for heat exchangers.

LANDING GEAR: Tricycle type; retractable. Single wheel on all units, including chined nosewheel tyre for water and slush deflection. Main gear is trailing-link type. Actuation is electrically controlled and hydraulically actuated: main gear inboard into the wing, where partly covered by door, while fairings aerodynamically blend the retracted tyres. Nose gear retracts forward into fuselage and enclosed by three doors, all remaining open when nose gear extended. Mainwheel tyre size 23.5 x 8.0-10 (12 ply) tubeless, pressure 14 bar (212 lb/sq in); nosewheel size 18x4.4DD (10 ply) tubeless, pressure 8.96 bar (130 lb/sq in).

Emergency manual free-fall extension with backup of pneumatic system to release uplocks and extend and lock the gear. Nosewheel mechanically steered by rudder pedals to 20° either side; maximum ground handling deflection is 90° either side. Toe-actuated multiple disc carbon brakes on the mainwheels. Anti-skid protection at speeds above approximately 12 kt (22 km/h; 14 mph). Braking by either of two independent systems: power brake hydraulic system or a backup pneumatic system.

POWER PLANT: Two 18.32 kN (4,119 lb st) Pratt & Whitney Canada PW545C turbofan engines with hydraulically actuated, target-type thrust reversers. Dual-channel FADEC. Continuous loop fire detection system and two-shot fire extinguishing system.

Usable fuel capacity 3,808 litres (1,006 US gallons; 838 Imp gallons) in two independent fuel systems consisting of an integral tank in each wing. System operation is fully automatic

throughout normal flight profile with each engine receiving fuel from its respective wing tank. Crossfeed capability enables both engines to receive fuel from a single tank. Fuelling via lockable filler port on each wing, or single point pressure system.

ACCOMMODATION: Ten persons, including one or two cockpit crew with dual controls on fully adjustable seats with five-point harnesses. Door port, ahead of wing; plug-type emergency exit, starboard, rearmost window. Constant cross-section cabin aft of cockpit includes port side refreshment centre and starboard closet ahead of door; two-place, side-facing couch with fold down centre armrest and aft armrest facing door; six pedestal seats (front pair facing aft; rear four facing forward) featuring dual flip-down armrests, adjustable headrest, seat back pocket and seat restraint, plus stowed lifevest; two executive and two slimline tables; two cupholders in side ledge at each seat location; overhead panels containing air vent, reading light and oxygen mask for each passenger; and the aft lavatory area including non-belted toilet, basin, emergency exit and centreline closet. Dropped aisle, extending from the cockpit divider aft to the aft pressure bulkhead. Passenger seats track forward/aft and laterally, with 360° swivelling capability and can recline fully. Eleven elliptical windows (five port; six starboard) in cabin, each with pleated manual window shades. Indirect LED lights with full dimming capability, dropped aisle lighting, entrance and emergency exit lights. Bagged insulation and soundproofing. Openable side windows for pilot and co-pilot.

Baggage compartment is located in tailcone, accessed through lockable door and integral step on port side; unpressurised, unheated. Compartment is accessible through a lockable door, with an integral step; anchors for cargo tiedown straps and net built into walls.

SYSTEMS: Honeywell RE100(XL) APU installed in tailcone equipment bay supplies bleed air pressurisation and air conditioning and electrical power for engine assisted starts; certified for use in flight up to 9,145 m (30,000 ft).

Open-centre hydraulic system of 103 bar (1,500 lb/sq in) operates two position horizontal stabiliser, landing gear, flaps, speed brakes and thrust reversers. All hydraulic control valves consolidated into main manifold and two thrust reverser control manifolds; separate independent system used for mainwheel anti-skid and power brake system. Hydraulic pressure from two positive displacement, engine-driven pumps; either able to operate the system. Electric motor-driven hydraulic pump charges an accumulator to power independent system for wheel brakes.

Electrical power from two 28 V DC, 300 A engine-driven starter/generators and by 28 V DC, 300 A, APU-mounted starter/generator. Generator control units provide static regulation, over-voltage, feeder fault, and ground fault protection for each generator. Additional AC system dedicated to windscreen. Separate 500 W inverter supplies 110 V AC power to three outlets in cockpit (one) and cabin. Ni/Cd battery, 24 V 44 Ah, for starting and emergency requirements; receptacle for connection of external power unit. Dual parallel main bus distribution system; essential equipment operation not interrupted in the event of a single power source or distribution system failure.

Pressurisation and air conditioning systems use APU or engine bleed via air cycle machine; two outflow valves in aft pressure bulkhead. Distribution via overhead air ducts and outlets, and underfloor and armrest air ducts; separate cockpit air distribution system is ducted forward through the underfloor from aft cabin. Dual thermostats provide independent sensing for automatic temperature control in both zones. Cabin altitude and rate of change automatically scheduled by pressurisation controller. One 2.18 m^3 (77.1 cu ft) oxygen bottle with pressure reducer. Automatic dropout, constant-flow oxygen masks for each passenger; pressure demand masks for crew. System maximum differential of 0.64 bar (9.3 lb/sq in) provides 2,075 m (6,800 ft) cabin altitude at 13,720 m (45,000 ft) and S/L level cabin altitude up to 7,685 m (25,220 ft).

Anti-icing of engine inlets and wing leading-edges by engine bleed air. Windscreens, pitot tubes, static ports, and angle of attack probe are electrically anti-iced. Pneumatic boot ice protection system on tailplane leading-edge. Wing inspection lights on fuselage assist in visual detection of ice buildup during night flights.

Integrated flight director/autopilot included in Collins Pro Line 21 avionics system; includes dual flight guidance computers and single, three-axis autopilot. Flight director modes consist of selected heading, lateral navigation capture and track, go-around attitude, altitude hold, preselected altitude capture and track, vertical speed, IAS or Mach hold, and vertical navigation capture and track. Flight director commands from either pilot's side can be coupled to the autopilot/yaw damper system, which consists of three electric servos in primary flight control system with integral automatic or manual pitch trim system. Incorporates emergency descent mode (EDM) for automatic descent after cabin depressurisation at altitude; becomes armed when autopilot is engaged and altitude is above FL310; descends to hold at FL150.

Collins maintenance diagnostic system will store and display diagnostic data, service and fault messages for many Collins Pro Line 21 LRUs; can store history of up to 500 faults during the previous 100 flights and also provides maintenance reports which can be downloaded in ASCII format to a USB storage device. Data are available through the co-pilot's MFD and can only be accessed on the ground.

AVIONICS: Collins Pro Line 21 as core system.

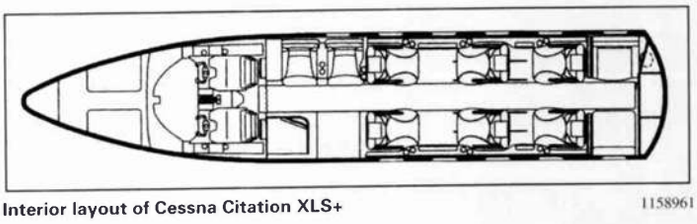
Comms: Dual Collins digital audio control panel amplifiers provide transmitter selection for microphone inputs and direct audio outputs from all receivers to either the speaker or headphones at each crew station. Collins CTL-23D remote VHF radio tuning head as back-up tuning source for COMM 1 and NAV 1 radios. Dual Collins VHF-4000 transceivers. L-3 Communications FA2100 (120-minute) cockpit voice recorder. Dual Collins TDR-94D Mode S solid-state transponders include Enhanced Surveillance capability. Tuning through CCPs or FMS-3000 keyboard. Artex C406-N ELT.

Radar: Collins TWR-850 turbulence Doppler weather radar; depiction can be overlaid on the arc or present position map displays on either the PFDs or MFDs, and corresponds to map/radar range selected.

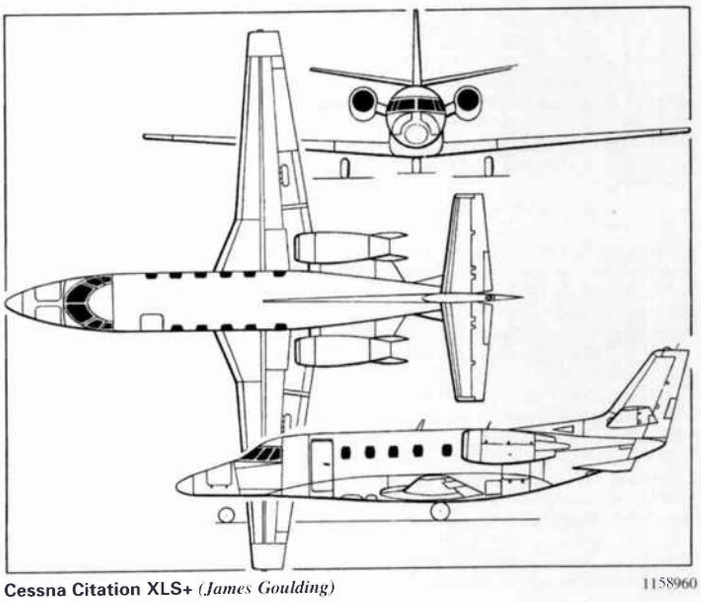
Flight: Collins FMS-3000 flight management system; second FMS-3000 optional; provides multiple waypoint navigation solution blended from available GPS, VOR and DME sources. Dual Collins NAV-4500 navigation receivers; dual VOR, localiser, glideslope and marker beacon receivers. Single ADF optional. Single Collins DME-4000 and ALT-4000 radio altimeter. Tuning and management through CCPs or the FMS-3000 keyboard. Dual Collins AHC-3000 solid-state AHRSs independently supply attitude and heading information to the EFIS and flight guidance system. Collins TCAS-4000 traffic collision avoidance system. Dual Collins ADC-3000 digital air data computers independently supply altitude, airspeed, vertical speed and temperature information to each pilot's PFD. Honeywell Mark V (Class A) terrain awareness warning system includes reactive windshear warning and windshear caution. Single Collins GPS-4000S global positioning system.

Instrumentation: Pro Line 21 EFIS has four 203 x 254 mm (8 x 10 in) active matrix LCDs in portrait orientation. Primary flight displays located on pilot's and co-pilot's panels with two enhanced MFDs on centre panel. All displays capable of providing compass, radar information and engine parameters in reversion mode. L-3 Communications GH-3000 electronic standby instrument system; L-3 Communications EHSI-4000 electronic horizontal situation indicator; standby engine indicator. Collins IFIS-5000 integrated flight information system integrated with FMS to increase situational awareness. Includes Collins FSU-5010 file server unit with storage, memory and processing power to display enhanced map overlays on an MFD using high speed ethernet connections. In addition, XM WX satellite weather data service and Jeppesen electronic charts can be displayed. MFDs can also display pilot-defined electronic checklists.

Computer-generated image of Cessna Citation XLS+ 1040435



Interior layout of Cessna Citation XLS+ 1158961



Cessna Citation XLS+ *(James Goulding)* 1158960

EQUIPMENT: Exterior lighting consists of one red flashing beacon, two anti-collision strobes, two wing inspection lights, navigation lights, two wing recognition/landing lights, two fuselage belly fairing recognition/landing lights and tail floodlight system consisting of two external lights mounted on horizontal stabiliser illuminating fin. Precise Flight Pulselite 2401 system causes the landing lights to cycle on and off to improve own visibility to other aircraft and birds.

DIMENSIONS, EXTERNAL:

Span: wings	16.97 m (55 ft 8 in)
incl navigation lights	17.17 m (56 ft 4 in)
Wing aspect ratio	8.4
Length overall	16.00 m (52 ft 6 in)
Height overall	5.23 m (17 ft 2 in)
Tailplane span	6.55 m (21 ft 6 in)
Wheelbase	6.68 m (21 ft 11 in)
Wheel track	4.55 m (14 ft 11 in)
Door: Height	1.37 m (4 ft 6 in)
Width	0.61 m (2 ft 0 in)
Emergency exit: Height	0.91 m (3 ft 0 in)
Width	0.51 m (1 ft 8 in)
Baggage door: Height	0.74 m (2 ft 5 in)
Width	0.63 m (2 ft 1 in)

DIMENSIONS, INTERNAL:

Cabin:	
Length: between pressure bulkheads	7.32 m (24 ft 0 in)
excl cockpit	5.63 m (18 ft 6 in)
excl cockpit and vestibule	4.67 m (15 ft 4 in)
Max width	1.68 m (5 ft 6 in)
Max height	1.73 m (5 ft 8 in)
Baggage capacity: tailcone	2.26 m^3 (80 cu ft)
forward closet	0.10 m^3 (3.6 cu ft)
rear closet	0.19 m^3 (6.6 cu ft)

AREAS:

Wings, gross	34.35 m^2 (369.7 sq ft)
Vertical tail surfaces (total, incl tab)	4.73 m^2 (50.9 sq ft)
Horizontal tail surfaces (total, incl tab)	7.88 m^2 (84.8 sq ft)

WEIGHTS AND LOADINGS:

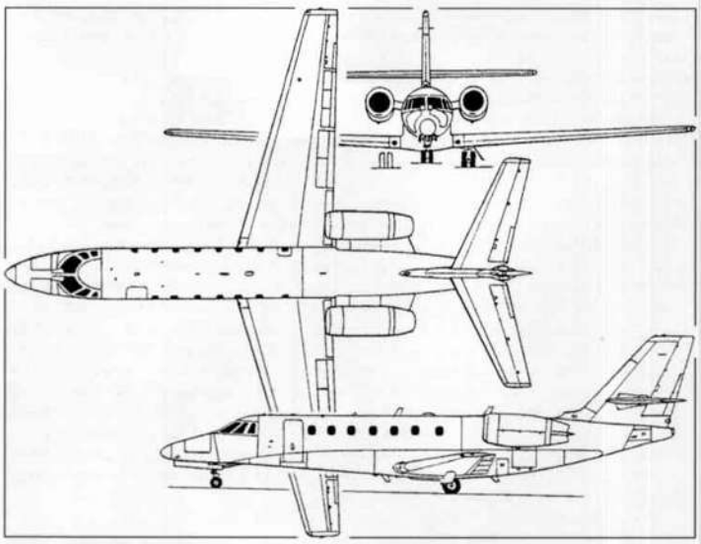
Weight empty, typically equipped	5,579 kg (12,300 lb)
Max baggage weight: tailcone	318 kg (700 lb)
forward closet	25 kg (56 lb)
rear closet	20 kg (44 lb)
Max fuel weight (usable)	3,057 kg (6,740 lb)
Max T-O weight	9,162 kg (20,200 lb)
Max ramp weight	9,253 kg (20,400 lb)
Max landing weight	8,482 kg (18,700 lb)
Max zero-fuel weight	6,849 kg (15,100 lb)
Max wing loading	266.8 kg/m^2 (54.64 lb/sq ft)
Max power loading	250 kg/kN (2.45 lb/lb st)

PERFORMANCE:

Max operating speed (VMO): FL80 to FL265	305 kt (564 km/h; 351 mph) IAS
above FL265	M0.75
Max cruising speed at FL310 and mid-cruise weight	440 kt (815 km/h; 506mph)
Stalling speed in landing configuration, at MLW	90 kt (167 km/h; 104 mph)
Time to climb to FL450	29 min
Max certified altitude	13,720 m (45,000 ft)
T-O balanced field length	1,085 m (3,560 ft)
Landing field length at MLW	969 m (3,180 ft)
NBAA IFR range (100 nm alternate)	1,858 n miles (3,441 km; 2,138 miles)

OPERATIONAL NOISE LEVELS:

T-O	72.7 EPNdB
Approach	92.8 EPNdB
Sideline	86.3 EPNdB



Cessna 680 Citation Sovereign *(Dennis Punnett)* 1154700

CESSNA 680 CITATION SOVEREIGN

TYPE: Business jet.

PROGRAMME: Design started mid-1998; announced at NBAA Convention at Las Vegas, Nevada, 18 October 1998; critical design review completed in late 1999 and Type Certificate application lodged 24 November 1999. Structural testing of fatigue test fuselage began in late 1999; official launch 3 January 2000; construction of cyclic fatigue test airframe started October 2000; manufacture of prototype started in 2001; first flight (prototype N680CS, c/n 000P, N680CS, c/n 000P) 27 February 2002, followed by first preproduction aircraft (N681CS/c/n 0001) on 27 June 2002. Public debut (N681CS) at NBAA Convention in Orlando, Florida, 10 September 2002. These aircraft, plus N682CS, c/n 0002, which flew in fourth quarter 2002, undertook a 2,000-hour, 19-month test programme. By 27 August 2003 the three aircraft had logged more than 1,600 flight hours. Two static test airframes have also been built, one of which will undertake a 36,000-cycle fatigue test programme.

After completion of initial flight tests and envelope expansion in June 2002, 000P was dedicated to stability and control checks, high altitude stall tests, cruise performance validation, systems and APU testing and airfield performance; c/n 0001 was the systems verification and certification article; and c/n 0002/N682CS dedicated to avionics and autopilot testing. Provisional FAA certification to FAR Pt 25 Amendment 98 and JAR 25 Change 15, both including RVSM compliance, granted 24 December 2003; full type certification achieved 2 June 2004; c/n 0002 was also used to perform a 150-hour function and reliability programme and, with c/n 0001, undertake 300 hours of post-certification in-service testing before first customer delivery; both pre-production aircraft were then refurbished and brought up to final production configuration before sale to customers. First production aircraft (N52114, c/n 0003, later N103SV) rolled out 27 August 2003. International debut at the European Business Aviation Convention and Exhibition, Geneva 25 May 2004. First deliveries to customers in Mexico and USA, 29 September 2004. EASA certification granted 31 March 2005. Increase in payload of 136 kg (300 lb) announced in May 2006, maximum take-off weight raised to 13,743 kg (30,300 lb).

CUSTOMERS: Launch customer Swift Air of Phoenix, Arizona, ordered six on day of launch announcement; Executive Jet Aviation ordered 50, with 50 options, on 20 October for its NetJets fractional ownership scheme. Total of nine delivered in 2004, 46 in 2005, and 38 in the first nine months of 2006.

100th delivery took place on 7 November 2006 to Agrium of Canada. Recent customers include Jetalliance of Austria, which ordered seven in November 2005 for delivery beginning in 2006; Gulf Jet-UAE, which ordered one in May 2006 for delivery in 2007; and Wallan Aviation, which ordered four in May 2006, for delivery in 2007.

COSTS: USD14.193 million, typically equipped (2004).

DESIGN FEATURES: Design goals included large cabin, good short-field performance and US coast-to-coast range. Low wing with sweptback leading-edge; Mid-mounted tailplane with leading-edge sweepback; podded engines on rear fuselage shoulders.

New wing design; sweepback 16° 18' at leading-edge, 12° 42' at quarter-chord, dihedral 3°, taper ratio 0.31. Mid-mounted tailplane, sweepback, dihedral 0° 22° 36' at quarter-chord, taper ratio 0.47; fin sweepback 38° 18' at quarter-chord taper ratio 0.41.

FLYING CONTROLS: Conventional. Five hydraulically actuated spoiler panels per wing; three centre panels on each wing function as roll spoilers, variable position speedbrakes and ground spoilers; inner (Nos. 5 and 6) and outboard (No. 1 and 10) panels function as variable speedbrakes and ground spoilers; ; roll spoilers comprise Nos. 2, 3, 4, 7, 8 and 9. Trim tabs in ailerons and rudder; trimmable tailplane maximum deflections −8°/+2°; yaw damper. Control surface deflections: ailerons +18° 48'/−13° 24' port, +18° 30'/−13° 36' starboard; elevator +16° 36'/−9° 24'; rudder ±30° 30'; brakes spoilers (Nos. 1, 2, 3, 8, 9 and 10) +35°; (Nos. 4, 5, 6 and 7) +24° flap deflections 7, 15 and 35°.

STRUCTURE: Primarily metal. Fokker Aerostructures of the Netherlands selected in 2000 to manufacture the tail surfaces of production aircraft.

LANDING GEAR: Hydraulically retractable tricycle type with twin wheels on trailing-link main units and nosewheel; main units retract inboard, nosewheel forwards. Carbon brakes; anti-skid standard; hydraulically boosted nosewheel steering.

POWER PLANT: Two Pratt & Whitney Canada PW306C turbofans with FADEC, each developing 25.7 kN (5,770 lb st) flat rated to ISA + 15°C; target-type thrust reversers. Integral fuel tanks in wings total usable capacity 6,340 litres (1,675 US gallons; 1,395 Imp gallons); further 47 litres (12.5 US gallons; 10.4 Imp gallons) unusable; single-point pressure fuelling. Oil capacity 40 litres (10.5 US gallons; 8.8 Imp gallons) per engine.

ACCOMMODATION: Crew of two on flight deck and up to 12 passengers in cabin; standard accommodation for eight passengers in double club arrangement, each with one worktable between each pair of seats, reading light and 28 V AC power outlet, with forward galley and aft lavatory. Fully dimmable LED cabin lighting. Baggage compartment in tailcone with external access. Cabin is pressurised, heated and air conditioned. Airstair door at front on port side; one emergency exit on starboard side, above the wing.

SYSTEMS: Pressurisation system, maximum differential 0.64 bar (9.3 lb/sq in), and air-conditioning system supplied by engine bleed air; pressurisation system maintains sea level cabin to 7,690 m (25,230 ft) and 2,210 m (7,250 ft) cabin to 14,325 m (47,000 ft); closed-centre hydraulic system, pressure 207 bar (3,000 lb/sq in), for operation of landing gear, nosewheel steering, braking system, spoilers and thrust reversers. 28 V DC split-bus electrical system, supplied by two 400 A starter/generators and two 44 Ah ni-cad batteries. Honeywell RE100 APU certified for in-flight operation up to 9,145 m (30,000 ft); and Honeywell environmental control and cabin pressure control systems. Oxygen system, 2.15 m^3 (76.0 cu ft), standard. Wing and tailplane leading-edges and engine inlets anti-iced by engine bleed air; electrically anti-iced windscreens and air data and AoA probes.

AVIONICS: Honeywell Primus Epic as core system.

Comms: L-3 Communications FA2100 CVR with underwater locator beacon standard.

Radar: Honeywell Primus 880 colour weather radar.

Flight: VOR, ILS, ADF, GPS, dual NZ-2000 FMS, dual Rockwell Collins AHC-3000 AHRS, TAWS, CAS 67A TCASII and three-axis autopilot standard.

Instrumentation: Four-tube EFIS with 203 × 254 mm (8× 10 in) active matrix quartz PFD, MFD and EICAS displays, L-3 Communications GH-3000 electronic standby instrument system, Goodrich standby EHSI, and Honeywell AA-300 radio altimeter. MaxViz EVS2000 enhanced visibility system optional.

DIMENSIONS, EXTERNAL:

Wing span	19.25 m (63 ft 2 in)
Wing aspect ratio	7.7
Length overall	19.35 m (63 ft 6 in)
Height overall	6.20 m (20 ft 4 in)
Tailplane span	8.41 m (27 ft 7 in)
Wheel track	3.05 m (10 ft 0 in)

Cessna 680 Citation Sovereign *(Paul Jackson)* 1040410

Wheelbase ..... 8.48 m (27 ft 10 in)
Crew-passenger door: Height ..... 1.42 m (4 ft 8 in)
Width ..... 0.71 m (2 ft 4 in)
DIMENSIONS, INTERNAL:
Cabin: Length: between pressure bulkheads ..... 8.94 m (29 ft 4 in)
excluding cockpit ..... 7.38 m (24 ft 2½ in)
Max width ..... 1.70 m (5 ft 6¾ in)
Max height ..... 1.73 m (5 ft 8 in)
Baggage compartment volume ..... 2.83 m³ (100 cu ft)
AREAS:
Wings, gross ..... 47.93 m² (515.9 sq ft)
Vertical tail surfaces ..... 8.85 m² (95.3 sq ft)
Horizontal tail surfaces ..... 12.87 m² (138.5 sq ft)
WEIGHTS AND LOADINGS:
Empty weight, typically equipped ..... 7,892 kg (17,400 lb)
Max fuel weight ..... 5,087 kg (11,216 lb)
Payload with max fuel ..... 862 kg (1,900 lb)
Max baggage weight ..... 454 kg (1,000 lb)
Max ramp weight ..... 13,721 kg (30,250 lb)
Max T-O weight ..... 13,743 kg (30,300 lb)
Max landing weight ..... 12,292 kg (27,100 lb)
Max zero-fuel weight ..... 9,435 kg (20,800 ft)
Max wing loading ..... 286.8 kg/m² (58.73 lb/sq ft)
Max power loading ..... 268 kg/kN (2.63 lb/lb st)
PERFORMANCE:
Max operating speed (VMO) M0.80
Max cruising speed:
at FL350 ..... 459 kt (850 km/h; 528 mph)
at FL410 ..... 438 kt (811 km/h; 504 mph)
Time to: FL410 ..... 18 min
FL430 ..... 23 min
Max certified altitude ..... 14,325 m (47,000 ft)
Service ceiling ..... 13,105 m (43,000 ft)
T-O balanced field length ..... 1,091 m (3,580 ft)
Landing run ..... 808 m (2,650 ft)
IFR range, 200 n mile (370 km; 230 mile) alternate, 30 min reserves ..... 2,880 n miles (5,333 km; 3,314 miles)
VFR range with max fuel ..... 3,040 n miles (5,630 km; 3,498 miles)

CESSNA 750 CITATION X

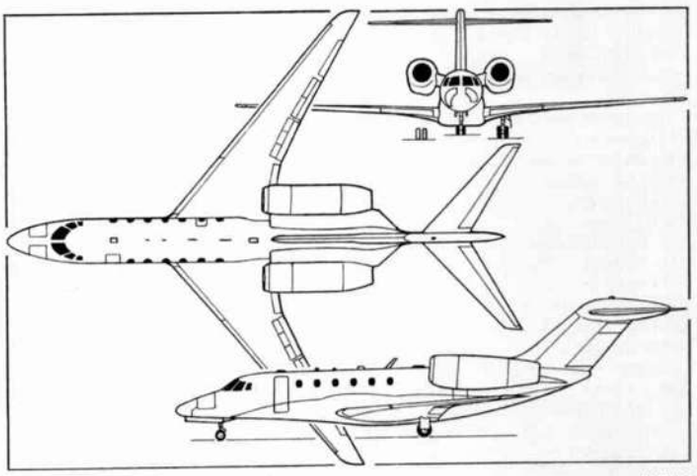
TYPE: Business jet.

PROGRAMME: Announced at NBAA Convention in New Orleans in October 1990; engine flew on Citation VII testbed (N650) 21 August 1992; first flight (N750CX) 21 December 1993; two preproduction aircraft to aid integration of production systems; first of these (N751CX) flown 27 September 1994, second (N752CX) flown 11 January 1995; FAA FAR Pt 25, Amendment 74 certification 31 May 1996 after flight test programme totalling more than 3,000 hours; JAA certification achieved 26 May 1998. First customer delivery July 1996. Citation X design team awarded the National Aeronautic Association's Robert J. Collier Trophy in February 1997. Cessna delivered its 3,000th Citation, a Citation X, on 19 November 1999.

In October 2000, Cessna announced improvements to the Citation X aimed at boosting range/payload performance and enabling the aircraft to operate from shorter runways. Improvements, to be incorporated on all aircraft delivered after 1 January 2002, beginning with c/n 0173 include uprated 30.01 kN (6,764 lb st) Rolls-Royce AE 3007C-1 turbofans; 181 kg (400 lb) increase in maximum take-off weight to 16,374 kg (36,100 lb), enabling a typically equipped aircraft to carry seven passengers with maximum fuel; and take-off balanced field length at MTOW of 1,567 m (5,140 ft). Several optional items of avionics became standard, including Honeywell TCAS II and EGPWS, CVR, satcom, VHF/AFIS, provisions for an FDR, and second HF transceiver, plus Teledyne angle of attack indicator/indexer, tail floodlights, red strobe light, pulse lights, Litton ELT, and 2,154 litre (76 cu ft) oxygen bottle. First delivery of an upgraded Citation X took place on 5 February 2002 to golfer Arnold Palmer (c/n 0176/N1AP).

Upgraded 2004 model year version announced at the NBAA Convention in Orlando, Florida in October 2003 features revised interior with new passenger seats, Goodrich Aerospace articulating crew seats, pin-in/pin-out cabin hardware, and LED controls for lighting, cabin temperature, window shades and audio/video equipment. New options include MaxViz EVS and Aircell satellite telephones. The upgrades were incorporated from c/n 0225 for deliveries from early 2004.

CUSTOMERS: First delivery (0003/N1AP) to Arnold Palmer July 1996; 100th Citation X delivered 23 December 1999 to Townsend Engineering of Des Moines, Iowa and 200th delivered 14 October 2002 to NetJets Inc. Shipments comprise seven in 1996, 28 in 1997, 30 in 1998, 36 in 1999, 37 in 2000, 34 in 2001, 31 in 2002, 18 in 2003, 15 in 2004, 14 in 2005, and eight in the first nine months of 2006. Most to US operators, but others exported to Canada, Finland, Germany, Mexico, South Africa and UK. Executive Jet Aviation (EJA) ordered 31 for delivery beginning in 1997 and extending beyond 2000, for its NetJets fractional ownership operation. Other early recipients included General Motors (five), Honeywell (two) and Williams Companies (three). Recent customers Jetalliance of Austria, which ordered two in November 2005 for delivery in 2006. The 250th Citation X was delivered in late 2005 to PCMT Aviation.



Cessna 750 Citation X *(Dennis Punnett)* 1158966

COSTS: USD19,345 million, typically equipped. Direct operating cost, based on 1,000 n mile (1,852 km; 1,151 mile) stage length, US$1,294.92 per hour (both 2004).

DESIGN FEATURES: Optimised for high maximum operating Mach number; US transcontinental and transatlantic range. Design generally as for Citation VII (which see), but with greater angles of sweepback on all flying surfaces and of increased size and weight.

Wing sweepback at quarter-chord 37°; dihedral 2°.

FLYING CONTROLS: Dual hydraulically powered controls with manual reversion. All-moving tailplane with secondary trim surfaces in trailing-edge, all with +1° 18′/–12° deflections; two-piece rudder, lower portion hydraulically powered (deflecting ±29° 30′), upper portion electrically powered (deflecting 17°); ailerons rigged with 1° 30′ droop, deflection ±15°; speed brakes/spoilers with manual back-up. Five spoiler panels per wing, operating in combination as aileron augmentors (Nos. 1, 2, 9 and 10), airbrakes (Nos. 3, 4, 5, 6, 7 and 8) and lift dumpers; max deflection (all) 43°.

STRUCTURE: Alloy fuselage. Thick wing skins, milled from solid; all control surfaces, spoilers, speedbrakes, wing fairings and flaps are of composites construction.

LANDING GEAR: Trailing-link main units, each with twin wheels; powered anti-skid carbon brakes; hydraulically steerable nose unit with twin wheels. Main tyres 26×6.6R14 (14 ply) tubeless; nose tyres 16×4.4D (6 or 10 ply) tubeless.

POWER PLANT: Two Rolls-Royce AE 3007C-1 turbofans, each rated at 30.01 kN (6,764 lb st) for take-off, pod-mounted on sides of rear fuselage; FADEC. Hydraulically operated target-type thrust reversers standard. Fuel contained in three separate tanks, one of 1,972 litres (521 US gallons; 434 Imp gallons) usable in each outer wing and one of 3,361 litres (888 US gallons; 739 Imp gallons) usable in centre-section/forward fairing; combined usable capacity 7,306 litres (1,930 US gallons; 1,607 Imp gallons). Two independent fuel supply systems; fuel is fed from centre tank to wing tanks; single point and over-wing refuelling.

ACCOMMODATION: Crew of two on separate flight deck, and up to 12 passengers; interior custom designed; cabin is pressurised, heated and air conditioned; heated and pressurised baggage compartment in rear fuselage with external door. Windscreen electrically heated and demisted.

SYSTEMS: Pressurisation system, maximum pressure differential 0.64 bar (9.3 lb/sq in), maintains 2,440 m (8,000 ft) cabin altitude at 15,545 m (51,000 ft). Dual isolated hydraulic systems, pressure 207 bar (3,000 lb/sq in), maintained by pressure-compensated pumps. Split-bus electrical system is powered by two engine-driven 400 A DC generators, plus an APU-driven 400 A DC generator usable to FL310, with two 24 V 44 Ah Ni/Cd batteries; wiring designed to minimise susceptibility of critical systems to HIRF interference. Wing and tail leading-edges and engine inlets heated by engine bleed air for ice protection; wing cuffs, pitot/static system, AoA system and windscreen electrically heated. Oxygen system, capacity 2.15 m³ (76 cu ft), with pressure demand masks for crew and dropout mask for each passenger.

AVIONICS: Honeywell Primus 2000 dual digital autopilot/flight director/EICAS as core system.

Comms: Dual Honeywell RCZ-833 communication units with 25 kHz and 8.33 kHz channel spacing; dual RM-855 radio management units; dual AV-850 audio control panels; single Honeywell KHF-950 HF with provision for second; dual Mode S transponders; Coltech CSD-714 Selcal; Honeywell airborne traffic information system (AFIS); L-3 Communications FA2100 CVR; three-frequency ELT.

Radar: Honeywell Primus 880 colour weather radar.

Flight: Dual Honeywell FMSes; dual Honeywell navigation systems including VOR/LOC/GS/MKR and DME; dual Laseref IV IRS; single ADF; Honeywell AA-300 radio altimeter. Air data is provided by dual AZ-840 micro air data computers. MaxViz EVS-1000 optional.

Cessna 750 Citation X *(Paul Jackson)* 1040393

Instrumentation: Five-tube EFIS with 178 × 203 mm (7 × 8 in) screens for pilot's and co-pilot's primary flight displays (PFD) and multifunction displays (MFD), with central EICAS display.

DIMENSIONS, EXTERNAL:

Wing span	19.38 m (63 ft 7 in)
Wing aspect ratio	7.8
Length overall	22.05 m (72 ft 4 in)
Height overall	5.87 m (19 ft 3 in)
Tailplane span	7.95 m (26 ft 1 in)
Wheel track	3.23 m (10 ft 7 in)
Wheelbase	8.74 m (28 ft 8 in)

DIMENSIONS, INTERNAL:

Cabin (front to mid-pressure bulkhead):	
Length: between pressure bulkheads	8.64 m (28 ft 4 in)
excl flight deck	7.16 m (23 ft 6 in)
Max width	1.70 m (5 ft 7 in)
Max height	1.73 m (5 ft 8 in)
Baggage compartment volume (aft, incl ski compartment)	2.03 m^3 (72 cu ft)

AREAS:

Wings, gross	48.96 m^2 (527.0 sq ft)
Vertical tail surfaces (total)	10.31 m^2 (111.0 sq ft)
Horizontal tail surfaces (total)	11.15 m^2 (120.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, typically equipped	9,809 kg (21,625 lb)
Basic operating weight	9,988 kg (22,020 lb)
Max fuel weight	5,865 kg (12,931 lb)
Payload with max fuel	657 kg (1,449 lb)
Max T-O weight	16,374 kg (36,100 lb)
Max ramp weight	16,511 kg (36,400 lb)
Max landing weight	14,424 kg (31,800 lb)
Max zero-fuel weight	11,068 kg (24,400 lb)
Max wing loading	334.5 kg/m^2 (68.50 lb/sq ft)
Max power loading	272 kg/kN (2.67 lb/lb st)

PERFORMANCE:

Max operating Mach No. (MMO)	0.92
Max operating speed (VMO):	
S/L to FL800	270 kt (500 km/h; 310 mph)
FL800 to FL306	350 kt (648 km/h; 403 mph)
above FL306	M0.92
Max cruising speed: mid-cruise weight at FL370	M0.91
at FL350	525 kt (972 km/h; 604 mph)
Max rate of climb at S/L	1,113 m (3,650 ft)/min
Max certified altitude	15,545 m (51,000 ft)
T-O balanced field length (FAR Pt 25)	1,567 m (5,140 ft)
FAR Pt 25 landing field length	1,036 m (3,400 ft)
VFR range with two crew, M0.82 at FL490, 100 n mile (185 km; 115 mile alternate and 45 min reserves	3,216 n miles (5,956 km; 3,700 miles)
NBAA IFR range	3,070 n miles (5,686 km; 3,533 miles)

OPERATIONAL NOISE LEVELS (FAR Pt 36 Amendment 20):

T-O	72.3 EPNdB
Approach	90.2 EPNdB
Sideline	83.0 EPNdB

CESSNA CITATION LARGE CABIN CONCEPT (LCC)

Announced as potential future development at NBAA Convention in Orlando, Florida, 16 October 2006, where full-scale fuselage/cabin mockup unveiled next day. Externally similar to Citation X but with taller, stand-up cabin for nine passengers, and upturned wingtips. Design optimised for maximum cruising speed of M0.86 and maximum range of 4,000 n miles (7,408 km; 4,603 miles). Launch decision expected in 2007; certification in 2012.

Computer-generated image of Cessna Citation Large Cabin Concept 1040432

CIRRUS

CIRRUS DESIGN CORPORATION

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VICE-PRESIDENT, ENGINEERING: Patrick Waddick
VICE-PRESIDENT, MARKETING: Mark Darling
VICE-PRESIDENT, RESEARCH AND TECHNOLOGY: Dean Vogel
VICE-PRESIDENT, SALES AND MARKETING: Thomas Shea

Founded 1984 by Klapmeier brothers. Previously engaged in production of kits, (ST-50 and VK-30), Cirrus is concentrating on fully certified factory- built aircraft.

Current products are SR20 and SR22. Cirrus purchased 20 per cent of parachute systems company BRS in September 1999. Workforce was 961 in July 2004, based at Duluth and Hibbing, Minnesota, and Grand Forks, North Dakota. In August 2001, Crescent Capital acquired 58 per cent share in Cirrus for USD100 million. The 1,000th SR series aircraft, an SR22 (N1000V), was delivered in August 2003 2,000th was SR22-G2 (N2000M, c/n 1475) delivered to aerobatic champion Patti Wagstaff in July 2005 as a communications aircraft.

In December 2005 Cirrus announced an agreement with Britten-Norman whereby the Bernbridge, UK-based company is re-assembling SR20s and SR22s for European market, following transatlantic shipment. A throughtput of some 100 aircraft per year is anticipated initially, with possible future expansion to include aircraft for customers beyond Europe.

Similar programme announced 14 June 2006 for aircraft destined for customers in Australia, New Zealand and the Pacific Rim. Whereby Sunland Aviation of Brisbane, a wholly-owned subsidiary of Cirrus, is reassembling aircraft destined for customers in those countries following shipment from the US. Initial throughput of some 25 aircraft per year anticipated, of which the first had been reassembled and delivered at the time of the announcement.

Western Michigan University College of Aviation in Battle Creek, Michigan, reached agreement in September 2005 for the supply of 130 SR20s and SR22s to replace its fleet of single-engine trainers. Delivery of the aircraft, which are being supplied on a 10-year lease, began in October 2005 with the first of an initial batch of 30 aircraft.

CIRRUS SR20 and SRV

TYPE: Four-seat lightplane.

PROGRAMME: Development began 1990; mockup revealed at Oshkosh 1994; first flight (N200SR) 31 March 1995; second prototype (N202CD) flown November 1995; FAR Pt 23 certification aircraft (N203FT), designated C-1, made first flight 28 January 1998 after completion of wing redesign to lower stall speed and improve lateral control. By end 1997, the two prototypes had accumulated 1,500 hours of test flying. A second production-standard aircraft (N204CD; C-2) joined the flight test programme on 3 June 1998, committed to trials of fuel and electrical systems and avionics. Recovery parachute trials involved eight deployments, including three for FAA. Late 1998 start of deliveries delayed by decision of avionics supplier, Trimble, to withdraw from general aviation. FAR Pt 23 certification Amdt 47 received 23 October 1998; Transport Canada certification granted in March 2002; first aircraft manufactured to Canadian certification standard delivered 2 April 2002 to Tim Harpell of Toronto. EASA certificaiton 27 May 2004; Civil Aviation Administration of Cirrus (CAAC) certification announced 20 July 2006.

Initial production aircraft first flew (N115CD) 22 March 1999, but lost on following day. First delivery (c/n 1005, N415WM) 20 July 1999, at which time 325 on order (although many since upgraded to SR22 orders). Production certificate, to enable Cirrus to carry out its own inspections, awarded 12 June 2000. EASA certification announced 1 June 2004.

CURRENT VERSIONS: **SR20:** Total 143 built (c/n 1005 to 1147) by April 2001, when production suspended. MTOW 1,315 kg (2,900 lb).

SR20A: In production from July 2001 (c/n 1148 upwards). Additional 45 kg (100 lb) MTOW; landing light repositioned lower on engine cowling; and optional Goodrich Skywatch and Sandel SN3308 EHSI for traffic information. Upgrades (including MTOW) retrofittable. *As described.*

SR20 Version 2.0, Version 2.1 and Version 2.2: Upgraded versions available from 2003; launched at EAA Sun 'n' Fun in April 2002. Differ from SR20A principally in having no vacuum instruments and featuring electrical system and avionics packages based on those of the SR22. *Version 2.0* has a single-alternator, dual-battery, dual-bus electrical system and features Avidyne FlightMax MFD, single Garmin GNS 430 GPS/com/nav and GNC 250XL GPS/com and S-Tec System 20 autopilot as standard. First delivery in January 2003 to 907th Flight Squadron Aero club at Jameson, Pennsylvania. *Version 2.1* adds a dual-alternator electrical system and GNS 430/420 package. *Version 2.2* has dual GNS 430s, S-Tec Fifty FiveX autopilot with altitude preselect and Sandel EHSI.

SR20-G2: Announced 28 July 2004. Enhancements generally as for SR22-G2.

SR20-GTS: Generation Two-Special. Special edition announced 21 October 2004 at AOPA Expo 2004 in Long Beach; features custom colour perforated leather interior, tinted

CIRRUS DELIVERIES

Year	SR20	SRV	SR22	Total
1999	9			9
2000	95			95
2001	59		124	183
2002	105		292	397
2003	112	2	355	469
2004	91	3	459	553
2005	116	9	475	600
Totals	**587**	**14**	**1,705**	**2,306**

1158217

Cirrus SR20-G2

cabin windows, three-blade propeller with polished spinner, custom GTS exterior graphics, chrome steps and grab handles, dual Garmin GNS-430 coupled with S-TEC 55X autopilot, EX5000C MFD upgrade, KGP-560 EGPWS, EMax engine monitoring system and fuel totaliser, Avidyne CMax electronic approach plates, WX Package comprising XMWX and StormScope, and Sky Watch traffic warning system.

SRV: Basic VFR-only version, introduced at EAA AirVenture, Oshkosh, 29 July 2003, when demonstrator N936CD (c/n 1337) shown. Specification and performance generally as for SR20 except: weight empty 930 kg (2,050 lb) payload with max fuel 279 kg (614 lb), cruising speed at 75 per cent power 150 kt (278 km/h; 173 mph); range with reserves 635 n miles (1,176 km; 731 miles); max range 876 n miles (1,622 km; 1,008 miles).

SRV-G2: Announced 28 July 2004. Enhancements generally as for SR22-G2.

CUSTOMERS: Refer to table in Cirrus company description. Recent customers include the University of North Dakota in Grand Forks, which took delivery of four in January 2006. Total of 660 SR20 series and 17 SRVs delivered by 30 June 2006.

COSTS: SRV-G2 USD199,900; SR20-G2 standard USD249,750; SR20-GTS USD334,785 (all 2006)..

DESIGN FEATURES: Low-wing, composites construction monoplane with upturned wingtips; mid-set tailplane with horn-balanced elevators; horn-balanced rudder; fixed tab on starboard aileron. First certified aircraft with ballistic parachute as standard equipment (Cirrus Airplane Parachute System or CAPS), fitted just aft of baggage compartment. Wing dihedral 4° 30'.

STRUCTURE: Composites monocoque; one-piece main spar attached to fuselage on two locations under front seats; spar carry-through attached to fuselage side-walls. Wing upper and lower surfaces bonded to spars and ribs, forming torsion box. All flying control surfaces are flush-riveted aluminium. Fin integral with fuselage; one-piece tailplane. Cabin incorporates composites roll-cage; acrylic windscreen and windows. Airframe life limit 12,000 hours.

FLYING CONTROLS: Conventional and manual. Actuation by pushrods, cables and bellcranks. Electric trim tabs for roll and pitch activated through springed centring devices; ground-adjustable rudder tab. Control surface deflections: ailerons ±12.5°; elevator +25°/–15°; rudder 20° either side of neutral. Three-position flaps, deflections 0, 16 and 32°.

LANDING GEAR: Tricycle type; fixed. Wing-mounted composites cantilever sprung main legs with speed fairings. Main tyres 15×6.00–6, nosewheel tyre 5.00–5. Hydraulic calliper disk brakes on mainwheels. Castoring nosewheel.

POWER PLANT: One 149 kW (200 hp) Teledyne Continental IO-360-ES flat-six engine driving a two-blade Hartzell BHC-J2YF-1BF/F7694 propeller (three-blade 1.88 m; 6 ft 2 in PHC-J3YF-1MF/F77392-1 propeller optional). Single fuel tank in each wing, each of 113.5 litres (30.0 US gallons; 25.0 Imp gallons) capacity, of which 212 litres (56.0 US gallons; 46.7 Imp gallons) usable. Oil capacity 7.6 litres (2.0 US gallons; 1.7 Imp gallons).

ACCOMMODATION: Four 26 *g* energy attenuating seats in pairs; two forward-hinged passenger doors. Dual controls. Baggage compartment door aft of cabin on port side of fuselage. Interior reflects modern motorcar design. Leather interior optional.

SYSTEMS: Single-axis S-Tec System 20 autopilot with GPS; dual-axis S-Tec System 30 and Fifty FiveX optional; 24 V DC power system with 28 V 75 A alternator and 24 V 10 Ah battery. 12 V power port. Fan-driven ventilation system optional.

AVIONICS: Garmin integrated package.

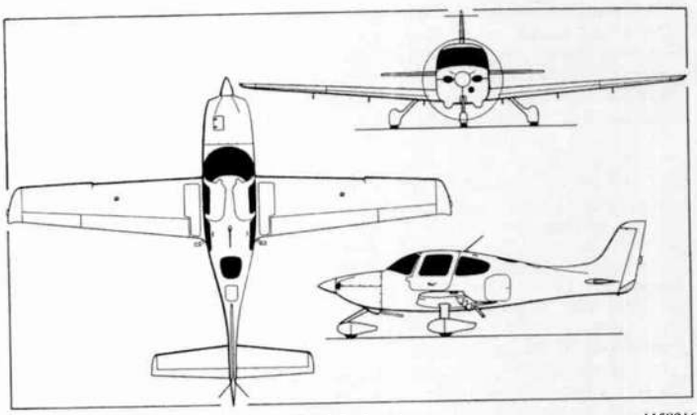
Comms: GNS 430 colour GPS/com/nav IFR approach-certified GPS plus back-up, GNS 250XL GPS/com, GMA 340 audio panel and GTX 327 transponder. Options include GNS 420 colour GPS/com and/or additional GNS 430 (back-up IFR GPS).

Flight: Garmin GI 106 GPS/VOR/LOC/GSI. S-Tec System FortyX autopilot. Options include Goodrich Stormscope WX-500, S-Tec System FiftyX or Fifty FiveX, Goodrich Skywatch system, GI 102 or second GI 106.

Instrumentation: Avidyne Entegra PFD and FlightMax EX3000C MFD standard, EX5000C optional.

Cirrus SRV with appropriate British registration, G-SRVA *(Paul Jackson)*

1158224



Cirrus SR20 four-seat lightplane *(Paul Jackson)*

1158216

EQUIPMENT: Integral ballistic recovery parachute (Cirrus Airplane Parachute System); vertical descent rate 7.3 m (24 ft)/s at S/L. Navigation, landing and strobe lights standard.

DIMENSIONS, EXTERNAL:

Wing span	10.85 m (35 ft 7 in)
Wing aspect ratio	9.1
Length overall	7.92 m (26 ft 0 in)
Height overall	2.59 m (8 ft 6 in)
Tailplane span	3.93 m (12 ft 10¾ in)
Wheel track	3.38 m (11 ft 1 in)
Wheelbase	2.29 m (7 ft 6 in)
Propeller diameter (two blade)	1.93 m (6 ft 4 in)
Cabin doors (each): Height	0.94 m (3 ft 1 in)
Width	0.86 m (2 ft 10 in)

DIMENSIONS, INTERNAL:

Cabin: Length	3.30 m (10 ft 10 in)
Max width	1.24 m (4 ft 1 in)
Max height	1.27 m (4 ft 2 in)

AREAS:

Wings, gross	12.56 m² (135.2 sq ft)
Horizontal tail	3.48 m² (37.50 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	939 kg (2,070 lb)
Max baggage weight	59 kg (130 lb)
Payload with max fuel	269 kg (594 lb)
Max fuel weight	163 kg (360 lb)
Max T-O weight	1,360 kg (3,000 lb)
Max landing weight	1,315 kg (2,900 lb)
Max wing loading	108.3 kg/m² (22.19 lb/sq ft)
Max power loading	9.12 kg/kW (15.00 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	200 kt (370 km/h; 230 mph)
Max cruising speed	165 kt (306 km/h; 190 mph)
Cruising speed at FL80 at 75% power	156 kt (289 km/h; 180 mph)
Manoeuvring speed	135 kt (250 km/h; 155 mph) IAS
Stalling speed: flaps up	64 kt (119 km/h; 74 mph) IAS
flaps down	54 kt (100 km/h; 63 mph) IAS
Max rate of climb at S/L	252 m (828 ft)/min
Service ceiling	5,335 m (17,500 ft)
T-O run	441 m (1,446 ft)
T-O and landing to 15 m (50 ft)	629 m (2,064 ft)
Landing from 15 m (50 ft)	622 m (2.040 ft)
Landing run	309 m (1,014 ft)
Range with reserves:	
at 75% power	745 n miles (1,379 km; 857 miles)
at 55% power	885 n miles (1,639 km; 1,018 miles)
g limits	+3.8/–1.9

CIRRUS SR22

TYPE: Four-seat lightplane.

PROGRAMME: Modifications to the SR20 (which see) resulted in the SR22, which comprised an SR20 airframe with modified wing, more powerful engine and all-electric instrumentation (no vacuum system); prototype (N140CD) displayed at AOPA convention in October 2000; FAA certification awarded 30 November 2000. Delivery of first production aircraft (N415PJ) 6 February 2001. EASA certification announced 27 January 2006. Civil Aviation Administration of China (CAAC) certification announced 20 July 2006.

CURRENT VERSIONS: **SR22:** Initial version. Conventional Hartzell three-blade propeller.

SR22-G2: Announced 9 March 2004, replacing SR22 as standard production version. Features improvements in comfort, serviceability and performance, and a new fuselage design that reduces empty weight, increasing payload/useful load. Key features include six-point engine mount as originally offered on the limited production SR22 Centennial Edition, with optional Teledyne Continental Platinum IO-550-N engine with custom exhaust; Hartzell Scimitar Select three-blade propeller; new cowling offering improved airflow management and performance by refining the shape and diminishing the size of the exhaust contours; redesigned streamlined oil access door; two-piece lower cowling simplifying removal and installation for servicing and incorporating a high-intensity landing light, 'Secure Latch' automobile-style oversized cabin doors closed and latched at two points by a single movement, and opened by pressing a button; 'Secure Latch' baggage door; new interior inspired by luxury cars, featuring perforated-leather seats in contemporary colours with French stitching, and leather-wrapped side-yoke, throttle lever and grab handles; 'Soft Touch' composites material for cabin trim; lower wing fairing attached with fasteners rather than by bonding, for easier access to spar; door on right side of tail section for greater access and flexibility for future options; and improved access for routine inspection of the CAPS emergency parachute system. Production line-integrated heating, ventilating air conditioning system (HVAC) introduced as an option from April 2006. *As described.*

SR22-GTS: Generation Two-Special. Special edition announced 21 October 2004 at AOPA Expo 2004 in Long Beach. Features as for SR20-GTS.

SR22-SE: Limited (50) 'Signature Edition' announced at EAA AirVenture Oshkosh on 23 July 2006 to commemorate 22nd anniversary of founding of Cirrus company. Features distinctive exterior colour scheme with red and yellow stripes over chequered flag pattern, cabin seats in black leather with red stitched highlights, custom floor mats, a 'keepsake' Mont Blanc pen, and signatures of Cirrus founders Alan and Dale Klapmeier on the fuselage. SR22-SE customers who select the optional Tornado Alley turbocharger package also receive a three-blade lightweight Hartzell ASC-II composite propeller and built-in oxygen system as standard.

Turbo SR22: Supplementary type certificate announced 9 November 2006. Tornado Alley Turbo turbonormalised TCM IO-550N engine, rated at 231 kW (310 hp) providing optimum cruising power at FL250, which also max certified altitude. Also GAMIjector fuel injection; Hartzell ASCII three-blade, composites propeller; four-place oxygen system; automatic alternate induction cabin air system; and automatic wastegate control. Empty weight 1,097 kg (2,418 lb); MTOW unchanged. Max cruising speed 211 kt (391 km/h; 243 mph) at FL250. Range (45 min reserves) 950 n miles (1,759 km; 1,093 miles) at 55 per cent power at 173 kt (320 km/h; 199 mph); or 840 n miles (1,555 km; 966 miles) at 75 per cent at 200 kt (370 km/h; 230 mph).

CUSTOMERS: Orders for 234 SR22s received by June 2001. Launch of SR22 saw approximately 20 per cent of SR20 customers upgrade to new model. Total of 2,616 delivered by 30 September 2006, including 403 in the first nine months of 2006. Refer also to table in Cirrus company entry. Recent customers include AirShares Elite of Atlanta, Georgia, which ordered 25, plus 25 options, on 8 April 2002, for its fractional ownership programme. SR22s have been delivered to customers in Australia, Canada, Europe, Mexico, New Zealand, South Africa and South America.

COSTS: Standard USD349,750; SR22-GTS USD448,685 (60th 2006).

DESIGN FEATURES: As for SR20, but with fuselage-mounted vortex generator ahead of wingroots and wingtip extensions.

STRUCTURE: As for SR20.

FLYING CONTROLS: As for SR20, but flight-adjustable rudder tab and ground-adjustable tab on port elevator.

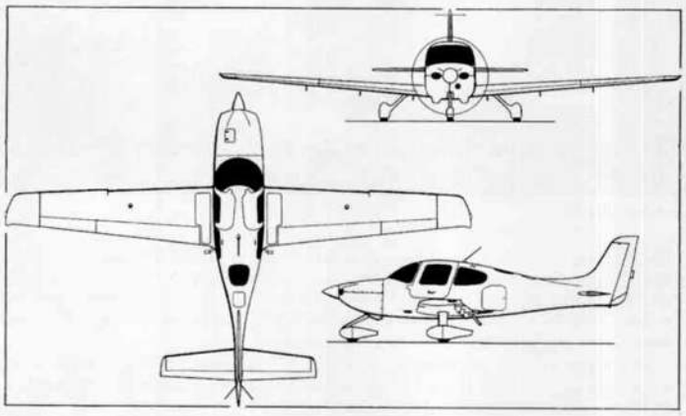
LANDING GEAR: As for SR20.

POWER PLANT: One 231 kW (310 hp) Teledyne Continental IO-550-N flat-six engine driving a three-blade Hartzell Scimitar Select constant-speed propeller; Platinum IO-550-N with custom exhaust system and Tornado Alley turbocharger package optional. Single fuel tank in each wing, total capacity 318 litres (84.0 US gallons; 69.9 Imp gallons) of which 307 litres (81.0 US gallons; 67.4 Imp gallons) are usable. Oil capacity as SR20.

ACCOMMODATION: As for SR20.

SYSTEMS: Dual 24 V DC power system with 28 V 75 A alternator and 24 V 10 Ah battery. 12 V power port. Optional Aerospace Systems and Technologies fluid de-icing system for wing and tailplane leading-edges and propeller. Fan-driven ventilation system and HVAC air conditioning system optional.

Cirrus SR22-GTS 1158246



Cirrus SR22 extended wing version of SR20 ***(Paul Jackson)*** 1158247

AVIONICS: *Comms:* Configuration A package includes single Garmin GNS 430 colour GPS/com/nav, GNS 420 GPS/com, GMA 340 audio panel and GTX 327 transponder as standard. Configuration B package substitutes second GNS 430 for GNS 420.

Flight: S-Tec Thirty autopilot standard in package A, replaced by S-Tec Fifty FiveX with altitude preselect in package B, which also adds Sandel SN3308 EHSI. Goodrich WX-500 Stormscope and SkyWatch traffic information system optional.

Instrumentation: Avidyne FlightMax Entegra EX5000C 10.4 in landscape format PFD and MFD standard.

EQUIPMENT: Cirrus Airframe Parachute System standard; air conditioning, TKS fluid ice protection system, and Precise Flight 0.62 m^3(22 cu ft) semi-portable oxygen system optional.

DIMENSIONS, EXTERNAL:

Wing span	11.73 m (38 ft 6 in)
Wing aspect ratio	9.9
Length overall	7.92 m (26 ft 0 in)
Height overall	2.62 m (8 ft 7 in)
Tailplane span	3.93 m (12 ft 10¾ in)
Wheel track	3.23 m (10 ft 7¼ in)
Wheelbase	2.20 m (7 ft 2½ in)
Propeller diameter	1.98 m (6 ft 6 in)
Cabin doors (each): Height	0.99 m (3 ft 3 in)
Width	0.86 m (2 ft 10 in)

DIMENSIONS, INTERNAL:

Cabin: Length	3.30 m (10 ft 10 in)
Max width	1.24 m (4 ft 1 in)
Max height	1.27 m (4 ft 2 in)
Baggage compartment volume	0.91 m^3 (32.0 cu ft)

AREAS:

Wings, gross	13.93 m^2 (149.9 sq ft)
Horizontal tail	3.48 m^2 (37.50 sq ft)

Cirrus SR22-G2 current production version 1158245

WEIGHTS AND LOADINGS:

Weight empty	1,021 kg (2,250 lb)
Baggage weight	59 kg (130 lb)
Payload with max fuel	301 kg (664 lb)
Max fuel weight	218 kg (480 lb)
Max T-O weight	1,542 kg (3,400 lb)
Max wing loading	110.7 kg/m² (22.68 lb/sq ft)
Max power loading	6.68 kg/kW (10.97 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	204 kt (377 km/h; 234 mph)
Cruising speed at FL80, at 75% power	185 kt (343 km/h; 213 mph)
Manoeuvring speed	142 kt (263 km/h; 163 mph) IAS
Stalling speed: flaps up	70 kt (130 km/h; 81 mph) IAS
flaps down	61 kt (113 km/h; 71 mph) IAS
Max rate of climb at S/L	397 m (1,304 ft)/min
Service ceiling	5,335 m (17,500 ft)
T-O run	311 m (1,020 ft)
T-O to 15 m (50 ft)	480 m (1,575 ft)
Landing from 15 m (50 ft)	709 m (2,325 ft)
Landing run	348 m (1,140 ft)
Range with reserves: at 75% power	700 n miles (1,296 km; 805 miles)
at 55% power	more than 1,000 n miles (1,852 km; 1,150 miles)
g limits	+3.8/−1.9

CIRRUS JET

TYPE: Private jet.

PROGRAMME: At the AOPA Expo in Tampa, Florida, on 4 November 2005, Cirrus announced that it was exploring development of a light 'personal' jet intended for single-pilot operation that would sell for less than USD1 million. A mockup was reported to be under construction in early 2006 and in July 2006 the company confirmed that design was proceeding on "the lowest, slowest, shortest-range jet in the market." By October 2006 it was understood that the Cirrus Jet would have one 8.45 kN (1,900 lb st) Williams FJ33-4A-19 turbofan (available in 2010); larger cabin than SR piston-powered aircraft; cruising speed more than 300 kt (556 km/h; 345 mph); 7,620 m (25,000 ft) cruising altitude; and ballistic recovery parachute.

On 19 September 2006, Cirrus reserved the registration N570TJ for future use on an unspecified aircraft. This registration appears on artist's impressions of Maverick CruiseJET, although no collaboration between the two companies has been proved.

COLUMBIA

COLUMBIA AIRCRAFT MANUFACTURING COMPANY

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VICE-PRESIDENT, ENGINEERING: Tom Bowen

Original Lancair Company was formed as an autonomous firm in 1994. Its first certified product is the four-seat Columbia 300, which was unveiled at Oshkosh in August 1997 and assembled at a new 13,100 m² (141,000 sq ft) facility at Bend Municipal Airport, Bend, Oregon; a 3,710 m² (40,000 sq ft) extension was started in October 2003 with completion and utilisation planned by end 2004; this slipped to end 2005, but extension size also increased to 3,809 m² (41,000 sq ft).

The company temporarily ceased production in August 2002 following financing difficulties arising from downturn in financial markets that year; production recommenced in January 2003.

In May 2003, the Columbia 350 was certified and production started immediately; this was followed by the Columbia 400 in April 2004, deliveries of which began the following month. Earlier Columbia 300 now discontinued.

On 18 July 2005 the Lancair Company was renamed Columbia Aircraft Manufacturing Company.

Factory manpower stood at 700 in late 2006.

COLUMBIA COLUMBIA

TYPE: Four-seat lightplane.

PROGRAMME: Announced 1996 as LC-40; aerodynamic prototype flown July 1996; first flight of certification prototype (N140LC), early 1997. Second prototype (N141LC) first flew 14 April 1997; public debut at Oshkosh August 1997; modified for FAA testing to confirm spin-resistance. Certification completed 18 September 1998; RLD certification completed March 2001; Australian and Canadian certifications also achieved.

First production aircraft (N424CH) delivered 24 February 2000.

CURRENT VERSIONS: **Columbia 300**: Engineering designation **LC40-550FG**. Version discontinued in July 2003 following certification of Columbia 350. One example delivered to NASA at Langley 10 January 2001 for use as testbed for general aviation-based AGATE and SATS programmes; designated **Columbia 300X**.

Columbia 350: *As described.* Engineering designation **LC42-550FG**. Announced and publicly displayed at Sun 'n' Fun 2002; prototype (N70090) first flown early 2002 with deliveries due to start late 2002; however, certification delayed until 30 March 2003 and deliveries started in late October 2003. Dual independent all-electric systems with dual busses, dual batteries and dual alternators replacing Columbia 300's vacuum pumps; fully redundant electrical system enables each bus to handle entire electrical load. Powered by 231 kW (310 hp) Teledyne Continental IO-550-N driving Hartzell three-blade propeller. Empty weight 1,043 kg (2,300 lb).

Columbia 350i: Adds to Columbia 350's standard equipment Mode S transponder, E-Monitor engine and systems monitoring, E-Plates electronic approach plates, SatWX weather datalink, SatRadio entertainment package, and E-Prox Class B TAWS.

Columbia 350SL: Adds to Columbia 350i's standard equipment T-Watch traffic advisory system, reclining sports seats, four Bose-X ANC headsets, E-Vade thermal anti-icing system or climate control, and portable oxygen system.

Columbia 350SLX: Adds to Columbia 350SL's standard equipment E-Vade thermal anti-icing system and climate control system.

Columbia 400: Engineering designation **LC41-550FG**. Turbocharged version of Columbia 350 with 231 kW (310 hp) Continental TSIO-550-C. Announced 9 April 2000; prototype (N143LC converted from Columbia 300) first flew June 2000; first production aircraft (N48PD) registered April 2004; certification had been due in 2002 but was delayed until 8 April 2004; deliveries began in following month. Claimed to be fastest piston-engined aircraft in mass production. Certified as spin recoverable, while retaining Lancair spin-resistant design features. Cockpit includes electronic primary flight display projection system; prototype equipped as demonstrator for Highways in the Sky (HITS) instrumentation.

Columbia 400i: Adds to Columbia 400's standard equipment Mode S transponder, E-Monitor engine and systems monitoring, E-Plates electronic approach plates, SatWX weather datalink, SatRadio entertainment package, and E-Prox Class B TAWS.

Columbia 400SL: Adds to Columbia 400i's standard equipment T-Watch traffic advisory system, reclining sports seats, speedbrakes, four Bose-X ANC headsets, E-Vade thermal anti-icing system or climate control, and BiO2 built-in oxygen system.

Columbia 400SLX: Adds to Columbia 400SL's standard equipment E-Vade thermal anti-icing system and climate control system.

CUSTOMERS: See table below, for production totals 2000-2005. Total of 130 (nine Columbia 350s and 121 Columbia 400s) delivered in the first nine months of 2006.

COLUMBIA DELIVERIES

Year	300	350	400
2000	5		
2001	27		
2002	24		
2003	19	32	50
2004		28	
2005		25	89
Totals	**75**	**85**	**139**

COSTS: Columbia 350 USD378,900; 350i USD398,000; 350SL USD453,900; 350SLX USD478,00; 400 USD479,000; 400I USD499,900; 400SL USD568,900; 400SLX USD593,900 (all 2006).

DESIGN FEATURES: Low-wing monoplane of typical Lancair appearance and design. Columbia 400 has underfin and rudder increased in chord and depth at base. Integral roll-over cage to protect cockpit area. Proprietary wing section, dihedral, and twist for spin resistant features. Airframe life 12,000 hours; extendable to unlimited, subject to NDT examination.

FLYING CONTROLS: Conventional and manual with sidestick controls. Aileron and elevator actuation by pushrods; rudder by cables. Optional Precise Flight speedbrakes in wing upper surface. Trim tabs in starboard elevator and starboard aileron. Fowler flaps droop 12° for T-O; 40° maximum.

Columbia 350: Aileron travel limits 22° up and 18° down; elevator travel up 13°, down 12°; rudder travel ±17°.

Columbia 400: Aileron travel limits 22° up and 18° down; elevator up 23°, down 14°; rudder travel ±30°.

STRUCTURE: Generally composites sandwich of outer layers of pre-preg glass fibre around a honeycomb interior. Honeycomb sandwich is assembled in moulds of the wing, fuselage, and control surfaces. In areas where added structural strength is needed, such as the wing spars, carbon fibres are added to the honeycomb sandwich. Fuselage in two halves, left and right; each from firewall back, including vertical stabiliser. Bulkheads bonded to right side of fuselage; halves then bonded together; floors bonded after joining.

Lower wing surface in one piece; spars placed in lower wing and bonded, followed by ribs bonded to inside surfaces of wing and spars; conduits and control tubes inserted before two top wing halves are bonded. Integral fuel tanks. Wing cuffs bonded to outboard leading-edge of wing to increase camber.

Horizontal stabiliser in two separate halves bonded to two horizontal tubes which, in turn, bonded to fuselage. Shear webs and ribs bonded into inside surface of lower skin; upper skin is then bonded to lower assembly. Ailerons of one-piece construction, with most stresses carried by control surface; end caps and drive rib, used to mount control's actuating hardware, provide additional structural support. Rudder and elevators similar.

LANDING GEAR: Fixed tubular steel tricycle type. Mainwheels 6.00-6, tyre pressure 3.8 bar (55 lb/sq in); nosewheel 5.00-5, tyre pressure 6.1 bar (88 lb/sq in). Cleveland brakes. Speed fairings on all wheels. Minimum ground turning radius 4.72 m (15 ft 6 in); nosewheel steerable ±60°.

POWER PLANT: *Columbia 350:* One 231 kW (310 hp) Teledyne Continental IO-550-N flat-six engine, driving three-blade constant-speed Hartzell PHC-J3YF-1RF/F7691D-1 propeller. Platinum IO-550-N optional. Total fuel capacity 402 litres (106 US gallons; 88.3 Imp gallons) in two integral wing tanks; usable fuel 371 litres (98.0 US gallons; 81.6 Imp gallons). Oil capacity 7.6 litres (2.0 US gallons; 1.7 Imp gallons).

Columbia 400: One 231 kW (310 hp) Teledyne Continental TSIO-550-C flat-six engine with two turbochargers and two intercoolers. Platinum TSIO-550-C engine optional. Hartzell HC-H3YF-1RF/FL693DF three-blade constant-speed propeller. Fuel and oil capacities as per Columbia 300 and 350.

ACCOMMODATION: Pilot and three passengers in two pairs of seats in enclosed cabin. Energy-absorbing seats. Seating certified to 26 *g*. Double gull-wing doors hinge upwards. Emergency exit through large baggage door behind rear passenger seats with outside access

Columbia 350 four-seat lightplane *(Paul Jackson)* 1159164

Guinness records 'aircraft types flown' champion Edwin Shackleton adds the Columbia 400, Nottingham, 2005 *(Paul Jackson)* 1159165

by emergency hinge release pin mechanism on pilot's door. Cabin has integral roll cage and impact-resistant windscreen.

SYSTEMS: Single 12 V battery; 14 V 60 A alternator; in Columbia 300; dual independent all-electric system with dual busses, dual 14 V batteries, dual 14 V 60A alternators in early Columbia 350/400, replaced by 28 V equipment in 2005. Air conditioning optional. E-Vade thermal de-icing on wing and tailplane leading edges and electro-thermal propeller anti-icing system, optional from January 2005. Digital climate control introduced April 2005; can be retrofitted to earlier aircraft.

AVIONICS: *Comms:* Dual Garmin G430 GPS/nav/com, Garmin GMA-340 stereo audio panel with remote marker beacon indicators, G327 Mode A, C transponder (Mode S optional); Trans-Cal SSD120 Blind Encoder.

Flight: Avidyne Flight Max Entegra EXP5000 colour 267 mm (10½ in) flat panel moving map display, with optional XM WX Satellite Weather and EMax engine/fuel monitoring system standard on Columbia 350 and 400; Garmin G1000 with ReadyPad data entry pad standard on Columbia 350i, 350SL, 350SLX, 400i, 400SL and 400SLX. Dual Garmin 430 GPS; S-Tec 55X autopilot with altitude preselect, autotrim and GPSS.

Instrumentation: Avidyne Entegra Primary Flight Display with ADAHRS; includes altitude, attitude, heading, airspeed, vertical speed and HSI. Back-up Stack includes electric artificial horizon, airspeed and altimeter.

EQUIPMENT: Fire extinguisher and crash axe standard.

DIMENSIONS, EXTERNAL:

Wing span	10.97 m (36 ft 0 in)
Wing chord: at root	1.40 m (4 ft 7 in)
at tip	1.02 m (3 ft 4 in)
Wing aspect ratio	9.2
Length overall: 350	7.67 m (25 ft 2 in)
400	7.77 m (25 ft 6 in)
Fuselage max width	1.27 m (4 ft 2 in)
Height overall	2.74 m (9 ft 0 in)
Tailplane span	4.17 m (13 ft 8 in)
Wheel track	2.24 m (7 ft 4 in)
Wheelbase	2.04 m (6 ft 8¼ in)
Doors: Max width	0.84 m (2 ft 9 in)
Max height	0.84 m (2 ft 9 in)
Propeller diameter: 350	1.96 m (6 ft 5 in)
400	1.98 m (6 ft 6 in)

DIMENSIONS, INTERNAL:

Cabin: Length	3.54 m (11 ft 7½ in)
Max width	1.22 m (4 ft ¼ in)
Max height	1.24 m (4 ft 1 in)
Baggage compartment: volume	0.76 m³ (27.0 cu ft)

AREAS:

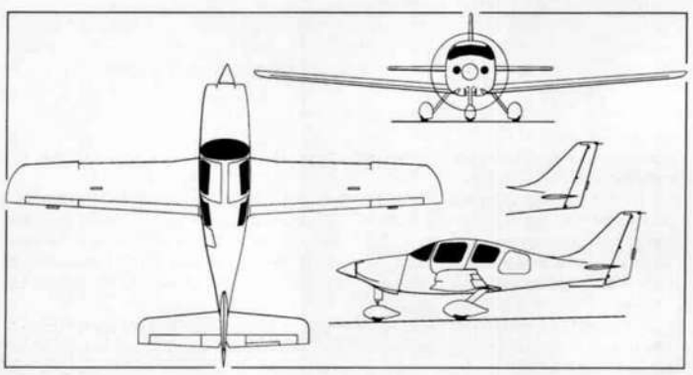
Wings, gross	13.12 m² (141.2 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: 350	1,043 kg (2,300 lb)
400	1,134 kg (2,500 lb)
Max baggage weight	54 kg (120 lb)
Max fuel weight	288 kg (636 lb)
Max T-O weight: 350	1,542 kg (3,400 lb)
400	1,633 kg (3,600 lb)
Max landing weight: 350	1,465 kg (3,230 lb)
400	1,551 kg (3,420 lb)
Max ramp weight: 400	1,638 kg (3,612 lb)
Max wing loading: 350	117.6 kg/m² (24.08 lb/sq ft)
400	124.5 kg/m² (25.50 lb/sq ft)
Max power loading: 350	6.90 kg/kW (11.33 lb/hp)
400	7.07 kg/kW (11.61 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE): 350	235 kt (435 km/h; 270 mph)
400	230 kt (426 km/h; 264 mph)
Max cruising speed at FL250: 350	235 kt (435 km/h; 270 mph)
400	181 kt (335 km/h; 208 mph)
Normal cruising speed at FL80	191 kt (354 km/h; 220 mph)
Stalling speed: flaps up: 350	71 kt (132 km/h; 82 mph)
400	69 kt (128 km/h; 80 mph)
flaps down: 350	57 kt (106 km/h; 66 mph)
400	59 kt (110 km/h; 68 mph)
Max rate of climb at S/L: 350	373 m (1,225 ft)/min
400	427 m (1,400 ft)/min
Max certified altitude: without oxygen	4,265 m (14,000 ft)
with oxygen	5,485 m (18,000 ft)
Service ceiling: 350	5,480 m (18,000 ft)
400	7,620 m (25,000 ft)
T-O run: 350, 400	397 m (1,300 ft)
T-O to 15 m (50 ft): 350	701 m (2,300 ft)
400	579 m (1,900 ft)
Landing from 15 m (50 ft): 350	716 m (2,350 ft)
400	792 m (2,600 ft)
Landing run: 350	472 m (1,550 ft)
400	381 m (1,250 ft)
Range, all with 45 min reserves:	
350: at 55% power economy cruise speed	1,315 n miles (2,435 km; 1,513 miles)
at normal cruising speed	934 n miles (1,729 km; 1,074 miles)
400: at 55% power economy cruise speed	1,383 n miles (2,561 km; 1,591 miles)
at max cruising speed	756 n miles (1,400 km; 870 miles)
Endurance at 55% power econ cruising speed: 350	8 h 30 min
400	6 h 48 min
g limits: all	+4.4/−1.76



Columbia 400 equipped with optional Precise Flight speed brakes in upper wing surface, plus scrap view of Columbia 350 fin and rudder *(Paul Jackson)* 1133252

COMMANDER

COMMANDER AIRCRAFT COMPANY

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Web: www.commanderair.com
PRESIDENT AND CEO: Joel M Hartstone
Chief Financial Officer: Claudia S Horn

Company (a division of Aviation General Inc from 1998) acquired manufacturing, marketing and support rights for Rockwell Commander 112 and 114 from Gulfstream Aerospace Corporation in 1988; spares and support services for existing aircraft and manufacturing based at Bethany, Oklahoma; 120 employees in 1999. Commander 114 maintained in production,

Commander 114 from previous construction *(Paul Jackson)* 1158223

including TC version introduced in 1995. Deliveries in 1997–2002 comprised 14, 13, 13, 21, 10 and seven (none in final quarter). In March 2000, Commander announced the introduction of the 115, an updated and refined replacement for the 114.

Aviation General Inc filed for Chapter 11 bankruptcy protection on 27 December 2002, citing USD1 million cash flow shortfall and USD3.7 million total net indebtedness. Reorganisaion plan presented on 5 July 2003, under which Tiger aircraft LLC to acquire 80 per cent of Aviation General for US$2.8 million; this formalised on 1 November 2003 and accepted by bankruptcy court on 10 December 2003, but in July 2004 Tiger elected not to proceed with the purchase. No further offers having been received, Commander entered Chapter 7 bankruptcy on 14 January 2005.

On 29 June 2005 Commander Premier Aircraft Corporation (CPAC) of Farmington, Connecticut, a group of over 50 owners of Commander aircraft, acquired all assets of the former Commander Aircraft Corporation from the bankruptcy trustee, including type certificates for the Commander single-engine aircraft, jigs, tooling and other assets necessary to restart production. Following transfer of HQ to Farmington in November 2005, CPAC expected to resume production in early 2006, with an initial production target of 15 aircraft in the first year, but none reported by August 2006. Opened factory service centre at Cape Girardeau, Missouri, in February 2006 and parts centre at same location in August 2006, suggesting delay in production launch for new aircraft.

COMP AIR

COMP AIR INC

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OWNERS:
Ron Lueck
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Formed in 1993 as Aerocomp and previously known for its production of floats (which range from 227 to 2,722 kg; 500 to 6,000 lb displacement), Comp Air (from 2006) markets the Comp Air 3 and 4 kitbuilts, together with six-, seven-, eight- and 10-seat versions, known respectively as the Comp Air 6, 7, 8 and 10. Comp Air acquired production rights for the Merlin GT and E-Z Flyer from Merlin Aircraft Inc, and has passed the latter to Blue Yonder Aviation of Canada (which see).

The company had 22 employees in 2003 in its 1,580 m² (17,000 sq ft) factory. In February 2002, Comp Air announced that it was working on a jet-powered kitbuilt, the CA-J and its turbine-power Comp Air 12 derivative. In late 2005 it announced that a redesigned flap system would be incorporated into all new kits, with retrofitting available on all older aircraft.

A further addition to the range is the Comp Air 9, publicly announced at AirVenture '06. Comp Air intends to certify this and the Comp Air 12. In addition, Comp Air is building a 4,645 m² (50,000 sq ft) factory at its Merritt Island Airport.

By late 2005, more than 600 kits had been delivered.

COMP AIR 3

TYPE: Three-seat kitbuilt.
PROGRAMME: Announced 1998; smaller version of Comp Air 4.
CUSTOMERS: At least two flying by early 2005.
COSTS: Kit USD33,391 (2006).
Data generally as for Comp Air 4, except as noted.
DESIGN FEATURES: Quoted build time 450 hours.
STRUCTURE: Wings removable for storage. Tapered wings optional.
POWER PLANT: One 119 kW (160 hp) Textron Lycoming O-320 in prototype; engines in range 112 to 186 kW (150 to 250 hp) recommended. Fuel capacity: standard 170 litres (45.0 US gallons; 37.5 Imp gallons), optional 757 litres (200 US gallons; 167 Imp gallons).
ACCOMMODATION: Pilot and passenger side by side; third occupant, or cargo, in back of cockpit.
DIMENSIONS, EXTERNAL:

Wing span	10.52 m (34 ft 6 in)
Wing aspect ratio	6.6
Length overall	7.32 m (24 ft 0 in)
Max width of fuselage	0.91 m (3 ft 0 in)
Height overall	2.46 m (8 ft 1 in)

DIMENSIONS, INTERNAL:

Cabin max width	1.09 m (3 ft 7 in)

AREAS:

Wings, gross	16.35 m² (176.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	590 kg (1,300 lb)
Max T-O weight	1,111 kg (2,450 lb)
Max wing loading	68.0 kg/m² (13.92 lb/sq ft)

PERFORMANCE (119 kW; 160 hp Textron Lycoming engine):

Max operating speed	152 kt (281 km/h; 175 mph)
Normal cruising speed	126 kt (233 km/h; 145 mph)
Stalling speed	40 kt (73 km/h; 45 mph)
Max rate of climb at S/L	335 m (1,100 ft)/min
Service ceiling	4,724 m (15,500 ft)
T-O run	107 m (350 ft)
Landing run	183 m (600 ft)
Range	725 n miles (1,342 km; 834 miles)

COMP AIR 4

TYPE: Four-seat kitbuilt.
PROGRAMME: First flew 3 April 1995. Public debut at Sun 'n' Fun 1995, when powered by 82 kW (110 hp) Hirth F 30 four-cylinder two-stroke engine. Also known as Comp Monster.
CURRENT VERSIONS: **150G:** Powered by 112 kW (150 hp) Textron Lycoming O-320.
180G: 134 kW (180 hp) Textron Lycoming O-360; *as described.*
180SF: Float-equipped version of 180G.
Trainer: 'Two plus two' seat trainer version; later cancelled.
CUSTOMERS: Total of 60 sold and 26 flying by end 2003.
COSTS: Basic kit USD36,295 without engine, propeller and instruments; fast-build option USD2,415 (all 2006).
DESIGN FEATURES: Easy-to-build composites aircraft; quoted build time 350 to 400 hours. High, braced wing; unswept, and with straight or, optionally, tapered trailing-edge.
Various construction options, including tricycle landing gear, tapered wing, enlarged flaps and 1,451 kg (3,200 lb) MTOW.
Modified Clark Y aerofoil wings with turned-down tips.
FLYING CONTROLS: Conventional and manual. Electric trim. Flaps of two optional sizes.
STRUCTURE: Composites construction with carbon and Kevlar reinforcement. Single-strut braced wings; braced tailplane. Optional tapered wing. Fuselage width upgrades available: 1.17 m (3 ft 10 in) and 1.21 m (3 ft 11½ in).
LANDING GEAR: Fixed; with nosewheel, tailwheel, floats or amphibious gear, last-mentioned using Matco wheels and hydraulic brakes with 5.00–5 in tyres. Non-retracting 0.15 m (6 in) Matco tailwheel acts as water rudder. Standard version has fuselage-mounted spring steel cantilever mainwheel legs with Matco brakes and 6.00-6 wheels; optional tailwheel is 0.20 m (8 in) on cantilever leg.
POWER PLANT: One 134 kW (180 hp) Textron Lycoming O-360-A1A flat-four engine, driving a Sensenich 76 × 57 three-blade metal propeller. Options exist for engines ranging from 82 to 186 kW (110 to 250 hp); prototype employed 82 kW (110 hp) Hirth 95. Fuel capacity 197 litres (52.0 US gallons; 43.3 Imp gallons).
ACCOMMODATION: Pilot and three passengers in two side-by-side pairs. Glass-panelled door on each side of cabin for improved downwards visibility. Optional baggage pod below fuselage.
DIMENSIONS, EXTERNAL:

Wing span	10.67 m (35 ft 0 in)
Wing chord (constant version)	1.88 m (6 ft 2 in)
Length overall	7.92 m (26 ft 0 in)
Height overall	2.44 m (8 ft 0 in)
Tailplane span	3.05 m (10 ft 0 in)
Doors (each): Height	0.76 m (2 ft 6 in)
Width	0.91 m (3 ft 0 in)

DIMENSIONS, INTERNAL:

Cabin: Length	2.74 m (9 ft 0 in)
Max width	1.08 m (3 ft 6½ in)
Max height	1.30 m (4 ft 3 in)

AREAS:

Wings, gross	19.70 m² (212.0 sq ft)

WEIGHTS AND LOADINGS (G: 180G landplane, SF: 180SF floatplane):

Weight empty: G	630 kg (1,390 lb)
SF	753 kg (1,660 lb)
Max baggage weight	81.6 kg (180 lb)
Max T-O weight: both	1,292 kg (2,850 lb)
Max wing loading: both	65.6 kg/m² (13.44 lb/sq ft)
Max power loading: both	9.64 kg/kW (15.83 lb/hp)

1159749

Comp Air 4 Comp Monster, powered by 179 kW (240 hp) Subaru SVX engine *(Paul Jackson)*

PERFORMANCE:
Max operating speed:
G ..... 152 kt (281 km/h; 175 mph)
SF ..... 110 kt (204 km/h; 127 mph)
Normal cruising speed at 70% power:
G ..... 135 kt (249 km/h; 155 mph)
SF ..... 100 kt (185 km/h; 115 mph)
T-O speed ..... 36 kt (68 km/h; 42 mph)
Stalling speed: G ..... 34 kt (63 km/h; 39 mph)
SF ..... 35 kt (65 km/h; 40 mph)
Max rate of climb at S/L: G ..... 442 m (1,450 ft)/min
SF ..... 366 m (1,200 ft)/min
Service ceiling ..... 4,880 m (16,000 ft)
T-O run: G ..... 122 m (400 ft)
SF ..... 221 m (725 ft)
Landing run ..... 168 m (550 ft)
Range ..... 660 n miles (1,222 km; 759 miles)

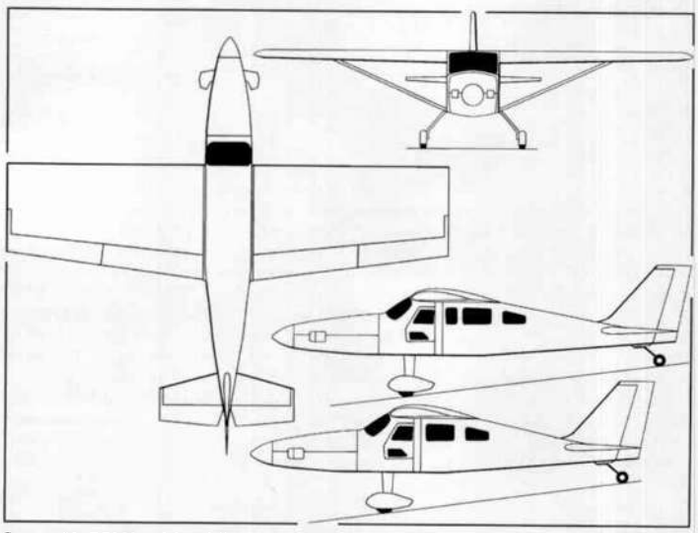
COMP AIR 6

TYPE: Six-seat kitbuilt.
PROGRAMME: Development of Comp Air 4; first flew January 1996.
CURRENT VERSIONS: **CA6G:** Normal landing gear, *as described.*
CA6SF: Float-equipped version.
CA6AF: Amphibian.
CA6TW: Tapered wing.
CA6TWHG: Tapered wing, high gross (1,451 kg; 3,200 lb MTOW).
CA6SHG: Super high gross (1,632 kg; 3,600 lb MTOW), wide-bodied version.
CUSTOMERS: At least 115 flying by early 2002 (latest information received).
COSTS: Kit USD45,645, without engine (2006).
DESIGN FEATURES: As Comp Air 4. Quoted build time 350 hours.
Data for CA6G generally as Comp Air 4, except those below.
STRUCTURE: Wings removable for storage. Optional wide-body fuselage, enlarged flap and tapered wing upgrades available.
LANDING GEAR: Fixed; with tricycle, tailwheel or float options. Mainwheels 6.00–6 in. Optional spring 7075-T6 aluminium alloy cantilever mainwheel legs in place of composites standard version.
POWER PLANT: Prototype had 164 kW (220 hp) Franklin engine; design compatible with engines in the 164 to 224 kW (220 to 300 hp) class. Automotive engine conversions are also possible. Fuel capacity 310 litres (82.0 US gallons; 68.3 Imp gallons).
ACCOMMODATION: Four adults plus full fuel and baggage; or four adults plus two children, with reduced fuel or baggage.
DIMENSIONS, EXTERNAL:
Wing span ..... 10.52 m (34 ft 6 in)
Wing aspect ratio 5.6
Length overall ..... 7.62 m (25 ft 0 in)
Height overall ..... 2.44 m (8 ft 0 in)
DIMENSIONS, INTERNAL:
Cabin: Length ..... 3.30 m (10 ft 10 in)
Max width ..... 1.08 m (3 ft 6½ in)
Max height ..... 1.30 m (4 ft 3 in)
AREAS:
Wings, gross ..... 19.70 m^2 (212.0 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 721 kg (1,590 lb)
Max T-O weight ..... 1,293 kg (2,850 lb)
Max wing loading ..... 65.6 kg/m^2 (13.44 lb/sq ft)
Max power loading ..... 7.88 kg/kW (12.95 lb/hp)
PERFORMANCE (164 kW; 220 hp Franklin engine):
Max operating speed ..... 152 kt (281 km/h; 175 mph)
Normal cruising speed ..... 143 kt (266 km/h; 165 mph)
Stalling speed ..... 42 kt (78 km/h; 48 mph)
Max rate of climb at S/L ..... 518 m (1,700 ft)/min
Service ceiling ..... 5,480 m (18,000 ft)
T-O run ..... 107 m (350 ft)
Landing run ..... 168 m (550 ft)
Range ..... 695 n miles (1,287 km; 800 miles)

COMP AIR 7

TYPE: Utility kitbuilt; utility turboprop kitbuilt.
PROGRAMME: Development of Comp Air 6. First shown 1998.
CURRENT VERSIONS: **Comp Air 7P:** Piston-engine version.
Comp Air 7T: Turbine version.

Comp Air 7SL with vision enhancement sensor pod below starboard wing
1159750



Comp Air 7SLX, with additional side view of Comp Air 7T ***(Paul Jackson)***
0581754

Comp Air 7SL: Stretched version, introduced in 2001, with 30 cm (12 in) fuselage stretch and equal addition to wing chord; narrow window immediately to rear of front doors.
Comp Air 7SLX: Turbine version of 7SL.
CUSTOMERS: At least 80 flying or under construction by early 2002, including 25 turbine versions; by January 2004, 58 Comp Air 7s and 18 Comp Air 7Ts had flown. Seven Comp Air 7SLX's given to Iraq Air Force by United Arab Emirates in 2003-04, and assembled in UAE by local agents; one subsequently lost near Baghdad on 30 May 2005; five surviving aircraft have under-fuselage sensor turret and are operated by 3 Squadron; following overhaul and rebuild first aircraft reflown 25 April 2006.
COSTS: Comp Air 7 USD60,490; Comp Air 7T USD66,545; Comp Air 7SL USD78,645; all minus engine (2006).
Data generally as for Comp Air 6, except those below.
DESIGN FEATURES: Suited for bush operations. Quoted build time 700 hours.
FLYING CONTROLS: Horn-balanced tail surfaces. Ground-adjustable tab on each aileron and on rudder. Trim tab in starboard elevator.
LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted spring composites cantilever mainwheel legs with optional wheel fairings. Mainwheels 8.00–6. Optional aluminium alloy landing gear.
POWER PLANT: *Comp Air 7:* One Textron Lycoming TIO-540 rated between 194 and 261 kW (260 and 350 hp), driving a two-blade metal propeller. Fuel capacity 333 litres (88.0 US gallons; 73.3 Imp gallons); optional extra tank increases capacity to 455 litres (120 US gallons; 100 Imp gallons).
Comp Air 7T: and 7SL: One 490 kW (657 shp) Walter M 601D turboprop driving an Avia three-blade, constant-speed, feathering propeller; optionally a five-blade Avia Hamilton propeller can be used. Fuel capacity 568 litres (150 US gallons; 125 Imp gallons) in 7T, 719 litres (190 US gallons; 158 Imp gallons) in 7SL.
ACCOMMODATION: Pilot and up to six passengers in enclosed cabin. Third (rear passengers') door, starboard side.
DIMENSIONS, EXTERNAL (Comp Air 7 and Comp Air 7T):
Wing span: CA 7P, CA 7T ..... 10.67 m (35 ft 0 in)
CA 7SL ..... 10.06 m (33 ft 0 in)

Comp Air 6G six-seat kitbuilt ***(Paul Jackson)***
0589331

Wing aspect ratio: CA 7P, CA 7T 6.9
CA 7SL 5.7
Length overall: CA 7P ..... 8.08 m (26 ft 6 in)
CA 7T ..... 8.99 m (29 ft 6 in)
CA 7SL ..... 9.30 m (30 ft 6 in)
Height overall: CA 7P, CA 7T ..... 2.44 m (8 ft 0 in)
CA 7SL ..... 2.74 m (9 ft 0 in)

DIMENSIONS, INTERNAL:
Cabin max width: CA 7P standard ..... 1.08 m (3 ft 6½ in)
CA 7P optional; CA 7T and CA 7SL standard ..... 1.17 m (3 ft 10 in)
CA 7P and CA 7SL optional ..... 1.21 m (3 ft 11½ in)

AREAS:
Wings, gross: CA 7P, CA 7T ..... 16.54 m² (178.0 sq ft)
CA 7SL ..... 17.74 m² (191.0 sq ft)

WEIGHTS AND LOADINGS:
Weight empty: CA 7P ..... 953 kg (2,100 lb)
CA 7T ..... 1,157 kg (2,550 lb)
CA 7SL: standard ..... 1,179 kg (2,600 lb)
high gross upgrade ..... 1,315 kg (2,900 lb)
Max T-O weight: CA 7P ..... 1,678 kg (3,700 lb)
CA 7T: standard ..... 1,710 kg (3,770 lb)
high gross upgrade ..... 2,177 kg (4,800 lb)
CA 7SL: standard ..... 2,086 kg (4,600 lb)
high gross upgrade ..... 2,358 kg (5,200 lb)
Max landing weight:
CA 7T high gross upgrade ..... 2,087 kg (4,600 lb)
Max wing loading:
CA 7P ..... 101.5 kg/m² (20.79 lb/sq ft)
CA 7T: standard ..... 103.4 kg/m² (21.18 lb/sq ft)
high gross upgrade ..... 131.7 kg/m² (26.97 lb/sq ft)
CA 7SL: standard ..... 117.6 kg/m² (24.08 lb/sq ft)
high gross upgrade ..... 132.9 kg/m² (27.23 lb/sq ft)
Max power loading:
CA 7T: standard ..... 3.49 kg/kW (5.74 lb/shp)
high gross upgrade ..... 4.45 kg/kW (7.31 lb/shp)
CA 7SL: standard ..... 4.26 kg/kW (7.00 lb/shp)
high gross upgrade ..... 4.82 kg/kW (7.91 lb/shp)

PERFORMANCE:
Never-exceed speed (VNE):
CA 7P ..... 191 kt (354 km/h; 220 mph)
CA 7T ..... 223 kt (413 km/h; 257 mph) IAS
CA 7SL ..... 206 kt (381 km/h; 237 mph) IAS
Max operating speed:
CA 7P ..... 178 kt (330 km/h; 205 mph)
Max cruising speed:
CA 7T ..... 239 kt (443 km/h; 275 mph)
CA 7SL ..... 217 kt (402 km/h; 250 mph)
Stalling speed: CA 7 ..... 46 kt (86 km/h; 53 mph)
CA 7T ..... 48 kt (89 km/h; 55 mph)
CA 7SL ..... 53 kt (97 km/h; 60 mph)
Max rate of climb at S/L:
CA 7P ..... 457 m (1,500 ft)/min
CA 7T ..... 1,219 m (4,000 ft)/min
CA 7SL ..... 914 m (3,000 ft)/min
Service ceiling: CA 7 ..... 7,620 m (25,000 ft)
T-O run: CA 7P ..... 145 m (475 ft)
CA 7T ..... 122 m (400 ft)
CA 7SL ..... 183 m (600 ft)
Landing run: CA 7 ..... 244 m (800 ft)
Range:
CA 7P ..... 1,100 n miles (2,037 km; 1,265 miles)
CA 7SL ..... 900 n miles (1,666 km; 1,035 miles)
g limits: CA 7T ..... +6/–4

COMP AIR 8

TYPE: Utility turboprop kitbuilt.

PROGRAMME: Prototype first flew mid-June 1999 and publicly displayed at Oshkosh in July 1999.

CURRENT VERSIONS: **Comp Air 8:** Initial version.
Comp Air 8-52XL: Introduced mid-2005; has higher maximum take-off weight.
Comp Air 8-SS52: Extra-wide fuselage model.

CUSTOMERS: 20 flying or under construction by late 2003. All believed to be CA 8T turboprop versions.

COSTS: Kit USD90,745 (2006), excluding engine.

DESIGN FEATURES: Generally similar to Comp Air 7. Quoted build time 800 hours.

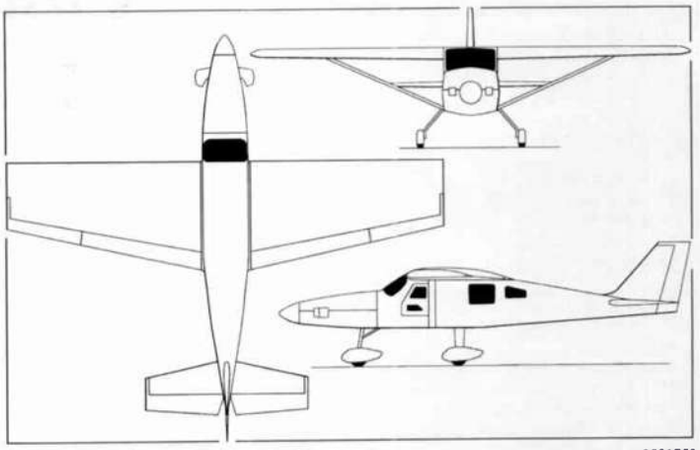
FLYING CONTROLS: Mass-balanced controls for high-speed handling.

STRUCTURE: Generally as Comp Air 7, but with strengthened carbon fibre fuselage and tail unit. Tapered wings standard. Fuselage width upgrades available.

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted spring composites cantilever mainwheel legs with optional wheel fairings. Optional aluminium alloy landing gear. Tricycle gear and floatplane versions also available.

POWER PLANT: One 490 kW (657 shp) Walter M 601D turboprop driving an Avia three-blade, feathering, constant-speed propeller. Fuel capacity 681 litres (180 US gallons; 150 Imp gallons) in Comp Air 8; 901 litres (238 US gallons; 198 Imp gallons) in Comp Air 8-52XL, of which 890 litres (235 US gallons; 196 Imp gallons) usable.

Comp Air 8SF *(Paul Jackson)* 1159751



Comp Air 8 utility turboprop *(Paul Jackson)* 0581753

ACCOMMODATION: Pilot and five adults in three pairs of bucket seats, plus rear bench seat for two children.

DIMENSIONS, EXTERNAL:
Wing span ..... 10.97 m (36 ft 0 in)
Wing aspect ratio 5.5
Length overall ..... 9.60 m (31 ft 6 in)
Height overall: Comp Air 8 ..... 2.46 m (8 ft 1 in)
Comp Air 8-52XL ..... 2.74 m (9 ft 0 in)
Propeller diameter ..... 2.51 m (8 ft 3 in)

DIMENSIONS, INTERNAL:
Cabin max width: standard ..... 1.17 m (3 ft 10 in)
wide option ..... 1.21 m (3 ft 11½ in)
8-SS52 ..... 1.32 m (4 ft 4 in)

AREAS:
Wings, gross ..... 22.02 m² (237.0 sq ft)

WEIGHTS AND LOADINGS:
Weight empty: standard ..... 1,315 kg (2,900 lb)
high gross option ..... 1,406 kg (3,100 lb)
Comp Air 8-52XL ..... 1,633 kg (3,600 lb)
Max T-O weight: standard: Comp Air 8 ..... 2,177 kg (4,800 lb)
intermediate: Comp Air 8 ..... 2,359 kg (5,200 lb)
high gross option: Comp Air 8 ..... 2,540 kg (5,600 lb)
Comp Air 8-52XL ..... 2,948 kg (6,500 lb)
Max wing loading: standard: Comp Air 8 ..... 98.9 kg/m² (20.25 lb/sq ft)
intermediate: Comp Air 8 ..... 107.1 kg/m² (21.94 lb/sq ft)
high gross option: Comp Air 8 ..... 115.4 kg/m² (23.63 lb/sq ft)
Comp Air 8-52XL ..... 133.9 kg/m² (27.43 lb/sq ft)
Max power loading: standard ..... 4.45 kg/kW (7.31 lb/shp)
intermediate ..... 4.82 kg/kW (7.91 lb/shp)
high gross option ..... 5.19 kg/kW (8.52 lb/shp)

PERFORMANCE:
Never-exceed speed (VNE) ..... 206 kt (381 km/h; 237 mph) IAS
Max cruising speed at FL210 ..... 217 kt (402 km/h; 250 mph) IAS
Normal cruising speed ..... 182 kt (338 km/h; 210 mph)
Stalling speed, power off, flaps down ..... 42 kt (78 km/h; 48 mph)
Max rate of climb at S/L: Comp Air 8 ..... 610 m (2,000 ft)/min
Comp Air 8-52XL ..... 457 m (1,500 ft)/min
Service ceiling ..... 7,620 m (25,000 ft)
T-O run ..... 122 m (400 ft)
Landing run ..... 183 m (600 ft)
Range: Comp Air 8 ..... 990 n miles (1,833 km; 1,139 miles)
Comp Air 8-52XL ..... 1,500 n miles (2,778 km; 1,726 miles)

COMP AIR 9

TYPE: Light utility turboprop.

PROGRAMME: Announced at AirVenture '06, Oshkosh, 25 July 2006. Intended to be offered as a certified aircraft.

CUSTOMERS: Prototype under construction late 2006.

COSTS: Estimated USD1.5 million (2006).

DESIGN FEATURES: High-wing cantilever monoplane. Low tailplane and sweptback fin.

FLYING CONTROLS: Conventional and manual.

STRUCTURE: Uses same structural technology as other Comp Air products; extensive use of composites throughout.

LANDING GEAR: Tricycle type; fixed. Fuselage mounted spring cantilever mainwheel legs. Speed fairings on all wheels.

Artist's impression of Comp Air 9 *(James Hausman, Comp Air)* 1159729

POWER PLANT: Prototype is due to be fitted with one 701 kW (940 shp) Honeywell TPE331-10 driving a four-blade Hartzell propeller. Fuel capacity 1,136 litres (300 US gallons; 250 Imp gallons).

ACCOMMODATION: Pilot and up to seven passengers in cabin; alternatively can be used for cargo.

All data provisional.

DIMENSIONS, EXTERNAL:

Wing span	13.11 m (43 ft 0 in)
Wing aspect ratio	6.7
Length overall	10.97 m (36 ft 0 in)

DIMENSIONS, INTERNAL:

Cabin: Max width	1.52 m (5 ft 0 in)
Max height	1.42 m (4 ft 8 in)

AREAS:

Wings, gross	25.55 m² (275.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	1,769 kg (3,900 lb)
Max baggage weight	181 kg (400 lb)
Max T-O weight	3,492 kg (7,700 lb)
Max wing loading	136.7 kg/m² (28.00 lb/sq ft)
Max power loading	4.99 kg/kW (8.19 lb/shp)

PERFORMANCE:

Normal cruising speed	240 kt (444 km/h; 276 mph) IAS
Stalling speed, flaps down	60 kt (112 km/h; 69 mph)
Max rate of climb at S/L	914 m (3,000 ft)/min
T-O run	183 m (600 ft)
Range with max fuel	1,650 n miles (3,055 km; 1,898 miles)
g limits	+6/–4

COMP AIR 10

TYPE: Utility turboprop kitbuilt.

PROGRAMME: Announced 1997; based on Comp Air 6.

CURRENT VERSIONS: **CA10:** Original version, no longer available.

CA10XLT: Turbine version. *As described.*

CUSTOMERS: Eleven flying by late 2004.

COSTS: USD102,845 turbopowered kit version (2006).

Data generally as for Comp Air 6, except that below.

DESIGN FEATURES: Twin outward-canted fins in addition to conventional horizontal tail surfaces. Quoted build time 800 hours. Optional HP (high performance) wing and two-stage increased MTOW options.

FLYING CONTROLS: Conventional and manual. Twin rudders operating in unison. Balance tab in starboard elevator.

STRUCTURE: Extensive use of composites throughout. Single-strut braced two-spar wings. Quoted build time 800 hours.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring 7075-T6 aluminium alloy cantilever mainwheel legs. Mainwheel size 8.00–6 in; nosewheel 6.00–6 in. Float and tailwheel configurations optional.

POWER PLANT: One 490 kW (657 shp) Walter M 601D driving an Avia three-blade, constant-speed propeller. Standard fuel capacity of 455 litres (120 US gallons; 100 Imp gallons); optionally 681 litres (180 US gallons; 150 Imp gallons). Oil capacity 5.7 litres (1.5 US gallons; 1.25 Imp gallons).

ACCOMMODATION: Pilot and up to nine passengers; passenger door, forward, each side; horizontally split, two-piece freight door, starboard, rear side; extra passenger door on port rear side. Optional luggage pannier.

DIMENSIONS, EXTERNAL:

Wing span	11.43 m (37 ft 6 in)
Length overall	9.45 m (31 ft 0 in)
Height overall	2.64 m (8 ft 8 in)
Wheel track	2.79 m (9 ft 2 in)

DIMENSIONS, INTERNAL:

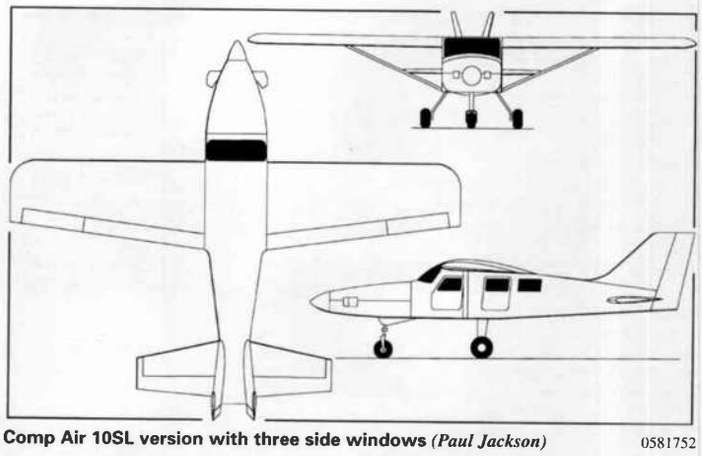
Cabin: Length	3.96 m (13 ft 0 in)
Max width	1.52 m (5 ft 0 in)
Max height	1.35 m (4 ft 5 in)

AREAS:

Wings, gross	23.60 m² (254.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: standard	1,247 kg (2,750 lb)
high gross	1,429 kg (3,150 lb)
Max baggage weight: standard	136 kg (300 lb)
Max T-O and landing weight:	
standard	2,358 kg (5,200 lb)
intermediate	2,540 kg (5,600 lb)
high gross	2,721 kg (6,000 lb)



Comp Air 10SL version with three side windows *(Paul Jackson)* 0581752

Max wing loading: standard	100.0 kg/m² (20.47 lb/sq ft)
intermediate	107.6 kg/m² (22.05 lb/sq ft)
high gross	115.3 kg/m² (23.62 lb/sq ft)
Max power loading: standard	4.82 kg/kW (7.91 lb/shp)
intermediate	5.19 kg/kW (8.52 lb/shp)
high gross	5.56 kg/kW (9.13 lb/shp)

PERFORMANCE:

Max level speed	186 kt (346 km/h; 215 mph)
Max cruising speed at 75% power	167 kt (309 km/h; 192 mph)
Normal cruising speed at 65% power	152 kt (282 km/h; 175 mph)
Stalling speed: flaps up	51 kt (95 km/h; 59 mph)
flaps down	46 kt (86 km/h; 53 mph)
Max rate of climb at S/L	762 m (2,500 ft)/min
Service ceiling	7,620 m (25,000 ft)
T-O run	152 m (500 ft)
Landing run	183 m (600 ft)
Range with max fuel at 65% power	795 n miles (1,472 km; 915 miles)
Endurance at 65% power, 60 min reserves	3 h 42 min

COMP AIR CA-J JET and COMP AIR 12

TYPE: Private jet kitbuilt; utility turboprop kitbuilt.

PROGRAMME: Announced 11 February 2002, and fuselage mockup shown at Sun 'n' Fun April 2002, when order book opened. Completion of first prototype was expected in the third quarter of 2003 with initial kit deliveries following during the first quarter of 2004; this subsequently slipped and Comp Air Jet prototype (N41861) made first taxi test runs on 30 June 2004 and 30-minute maiden flight on 20 July 2004, piloted by Ron Lueck. By its first public appearance, at Sun 'n' Fun, April 2005, prototype had accumulated 43 hours and by August 2005, 157 sorties had been completed. Prototype suffered flame-out en route to AirVenture '05 and made safe dead-stick landing at airport en route; in September 2006, company planned to re-engine with Honeywell TFE-731. Comp Air intends to certify the Comp Air 12.

CURRENT VERSIONS: **Comp Air Jet:** *As described.*

Comp Air 12: Turbine-engined version announced late 2002. Powered by a nose-mounted 1,044 kW (1,400 shp) Honeywell T53, later changed to 1,230 kW (1,650 shp) Honeywell TPE-14GR. First flight was scheduled for September 2005 but progress delayed and rescheduled for late 2006 with first deliveries early 2007; wing/fuselage mating achieved October 2005. Provisional cruising speed 275 kt (509 km/h; 316 mph) and range 2,800 n miles (5,185 km; 3,222 miles).

CUSTOMERS: By August 2005, 209 positions reserved, of which 18 were firm orders. Initial customer machine then due to fly first quarter 2006.

COSTS: Kits for both versions cost USD499,000 including engine or USD329,000 (CA-J) and USD249,000 (Comp Air 12) without engine, instruments and interior; estimated cost to finished standard USD1.2 million (CA-J) or USD866,000 (Comp Air 12) (both 2006). Operating cost USD600 per hour. Estimated cost of certified Comp Air 12 USD2.5 million.

DESIGN FEATURES: Low-wing monoplane with wing set towards rear of passenger cabin. Wing leading-edge sweepback approx 2°; trailing-edge sweepforward approx 7°; tailplane similar. Tailplane set at base of fin, above fuselage. Engine inlets mounted at rear of fuselage behind cabin. Quoted build time 2,500 hours.

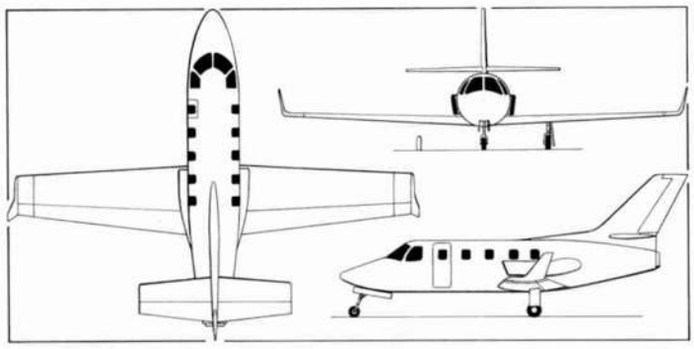
Modified NACA 65-0215 laminar flow airfoil.

FLYING CONTROLS: Conventional and manual.

Comp Air 10XLT utility kitbuilt *(Paul Jackson)* 1159752

Comp Air Jet prototype *(James Hausman, Comp Air)* 1159730

Artist's impression of CA-12 *(James Hausman, Comp Air)* 1159731



Comp Air CA-J Jet *(James Goulding)* 1047689

STRUCTURE: Uses same structural technology as other aircraft in the Comp Air product line, but company suggests builders use professional assistance in kit completion; quoted completion time six to eight months. Extensive use of carbon fibre hybrid sandwich throughout structure.

LANDING GEAR: Tricycle layout. Retractable.

POWER PLANT: Initially to be factory remanufactured ZMKB Progress AI-25 turbofan rated at 15.12 kN (3,400 lb st) for T-O and 11.12 kN (2,500 lb) during cruise with 5,000 hour TBO and 3,000 hour inspection; later upgraded to AI-25TL. Design will also accommodate Pratt & Whitney JT12-8 or CJ610 engines. Fuel capacity 1,817 litres (480 US gallons; 400 Imp gallons).

ACCOMMODATION: Pilot and seven to nine passengers. Main door on port side, immediately behind cockpit.

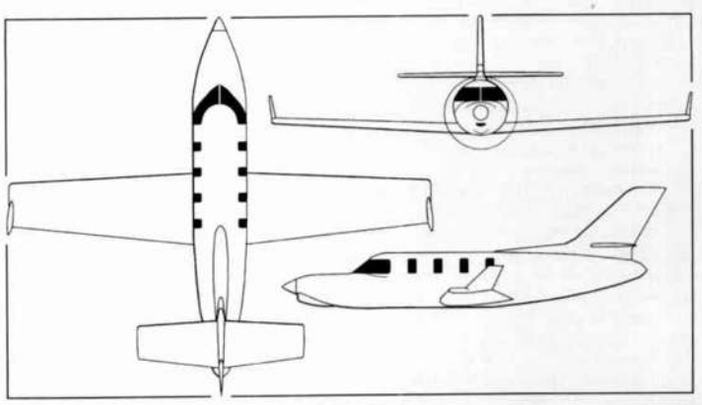
SYSTEMS: Pressurisation maintains 3,050 m (10,000 ft) cabin altitude at 9,115 m (29,900 ft) service ceiling.

All data are provisional.

AVIONICS: Variety of packages offered; below is mid-range.

Comms: Garmin GNS-530 nav/com/GPS with TAWS; GI-106A VOR/GPS, GTX-330 transponder, Ameri-King AK-450 ELT, PS Engineering PMA-7000B audio panel.

Flight: L3 Comm WX-500 Stormscope weather radar; TruTrak Sorcerer digital Autopilot.



Provisional views of Comp Air CA-12 *(Paul Jackson)* 0581751

DIMENSIONS, EXTERNAL:

Wing span: CA-J	13.87 m (45 ft 6 in)
Comp Air 12	14.63 m (48 ft 0 in)
Length overall	11.43 m (37 ft 6 in)
Comp Air 12	12.62 m (41 ft 5 in)
Height overall	4.42 m (14 ft 6 in)

DIMENSIONS, INTERNAL:

Cabin: Max height	1.78 m (5 ft 10 in)
Max width	1.73 m (5 ft 8 in)
Length	6.90 m (21 ft 0 in)

AREAS:

Wings, gross: CA-J	25.46 m^2 (274.0 sq ft)
Comp Air 12	27.87 m^2 (300.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: CA-J	2,268 kg (5,000 lb)
Comp Air 12	2,667 kg (5,880 lb)
Max T-O weight: CA-J	4,445 kg (9,800 lb)
Comp Air 12	4,899 kg (10,800 lb)
Max wing loading: CA-J	174.6 kg/m^2 (35.77 lb/sq ft)
Comp Air 12	175.8 kg/m^2 (36.00 lb/sq ft)
Max power loading: CA-J	294 kg/kN (2.88 lb/lb st)
Comp Air 12	3.98 kg/kN (6.54 lb/shp)

PERFORMANCE (estimated):

Never-exceed speed (VNE)	369 kt (684 km/h; 425 mph)
Normal cruising speed: CA-J	348 kt (644 km/h; 400 mph)
Comp Air 12	300 kt (556 km/h; 345 mph) IAS
Stalling speed: CA-J	70 kt (130 km/h; 81 mph)
Comp Air 12	73 kt (136 km/h; 84 mph)
Max rate of climb at S/L: CA-J	1,765 m (5,800 ft)/min
Comp Air 12	1,219 m (4,000 ft)/min
Service ceiling	9,115 m (29,900 ft)
T-O run: CA-J	610 m (2,000 ft)
Comp Air 12	274 m (900 ft)
Landing run: CA-J	855 m (2,800 ft)
Comp Air 12	335 m (1,100 ft)
Range: CA-J	955 n miles (1,770 km; 1,100 miles)
Comp Air 12	2,535 n miles (4,694 km; 2,917 miles)

COMP AIR MERLIN GT

TYPE: Side-by-side kitbuilt.

PROGRAMME: Developed by Macair Aircraft in Canada; later Merlin Aircraft. Rotax 582-powered version first flown January 1985; 912-powered version in January 1993. In September 2006, company announced it was discontinuing the Merlin from its product range.

CUB CRAFTERS

CUB CRAFTERS INC

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CEO: Jim Richmond
MARKETING DIRECTOR: Todd Simmons

Having rebuilt and restored Piper PA-18 Super Cubs since 1980, Cub Crafters began production of new aircraft in 1999. It currently holds 51 Supplementary Type Certificates for various improvements to the original design and continues to offer engine upgrades of existing Super Cubs to 112 kW (150 hp), 119 kW (160 hp) or 134 kW (180 hp). The conversion is not approved by New Piper Aircraft.

In 2004, Cub Crafters increased the standard MTOW of its Top Cub and obtained FAR Pt 23 certification. Cub Sport was launched in 2005 for the new LSA certification category and deliveries began in 2006.

CUB CRAFTERS CC18 TOP CUB

TYPE: Two-seat lightplane.

PROGRAMME: Original Piper Super Cub was development of L-4 Cub, via, PA-11/US Army L-18B; first certified in PA-19/L-18C guise 1 April 1949, followed by civil PA-18 Super Cub equivalent 18 November 1949 (67 kW; 90 hp Continental C90-12F); further variants included PA-18-125 (L-21A), PA-18-135 (L-21B) and PA-18A agricultural version and PA-18S seaplane. Remained in production until final 24 Super Cubs built in 1994; marketing from mid-1980s was by WTA Inc of Lubbock, Texas, but aircraft supplied by Piper.

Current production began in 1999; prototype N901CC. Type certificate (1A2) retained by New Piper Aircraft Inc, although that company does not participate in present aircraft.

CURRENT VERSIONS: **PA-18–180 Top Cub:** Not previously available in this engine power from Piper; initial MTOW 793 kg (1,750 lb); previously optional MTOW of 907 kg (2,000 lb) standard from 2004. Early aircraft registered as Piper/Cub Crafters products. Replaced by certified CC18 in late 2004.

CC18-180 Top Cub: Certified to FAR Pt 23 in Normal category on 16 December 2004 with 1,043 kg (2,300 lb) MTOW (Type Certificate A00006SE). Available as CC18-180 Top Cub **Legend** with blue, red or green upper surfaces and upgraded interior; CC18-180A Top Cub **Ranger** baseline version with yellow colour scheme; or Top Club **Amphib** variant of -180A on floats.

Prototype (N202HS) flown 2004 as CC18-180A; first CC18-180 Top Cub Ranger N43CR displayed at Airventure, Oshkosh, July 2005.

Cub Sport: *Described separately.*

CUSTOMERS: Total 10,346 (plus three PA-19s) built by Piper. Cub Crafters built 73 PA-18-180s up to mid-2004, when production turned to CC18-180. Twenty of latter registered by April 2006. Six PA-18-180s employed by US Air Force Academy, Colorado Springs, for glider towing; others to US Border Patrol.

COSTS: USD159,500 (2005). Extras include Wipline floats at USD45,500 and Basic VFR (USD9,975), Deluxe VFR (USD10,975) and Deluxe IFR (USD19,975) avionics; Ranger colour scheme (USD 3,900) and 31-inch Alaska bush tyres (USD3,795).

DESIGN FEATURES: Braced high-wing monoplane, with V struts each side. Lightweight aluminium oil cooler below engine cowling is recognition feature of Cub Crafters' aircraft (but is optional Super Cub retrofit), as are optional drooped wingtips, anti-spin strakes ahead of tailplane and 36 vortex generators on each wing leading-edge, all for enhanced STOL performance.

Wing section USA 35B. Thickness/chord ratio 12 per cent. Dihedral 1°. No incidence at mean aerodynamic chord. Total washout of 3° 18'.

FLYING CONTROLS: Conventional and manual. Plain ailerons and trailing edge flaps of light-alloy construction and skinning. Tailplane incidence variable (+2° 30'/–4°) for trimming. Balanced rudder and elevators. Control surface deflections: ailerons ±18°; elevator +25/–15°; rudder ±20°; flaps 22° (T-O), 50° (landing).

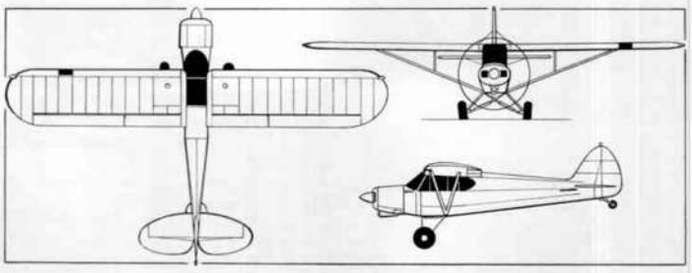
STRUCTURE: Wing has aluminium spars and stamped aluminium ribs, aluminium sheet leading-edge and aileron false spar, with Ceconite 7600 covering polyurethane finished, pop-riveted to structure. The fuselage is a rectangular welded 4130 chrome molybdenum steel tube structure covered with Stits Polyfiber; glass fibre engine cowling. Tail unit is a wire-braced structure of welded steel tubes and channels, covered with Ceconite 7600; optional metal belly skin extending 1.07 m (3 ft 6 in) forward of sternpost.

LANDING GEAR: Tailwheel type; fixed. Two side Vs and half axles hinged to bottom of fuselage. Rubber chord shock absorption. Mainwheel tyres size 8.50-6; optional Goodyear 26×10.50-6 (6 ply) or 79 cm (31 in) Alaska Bush wheels; Scott 3200 steerable leaf spring tailwheel size 2.60/2.50–4. Dual Cleveland wheels and brakes; parking brake standard. Wipline 2100 floats optional.

POWER PLANT: One 134 kW (180 hp) Textron Lycoming O-360-C4P flat-four engine, driving a Sensenich 76EM8-0-56 two-blade fixed-pitch metal propeller as standard, or McCauley 1A200/FA climb-optimised propeller as option. Sensenich W80CM8 wooden propeller permissible. Fuel tanks in wings; combined capacity 205 litres (54.0 US gallons; 45.0 Imp gallons), of which 174 litres (46.0 US gallons; 38.3 Imp gallons) usable.

ACCOMMODATION: Two persons in tandem with dual controls; 26 *g* restraints. Adjustable front seat. Heater and adjustable fresh air control. Downward-hinged door on starboard side, and upward-hinged window above, can be opened in flight. Sliding window on port side. Baggage compartment aft of rear seat can be enlarged by removal of latter; additional 23 kg (50 lb) of baggage in optional cargo/fuel belly tank; optional 64 kg (140 lb) baggage (only) pod; baggage door on starboard side; 11 baggage tiedown points.

Cub Crafters CC18-180 Top Cub Ranger as a floatplane *(Paul Jackson)* 1037972



Cub Crafters Top Cub *(James Goulding)* 0143322

SYSTEMS: Electrical system comprising 50 A alternator, 12 V engine starter and 17 A battery, standard.

AVIONICS: *Comms:* Garmin GNC 250XL GPS/com, GTX 327 transponder, Mode C encoder and PM 1000 intercom standard for VFR; optional GNC 420 colour GPS/com replacing GNC 250 in Deluxe VFR; Deluxe IFR option of GNS 430 colour GPS/nav/com GTX 327 plus encoder and GMA 340 audio panel/intercom.

Flight: Optional Garmin GI 106A course deviation indicator in Deluxe IFR package.

EQUIPMENT: Navigation lights and tail strobe warning light standard.

DIMENSIONS, EXTERNAL:

Wing span	10.74 m (35 ft 3 in)
Wing chord, constant	1.60 m (5 ft 3 in)
Wing aspect ratio	7.0
Length overall	7.11 m (23 ft 4 in)
Height overall	2.57 m (8 ft 5 in)
Tailplane span	3.20 m (10 ft 6 in)
Wheel track	1.84 m (6 ft 0½ in)
Propeller diameter: standard	1.93 m (6 ft 4 in)
optional (climb)	2.08 m (6 ft 10 in)

DIMENSIONS, INTERNAL:

Baggage volume, max	1.0 m^3 (36 cu ft)

AREAS:

Wings, gross	16.58 m^2 (178.5 sq ft)
Ailerons (total)	1.75 m^2 (18.80 sq ft)
Trailing-edge flaps (total)	1.07 m^2 (11.50 sq ft)
Fin	0.43 m^2 (4.66 sq ft)
Rudder	0.63 m^2 (6.76 sq ft)
Tailplane	1.40 m^2 (15.10 sq ft)
Elevators (total)	1.09 m^2 (11.70 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	544 kg (1,200 lb)
Max baggage weight (single pilot)	93 kg (205 lb)
T-O weight	1,043 kg (2,300 lb)
Max wing loading	62.9 kg/m^2 (12.89 lb/sq ft)
Max power loading	7.78 kg/kW (12.78 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	132 kt (244 km/h; 152 mph)
Max level speed at S/L	122 kt (225 km/h; 140 mph)
Cruising speed:	
at 75% power	110 kt (204 km/h; 127 mph)
at 55% power	91 kt (169 km/h; 105 mph)
Stalling speed, flaps down	38 kt (70 km/h; 43 mph)
Max rate of climb at S/L	274 m (900 ft)/min
Max certified altitude	4,450 m (14,600 ft)
T-O and landing run	177 m (580 ft)

CUB CRAFTERS CC11 SPORT CUB

TYPE: Two-seat lightplane.

PROGRAMME: Based on Piper PA-11 Cub Special, produced during late 1940s between J3 Cub and PA-18 Super Cub; certified 30 April 1947, followed by PA-11S seaplane on 11 September 1947. Current version launched at AirVenture, Oshkosh, July 2003 as Cub Light; one prototype built. First flight of prototype Sport Cub (N502CR) announced 18 July 2005, but may have taken place some weeks earlier. Public debut at AirVenture, 26 June 2005. First production aircraft (N503CR) shown at Sun 'n' Fun, Lakeland, Florida, April 2006.

CURRENT VERSIONS: **CC11-100:** *As described.*

CUSTOMERS: Total 32 sales at time of public debut, including 12 trainers for Cub Air of Florida. Piper had previously built 1,541 PA-11 Cub Specials between 1947 and 1949.

COSTS: USD89,500 flyaway excluding avionics (extra USD17,900) and flaps (extra USD4,900) (2005).

DESIGN FEATURES: Original design enhanced by modern materials, manufacturing techniques and avionics.

High wing braced by streamlined V-struts and auxiliary struts; rounded fin and tailplane mutually wire-braced. Vortex generators on full wing leading-edge upper surface. Increased elevator span, more raked windscreen and more streamlined engine cowling compared to PA-11.

Wing section US 35B.

FLYING CONTROLS: Conventional and manual. Variable incidence tailplane. Flaps optional for non-LSA use. Control actuation by cables.

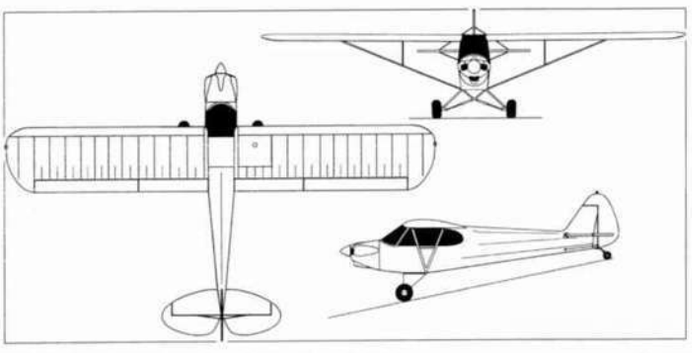
STRUCTURE: Generally as Cub Crafters Top Cub. Compared with original design, top longerons moved to upper surface of fuselage to increase door size; and additional stringers in fuselage sides to increase width by 10 cm (4 in). Stamped aluminium wing ribs; aluminium flap and aileron structure, fabric covered. Lift (V) struts of aluminium.

LANDING GEAR: Generally as Cub Crafters Top Cub, with 6.00×6 or 5.00×6 wheels and 8.00-6 tyres. Optional floats.

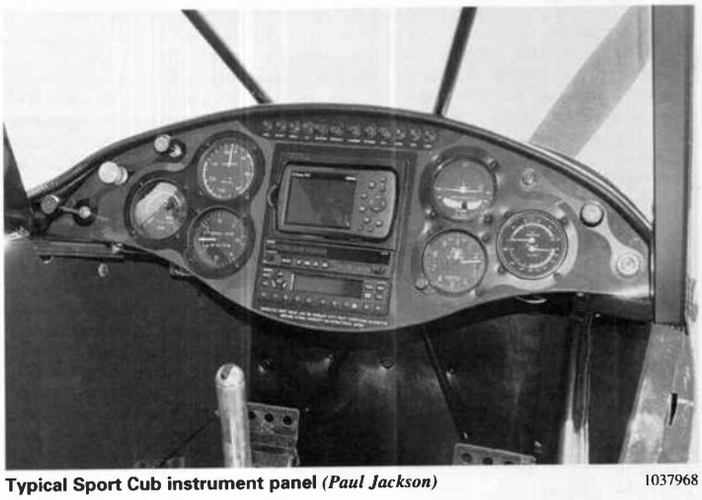
POWER PLANT: One 74.6 kW (100 hp) Teledyne Continental O-200 flat-four driving a Sensenich 72GK52 two-blade, wooden propeller. Optional McCaulley metal propeller. Fuel tank in port wing root, capacity 45 litres (12.0 US gallons; 10.0 Imp gallons), of which 42 litres (11.0 US gallons; 9.2 Imp gallons) usable. Optional additional tank of same capacity in starboard wing.

ACCOMMODATION: Two persons in tandem; horizontally split door, starboard side. Rear seat folds to increase baggage space at rear. Optional additional door, port side. Instrument panel moved 10 cm (4 in) forward and angled upward, compared with PA-11.

First production CC11-100 Sport Cub built by Cub Crafters 1037956



Cub Crafters CC11-100 Sport Cub ***(Paul Jackson)*** 1158037



Typical Sport Cub instrument panel ***(Paul Jackson)*** 1037968

AVIONICS: *Comms:* Becker transceiver; Becker transponder with Mode C; PS Engineering intercom.
Flight: AvMap EKP IV GPS with 178 mm (7 in) colour display.
Instrumentation: Twin Dynon EFIS.
EQUIPMENT: Strobe lights, ballistic recovery parachute and crew airbags optional.
DIMENSIONS, EXTERNAL:

Wing span	10.59 m (34 ft 9 in)
Wing chord, constant	1.60 m (5 ft 3 in)
Length overall	7.11 m (23 ft 4 in)
Height overall	2.57 m (8 ft 5 in)
Tailplane span	3.00 m (9 ft 10 in)
Cockpit door max width	1.27 m (4 ft 2 in)

DIMENSIONS, INTERNAL:

Cockpit max width	0.71 m (2 ft 4 in)
Max baggage volume (single pilot)	1.3 m^3 (46 cu ft)

AREAS: Generally as Cub Crafters Top Cub, except

Wings, gross	16.35 m^2 (176.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: prototype	402 kg (886 lb)
production (estimated)	385 kg (850 lb)
Max baggage weight	50 kg (110 lb)
Max T-O weight	598 kg (1,320 lb)
Max wing loading	36.6 kg/m^2 (7.50 lb/sq ft)
Max power loading	8.03 kg/kW (13.20 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	120 kt (222 km/h; 138 mph)
Max level speed	106 kt (196 km/h; 122 mph)
Cruising speed	91 kt (169 km/h; 105 mph)
Stalling speed: flaps up	35 kt (65 km/h; 40 mph)
flaps down	32 kt (58 km/h; 36 mph)
Max rate of climb at S/L	244 m (800 ft)/min
Service ceiling	4,265 m (14,000 ft)
T-O run	77 m (250 ft)
T-O to 15 m (50 ft)	290 m (950 ft)
Landing run	61 m (200 ft)
Landing from 15 m (50 ft)	305 m (1,000 ft)
Range: single tank	195 n miles (362 km; 225 miles)
two tanks	391 n miles (724 km; 450 miles)
Endurance: single tank	2 h 30 min
two tanks	5 h 0 min

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CULP'S

CULP'S SPECIALTIES

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Web: www.culpsspecialties.com
PRESIDENT: Steve Culp

WORKS
Hangar 3, 1530 Airport Road, Shreveport, Louisiana 71107

In addition to producing the Special biplane, Culp's Specialties restores and rebuilds classic aircraft and designs motorcycles. In 1998, Culp's began building six Monocoupes, and in 2000 announced a Sopwith Pup replica.

CULP'S SPECIAL

TYPE: Aerobatic three-seat biplane/kitbuilt.

PROGRAMME: Design started September 1993; work on first prototype began in following November and first flight achieved (N367LS) on 15 April 1996. Made public debut at Sun 'n' Fun 1996; initially had 670 kg (1,478 lb) empty weight and 930 kg (2,050 lb) MTOW. Manufacture of first production aircraft began in August 1994. FAA Experimental certification granted April 1996 and aircraft embarked on intensive demonstration programme.

CUSTOMERS: By January 2004, five aircraft were flying and at least seven were under construction. 200 sets of plans and six kits sold (latest figures received).

COSTS: Factory-built USD145,000; kit USD51,000; plans USD280 (2006).

DESIGN FEATURES: Fully aerobatic, single-bay biplane with 1930s styling, but offering modern performance. Loosely based on the Steen Skybolt. Cabane-mounted upper wing with single interplane strut and wire bracing; wire-braced empennage. Quoted build time 3,500 hours. Roll rate 260°/s.

FLYING CONTROLS: Conventional and manual. Actuation by pushrods; electric rudder trim and manual elevator trim. Aileron design influenced by Curtis Pitts. Horn-balanced elevator and rudder.

STRUCTURE: Fuselage is 4130 steel tubing covered with spruce; metal-skinned forward of cockpit, with fabric to rear. Wings are of fabric-covered wooden construction.

LANDING GEAR: Tailwheel type; fixed. Two faired-in side Vs of 4130 steel tubing hinged to lower longerons, plus half-axles sprung with bungee cord. Goodyear tyres: mainwheels 10.00-6, pressure 1.86 bar (27 lb/sq in); tailwheel 8.00-4, pressure 3.10 bar (45 lb/sq in). Cleveland brakes. Minimum ground turning radius 7.92 m (26 ft 0 in).

POWER PLANT: One 265 kW (355 hp) VOKBM M-14PT radial engine driving a constant-speed two-blade wooden propeller. Main fuel tank in fuselage contains 121 litres (32.0 US gallons; 26.6 Imp gallons); wing tank contains 38 litres (10.0 US gallons; 8.3 Imp gallons) and ferry tank a further 151 litres (40.0 US gallons; 33.3 Imp gallons); total usable fuel 299 litres (79.0 US gallons; 65.8 Imp gallons). Oil capacity 15 litres (4.0 US gallons; 3.3 Imp gallons).

ACCOMMODATION: Pilot and either one or two passengers, depending on model, in open cockpit. Baggage compartment behind headrest.

SYSTEMS: 10 A electrical system for radio and lights; pneumatic engine starting system.

AVIONICS: *Comms:* Honeywell radio, transponder and GPS.

DIMENSIONS, EXTERNAL:

Wing span: upper	7.32 m (24 ft 0 in)
lower	7.01 m (23 ft 0 in)
Wing chord, constant	1.07 m (3 ft 6 in)
Length overall	6.40 m (21 ft 0 in)
Max diameter of fuselage	1.05 m (3 ft 5½ in)
Height overall	2.44 m (8 ft 0 in)
Tailplane span	2.29 m (7 ft 6 in)
Wheel track	1.98 m (6 ft 6 in)
Wheelbase	5.18 m (17 ft 0 in)
Propeller diameter	2.39 m (7 ft 10 in)
Propeller ground clearance	0.91 m (3 ft 0 in)

DIMENSIONS, INTERNAL:

Cabin: Length	2.44 m (8 ft 0 in)
Max width	0.81 m (2 ft 8 in)
Max height	0.81 m (2 ft 8 in)
Floor area	0.56 m² (6.0 sq ft)
Baggage hold volume	0.11 m³ (4.0 cu ft)

AREAS:

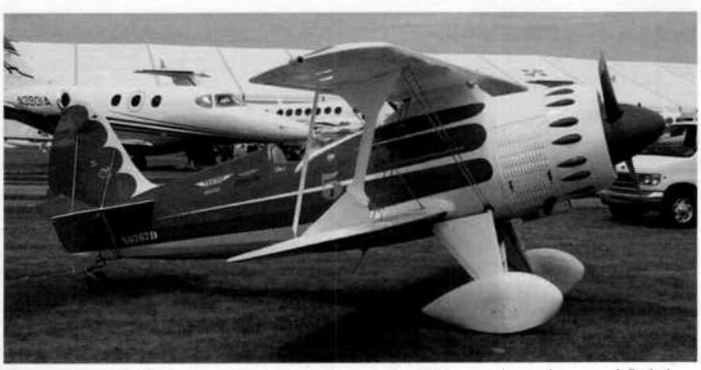
Wings, gross	14.96 m² (161.0 sq ft)
Ailerons (total)	2.60 m² (28.00 sq ft)
Rudder, incl tab	1.02 m² (11.00 sq ft)
Tailplane	2.97 m² (32.00 sq ft)
Elevators, incl tab	1.49 m² (16.00 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	689 kg (1,520 lb)
Max fuel weight	218 kg (480 lb)
Max T-O and landing weight	1,043 kg (2,300 lb)
Max zero-fuel weight	848 kg (1,870 lb)
Max wing loading	69.7 kg/m² (14.29 lb/sq ft)
Max power loading	3.94 kg/kW (6.48 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE) at S/L	208 kt (386 km/h; 240 mph)
Max operating speed (VMO)	147 kt (273 km/h; 170 mph)
Econ cruising speed at 2,590 m (8,500 ft)	148 kt (274 km/h; 170 mph)
Stalling speed, power off	59 kt (108 km/h; 67 mph)
Max rate of climb at S/L	1,371 m (4,500 ft)/min
Service ceiling	3,660 m (12,000 ft)
T-O run	91 m (300 ft)
T-O to 15 m (50 ft)	122 m (400 ft)
Landing from 15 m (50 ft)	213 m (700 ft)
Landing run	244 m (800 ft)
Range: with max fuel at econ cruising speed	955 n miles (1,770 km; 1,100 miles)
with max payload	487 n miles (902 km; 561 miles)
g limits	±10



Hamm Special Skybolt, built by John Hamm in 2005 and based around Culp's Special *(Paul Jackson)* 1158787

Culp's Special built by the designer 1158804

CULP'S MONOCULP

TYPE: Four-seat kitbuilt.

PROGRAMME: Announced at Sun 'n' Fun, April 2000, when prototype under construction; development continues.

CUSTOMERS: Two kits and three sets of plans sold by May 2000 (latest data received).

COSTS: Kit price USD47,000 with wings completed (2004).

DESIGN FEATURES: Scaled-up (125 per cent) version of 1930s Monocoupe 90A. Quoted build time 2,500 hours.

FLYING CONTROLS: Conventional and manual.

STRUCTURE: Strut-braced high wing; wire-braced tailplane.

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted, streamlined, cantilever main legs with integral shock-absorbers. Cantilever tailwheel. Speed fairings on mainwheels.

POWER PLANT: One 294 kW (394 hp) VOKBM M-14PF nine-cylinder radial engine. Fuel capacity 318 litres (84.0 US gallons; 70.0 Imp gallons).

ACCOMMODATION: Pilot and three passengers in two pairs of seats; cabin door on port side.

DIMENSIONS, EXTERNAL:

Wing span	9.75 m (32 ft 0 in)
Length overall	7.47 m (24 ft 6 in)
Height overall	2.54 m (8 ft 4 in)

DIMENSIONS, INTERNAL:

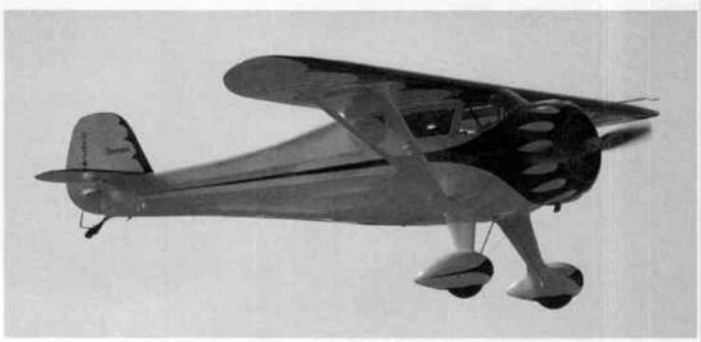
Cabin max width	1.22 m (4 ft 0 in)

AREAS:

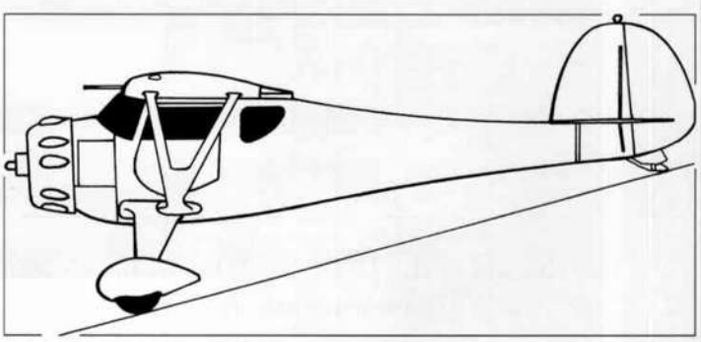
Wings, gross	17.84 m² (192.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	771 kg (1,700 lb)
Max T-O weight	1,315 kg (2,900 lb)
Max wing loading	73.7 kg/m² (15.10 lb/sq ft)
Max power loading	4.48 kg/kW (7.36 lb/hp)



Original Mono Aircraft Monocoupe 110, built in 1933, on which the MonoCulp is based *(Paul Jackson)* 1047137



Culp's MonoCulp *(Paul Jackson)* 0092144

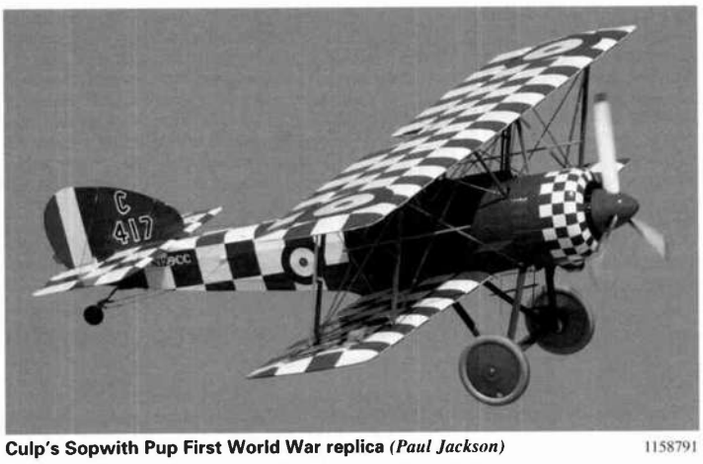
PERFORMANCE:
- Never-exceed speed (VNE) ..... 234 kt (434 km/h; 270 mph)
- Normal cruising speed ..... 148 kt (274 km/h; 170 mph)
- Stalling speed, power off ..... 54 kt (100 km/h; 62 mph)
- Max rate of climb at S/L ..... 914 m (3,000 ft)/min
- Service ceiling ..... 3,660 m (12,000 ft)
- T-O run ..... 122 m (400 ft)
- Landing run ..... 274 m (900 ft)
- Range with max fuel ..... 827 n miles (1,532 n miles; 952 miles)
- Endurance ..... 4 h 0 min

CULP'S SOPWITH PUP

TYPE: Tandem-seat biplane kitbuilt.

PROGRAMME: Announced at Sun 'n' Fun, April 2000, prototype then under construction. First aircraft (N329CC), owned by John S Culp, displayed at AirVenture, Oshkosh, July 2004, immediately following completion.

CUSTOMERS: Orders for 12 kits and 18 sets of plans received by May 2000. Three completed by September 2003, and by August 2005, 12 fuselage frames had been built to satisfy orders.



Culp's Sopwith Pup First World War replica *(Paul Jackson)* 1158791

COSTS: Plans USD200; kit USD47,000 (2006).

DESIGN FEATURES: Based on First World War Sopwith Pup fighter, but using all-new materials and with some modifications. Single-bay biplane with wood strut and wire bracing. Quoted build time 3,500 hours.

FLYING CONTROLS: Conventional and manual. Plain rudder and elevator; ailerons on both upper and lower wings; no flaps. Tab in each elevator.

STRUCTURE: Welded steel tube fuselage with wooden stringers, metal forward fuselage skin; fabric-covered wooden wings; latter with M-6 section.

LANDING GEAR: Tailwheel type; fixed. Two steel tube side Vs and free axle with wound bungee binding to landing gear legs. Hydraulic brakes. Firestone mainwheels with 30 × 3½ tyres; 2.80/2.50-4 tailwheel.

POWER PLANT: One VOKBM M-14P nine-cylinder radial derated to 179 kW (240 hp) driving an MT-Propeller three-blade, constant-speed composites propeller; engines in range 164 to 268 kW (220 to 360 hp) can be fitted. Fuel capacity 189 litres (50.0 US gallons; 41.7 Imp gallons).

ACCOMMODATION: Pilot and passenger in tandem in open cockpit; optional front seat can be faired over for use as baggage space and dummy machine gun fitted to fairing. Compared to original Sopwith Pup, pilot's seat is 15 cm (6 in) further aft.

DIMENSIONS, EXTERNAL:
- Wing span ..... 8.08 m (26 ft 6 in)
- Length overall ..... 5.49 m (18 ft 0 in)
- Height overall ..... 2.74 m (9 ft 0 in)
- Propeller diameter ..... 2.57 m (8 ft 5 in)

DIMENSIONS, INTERNAL:
- Cabin max width ..... 0.71 m (2 ft 4 in)

AREAS:
- Wings, gross ..... 24.62 m² (265.0 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty ..... 590 kg (1,300 lb)
- Max T-O weight ..... 1,088 kg (2,400 lb)
- Max wing loading ..... 44.2 kg/m² (9.06 lb/sq ft)
- Max power loading ..... 6.09 kg/kW (10.00 lb/hp)

PERFORMANCE:
- Never-exceed speed (VNE) ..... 191 kt (354 km/h; 220 mph)
- Normal cruising speed ..... 130 kt (241 km/h; 150 mph)
- Stalling speed ..... 33 kt (62 km/h; 38 mph)
- Max rate of climb at S/L ..... 1,372 m (4,500 ft)/min
- Service ceiling ..... 3,660 m (12,000 ft)
- T-O run ..... 76 m (250 ft)
- Landing run ..... 152 m (500 ft)
- Range with max fuel ..... 521 n miles (965 km; 600 miles)

DARPA

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY (TACTICAL TECHNOLOGY OFFICE)

3701 North Fairfax Drive, Arlington, Virginia 22203-1714
Tel: (+1 703) 696 24 04
Web: www.darpa.mil
WALRUS PROGRAMME MANAGER: Phil Hunt
PUBLIC INFORMATION OFFICER: Ms Jan Walker

In 2004, DARPA launched a feasibility study for an outsize future airlift vehicle under the programme name Walrus. Phase 1, 12-month design study contracts were awarded in August 2005 to Lockheed Martin Advanced Development Programs (USD2.99 million) and Aeros Aeronautical Systems Corporation (USD3.27 million), but the programme ended with the expiry of this funding.

EAGLE

EAGLE R&D LTD CO

2512 Caldwell Boulevard, Nampa, Idaho 83651-1518
Tel/Fax: (+1 208) 466 41 20 (office)
Tel: (+1 208) 461 25 67 (factory)
Web: www.helicycle.com
PRESIDENT: Carolyn Schramm

Company founded 23 April 1998 by Buford J Schramm, originator of the RotorWay kit helicopter programme, who was killed in a flying accident to an Eagle on 27 April 2004. Eagle's sales policy for its Helicycle includes mandatory test flying of customer-completed aircraft by a factory pilot before handover of final key components.

EAGLE HELICYCLE

TYPE: Single-seat ultralight helicopter kitbuilt.

PROGRAMME: Prototype (N3275Q) registered in April 1995; crashed 27 April 2004, with loss of B J Schramm. First customer-built aircraft (N9019U) assembled by Douglas Swochert of Burlington, Wisconsin; initially intended with two-stroke Rotax, but completed with T62 turboshaft and registered as a Swochert A/W 95.

CUSTOMERS: At least 41 kits sold by 2005, of which 24th completed and first flown by Joe Loxtercamp of Cincinnati on 31 May 2006. One obtained by South African customer in 2004. New Zealand example completed early 2005 and one in Australia at same time.

COSTS: Kit USD24,000, plus USD12,500 for T62 engine (2006).

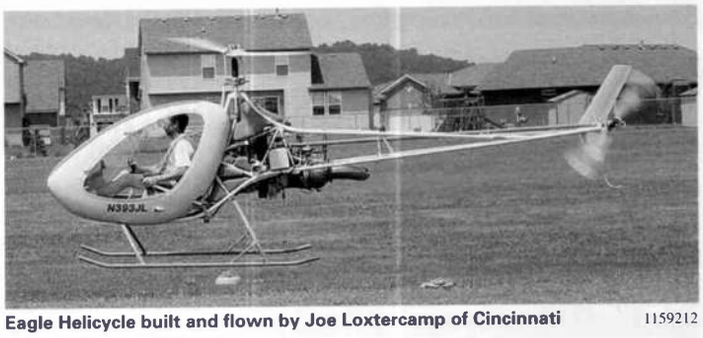
DESIGN FEATURES: Embodies best features from Mr Schramm's experience of rotary-wing design; comparable in capabilities to industry-standard Robinson R22, but single-seat. Conventional appearance; small streamlined, enclosed cabin with power plant, gearbox and fuel immediately to rear; tail rotor and empennage mounted on open boom; dorsal and ventral fins, latter incorporating tail bumper. Two-blade main and tail rotors.

Handling assisted by fully harmonised rotor; modulated collective system; elastomeric thrust bearings; generous flapping angle for low *g* and slope landing conditions; control friction devices; and electronic throttle control.

STRUCTURE: Metal tube structure with composites cabin.

LANDING GEAR: Twin-skid type.

POWER PLANT: One piston or turbine engine. Two-stroke Rotax 618 initially proposed, but manufacturer discontinued production. Interest changed in 2002 to Hirth 3701 rated at



Eagle Helicycle built and flown by Joe Loxtercamp of Cincinnati 1159212

64.9 kW (87 hp) at 5,000 rpm, although not pursued. Alternative 59.6 kW (79.9 hp) Rotax 912 flat-four installation under development in 2002, but proved too expensive.

First production helicopter flown with Solar T62 turbine ground power plant derated to 78.3 kW (105 shp); modified T62 installation offered by Eagle as standard power plant, currently derated to 67.1 kW (90 shp). Fuel capacity 79.0 litres (21.0 US gallons; 17.5 Imp gallons), including reserve tank.

Data for T62 engine installation:

DIMENSIONS, EXTERNAL:
- Main rotor diameter ..... 6.35 m (20 ft 10 in)
- Tail rotor diameter ..... 1.12 m (3 ft 8 in)
- Length overall ..... 6.05 m (19 ft 10 in)
- Height overall ..... 2.18 m (7 ft 2 in)

WEIGHTS AND LOADINGS:
- Weight empty ..... 227 kg (500 lb)
- Max T-O weight ..... 385 kg (850 lb)

PERFORMANCE:
- Max level speed ..... 96 kt (177 km/h; 110 mph)
- Max cruising speed (with doors) ..... 83 kt (153 km/h; 95 mph)
- Max rate of climb at S/L ..... 274 m (9,500 ft)
- Hovering ceiling IGE ..... 2,895 m (9,500 ft)
- Max range, incl reserves ..... 139 n miles (257 km; 160 miles)

ECLIPSE

ECLIPSE AVIATION CORPORATION

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Dr Oliver Masefield
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VICE-PRESIDENT, ENGINEERING: Ken Harness
VICE-PRESIDENT, MANUFACTURING: Paul Schumacher
VICE-PRESIDENT, SUPPLY MANAGEMENT: Chris Herzog
VICE-PRESIDENT, MARKETING, SALES AND CUSTOMER CARE: Michael McConnell
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VICE-PRESIDENT, TRAINING AND FLIGHT OPERATIONS: Don Taylor
VICE-PRESIDENT/CIO: Michael Brown
VICE-PRESIDENT, INVESTOR RELATIONS: Perry Denker
VICE-PRESIDENT, CUSTOMER CARE: Ken McNamara
VICE-PRESIDENT, SUPPLY CHAIN MANAGEMENT: Bill Bonder
VICE-PRESIDENT, QUALITY: Saul Pacheco
VICE-PRESIDENT, HUMAN RESOURCES: Tina Rulo
DIRECTOR, PUBLIC RELATIONS: Andrew Broom

Eclipse Aviation formed May 1998 (as Pronto Aircraft) to market the Eclipse 500, which supersedes the Williams V-Jet II (1999–2000 *Jane's*). Eclipse had funding of more than USD600 million in place by October 2006. At that time the company had more than 850 employees.

ECLIPSE ECLIPSE 500

TYPE: Light business jet.

PROGRAMME: Development began June 1999 and announced March 2000; 22 per cent scale model wind tunnel testing undertaken March to April 2000; preliminary design review completed September 2000; full-size mockup displayed at EAA AirVenture 2000 and NBAA 2000. Third round of wind tunnel tests completed January 2001 and critical design review began May 2001; transfer of engineering and certification responsibility from Williams completed July 2001. Designated 3.43 kN (770 lb st) Williams EJ-22 engine first flown in Rockwell Sabreliner 60 testbed (N15HF) 30 May 2002.

Prototype (c/n 500-100/N500EA) rolled out 13 July 2002; first flight 26 August 2002, but no further flights reported by mid-November when Eclipse announced abandonment of Williams engine; selection of Pratt & Whitney Canada announced 19 February 2003. Six flying aircraft used in the development and certification programme, as described under Current Versions. Pending availability of Pratt & Whitney Canada PW610F, the prototype resumed flight testing on 15 May 2003 with two 4.48 kN (1,000 lb st) Teledyne CAE F408-CA-400 turbofans and completed its flying career in October 2003.

First ground run of engine completed 4 May 2004; flight trials (on Pratt & Whitney Canada's Boeing 720 testbed) began 16 December 2004; first engine deliveries to Eclipse on 15 December 2004, followed by first flight of Eclipse 500 with PW610Fs. This was N503EA (third airframe, but second to fly) which achieved two sorties on 31 December 2004. The first four aircraft accumulated some 3,500 flight hours during the test programme, leading to initial type certification on 27 July 2006, and FAR Pt 23 plus take-off and landing to Pt 25 standard and RVSM certification, on 30 September 2006. First delivery (N508JA c/n 000001) to David Crowe 31 December 2006 at which time seven further aircraft were complete and being prepared for customer delivery; second (N126DJ) was initial aircraft for DayJet in air taxi role.

Airframe static testing completed by 14 September 2005, paving the way for initial FAA approval of 10,000-hour airframe life.

CURRENT VERSIONS (SPECIFIC): **N500EA**: Airframe 500-100; build order 1. Prototype. First flight 26 August 2002; final flight 22 October 2003 (55 sorties; 54 hours); lightning survivability trials December 2003. (Note that N501EA is an unrelated Cessna 501 Citation).

N502EA: Build order changed from 2 to 3 in 2004. First flight 14 April 2005. Structures and aerodynamics testing (ground vibration, loads, strain measurements, air data calibration for RVSM, flutter, stability and stall, field performance and icing).

N503EA: Airframe 500-108; build order 2. Second to fly; first production-conforming airframe. First flight 31 December 2004. First public appearance at EAA Sun 'n' Fun March 2005. FAA certification testing for mechanical systems (climate control, landing gear, fuel system, power plant, oxygen system and hot/cold weather).

N504EA: Build order 4. First flight 21 April 2005. FAA certification testing for avionics and electrical systems (electrical navigation, communication systems, primary flight display, MFDs, autopilot, lighting).

N505EA: Build order 5. First flight 11 July 2005. 'Beta' test airframe to full production configuration for accelerated, 1,000-hour test programme to prove functionality and reliability.

Static test: Build order 6. Airframe loads testing.

N506EA: Build order 7. First flight 24 August 2005. 'Beta' test airframe No. 2 plus high intensity radiated fields and lightning tests.

Fatigue Test: Build order 8. To undergo three 'lifetimes' of fatigue testing.

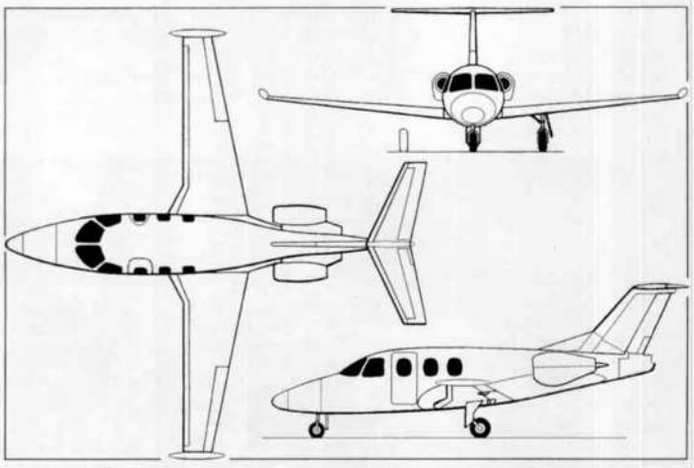
CUSTOMERS: Total of 2,500 firm orders and options held by mid-October 2006 from customers in the USA, Europe and South America. Announced customers include Aviace AG of Switzerland, which ordered 112 on 28 May 2002 for its fractional ownership scheme; OurPLANE Inc, which has ordered 10, plus 10 options; Linear Air of Massachusetts, which has ordered 15 plus 15 options; JetSet Air of the UK which has ordered 25, with 25 options; TAG Aviation USA (10); DayJet, which has ordered 293 plus 70 options; and Dole Food Company, Inc, which has ordered three. In October 2006 the next available individual aircraft order delivery position was in October 2008, while fleet customer delivery commitments extended into 2010.

COSTS: Development programme USD350 million (estimated). Unit cost USD950,000-USD975,000 for pre-2003 orders (all at 2000 values); USD1.63 million (2006).

DESIGN FEATURES: Designed to fulfil goals of NASA's Small Air Transportation System programme. Friction stir welding to be used for first time on high-volume production, obviating need for large numbers of rivets and reducing weight of finished article. Unswept, low-mounted wing and T tail. Redesign work undertaken during 2001 included increasing the size of the horizontal engine pylons, modifying the rear fuselage to improve engine intake airflow and modifications to wingroot shape, wing placement (moved aft 9 cm (3½ in)) and redesigned tail.

Airframe modifications resulting from installation of the PW610Fs included moving the engine mounts forward by 0.24 m (9 ½ in), strengthening the wing spar, moving the vapour-cycle machine from the wingroot fairing to the nose, modifying the flaps to increase Fowler effect, and addition of small tip tanks to accommodate the additional fuel needed to

First Eclipse 500 for an air taxi operator, DayJet *(Paul Jackson)* 1159733



Eclipse 500 prior to larger wingtip tanks and fin bullet fairing *(James Goulding)* 1159687

Eclipse 500 light business jet *(Paul Jackson)* 1159732

meet range guarantees. These tanks further enlarged in 2006, again for achievement of guaranteed range. Simultaneously, bullet fairing added to tailplane intersection.

FLYING CONTROLS: Conventional and manual. Sidestick controller. Electrically actuated Fowler flaps and split tailcone speedbrakes.

STRUCTURE: Principally of aluminium; sharply tapered rear fuselage means distance between engine centres will be 1.04 m (3 ft 5 in). Suppliers include: Autronics (aircraft computer system); Crossbow Technology (AHRS); FreeFlight Systems (GPS); Fuji Heavy Industries (wing); Hampson Industries PLC Aerospace Fabrications & Assemblies Division (tail unit); Harco Laboratories (pitot/static system and air data computer); Hispano-Suiza Canada (FADEC); and Meggitt Avionics (autopilot).

LANDING GEAR: Retractable tricycle type with trailing-link main gear designed by Cal-Draulics. Cleveland wheels and brakes with Michelin radial tyres fitted for improved rough-field operations. Nosewheel steering ±65°. Turning circle about wingtip 15.1 m (49 ft 6 in).

POWER PLANT: Two pod-mounted Pratt & Whitney Canada PW610F turbofans, each rated at 4.00 kN (900 lb st) at ISA+10°C, with FADEC. Fuel capacity 871 litres (230 US gallons; 191.5 Imp gallons) in prototypes; further 91 litres (24 US gallons; 20 Imp gallons) in production versions, which have enlarged wingtip tanks.

ACCOMMODATION: Pilot and up to five passengers; dual sidestick controllers for pilot(s); cabin laid out in club format. Choice of Standard or LX interiors in four colour combinations. Polarised windows throughout; door on port side of cabin behind flight deck. Optional lavatory. Horizontally split door on port side, behind pilots. All-LED cabin lighting and dual-zone air-conditioning/heating standard; entertainment package and refreshment centre optional.

SYSTEMS: Pressurisation system maximum differential 0.57 bar (8.25 lb/sq in) maintains sea level cabin environment to 6,553 m (21,500 ft) and 2,440 m (8,000 ft) cabin at FL410. Pneumatic de-icing system for wing and tailplane leading-edges, bleed anti-icing for engine inlet, and electrically heated windscreen and air system probes. Lighting system by DeVore Aviation. Oxygen system with 0.62 m^3 (22 cu ft) tank standard.

AVIONICS: Avio intelligent flight system, developed in conjunction with Avidyne and General Dynamics; features all-glass, three-screen, fully IFR cockpit with two PFDs and one MFD. Standard avionics suite includes dual three-axis autopilots; FMS; dual AHRS; with air data computer and pitot static systems; autothrottle; aircraft performance computer; colour weather radar; traffic information services; dual VHF nav/com/LOC/GS, Mode S transponders, GPS active route moving map display; flight path predictor; VNAV; LNAV; ELT; data loader, health monitoring, and RVSM capability. Options include ADS-B; Class B TAWS; Stormscope WX-500/Skywatch HP; co-pilot package; FAA FAR Pt 135 package; Iridium Satellite mobile satcom system; Avio FlightBag software; and international operations package.

All data are provisional.

DIMENSIONS, EXTERNAL:

Wing span	11.40 m (37 ft 4¾ in)
Length overall	10.08 m (33 ft 1 in)
Height overall	3.35 m (11 ft 0 in)
Wheelbase	3.32 m (10 ft 10¾ in)

DIMENSIONS INTERNAL:

Cabin: Length	3.76 m (12 ft 4 in)
Max width	1.42 m (4 ft 8 in)
Max height	1.27 m (4 ft 2 in)
Cabin door: Height	1.19 m (3 ft 11 in)
Width	0.60 m (1 ft 11½ in)
Volume	4.5 m^3 (160 cu ft)
Baggage compartment volume	0.74 m^3 (26 cu ft)

WEIGHTS AND LOADINGS:

Weight empty	1,610 kg (3,550 lb)
Baggage capacity	118 kg (260 lb)
Max fuel weight	765 kg (1,686 lb)
Max T-O weight	2,685 kg (5,920 lb)
Max ramp weight	2,699 kg (5,950 lb)
Max landing weight	2,504 kg (5,520 lb)
Max zero-fuel weight	2,212 kg (4,876 lb)
Payload with full fuel	322 kg (710 lb)
Max power loading	335.6 kg/kN (3.29 lb/lb st)

PERFORMANCE:

Max operating Mach No. (MMO): S/L to FL200	0.68
above FL200	0.64
Max cruising speed	370 kt (685 km/h; 426 mph)
Stalling speed	69 kt (128 km/h; 79 mph)
Max rate of climb at S/L	1,010 m (3,314 ft)/min
Rate of climb at S/L, OEI	277 m (910 ft)/min
Time to climb to FL350	19 min
Service ceiling	12,495 m (41,000 ft)
Service ceiling, OEI	7,620 m (25,000 ft)
T-O run	700 m (2,297 ft)
Landing run	657 m (2,155 ft)
Range with max fuel, four occupants, 45 min reserves	1,300 n miles (2,408 km; 1,496 miles)
Range with NBAA IFR reserves, 100 n mile (185 km; 115 mile) alternate	1,125 n miles (2,083 km; 1,295 miles)

ENSTROM

THE ENSTROM HELICOPTER CORPORATION

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PRESIDENT: Jerry M Mullins
DIRECTOR, ENGINEERING: William E Taylor Jnr
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DIRECTOR, MANUFACTURING: Billy Selmon
INFORMATION CONTACT: Marian Lambrecht

Enstrom Helicopter Corporation was established in 1959 to develop and produce light helicopters, based on Rudy Enstrom's initial design work. Extensive development and certification efforts led to start of production of the F28 helicopter in April 1965; development of turbine-powered model was initiated in 1988, culminating in certification of the TH28 in September 1992 and the 480, to FAR Pt 27 standards, in December 1994.

Initially publicly owned, the company has passed through a period as a subsidiary of a large corporation and is now privately owned by a Swiss national. By the beginning of 2000, Enstrom had produced over 1,000 helicopters of which over 700 remain in operation; deliveries have comprised eight in 1999, seven in 2000, eight in 2001, nine in 2002, 17 in 2003, 23 in 2004 and 29 in 2005. 1,000th delivery made at Heli-Expo 2002 on 14 February 2002. The fleet has amassed over three million flying hours. Factory floor area 7,897 m^2 (85,000 sq ft); workforce 90.

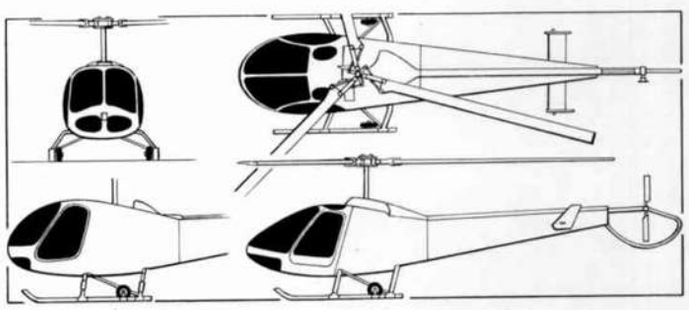
ENSTROM F28F and 280FX

TYPE: Three-seat helicopter.

PROGRAMME: Prototype F28 flew 12 November 1960. Basic F28A and 280 replaced by turbocharged F28C and 280C, certified by FAA 8 December 1975; production of these models ceased November 1981; succeeded by F28F and 280F Shark.

CURRENT VERSIONS: **F28F Falcon:** Basic model certified to FAR Pt 6 on 31 December 1980; South Korean certification achieved in early 2006. The two major changes incorporated into the F28F and 280F/280FX over the earlier F28C/280C series were an increase in power from 153 kW (205 shp) to 168 kW (225 shp) and the addition of a throttle correlator to reduce pilot workload. Most recent changes to the F28F and 280FX are the redesigned main gearbox with a heavy wall main rotor shaft (standard equipment on all new aircraft and retrofittable to all existing F models); optional lightweight exhaust silencer, which reduces noise in the hover by 40 per cent and gives a 30 per cent reduction when flying at 152 m (500 ft) (can also be retrofitted to F28F, 280F and 280FX); and a lightweight starter motor.

Enstrom 280FX three-seat helicopter *(Paul Jackson)* 1159369



Enstrom 280FX, with scrap side view of F28F *(James Goulding)* 0085773

F28F-P Sentinel: Dedicated police patrol version; first delivery October 1986; can be fitted with a PA and siren system, Spectrolab SX-5 or Carter searchlight, specialised police equipment, FLIR and datalink. F28F-P has same specification and performance as F28F. No recent production.

280FX Shark: Certified to FAR Pt 6 on 14 January 1985. Prototype N280FX; South Korean certification achieved in early 2006. Improvements over previous 280 series (see also F28F entry) include new seats with lumbar support and energy-absorbing NASA foam, new tailplane with endplate fins, tail rotor guard, covered tail rotor drive shaft, redesigned air inlet system, and completely faired landing gear. Optional internal auxiliary fuel tank extends range to 339 n miles (627 km; 390 miles).

CUSTOMERS: Total of 735 of earlier versions (14 F28, 315 F28A, 121 F28C, 56 F28C-2, 21 280, 206 280C and two 280L). F28F in low-rate production; 140 built by mid-2005; none further by mid-2006. Total of 128 280FXs built up to mid-2006, increasing Enstrom piston-engined helicopter production to 1,003. Deliveries in 2005 totalled 15. Peruvian Army has 10 F28Fs for flight training; Colombian Air Force operates 12 F28Fs for primary and instrument training. Numerous US police departments operate F28F-P for patrol and surveillance missions. Most recent military customer is the Venezuelan National Guard, which took delivery of four 280FXs for training in January 2002. Other recent customers include Hanseo University of Korea, which ordered one on 28 April 2005.

COSTS: Basic 2005 price USD333,500 for F28F Falcon and 280FX Shark. Direct operating cost USD115.21 per hour.

DESIGN FEATURES: Conventional light helicopter with skid landing gear and tubular metal tail rotor protector; horizontal stabiliser with fins at tips. High inertia, three-blade fully articulated rotor head with blades attached by retention pin and drag link; control rods pass inside tubular rotor shaft to swashplate inside fuselage; no rotor brake; blade section NACA 0013.5; blades do not fold; two-blade teetering tail rotor. Thirty-groove belt drive from horizontally mounted engine to transmission.

FLYING CONTROLS: Conventional and manual. Trim system absorbs feedback from rotor and repositions stick datum as required by pilot.

STRUCTURE: Bonded light alloy blades. Fuselage has glass fibre and light alloy cabin section, steel tube centre-section frame, and stressed skin aluminium tailboom.

LANDING GEAR: Skids carried on Enstrom oleo-pneumatic shock-absorbers. Air Cruiser inflatable floats available optionally. Oleo extenders optional on F28F.

POWER PLANT: One 168 kW (225 hp) Textron Lycoming HIO-360-F1AD flat-four engine with Rotomaster 3BT5EE10J2 turbocharger. Two fuel tanks, each of 79.5 litres (21.0 US gallons; 17.5 Imp gallons). Total standard fuel capacity 159 litres (42.0 US gallons; 35.0 Imp gallons), of which 151 litres (40.0 US gallons; 33.3 Imp gallons) are usable.

Auxiliary tank, capacity 49 litres (13.0 US gallons; 10.8 Imp gallons), can be installed in the baggage compartment. Oil capacity 9.5 litres (2.5 US gallons; 2.1 Imp gallons).

ACCOMMODATION: Pilot and two passengers, side by side on bench seat; centre place removable. Removable door on each side of cabin. Baggage space aft of engine compartment, with external door. Cabin heated and ventilated.

SYSTEMS: Electrical power provided by 24 V 70 A engine-driven alternator; 12 V 70 A system optional. No hydraulic system.

AVIONICS: Options include:

Comms: Bendix/King KY 196A/197A com; KX 155A nav/com with KI 208 VOR/LOC or KI 209 VOR/LOC/GS; Garmin GTX 327 or Bendix/King KT 76A transponder; ACK A-30 blind encoder; Garmin GMA 340 or Bendix/King KMA 24H-71 audio panels; Ameri-King AK-450 ELT; PS Engineering PM 1000 VOX mono or PM 3000 VOX stereo intercom; PS Engineering PCD 7100-1 VOX intercom with CD player; PS Engineering PMA 7000CD audio panel with CD player; David Clark H10-36 or H10-56 or Bose Series X headsets.

Flight: Garmin GNS 430 or GNS 530 GPS/COM or GPS/COM/GS/LOC; Bendix/King KCS 55A compass system with KI 525 HSI; KR 87 digital ADF; KRA 10A radar altimeter; Skyforce Color Skymap Model IIIC; KA 33 avionics cooling fan.

Instrumentation: Standard equipment includes dual scale airspeed indicator, vertical speed indicator, sensitive altimeter, compass, outside air temperature gauge, turn and bank indicator, rotor/engine tachometer, manifold pressure/fuel flow gauge, EGT gauge, oil pressure gauge, gearbox and oil temperature gauge, ammeter, cylinder head temperature gauge, fuel quantity gauge and clock. Eight-light annunciator panel consisting of low rotor rpm, chip detectors (main and tail rotor transmissions), overboost, clutch not fully engaged, low fuel pressure, starter engaged, and low-voltage warning lights. AIM 1100-28LS or AIM 205-1BL electric directional gyro and MC-3T2 turn and slip indicator optional.

EQUIPMENT: Shoulder harnesses for three seats. NASA foam seat cushions, carpet with scuff plates, and pneumatic door openers standard. Night lighting is optional for F28F and standard on 280FX. Night lighting includes instrument lighting with dimmer control, position light on each horizontal stabiliser tip, anti-collision light and nose-mounted landing light. Optional equipment for both F28F and 280FX includes fixed float kit, wet or dry agricultural chemical spray kit cargo hook for utility missions, all leather seats custom paint schemes and main and tail rotor high visibility paint schemes all optional. Wide instrument panel available for IFR training.

DIMENSIONS, EXTERNAL (F28 and 280, except where specified):

Main rotor diameter	9.75 m (32 ft 0 in)
Tail rotor diameter	1.42 m (4 ft 8 in)
Distance between rotor centres	5.56 m (18 ft 3 in)
Main rotor blade chord	0.24 m (9½ in)
Tail rotor blade chord	0.11 m (4½ in)
Length overall, rotors stationary	8.92 m (29 ft 3 in)
Fuselage: Length: F28F	8.56 m (28 ft 1 in)
280FX	8.75 m (28 ft 8½ in)
Max width: F28F	1.55 m (5 ft 1 in)
280FX	1.52 m (5 ft 0 in)
Height:	
to top of cabin: F28F	1.85 m (6 ft 1 in)
280FX	1.83 m (6 ft 0 in)
to top of rotor head	2.74 m (9 ft 0 in)
Tailplane span	1.60 m (5 ft 3 in)
Skid track	2.21 m (7 ft 3 in)
Cabin doors (each): Height	1.04 m (3 ft 5 in)
Width	0.84 m (2 ft 9 in)
Height to sill	0.64 m (2 ft 1 in)
Baggage door: Height	0.55 m (1 ft 9½ in)
Width	0.39 m (1 ft 3½ in)
Height to sill	0.86 m (2 ft 10 in)

DIMENSIONS, INTERNAL:

Cabin max width: F28F	1.55 m (5 ft 1 in)
280FX	1.50 m (4 ft 11 in)
Baggage compartment volume	0.18 m^3 (6.3 cu ft)

AREAS:

Main rotor disc	74.72 m^2 (804.25 sq ft)
Tail rotor disc	1.66 m^2 (17.88 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, equipped: F28F	712 kg (1,570 lb)
280FX	719 kg (1,585 lb)
Baggage capacity: tailboom	49 kg (108 lb)
Max T-O weight: F28F, 280FX	1,179 kg (2,600 lb)
Max disc loading:	
F28F, 280FX	15.8 kg/m^2 (3.23 lb/sq ft)

PERFORMANCE (both versions at AUW of 1,066 kg; 2,350 lb, except where indicated):

Never-exceed speed (VNE):	
F28F	97 kt (180 km/h; 112 mph)
280FX	102 kt (189 km/h; 117 mph)
Max level speed, S/L to FL30:	
F28F	97 kt (180 km/h; 112 mph) IAS
280FX	102 kt (189 km/h; 117 mph) IAS
Econ cruising speed: F28F	89 kt (165 km/h; 102 mph)
280FX	93 kt (172 km/h; 107 mph)
Max rate of climb at S/L:	
at AUW of 1,066 kg (2,350 lb)	442 m (1,450 ft)/min
at AUW of 1,179 kg (2,600 lb)	350 m (1,150 ft)/min
Max certified altitude	3,660 m (12,000 ft)
Hovering ceiling:	
IGE: at 1,066 kg (2,350 lb)	4,020 m (13,200 ft)
at 1,179 kg (2,600 lb)	2,345 m (7,700 ft)
OGE: at 1,066 kg (2,350 lb)	2,650 m (8,700 ft)
at 1,179 kg (2,600 lb)	1,707 m (5,600 ft)
Max range, standard fuel, no reserves:	
F28F	240 n miles (445 km; 277 miles)
280FX	260 n miles (483 km; 300 miles)
Max endurance	3 h 30 min

ENSTROM 480 and TH-28

TYPE: Light utility helicopter.

PROGRAMME: Proof-of-concept 280FX, powered by Allison 250-C20W turbine engine, flown December 1988; first flight of wide-cabin 480/TH-28 prototype (N8631E) in October 1989; second 480/TH-28 (production prototype) flew December 1991; TH-28 FAA certified September 1992 (three-seat), 480 FAA certified in June 1993 and recertified to FAR Pt 27 in December 1994.

CURRENT VERSIONS: **480:** Initial version. five-seat (two plus three) configuration with staggered seating for forward visibility from all seats. Easily reconfigured to three seats for training or executive transport; or pilot's seat only for transporting light cargo. Instrument panel centrally located above avionics console.

480B: Certification received 8 February 2001; UK CAA certification achieved August 2003; South Korean certification achieved in early 2006. Compared to 480, has increased gross weight and improved transmission, incorporates cyclic control and airframe vibration damping, providing significant improvement in comfort. Prototype, N480EN exhibited at NBAA Convention, New Orleans, October 2000. FAA approval granted in February 2004 for increase in maximum take-off altitude at maximum take-off weight from 915 m (3,000 ft) to 3,050 m (10,000 ft) density altitude.

Guardian: Dedicated police patrol/security version.

TH-28: Prototype (N8631E) first flew 7 October 1989. Specially configured as a training/light patrol helicopter; unique features include three crashworthy seats, crashworthy fuel system, and a large instrument panel which will accommodate dual instrumentation for either VFR or IFR training. Seating configuration allows training of two students simultaneously.

CUSTOMERS: Production began in 1994 with initial deliveries to Europe. Sixth and final TH-28 produced in 1993 and delivered to China in 1997. Total of 18 480Bs delivered in 2004 and 14 in 2005; 95 registered by mid-2006, including 43 480s up to 2002. Certified and operating in 14 countries: Australia, Belgium, Brazil, Canada, China, France, Germany, Japan, South Africa, Sweden, Switzerland, Thailand, UK and US. In addition, 480s are also operating in Burkina Faso and Russian Federation. Recent customers include the Indonesian Police which ordered 18 480Bs in 2003, of which two were delivered in 2003 and the last on 14 November 2004; and Hanseo University of Korea, which ordered one on 28 April 2005.

COSTS: Standard equipped USD709,500 (2005). Direct operating cost USD201 per hour. TH-28 price on application.

Description generally as for F28/280, except that below (for 480B).

DESIGN FEATURES: High-inertia, three-blade, fully articulated main rotor system with upgraded and sturdier main rotor gearbox than piston models; larger tail rotor; unboosted flight controls and high skid gear are standard equipment. Rotor speed 372 rpm nominal; 385 rpm maximum permissible; anti-nodal vibrating cantilever beam to damp vibration at low speeds. Extensive crashworthiness and safety features incorporated into basic design. The 480B cabin layout can be quickly reconfigured to seat one, three or five persons.

Enstrom 480 turbine-powered light helicopter *(Paul Jackson)* 1159370

Elastomeric dampers for main rotor head introduced from January 2005 and available as retrofit, but removed as precautionary measure after August 2005 ground resonance incident.

POWER PLANT: One 313 kW (420 shp) Rolls-Royce 250-C20W turboshaft engine derated to 227 kW (305 shp) for take-off and 207 kW (277 shp) for continuous operation. Engine air inlet particle separator with 93 per cent removal capability is standard. Fuel capacity 340 litres (90.0 US gallons; 74.9 Imp gallons) in two interconnected tanks.

ACCOMMODATION: See Current Versions. Options include air conditioning (two or three evaporator system). Baggage compartment in tailboom.

SYSTEMS: Electrical power provided by 28 V 150A starter/generator; 18 Ah lead-acid battery; external power receptacle standard.

AVIONICS: Generally as for F28F, but additional options include Bendix/King KMD 150MFD multifunction display, UPS Technologies MX20 MFD, and RC Allen 26 BK-2-8 attitude gyro and 15 BK-1 directional gyro.

EQUIPMENT: Optional equipment include emergency pop-out floats, two- or three-evaporator air conditioning systems and cargo hook rated for external loads up to 454 kg (1,000 lb); 480B can also be fitted with police patrol equipment including special police radios, searchlight, siren/PA system, FLIR and data recording facility.

DIMENSIONS, EXTERNAL:

Main rotor diameter	9.75 m (32 ft 0 in)
Tail rotor diameter	1.54 m (5 ft 0½ in)
Distance between rotor centres	5.64 m (18 ft 6 in)
Fuselage: Length, incl tailskid	9.09 m (29 ft 10 in)
Max width	1.79 m (5 ft 10½ in)
Height: to top of cabin	2.11 m (6 ft 11¼ in)
to top of rotor head	3.00 m (9 ft 10 in)
Skid track	2.50 m (8 ft 2½ in)

DIMENSIONS, INTERNAL:

Cabin max width	1.80 m (5 ft 10¾ in)

AREAS:

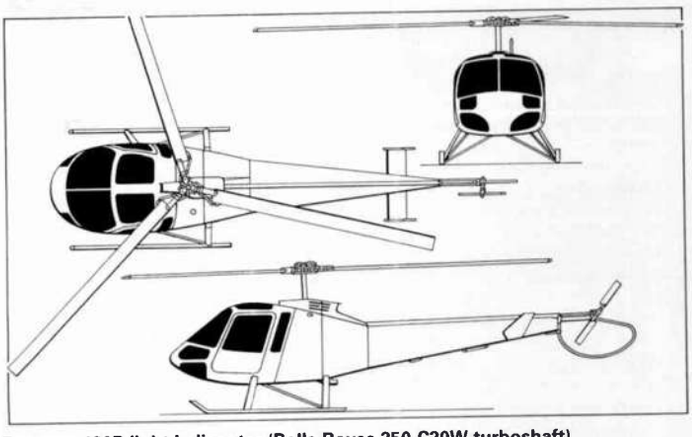
Main rotor disc	74.72 m² (804.25 sq ft)
Tail rotor disc	1.85 m² (19.96 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, equipped	826 kg (1,820 lb)
Baggage capacity: cabin	23 kg (50 lb)
tailboom	70 kg (155 lb)
Max T-O weight	1,360 kg (3,000 lb)
Max disc loading	18.2 kg/m² (3.73 lb/sq ft)

PERFORMANCE (A: at 1,360 kg; 3,000 lb AUW, B: at 1,134 kg; 2,500 lb):

Never-exceed speed (VNE): A	124 kt (229 km/h; 142 mph)
B	125 kt (231 km/h; 143 mph)
Cruising speed: A	109 kt (202 km/h; 125 mph)
B	115 kt (213 km/h; 132 mph)
Max rate of climb at S/L: A	419 m (1,375 ft)/min
B	488 m (1,600 ft)/min
Service ceiling: A	3,050 m (10,000 ft)
B	3,965 m (13,000 ft)
Hovering ceiling:	
IGE: A	3,750 m (12,300 ft)
B	4,755 m (15,600 ft)
OGE: A	1,645 m (5,400 ft)
B	4,265 m (14,000 ft)
Max range (no reserves) at FL30:	
A	355 n miles (657 km; 408 miles)
B	370 n miles (685 km; 426 miles)
Endurance (no reserves): A	4 h 30 min
B	4 h 42 min



Enstrom 480B light helicopter (Rolls-Royce 250-C20W turboshaft) *(Mike Keep)* 0016199

EVIATION

EVIATION LC

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Web: eviationjets.com

CHAIRMAN: Matt Eller
PRESIDENT AND CEO: Gregory Powers

Eviation Jets formed by businessman, Matt Eller upon acquisition on 2 October 2003 of bankrupt VisionAire company, facilities, drawings and tools. Prototype of single-engined VA-10 Vantage business jet purchased separately from a VisionAire creditor.

Eviation Jets do Brasil Engenharia de Aeronaves Ltda, established in November 2004 to completely redesign VA-10 to twin-engined configuration under leadership of Guido Fontegalant Pessotti, at São José dos Campos, Brazil, where certification is to take place. VA-10 prototype flown to Brazil in November 2004. In mid-2005, the company changed its name to Eviation Jets do Brasil Indústria Aeronáutica Ltda to reflect aircraft manufacturing intentions. EV-20 to be manufactured in Brazil at location to be decided. Marketing to be carried out by Ames office. Prototype first flight delayed by redesign and search for funding.

EVIATION EV-20 VANTAGE

TYPE: Business jet.

PROGRAMME: Four-passenger, unpressurised VA-10 Vantage designed in US by Burt Rutan's Scaled Composites as Model 247-4 around single 13.55 kN (3,045 lb st) Pratt & Whitney JT15D-5D turbofan buried in rear fuselage, fed by twin intakes on top fuselage corners. First flew (N247VA) 16 November 1996; accumulated some 300 flying hours prior to VisionAire's bankruptcy on 31 January 2003. Further flight trials in Brazil by current company; returned to US for storage, February 2006.

Extensively redesigned in Brazil by Guido Pessotti as nine-passenger, pressurised twin-jet. Work began in January 2005; Brazilian RBHA Pt 23 certification process began 28 April 2005; new configuration frozen mid-2005; detail design phase then begun; critical design review December 2005. Prototype then due to fly in October 2006; certification due late 2007 after 1,200 hours by prototype, plus static test and fatigue airframes, all being built in Brazil from outsourced materials on production tooling.

In early 2006, Eviation was continuing search for funding to complete the programme. By late 2006, the required funds had not been secured and the prototype remained unbuilt.

COSTS: USD3,595 million (2007).

DESIGN FEATURES: Low-set, laminar flow, straight wing replaces mid-positioned, forward-swept (8° 30') unit of VA-10. Two podded turbofans on rear fuselage shoulders allow additional internal space. Initial redesign by Pessotti featured low-set tailplane with anhedral, to avoid jet efflux, but changed to T tail for better performance.

Operable within FAR Pt 91 or Pt 135 requirements and FAR Pt 36 noise criteria.

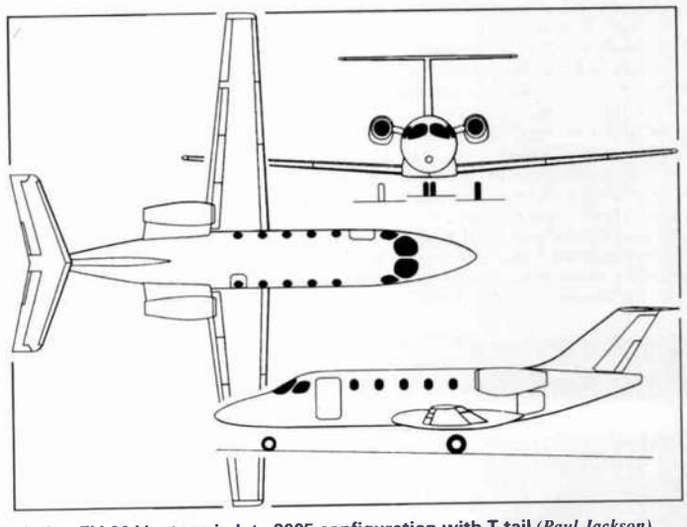
FLYING CONTROLS: Conventional and manual. Electrically actuated flaps and spoilers; electric trim tabs on ailerons, rudder and elevator.

STRUCTURE: Wholly of resin-impregnated carbon fibre, except tailplane and wing leading-edges of metal.

LANDING GEAR: Tricycle type; retractable. Offset twin-wheel nose gear and wing-mounted cantilever single-wheel main units with integral half-forks replace VA-10 units. Free-fall emergency deployment.

POWER PLANT: Two 8.74 kN (1,965 lb st) dual FADEC-controlled Williams FJ44-1AP turbofans. Fuel capacity 1,556 litres (411 US gallons, 342 Imp gallons).

ACCOMMODATION: Up to 10 persons, including pilot(s), with lavatory and baggage area. Cabin seats six, including club-four arrangement of forward seats; or eight all in forward-facing seats. Cabin equivalent altitude S/L up to FL250; reducing to 2,375 m (7,800 ft) at FL410.



Eviation EV-20 Vantage in late 2005 configuration with T tail *(Paul Jackson)* 1159408

Artist's impression of Eviation EV-20 Vantage business jet 1159330

AVIONICS: *Instrumentation:* Garmin G1000 two-screen EFIS, including 264 mm (10.4 in) PFD and 381 mm (15 in) MFD (single-pilot operation) or optional three-screen EFIS with second 10.4 in PFD on starboard side (dual-pilot operation).

DIMENSIONS, EXTERNAL:

Wing span	14.97 m (49 ft 1½ in)
Length: fuselage	12.93 m (42 ft 5 in)
overall	14.09 m (46 ft 2½ in)
Height overall	4.57 m (14 ft 11¾ in)
Tailplane span	5.40 m (17 ft 8½ in)
Wheelbase	5.69 m (18 ft 8 in)
Wheel track	2.93 m (9 ft 7 in)
Passenger door width	0.75 m (2 ft 5½ in)

DIMENSIONS, INTERNAL:

Cabin:	
Length: between bulkheads	6.83 m (22 ft 5 in)
aft of cockpit	5.38 m (17 ft 8 in)
Max width	1.61 m (5 ft 3½ in)
Max height	1.62 m (5 ft 3¾ in)
Baggage compartment volume	2.1 m³ (74 cu ft)

WEIGHTS AND LOADINGS (estimated):

Weight empty, equipped (typical)	2,291 kg (5,050 lb)
Payload: max	907 kg (2,000 lb)
for max range	658 kg (1,450 lb)
Max usable fuel weight	1,247 kg (2,750 lb)
Max T-O weight	4,195 kg (9,250 lb)
Max ramp weight	4,241 kg (9,350 lb)
Max landing weight	4,014 kg (8,850 lb)
Max zero-fuel weight	3,288 kg (7,250 lb)
Max power loading	240 kg/kN (2.35 lb/lb st)

PERFORMANCE (estimated):

Max cruising speed at FL360	424 kt (785 km/h; 488 mph)
Econ cruising speed	350 kt (648 km/h; 403 mph)
Stalling speed, flaps down	79 kt (147 km/h; 91 mph) IAS
Max rate of climb at S/L	914 m (3,000 ft)/min
Max certified altitude	12,495 m (41,000 ft)
T-O to 15 m (50 ft)	762 m (2,500 ft)
Range:	
with max payload, VFR, 45 min reserves	1,040 n miles (1,926 km; 1,196 miles)
IFR, 45 min reserves	1,300 n miles (2,407 km; 1,496 miles)

EXCEL

EXCEL-JET LTD

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On 15 December 2005, Excel-Jet announced plans for an imminent move from Monument, Colorado, to Guthrie, Oklahoma, following an offer of USD5 million support from Guthrie Industrial Development Authority. Prototype Sport-Jet first flew at Guthrie on 13 May 2006, but was destroyed in a take-off accident on 29 June.

EXCEL-JET SPORT-JET

TYPE: Private jet.

PROGRAMME: Prototype, under construction in Poland during 2004, was scheduled to fly before the end of 2004 or in early 2005. In October 2004 Excel-Jet announced plans to relocate to New Mexico in the first half of 2005. This did not take place, and a move to Guthrie, Oklahoma, was announced in December 2005. By that time prototype had been registered N350SJ (as Bornhofen Sport-Jet) and subsequently made its first flight on 13 May 2006. However, it crashed on takeoff on 29 June, apparently as a result of wake turbulence from a preceding aircraft. At that time the prototype had completed some 25 hours of test flying covering more than 95 per cent of the performance envelope.

COSTS: USD1 million (2006).

DESIGN FEATURES: Unswept wing with small sweptback winglets; T tail.

STRUCTURE: Composites fuselage; light alloy wings and tail surfaces.

FLYING CONTROLS: Conventional and manual.

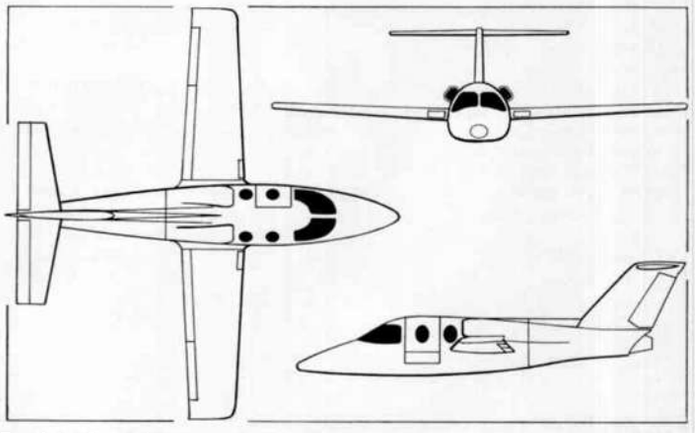
LANDING GEAR: Retractable tricycle type.

POWER PLANT: One 6.67 kN (1,500 lb st) Williams FJ33-4A turbofan with dual inlets above wings; max fuel capacity 795 litres (210 US gallons; 175 Imp gallons).

ACCOMMODATION: Four/five in pressurised cabin. Door on port side aft of cockpit.

AVIONICS: Three-screen EFIS panel.

Prototype Excel-Jet Sport-Jet during its first flight on 13 May 2006 1158268



Excel-Jet Sport-Jet *(James Goulding)* 1158260

DIMENSIONS, EXTERNAL:

Wing span	10.12 m (33 ft 2½ in)
Wing aspect ratio	7.2
Length overall	9.14 m (30 ft 0 in)
Height overall	2.50 m (8 ft 2½ in)

DIMENTIONS, INTERNAL:

Cabin: Length	2.41 m (7 ft 11 in)
Max width	1.50 m (4 ft 11 in)
Max height	1.19 m (3 ft 11 in)
Baggage compartment volume	0.51 m³ (18.0 cu ft)

AREAS:

Wings, gross	14.21 m² (153.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	1,270 kg (2,800 lb)
Max T-O weight	2,223 kg (4,900 lb)
Max wing loading	156.4 kg/m² (32.03 lb/sq ft)
Max power loading	357 kg/kN (3.50 lb/lb st)

PERFORMANCE:

Max cruising speed	375 kt (695 km/h; 432 mph)
Normal cruising speed	340 kt (630 km/h; 391 mph)
Econ cruising speed	310 kt (574 km/h; 357 mph)
Landing speed	80 kt (148 km/h; 92 mph)
Stalling speed	68 kt (126 km/h; 79 mph)
Service ceiling	7,620 m (25,000 ft)
Max rate of climb at S/L	762 m (2,500 ft)/min
T-O run	701 m (2,300 ft)
Landing run	549 m (1,800 ft)
Range with IFR reserves	869 n miles (1,609 km; 1,000 miles)

Excel-Jet Sport-Jet four/five-seat private jet 1158261

EXPLORER

EXPLORER AIRCRAFT INC

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PRESIDENT: Bryan E Lynch
DIRECTOR, OPERATIONS, RESEARCH AND DEVELOPMENT: Geoffrey P Danes
CHIEF FINANCIAL OFFICER: Charles W Yeargain

Explorer Aircraft Inc was established in Colorado in 1998 to develop and market the Australian-designed Explorer range of single-engined utility aircraft. The company moved to Texas in July 2001, and established a new 1,300 m² (14,000 sq ft) office and hangar facility there.

On 1 December 2005, Explorer was issued with a notice of default for hangar rent by Jasper Economic Development Corporation; on 7 March 2006, latter offered hangar for sale. Explorer continued promotion in 2006.

FH-1100

FH-1100 MANUFACTURING CORPORATION

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PRESIDENT: Georges R van Nevel
VICE-PRESIDENT: Remy Y van Nevel

The company was formed to return to production the Fairchild Hiller FH-1100 light helicopter, although is also refurbishing original FH-1100s, and operates helicopter flying school. Manufacture subject to certification of new rotor design, this is still under development in 2006. Middle East marketing began in 2005.

FH-1100 FHOENIX

TYPE: Light utility helicopter.

PROGRAMME: Hiller 1100 designed to meet US Army requirement for light observation helicopter; first flew 26 January 1963; three evaluated as HO-5s (later OH-5As), but not ordered in quantity. Type certificate awarded 22 May 1964; became Fairchild Hiller FH-1100 in September 1964 and certified as such on 10 November 1966; total 254 (including prototypes) built up to 1974, of which about 80 were believed still to be active in 2006.

Hiller Aviation formed January 1973 and acquired FH-1100 rights; built one; renamed Rogerson Hiller and produced five examples of RH-1100B Pegasus between 1983 and 1986; converted one in 1985 to RH-1100M Hornet military version. Promotion continued and further variants proposed, including seven-seat RH-1100S, but none built; last full description in 1992–93 edition. Rights eventually passed to Siam Hiller Holdings.

Type certificate acquired by current owners on 28 February 2000; two FH-1100s (N372F and Pegasus N4035G) obtained simultaneously as demonstrators; promotion of newly named FHoenix began at Heli-Expo, Anaheim, California, in February 2002. Four years later, production had not begun, although VN 1100 began Middle East marketing in 2005.

In mid-2006, company was near certification of new rotor design with 5 cm (2 in) greater chord and KaFlex lubrication-free driveshaft. Upgrade of existing FH-1100s available, but new rotors only compatible with 250-C20B engine, some earlier machines having -C18.

CURRENT VERSIONS: **FH-1100 FHoenix:** *As described.*

VN 1100: Designation reflects van Nevel partners. At Dubai Air Show in November 2005, Seabird Jordan announced version for Middle East markets.

CUSTOMERS: None reported by mid-2006. (Total of 82 of original version remained on US civil aircraft register in 2006.)

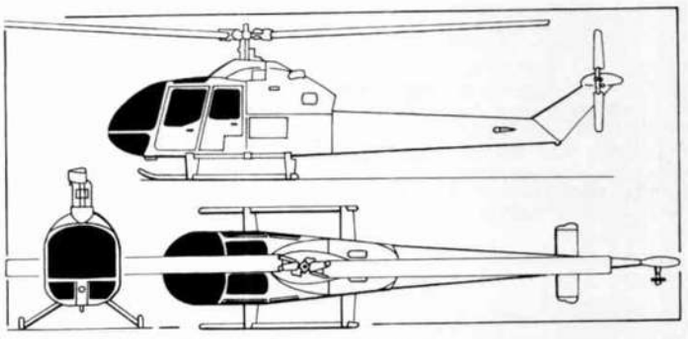
COSTS: USD925,000 (2005). Estimated operating cost USD171 per hour (2003).

DESIGN FEATURES: Conventional helicopter of early 1960s design; extensively glazed nose; low-set tailboom. FHoenix has revised nose shape; original mock-up showed sharper profile than currently proposed configuration.

Two-blade, semi-rigid main rotor; aerofoil section NACA 63_2015; each blade attached to rotor head by single main retention bolt and drag link. Main rotor rpm 368. Main blades fold; rotor brake optional. Rotor drive through single-stage bevel and two-stage planetary main transmission, with intermediate and tail rotor gearboxes. Rotor/engine rpm ratio 1:16.30 main, 1:2.47 tail. Tubular guard for tail rotor.

FLYING CONTROLS: Electric forced trim system.

STRUCTURE: All-metal main rotor with rolled stainless steel leading-edge spar bolted to an aluminium trailing section with a honeycomb core. Tail rotor of stainless steel and honeycomb. Aluminium alloy, semi-monocoque pod-and-boom fuselage; aluminium alloy and honeycomb construction of vertical and horizontal tail surfaces.



FH-1100 FHoenix five-seat helicopter ***(Paul Jackson)*** 1159394

LANDING GEAR: Skid type; torsion tube suspension.

POWER PLANT: One 313 kW (420 shp) Rolls-Royce 250-C20B turboshaft engine, derated to 204 kW (274 shp) for T-O; 174 kW (233 shp) max continuous. Single bladder fuel tank in bottom of centre-fuselage with usable capacity of 259 litres (68.5 US gallons; 57.0 Imp gallons). Refuelling point on starboard side of rear fuselage. Optional cabin fuel tanks (two) with total 244 litres (64.4 US gallons; 53.7 Imp gallons). Oil capacity 2.6 litres (0.7 US gallons; 0.6 Imp gallons).

ACCOMMODATION: Pilot and co-pilot side by side with three passengers to rear, or pilot and four passengers. Four forward-hinged doors, two on each side of cabin. Dual internal stretcher kit optional. Baggage compartment to rear of cabin, capacity 0.30 m³ (10.5 cu ft). Accommodation ventilated. Cabin heater and windscreen defroster standard.

SYSTEMS: Hydraulic system for cyclic and collective pitch controls; operating pressure 65.5 bar (950 lb/sq in). Electrical system includes a 28 V 60 A DC starter/generator and lead/acid battery; Ni/Cd battery optional.

AVIONICS: Chelton FlightLogic EFIS standard.

DIMENSIONS, EXTERNAL:

Main rotor diameter	11.05 m (36 ft 3 in)
Tail rotor diameter	1.83 m (6 ft 0 in)
Distance between rotor centres	6.29 m (20 ft 7½ in)
Main rotor blade chord	0.33 m (1 ft 1 in)
Length overall, rotors turning	12.57 m (41 ft 3 in)
Length of fuselage	9.08 m (29 ft 9½ in)
Fuselage max width	1.32 m (4 ft 4 in)
Height overall	2.80 m (9 ft 2¼ in)
Skid track	2.20 m (7 ft 2¾ in)

AREAS:

Main rotor disc	95.89 m² (1,032.1 sq ft)
Tail rotor disc	2.63 m² (28.3 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	687 kg (1,515 lb)
Payload: max	463 kg (1,020 lb)
with max fuel	328 kg (723 lb)
Max fuel weight	200 kg (442 lb)
T-O weight: normal	1,292 kg (2,850 lb)[1]
FAR Pt 133	1,451 kg (3,200 lb)
Max disc loading: normal	13.48 kg/m² (2.76 lb/sq ft)
FAR Pt 133	15.14 kg/m² (3.10 lb/sq ft)

[1] *Awaiting certification; currently 1,247 kg (2,750 lb)*

Fairchild Hiller FH-1100 from original production, but with FHoenix nose and new registration 1159298

PERFORMANCE:
Never-exceed speed (VNE) at S/L ..... 110 kt (204 km/h; 127 mph)
Max cruising speed ..... 105 kt (194 km/h; 121 mph)
Max rate of climb at S/L ..... 488 m (1,600 ft)/min
Vertical rate of climb at S/L ..... 244 m (800 ft)/min
Service ceiling ..... 5,690 m (18,660 ft)
Hovering ceiling: IGE ..... 5,180 m (17,000 ft)
OGE ..... 3,660 m (12,000 ft)
Range at FL50 ..... 330 n miles (611 km; 379 miles)
Endurance ..... 3 h

FISHER

FISHER FLYING PRODUCTS

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VICE-PRESIDENT: Gene Hanson

Formed in 1982, Fisher Flying Products markets a range of 16 homebuilt light aircraft. These comprise the FP-202 Koala, FP-303 microlight, FP-404 EXP, FP-505 Skeeter, FP-606 Sky Baby microlight, Avenger, Avenger V and Youngster single-seat aircraft; and Super Koala, Classic, Dakota Hawk, Tiger Moth (two versions), Celebrity and Horizon 1 and 2 two-seaters. Only the more recent are described here. In 1998, Fisher took over Fisher Aero of Portsmouth, Ohio, which added the Celebrity, Horizon 1 and Horizon 2 to the product line. In late 2006, Fisher's workforce numbered 12 in its 930 m² (10,000 sq ft) factory; nearly 1,500 kits had been supplied by end 2005.

FISHER AVENGER

TYPE: Single-seat ultralight kitbuilt.
PROGRAMME: First flown June 1994.
CURRENT VERSIONS: **Avenger:** Baseline version.
Avenger V: Powered by one 37.3 kW (50 hp) Volkswagen four-cylinder engine.
CUSTOMERS: Total of 191 sold by 2004, of which around 70 were flying.
COSTS: Avenger standard kit USD5,200; quick-build kit USD6,700 (2005); Avenger V standard kit USD5,600; quick-build kit USD7,100. All exclude engine (2006).
DESIGN FEATURES: Low-wing monoplane; wings braced by V-struts to mainwheel hubs; mutually braced tail surfaces. Wire-braced tailplane. Quoted build time 400 hours, reducing to 300 with quick-build kit.
FLYING CONTROLS: Conventional and manual.
STRUCTURE: Wood and fabric.
LANDING GEAR: Tailwheel type; fixed. Full axle. Tyre size 4.00–8.
POWER PLANT: One 37.0 kW (49.6 hp) two-cylinder Rotax 503 UL-2V; other engines from 20.9 to 48.5 kW (28 to 65 hp) are optional. Fuel capacity 19 litres (5.0 US gallons; 4.2 Imp gallons).
DIMENSIONS, EXTERNAL:
Wing span ..... 8.23 m (27 ft 0 in)
Length overall ..... 4.95 m (16 ft 3 in)
Height overall ..... 1.52 m (5 ft 0 in)
AREAS:
Wings, gross ..... 11.24 m² (121.0 sq ft)
WEIGHTS AND LOADINGS:
Weight empty: Avenger ..... 113 kg (250 lb)
Avenger V ..... 159 kg (350 lb)
Max T-O weight: Avenger ..... 272 kg (600 lb)
Avenger V ..... 294 kg (650 lb)
PERFORMANCE:
Max level speed: Avenger ..... 82 kt (152 km/h; 95 mph)
Avenger V ..... 86 kt (160 km/h; 100 mph)
Normal cruising speed ..... 52 kt (97 km/h; 60 mph)
Stalling speed: Avenger ..... 23 kt (42 km/h; 26 mph)
Avenger V ..... 28 kt (52 km/h; 32 mph)
Max rate of climb at S/L: Avenger ..... 274 m (900 ft)/min
Avenger V ..... 259 m (850 ft)/min

Fisher Avenger single-seat kitbuilt 0110843

T-O run: Avenger ..... 30 m (100 ft)
Avenger V ..... 61 m (200 ft)
Landing run: Avenger ..... 61 m (200 ft)
Avenger V ..... 76 m (250 ft)
Range: Avenger ..... 150 n miles (277 km; 172 miles)
Avenger V ..... 250 n miles (463 km; 287 miles)

FISHER DAKOTA HAWK

TYPE: Side-by-side ultralight kitbuilt.
PROGRAMME: First flight September 1994.
CUSTOMERS: Total of 80 kits sold by mid-2003 of which 25 were flying by October 2006.
COSTS: Standard kit USD12,500; quick-build kit USD14,500 (2006). Both exclude engine.
DESIGN FEATURES: Geodetic wing structure built upon I-beam spar and braced with V struts. Wire-braced tailplane. Quoted build time 700 hours for standard kit and 600 for quick-build kit. Wings fold for storage.
FLYING CONTROLS: Conventional and manual.
STRUCTURE: Precut, shaped and slotted wooden pieces; wooden truss fuselage with plywood skin; glass fibre cowling.
LANDING GEAR: Tailwheel type; fixed. Two faired-in side Vs hinged to lower longerons, plus half-axles, each with bungee cord shock-absorber, attached to compression frame. Steerable tailwheel. Matco wheels and hydraulic brakes. Steerable tailwheel; shock-absorbers and Matco speed fairings on main legs.
POWER PLANT: One 59.6 kW (79.9 hp) Rotax 912 UL four-stroke engine driving a two-blade propeller. Optional alternatives include Teledyne Continental engines between 48.4 and 63 kW (65 and 85 hp) or 74.6 kW (100 hp) Subaru. Fuel capacity 45.4 litres (12.0 US gallons; 10.0 Imp gallons).
DIMENSIONS, EXTERNAL:
Wing span ..... 8.69 m (28 ft 6 in)
Length overall ..... 6.02 m (19 ft 9 in)
Height overall ..... 1.85 m (6 ft 1 in)
AREAS:
Wings, gross ..... 11.89 m² (128.0 sq ft)

Fisher Dakota Hawk side-by-side ultralight *(Paul Jackson)* 1133277

WEIGHTS AND LOADINGS:
Weight empty ..... 272 kg (600 lb)
Max T-O weight ..... 522 kg (1,150 lb)
PERFORMANCE:
Max cruising speed ..... 87 kt (161 km/h; 100 mph)
Normal cruising speed ..... 78 kt (145 km/h; 90 mph)
Stalling speed ..... 31 kt (57 km/h; 35 mph)
Max rate of climb at S/L ..... 244 m (800 ft)/min
T-O run ..... 107 m (350 ft)
Landing run ..... 122 m (400 ft)
Range with max fuel ..... 217 n miles (402 km; 250 miles)

FISHER YOUNGSTER and YOUNGSTER V

TYPE: Single-seat ultralight biplane kitbuilt.
PROGRAMME: First flown June 1994.
CURRENT VERSIONS: **Youngster:** *As described.*
Youngster V: Uprated version with 48.5 kW (65 hp) Volkswagen motorcar engine.
CUSTOMERS: Total of 35 flying by mid-2004; over 100 kits sold by October 2005.
COSTS: Youngster standard kit USD7,200, quick-build kit USD9,350; Youngster V standard kit USD7,500, quick-build kit USD9,650, all excluding engine (2006).
DESIGN FEATURES: Open cockpit, strut-braced biplane with detachable cockpit transparency for winter operations. Constant-chord wings of geodetic construction. Wire-braced low-mounted tailplane. Stainless steel control wires. Additional central strut between nose and upper wing forward of cockpit. Aerofoil type 2315. Quoted build time 400 hours, reducing to 300 with quick-build kit.
FLYING CONTROLS: Conventional and manual.
STRUCTURE: Wood and fabric.
LANDING GEAR: Tailwheel type; fixed. Tyres 8.00-6. Bungee cord shock absorption.
POWER PLANT: One 37.3 kW (50 hp) Great Plains four-cylinder engine; Rotax engines up to 47.8 kW (64.1 hp) are optional. Fuel capacity 30.3 litres (8.0 US gallons; 6.7 Imp gallons).
DIMENSIONS, EXTERNAL:
Wing span ..... 5.49 m (18 ft 0 in)
Length overall ..... 4.72 m (15 ft 6 in)
Height overall ..... 1.85 m (6 ft 1 in)
AREAS:
Wings, gross ..... 11.71 m² (126.0 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 181 kg (400 lb)
Max T-O weight ..... 294 kg (650 lb)
PERFORMANCE:
Max level speed ..... 95 kt (177 km/h; 110 mph)
Normal cruising speed ..... 74 kt (137 km/h; 85 mph)
Stalling speed ..... 30 kt (55 km/h; 34 mph)
Max rate of climb at S/L ..... 244 m (800 ft)/min
T-O run ..... 61 m (200 ft)
Landing run ..... 76 m (250 ft)
Range ..... 225 n miles (416 km; 259 miles)

Fisher Youngster (37.3 kW; 50 hp Great Plains) 0110842

FISHER R-80 and RS-80 TIGER MOTH

TYPE: Tandem-seat ultralight biplane kitbuilt.
PROGRAMME: Scale (80 per cent) replica of de Havilland D.H.82A Tiger Moth. First flight June 1994.
CURRENT VERSIONS: **R-80 Tiger Moth:** *As described.*
RS-80 Tiger Moth: Introduced 1999; has steel tube fuselage and 89.5 kW (120 hp) LOM M132 engine.
CUSTOMERS: Total of 26 flying by mid-2005, comprising 20 R-80 and six RS-80 models. Four under construction in Zimbabwe for use on aerial safaris.
COSTS: R.80 standard airframe kit USD12,950, quick-build kit USD18,000; RS-80 standard airframe kit USD19,000, quick-build kit USD21,000, all excluding engine (2006).
DESIGN FEATURES: Can be built using the contents of a basic tool kit. Quoted build time 550 hours.
Single-bay, staggered biplane with N-type interplane struts and slight sweepback to constant-chord wings.
FLYING CONTROLS: Conventional and manual, with horn-balanced rudder.
STRUCTURE: Wood construction using epoxy adhesives on preformed components.
LANDING GEAR: Tailwheel type; fixed. Two tubular steel side Vs hinged to lower longerons, plus half-axles, each with bungee cord shock-absorber, attached to compression frame. Matco wheels with hydraulic brakes.
POWER PLANT: Prototype has one 70.8 kW (95 hp) Mid West AE 100 rotary, but any engine between 55.9 and 89 kW (75 and 120 hp) can be fitted, including Rotax 912, Jabiru 3300, Subaru EA81-100, Norton rotary and LOM M132. One 72 litre (19.0 US gallon; 15.8 Imp gallon) centre-section fuel tank.
DIMENSIONS, EXTERNAL:
Wing span ..... 7.01 m (23 ft 0 in)
Length overall ..... 5.79 m (19 ft 0 in)
Height overall ..... 2.24 m (7 ft 4 in)
DIMENSIONS, INTERNAL:
Cockpit max width ..... 0.66 m (2 ft 2 in)
AREAS:
Wings, gross ..... 15.79 m² (170.0 sq ft)
WEIGHTS AND LOADINGS:
Weight empty: R-80 ..... 254 kg (560 lb)
RS-80 ..... 363 kg (800 lb)
Max T-O weight: R-80 ..... 522 kg (1,150 lb)
RS-80 ..... 612 kg (1,350 lb)
PERFORMANCE:
Max level speed: R-80 ..... 95 kt (177 km/h; 110 mph)
RS-80 ..... 104 kt (193 km/h; 120 mph)
Cruising speed: R-80 ..... 69 kt (129 km/h; 80 mph)
RS-80 ..... 78 kt (145 km/h; 90 mph)
Stalling speed: R-80 ..... 31 kt (57 km/h; 35 mph)
RS-80 ..... 35 kt (65 km/h; 40 mph)
Max rate of climb: both ..... 244 m (800 ft)/min
T-O run: R-80 ..... 91 m (300 ft)
RS-80 ..... 76 m (250 ft)
Landing run: R-80 ..... 122 m (400 ft)
RS-80 ..... 91 m (300 ft)
Range with max fuel: both ..... 250 n miles (463 km; 287 miles)

Fisher R-80 Tiger Moth *(Paul Jackson)* 1158792

FLIGHTSTAR

FLIGHTSTAR SPORTSPLANES

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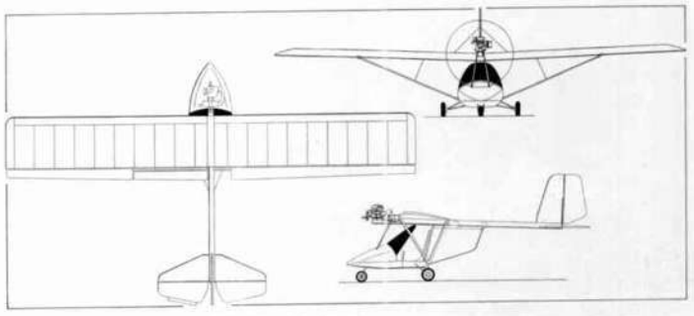
PRESIDENT: Thomas A Peghiny
TECHNICAL DIRECTOR: Dana Porsiani

Pioneer International formed as a division of Pioneer Parachute Company in 1981 to produce the initial Flightstar; design was sold to Pampa's Bull of Argentina as the Aviastar I (see 1992–93 *Jane's All the World's Aircraft*) when Pioneer closed in 1985. Pioneer Flightstar (later Flightstar) formed in 1992 initially to import the Aviastar design, and has since developed it into the current range of ultralights. Kits produced under contract by Leza-Aircam. The initial Flightstar Classic is no longer available.

In August 2004, the company employed 14 people; its Sebring production facility covered 4,180 m² (45,000 sq ft). It is also US agent for the Flight Design CT.

FLIGHTSTAR IISL and IISC

TYPE: Side-by-side ultralight kitbuilt.
PROGRAMME: Originally designed by Pioneer International; construction of prototype Flightstar started 1992; first flight 1993. Certified to German BFU-95 standards 1997; also certified in Australia. SL version introduced in 1995.
CURRENT VERSIONS: **IISL:** (SL = Sport Light) Standard version, *as described.*
IISC: (SC = Sport Cabin) Introduced 1999; cabin version with doors for cold-weather operations.



Open cockpit Flightstar IISL *(Paul Jackson)*

CUSTOMERS: Over 1,000 of original Flightstar II built. 180 IISCs and 90 IISLs completed by December 2005.
COSTS: IISL USD16,595; IISC USD17,995, both without engines (2006).
DESIGN FEATURES: Wings fold for storage and transportation. Quoted build time 100 hours for IISL; 130 hours for IISC.
Flightstar FS-II-2 aerofoil section; dihedral 2° 48'; incidence 4°, twist 2°, 13% chord:span.
FLYING CONTROLS: Conventional and manual. Push-pull cables; optional flaps on IISL.
STRUCTURE: 6061-T6 aluminium dual tube spar, strut-braced wing with Dacron covering; Five-ply Mylar covering optional. Composites-covered chromoly 4130 steel fuselage cage with stainless steel brackets; engine attached to heavy-duty aluminium tube running length of aircraft; all metal parts anodised to obviate painting. Strut-braced, low-mounted tailplane.

Flightstar IISL two-seat ultralight *(Paul Jackson)* 1158794

LANDING GEAR: Tricycle type; fixed. Cantilever mainwheel suspension comprising two radius arms and damped leg attached each side of pod at rear. Steerable nosewheel. Azusa wheels and optional drum brakes. Tyres size 13 in nose; 15 in main. Shock cord absorption. Optional Full Lotus floats.

POWER PLANT: One 37.0 kW (49.6 hp) Rotax 503 UL-2V driving three-blade Powerfin, two-blade Tennessee or three-blade IVO propeller; optional engines include 47.8 kW (64.1 hp) Rotax 582 UL and 44.7 kW (60.0 hp) four-stroke HKS 700E; latter is standard on IISC and has 3.47:1 gearbox reduction. Fuel capacity 37.9 litres (10.0 US gallons; 8.3 Imp gallons), of which 36.0 litres (9.5 US gallons; 7.9 Imp gallons) usable.

ACCOMMODATION: Fastback fabric rear fairing fitted to IISL. Cabin doors closed by zips.

EQUIPMENT: Optional BRS-5 parachute.

DIMENSIONS, EXTERNAL:

Wing span	9.75 m (32 ft 0 in)
Length overall	5.97 m (19 ft 7 in)
Height overall	2.39 m (7 ft 10 in)

AREAS:

Wings, gross	14.59 m² (157.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	175 kg (385 lb)
Max T-O weight	431 kg (950 lb)

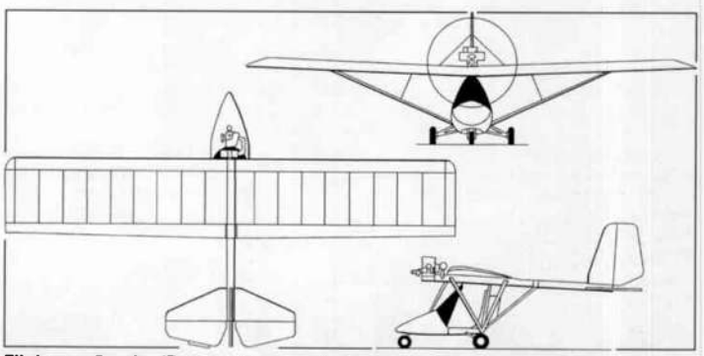
PERFORMANCE (with 37.0 kW; 49.6 hp engine):

Never-exceed speed (VNE)	83 kt (154 km/h; 96 mph)
Max operating speed	74 kt (137 km/h; 85 mph)
Normal cruising speed	56 kt (105 km/h; 65 mph)
Stalling speed	32 kt (58 km/h; 36 mph)
Max rate of climb at S/L	183 m (600 ft)/min
T-O run	63 m (205 ft)
Landing run	91 m (300 ft)
Range with max fuel	173 n miles (321 km; 200 miles)

FLIGHTSTAR SPYDER

TYPE: Single-seat ultralight kitbuilt.

Flightstar Spyder single-seat ultralight 0110699



Flightstar Spyder (Rotax 447 two-cylinder engine) *(Paul Jackson)* 0533719

PROGRAMME: Derived from Pioneer Flightstar II. Can conform to FAR Pt 103.

CURRENT VERSIONS: **Spyder**: Standard version, *as described.*

Formula: High-performance upgraded model with wider windscreen and cockpit doors for cold weather flying; now discontinued.

CUSTOMERS: Over 700 kits sold by December 2005.

COSTS: Spyder USD13,895 without engine (2006).

DESIGN FEATURES: Flightstar FS-I-2 aerofoil. Wings fold for storage and transportation. Optional BRS parachute recovery system.

FLYING CONTROLS: As Flightstar IISL.

STRUCTURE: As Flightstar IISL.

LANDING GEAR: As Flightstar IISL.

POWER PLANT: One 31.0 kW (41.6 hp) Rotax 447 UL-2V driving Tennessee two-blade or Ivo three-blade propeller. Options include 37.0 kW (49.6 hp) Rotax 503 UL-2V, 47.8 kW (64.1 hp) Rotax 582 UL and 44.7 kW (60.0 hp) HKS-700E. Standard fuel capacity 18.9 litres (5.0 US gallons; 4.2 Imp gallons); optionally 37.9 litres (10.0 US gallons; 8.3 Imp gallons).

EQUIPMENT: Optional BRS-5 parachute.

DIMENSIONS, EXTERNAL:

Wing span	9.14 m (30 ft 0 in)
Length overall	5.03 m (16 ft 6 in)
Height overall	2.39 m (7 ft 10 in)

AREAS:

Wings, gross	13.38 m² (144.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	127 kg (280 lb)
Max T-O weight	294 kg (650 lb)

PERFORMANCE:

Never-exceed speed (VNE)	83 kt (154 km/h; 96 mph)
Normal cruising speed	56 kt (105 km/h; 65 mph)
Stalling speed	28 kt (52 km/h; 32 mph)
Max rate of climb at S/L	201 m (660 ft)/min
T-O run	62 m (205 ft)
Landing run	61 m (200 ft)
Range with standard fuel	86 n miles (161 km; 100 miles)

FOUR WINDS

FOUR WINDS AIRCRAFT

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PRESIDENT: Jeff Rahm

The company's 6,300 m² (68,000 sq ft) plant employed 24 persons in 2003. During 1990s, completed 22 Lancairs, two GlaStars, two Stallions, two Glass Gooses and one BD-5 on behalf of private owners. Marketing of new four-seat aircraft delayed by loss of prototype, but deliveries eventually began in April 2004 and first customer-built aircraft was completed two years later. In 2006, Four Winds was negotiating transfer of kit fabrication to VX Aerospace of North Carolina to allow it to concentrate on development of other aircraft, including UAVs, a small-scale prototype of one such having recently been tested.

FOUR WINDS FX-210 and FX-250T

TYPE: Four-seat kitbuilt.

PROGRAMME: Stretched version of GlaStar (currently produced by New Glastar LLC); partly completed prototype exhibited at Sun 'n' Fun, Lakeland, Florida, April 2002; first kit deliveries then scheduled for September 2002, but date revised to September 2003. Prototype (N192FW), a Model 192, registered in July 2002, but lost in accident on 6 December 2002. By early 2004, company had decided not to proceed with 194 kW (200 hp) Model 192. Manufacturer officially notified as AAA Aircraft Leasing.

Second prototype, N250FW, a Model 210C, with IO-520 engine, first flew 27 February 2004 and exhibited at Sun 'n' Fun, April 2004. Features enlarged cockpit and wing moved 10 cm (4 in) rearward. Kit deliveries began later same month, at which time most orders were for Model 210. First customer-built aircraft was exhibited, almost complete, at Sun 'n' Fun, Lakeland, Florida, April 2005.

CURRENT VERSIONS: See Power Plant.

CUSTOMERS: Total more than 40 kits sold and 28 delivered by mid-2005.

COSTS: Kit USD68,000, less engine, avionics and interior (2004); estimated USD120,000 to flyable, equipped configuration, including builder assistance programme of 14 days in-works support.

DESIGN FEATURES: Four-seat version of GlaStar, but with cabin reinforcement cage similar to Symphony (built in Canada); however, wing of composites, with no bracing struts. Design modified in 2005 (and N250FW employed as testbed) with increased fin chord and two ventral strakes. Revised engine cowling shape from December 2005, replacing twin cylinder cooling intakes each side of spinner with U-shape surrounding spinner at sides and below; accommodates IO-550 engine and, with side blisters for intercooler, TIO-540.

Quoted build time 1,000 hours, or 200 hours with builder assistance programme.

Unswept wing and tailplane; High aspect ratio wing. Aerofoil C-65-215; dihedral 1° 30'; fin sweepback 48° 50'.

FLYING CONTROLS: Conventional and manual. Mass-balanced (lead) control surfaces. Actuation by pushrods (elevator and ailerons) and cables (rudder). Electrically actuated flaps; max deflection 30°.

STRUCTURE: Generally of fireproof 7781 E-Glass, but 4130 steel (1.5 mm; 0.058 in thickness rectangular tube) structural cage surround to cabin, twin carbon-graphite wing spars and 7075 aluminium main landing gear legs.

LANDING GEAR: Tricycle type, fixed. Fuselage-mounted spring cantilever mainwheel legs with wheel fairings; trailing-link, steerable nosewheel. Grove Gear aluminium mainwheels 15×6.00–6; nosewheel 11×4.00–5. Hydraulic brakes. Optional Aerocet 3400 twin-float version.

POWER PLANT: Choice of engines to drive single propeller, as under.

FX-210: One 224 kW (300 hp) Teledyne Continental IO-520 (Model 210C) or 231 kW (310 hp) IO-550-N flat-six. Textron Lycoming TIO-540 of similar rating under development. Fuel capacity 454 litres (120 US gallons; 100 Imp gallons).

FX-250T: One 313 kW (420 shp) Rolls-Royce 250B-17 turboprop recommended; P&WC PT6A-20 and Walter M 601 alternatives. Fuel capacity as FX-210 or, optionally, 568 litres (150 US gallons; 125 Imp gallons) optional.

'Wet' wing, with fuel between spars.

ACCOMMODATION: Four persons, including one or two pilots, in two side-by-side pairs. Four doors; forward pair front-hinged; rear pair upward-hinged. Baggage space behind rear seats; latter tip up, or rapidly removable, for additional stowage.

SYSTEMS: Air conditioning optional. No pressurisation or pneumatics.

AVIONICS: To customer's choice, including Bendix/King, Chelton and Garmin.

EQUIPMENT: Optional BRS ballistic parachute.

DIMENSIONS, EXTERNAL:

Wing span	11.19 m (36 ft 8½ in)
Wing chord, mean	1.14 m (3 ft 9 in)
Wing aspect ratio	9.8
Length overall	7.92 m (26 ft 0 in)
Tailplane span	3.73 m (12 ft 3 in)
Tailplane chord, constant	0.91 m (3 ft 0 in)
Propeller diameter	2.08 m (6 ft 10 in)

DIMENSIONS, INTERNAL:

Cabin: Length	2.90 m (9 ft 6 in)
Max width	1.24 m (4 ft 1 in)
Max height	1.40 m (4 ft 7 in)

AREAS:

Wings, gross	12.79 m² (137.7 sq ft)
Vertical tail surfaces (total)	1.77 m² (19.03 sq ft)
Horizontal tail surfaces (total)	3.41 m² (36.75 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: 210	953 kg (2,100 lb)
250T	930 kg (2,050 lb)
Baggage capacity:	
210	68 kg (150 lb)
250T	91 kg (200 lb)
Max T-O weight: 210	1,542 kg (3,400 lb)
250T	1,723 kg (3,800 lb)
Max wing loading: 210	120.6 kg/m² (24.69 lb/sq ft)
250T	134.7 kg/m² (27.60 lb/sq ft)
Max power loading:	
210 (IO-540)	6.90 kg/kW (11.33 lb/hp)
250T	5.51 kg/kW (9.05 lb/shp)

PERFORMANCE:

Never-exceed speed (VNE)	250 kt (463 km/h; 287 mph) IAS
Cruising speed at 70% power:	
210	175 kt (324 km/h; 201 mph)
250T	230 kt (426 km/h; 265 mph)
Stalling speed: 210	54 kt (100 km/h; 63 mph)
250	59 kt (110 km/h; 68 mph)
Max rate of climb at S/L: 210	427 m (1,400 ft)/min
250	762 m (2,500 ft)/min
Service ceiling	8,535 m (28,000 ft)
T-O run: 210	275 m (900 ft)
250T	183 m (600 ft)
Landing run: 210, 250T	397 m (1,300 ft)
Max range:	
210	1,121 n miles (2,076 km; 1,290 miles)
250T	1,129 n miles (2,092 km; 1,300 miles)
g limits: 210, 250T	+9.0/–4.0

Four Winds FX-210 prototype after addition of fin leading-edge extension and twin ventral strakes *(Paul Jackson)* 1037973

FREE BIRD

FREE BIRD INNOVATIONS INC

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Web: www.sportlite103.com; www.flyfbi.com
OWNERS: Eric Grina
Keith LeCleir

Free Bird Innovations purchased the Freebird and Sportlite 103 ultralights from Pro Sport Aviation in early 2004.

FREE BIRD LITESPORT CLASSIC

TYPE: Side-by-side ultralight kitbuilt.

PROGRAMME: Launched 1993 by earlier Freebird company as Freebird Classic. Meets FAR Pt 103 requirements.

CURRENT VERSIONS: **Litesport Classic:** Standard version, as described.

Litesport Ultra: Basic version, available in singel- and two-seat versions.

CUSTOMERS: Over 100 under construction and over 50 flying by mid-2003.

Free Bird Litesport Ultra single-seat version *(Paul Jackson)* 1158793

COSTS: Litesport Classic kit USD11,150; ready-to-fly with Rotax 582 from USD28,235. Litesport Ultra kit USD3,000 minus engine and propeller, quick-build kit USD9,995; ready-to-fly with Rotax 447 USD17,665 (all 2006).

DESIGN FEATURES: Wings removable for storage. Quoted build time 125 hours.

FLYING CONTROLS: Conventional and manual; flaps. Large horn balance on rudder.

STRUCTURE: Fabric-covered aluminium tubing and composites nose skin. Strut-braced wings and tailplane. Wing-to-tailplane bracing struts augment slim rear fuselage.

LANDING GEAR: Tricycle type; fixed. Semi-recessed steerable nosewheel. Hydraulic brakes. Optional Full Lotus floats.

POWER PLANT: *Litesport Classic:* One 47.8 kW (64.1 hp) Rotax 582 UL-2V two-cylinder engine driving a wooden fixed-pitch pusher propeller. Fuel capacity 37.8 litres (10.0 US gallons; 8.3 Imp gallons).

Litesport Ultra: One 29.5 kW (39.6 hp) Rotax 447 UL-1V two-cylinder engine driving a wooden fixed-pitch pusher propeller. Fuel capacity 18.9 litres (5.0 US gallons; 4.2 Imp gallons).

ACCOMMODATION: Optional enclosed cockpit with provision for heater.

SYSTEMS: Optional electric starter.

DIMENSIONS, EXTERNAL:

Wing span: both	8.08 m (26 ft 6 in)
Length overall: Classic	5.18 m (17 ft 0 in)
Ultra: single-seat	5.05 m (16 ft 7 in)
two-seat	5.21 m (17 ft 1 in)
Height overall: both	2.03 m (6 ft 8 in)
Propeller diameter	1.83 m (6 ft 0 in)

AREAS:

Wings, gross	11.24 m² (121.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: Classic	204 kg (450 lb)
Ultra	115 kg (254 lb)
Max T-O weight: Classic, Ultra two seat	408 kg (900 lb)
Ultra single seat	226 kg (500 lb)

PERFORMANCE (enclosed cockpit):

Max level speed: Classic	78 kt (144 km/h; 90 mph)
Ultra	54 kt (100 km/h; 62 mph)
Normal cruising speed at 75% power: Classic	70 kt (129 km/h; 80 mph)
Ultra	48 kt (89 km/h; 55 mph)
Stalling speed, flaps down: Classic	28 kt (52 km/h; 32 mph)
Ultra	21 kt (39 km/h; 24 mph)

Max rate of climb at S/L: Classic ..... 244 m (800 ft)/min
Ultra ..... 259 m (850 ft)/min
T-O run: Classic ..... 46 m (150 ft)
Ultra ..... 23 m (75 ft)
Landing run: Classic ..... 46 m (150 ft)
Range at 75% power: Classic ..... 173 n miles (321 km; 200 miles)
g limits ..... +6/–3

FREE BIRD SPORTLITE 103

TYPE: Single-seat ultralight kitbuilt; tandem-seat ultralight kitbuilt.
PROGRAMME: Based on Freebird Classic.
CURRENT VERSIONS: **Sportlite 103:** Basic single-seat version.
Litesport II: Tandem version.
CUSTOMERS: Over 350 flying by end 2005.
COSTS: Basic kit USD3,495; quick-build plus kit USD11,650 including 29.8 kW (40 hp) Hirth 2702 engine and propeller; ready-to-fly USD14,995 (2005).
DESIGN FEATURES: Intended for use under FAA Pt 103 ultralight regulations; can be converted to tandem-seater. Wings detach for storage and transportation. Quoted build time 125 hours.
FLYING CONTROLS: Conventional and manual.
STRUCTURE: As Freebird Classic. 6061-T6 aluminium tube throughout with fabric covering. Strut-braced wings. Cruciform tailplane.
LANDING GEAR: Tricycle type; fixed. Steerable nosewheel. Optional floats.
POWER PLANT: Engines in the range 16.4 to 38.8 kW (22 to 52 hp) can be fitted, including 29.5 kW (39.6 hp) Rotax 447 or 34.0 kW (45.6 hp) Rotax 503 in two-seat version, both driving two-blade propeller. Fuel capacity 18.9 litres (5.0 US gallons; 4.2 Imp gallons) in single-seat; 32.2 litres (8.5 US gallons; 7.1 Imp gallons) in two-seat.
ACCOMMODATION: Pilot and passenger in open seat(s).
DIMENSIONS, EXTERNAL:
Wing span ..... 8.08 m (26 ft 6 in)
Length overall: Sportlite 103 ..... 5.05 m (16 ft 7 in)
Litesport II ..... 5.21 m (17 ft 1 in)
Height overall ..... 2.03 m (6 ft 8 in)
AREAS:
Wings, gross ..... 11.80 m² (127.0 sq ft)
WEIGHTS AND LOADINGS:
Weight empty: Sportlite 103 ..... 113 kg (250 lb)
Litesport II ..... 134 kg (295 lb)
Max T-O weight: Sportlite 103 ..... 240 kg (530 lb)
Litesport II ..... 408 kg (900 lb)
PERFORMANCE:
Max operating speed ..... 54 kt (100 km/h; 62 mph)
Normal cruising speed ..... 48 kt (89 km/h; 55 mph)
Stalling speed: Sportlite 103 ..... 21 kt (39 km/h; 24 mph)
Litesport II ..... 28 kt (52 km/h; 32 mph)
Max rate of climb at S/L: Sportlite 103 ..... 259 m (850 ft)/min
Litesport II ..... 244 m (800 ft)/min
T-O run: Sportlite 103 ..... 23 m (75 ft)
Litesport II ..... 46 m (150 ft)

FREEBIRD

FREEBIRD SPORT AIRCRAFT

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PRESIDENT: Sherman Hawley

FreeBird Sport Aircraft is unrelated to Free Bird Innovations, save that the latter's current products were obtained from Prosport Aviation, which is related to FreeBird Sport.

The company is marketing the FreeBird Extreme as an LSA-compliant ready-to-fly aircraft, via Discovery Concepts.

FREEBIRD XTREME

TYPE: Two-seat lightplane.
PROGRAMME: Progress Aero R&D Discovery, registered N81D, built in 1988 to designs of Martin Hollmann, but damaged during parachute-assisted recovery from an uncontrollable flat spin during flight testing on 2 July 1989. Airframe now employed as static demonstrator for Xtreme, which was launched as LSA project at Sun 'n' Fun, April 2005. First aircraft was then due for completion in September 2005; however, this does not appear to have taken place.
CURRENT VERSIONS: **LSA:** To US LSA rules.
Experimental: Piston-engine version to Experimental category rules.
Prop-Jet: Turboprop; Experimental category.
CUSTOMERS: Nine ordered by July 2005.
COSTS: LSA flyaway USD134,600; LSA basic kit USD32,850; Experimental piston USD36,275; Experimental turboprop USD44,900; all kits excluding engine and avionics (2006).
DESIGN FEATURES: Twin-boom pusher canard with mid-wing and high tailplane. 'Three wing' configuration for greater aerodynamic efficiency.
Wing and foreplane section NACA NLF-0215; tailplane section NACA 63218.
Quoted build time 800 to 1,200 hours.
FLYING CONTROLS: Manual. Elevator on tailplane; 'piano hinged' rudders actuated by Bowden cable; trim tabs on foreplane, electrically actuated. No flaps.
STRUCTURE: Composites throughout.
LANDING GEAR: Tricycle type. Fixed for LSA version; with fuselage-mounted spring cantilever main legs. Retraction optional for Experimental version and standard for Prop-Jet version.
POWER PLANT: *LSA:* One 85.8 kW (115 hp) Textron Lycoming O-235 flat-four driving a pusher propeller. Fuel capacity 76 litres (20.0 US gallons; 16.7 Imp gallons).
Experimental: As LSA, except fuel 114 litres (30.0 US gallons; 25.0 Imp gallons).
Prop-Jet: One 123 kW (165 shp) Innodyn 165TE turboprop driving a pusher propeller. Fuel capacity 189 litres (50.0 US gallons; 41.7 Imp gallons).
ACCOMMODATION: Two persons, side by side, beneath single-piece, forward-hinged canopy/windscreen. Baggage area at rear.
EQUIPMENT: BRS ballistic recovery parachute.
DIMENSIONS, EXTERNAL:
Wing span ..... 9.14 m (30 ft 0 in)
Wing chord: at root ..... 1.50 m (4 ft 11 in)
at tip: LSA ..... 1.21 m (3 ft 11½ in)
Experimental ..... 0.97 m (3 ft 2 in)
Prop-Jet ..... 0.69 m (2 ft 3 in)
Wing aspect ratio: LSA 6.7
Experimental 7.2
Prop-Jet 7.8
Foreplane span ..... 3.32 m (7 ft 10¾ in)
Foreplane chord: at root ..... 0.41 m (1 ft 4 in)
at tip ..... 0.16 m (8 in)
Length overall ..... 5.46 m (17 ft 11 in)
Tailplane span ..... 2.41 m (7 ft 10¾ in)
Tailplane chord (constant) ..... 0.61 m (2 ft 0 in)

Progress Aero Discovery, basis of the FreeBird Xtreme *(Paul Jackson)* 1158797

Wheelbase ..... 1.80 m (5 ft 11 in)
DIMENSIONS, INTERNAL:
Cockpit: Max width ..... 1.09 m (3 ft 7 in)
Max height ..... 0.99 m (3 ft 3 in)
Baggage volume ..... 0.68 m³ (24.0 cu ft)
AREAS:
Wings, gross: LSA ..... 12.54 m² (135.0 sq ft)
Experimental ..... 11.61 m² (125.0 sq ft)
Prop-Jet ..... 10.68 m² (115.0 sq ft)
Foreplanes (total) ..... 0.73 m² (7.90 sq ft)
Tailplane ..... 1.47 m² (15.80 sq ft)
WEIGHTS AND LOADINGS:
Weight empty: LSA ..... 357 kg (810 lb)
Experimental, Prop-Jet ..... 390 kg (860 lb)
Max T-O weight: LSA ..... 598 kg (1,320 lb)
Experimental, Prop-Jet ..... 734 kg (1,620 lb)
Max wing loading: LSA ..... 47.7 kg/m² (9.78 lb/sq ft)
Experimental ..... 63.3 kg/m² (12.96 lb/sq ft)
Prop-Jet ..... 68.8 kg/m² (14.09 lb/sq ft)
Max power loading: LSA ..... 6.99 kg/kW (11.47 lb/hp)
Experimental ..... 8.57 kg/kW (14.09 lb/hp)
Prop-Jet ..... 5.98 kg/kW (9.82 lb/shp)
PERFORMANCE (estimated):
Never-exceed speed (VNE): LSA ..... 156 kt (289 km/h; 180 mph)
Experimental ..... 208 kt (386 km/h; 240 mph)
Prop-Jet ..... 347 kt (643 km/h; 400 mph)
Max level speed: at S/L: LSA ..... 115 kt (212 km/h; 132 mph)
Experimental ..... 174 kt (322 km/h; 200 mph)
at FL280: Prop-Jet ..... 340 kt (563 km/h; 350 mph)
Cruising speed at 75% power: LSA ..... 100 kt (185 km/h; 115 mph)
Experimental ..... 148 kt (274 km/h; 170 mph)
Prop-Jet ..... 269 kt (499 km/h; 310 mph)
Stalling speed: LSA ..... 42 kt (78 km/h; 48 mph)
Experimental ..... 51 kt (94 km/h; 58 mph)
Prop-Jet ..... 60 kt (110 km/h; 68 mph)
Max rate of climb at S/L: LSA ..... 366 m (1,200 ft)/min
Experimental ..... 457 m (1,500 ft)/min
Prop-jet ..... 1,067 m (3,500 ft)/min
Range at cruising speed: LSA ..... 451 n miles (836 km; 520 miles)
Experimental ..... 620 n miles (1,149 km; 714 miles)
Prop-Jet ..... 521 n miles (965 km; 600 miles)
g limits: LSA ..... +4.4/–2.2
Experimental ..... +6.4/–3.2
Prop-Jet ..... +9.0/–6.0

GLASAIR

NEW GLASAIR LLC

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Stoddard-Hamilton company formed in 1979. Glasair I, II and II-S were superseded by Super II and III. Details of Glasair I in 1989–90 *Jane's All the World's Aircraft*. Two-seat GlaStar added to product range in 1995; float production rights sold to Aero Marine Inc in 1996.

Work began on a six-seater, named Aurora, in early 2000, but Stoddard-Hamilton ceased trading in May 2000 and filed for Chapter 11 bankruptcy on 17 July. At a bankruptcy hearing on 18 August 2000, the bulk of the assets was sold to Anduril Private Investment Fund, but this agreement was set aside on 27 November 2000 and bidding for the company was re-opened.

Stoddard-Hamilton then received offer from Phoenix Composites for Glasair rights but failed to complete. Rights to both aircraft lines were purchased from Arlington Advanced Development by Thomas Wathen on 15 June 2001. Separate marketing companies were established by Mr Wathen for the two main product lines, namely New Glasair and New GlaStar. In 2005, New Glasair and New GlaStar were merged into Glasair Aviation, at which time more than 2,500 kits had been sold and 1,600 aircraft were flying.

In July 2004, the company announced a 1,115 m^2 (12,000 sq ft) extension to its facilities to cope with increased demand.

On 4 March 2006, a Glasair ITD piloted by Bruce Hammer seat a new transcontinental eastbound record in Class C1b, flying from San Diego to Jacksonville, Florida, at an average of 224 kt (415 km/h; 258 mph).

Glasair Super II-FT *(Paul Jackson)* 1158798

GLASAIR SUPER II

TYPE: Side-by-side kitbuilt.

PROGRAMME: Derived from 1980 Glasair TD via Glasair II and stretched II-S (by which name it was initially known). Prototype first flown in 1990. Jump-start kit options, to reduce quoted build time by around 750 hours, offered from 1999 onwards. Over 3,100 hours flown by factory demonstrator N902S by August 2003.

CURRENT VERSIONS: Available in **RG** (retractable landing gear), **FT** (non-retractable tricycle gear) and **TD** (taildragger) forms introduced in 1992 to supersede earlier Glasair series; TD not marketed since 2002, but remains available to order.

CUSTOMERS: Over 600 kits sold by October 2005, when 294 on US register.

COSTS: Kits: USD39,945 for RG; USD32,196 for FT; both without engine, propeller, instruments and avionics; 'jumpstart' (quick build) fuselage extra USD9,295 for RG and USD8,009 for FT; 'jumpstart' wing extra USD8,635 for RG and USD8,331 for FT (all 2006).

DESIGN FEATURES: Low-wing monoplane with moderately tapered wing and sweptback tail surfaces; optimised for high performance consistent with amateur assembly. Quoted build time 1,400 hours for fixed landing gear versions and 1,800 hours for RG (both with 'jumpstart' options; times increased by 30-35 per cent without options.

Wing section NASA LS(I)-0413; dihedral 3°; incidence 2° 20'. Upswept Hoerner style wingtips. Optional 61 cm (2 ft 0 in) extension on each wingtip.

FLYING CONTROLS: Conventional and manual. Horn-balanced rudder and elevators; ailerons with trim tab; plain flaps (slotted flaps optional).

STRUCTURE: Glass fibre and foam composites construction. One-piece wing spar; stressed for aerobatic flight loads.

LANDING GEAR: Fixed or retractable. Nosewheel or tailwheel options for fixed gear. Fuselage-mounted spring cantilever mainwheel legs; trailing link nosewheel. RG version has inward-retracting mainwheels and rearward-retracting, free-castoring nosewheel; oleo shock-absorbers. Brakes fitted. Wheel size 5.00-5 in. TD has full-swivel, locking tailwheel.

POWER PLANT: One 119 to 149 kW (160 to 200 hp) Textron Lycoming O-320 or IO-360 flat-four engine driving a Hartzell constant-speed metal propeller; standard engine for RG and FT is 134 kW (180 hp) Textron Lycoming IO-360. Fuel capacity 235 litres (62.0 US gallons; 51.6 Imp gallons) in main wing tanks plus 30 litres (8.0 US gallons; 6.7 Imp gallons) in header tank of which total of 257 litres (68.0 US gallons; 56.6 Imp gallons) usable. Auxiliary tanks of 41.6 litres (11.0 US gallons; 9.2 Imp gallons) capacity in optional wingtip extensions.

ACCOMMODATION: Two persons, side by side. Enclosed cockpit with gull-wing doors. NACA air vents provide cabin ventilation.

DIMENSIONS, EXTERNAL (all versions):

Wing span: standard	7.11 m (23 ft 4 in)
optional	8.33 m (27 ft 4 in)
Wing aspect ratio: standard	6.7
optional	8.2
Length overall	6.31 m (20 ft 8½ in)
Height overall	2.07 m (6 ft 9½ in)
Propeller diameter	1.78 m (5 ft 10 in)

DIMENSIONS, INTERNAL:

Cabin max width	1.07 m (3 ft 6 in)
Baggage volume	0.34 m^3 (12.0 cu ft)

AREAS:

Wings, gross: standard	7.55 m^2 (81.3 sq ft)
optional	8.50 m^2 (91.5 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: RG	635 kg (1,400 lb)
FT	590 kg (1,300 lb)
TD	544 kg (1,200 lb)
Max baggage weight: all versions	45 kg (100 lb)
Max T-O weight:	
standard wing:	
RG, FT	953 kg (2,100 lb)
TD	907 kg (2,000 lb)
extended wing: RG, FT	998 kg (2,200 lb)
TD	952 kg (2,100 lb)
Max wing loading:	
standard wing:	
RG, FT	126.1 kg/m^2 (25.83 lb/sq ft)
TD	120.1 kg/m^2 (24.60 lb/sq ft)
extended wing: RG, FT	117.4 kg/m^2 (24.04 lb/sq ft)
TD	112.1 kg/m^2 (22.95 lb/sq ft)
Max power loading:	
standard wing, 119 kW (160 hp) engine: FT	7.99 kg/kW (13.13 lb/hp)
extended wing: FT	8.37 kg/kW (13.75 lb/hp)
standard wing, 134 kW (180 hp) engine:	
RG	7.10 kg/kW (11.67 lb/hp)
TD	6.76 kg/kW (11.11 lb/hp)
extended wing: RG	7.44 kg/kW (12.22 lb/hp)
TD	7.10 kg/kW (11.67 lb/hp)

PERFORMANCE (180 hp engine):

Never-exceed speed (VNE)	226 kt (418 km/h; 260 mph)
Max level speed at S/L:	
RG	207 kt (383 km/h; 238 mph)
FT, TD	198 kt (367 km/h; 228 mph)

Glasair Super II-RG *(Paul Jackson)* 1158799

Econ cruising speed at 75% at FL80:	
RG	192 kt (356 km/h; 221 mph)
FT, TD	182 kt (338 km/h; 210 mph)
Stalling speed, power off:	
plain flaps down: RG, FT	63 kt (117 km/h; 73 mph)
TD	55 kt (102 km/h; 63 mph)
slotted flaps down:	
RG, FT	59 kt (110 km/h; 68 mph)
TD	50 kt (92 km/h; 57 mph)
Max rate of climb at S/L: all	823 m (2,700 ft)/min
Max rate of roll:	
standard wing: FT, TD	130°/s
RG	140°/s
extended wing: FT, TD	85°/s
RG	90°/s
Service ceiling: all	approx 5,790 m (19,000 ft)
T-O and landing run: TD, FT	213 m (700 ft)
RG	244 m (800 ft)
Range:	
RG, standard fuel	1,320 n miles (2,446 km; 1,520 miles)
RG, with auxiliary fuel	1,543 n miles (2,858 km; 1,776 miles)
FT, TD, standard fuel	1,256 n miles (2,327 km; 1,446 miles)
FT, TD, with auxiliary fuel	1,468 n miles (2,719 km; 1,690 miles)
g limits at AUW of 708 kg (1,560 lb): all	+6/–4
	(+9/–6 ultimate)

GLASAIR III

TYPE: Side-by-side kitbuilt.

PROGRAMME: First flight July 1986.

CURRENT VERSIONS: **Glasair III:** *As described.*

Glasair III Turbo: Powered by 224 kW (300 hp) Textron Lycoming TIO-540. Maximum level speed 284 kt (526 km/h; 327 mph); maximum rate of climb 1,143 m (3,750 ft)/min; withdrawn in 1998 and superseded by Glasair Super III.

Glasair Super III: Prototype (N401KT) flying by third quarter 1998, when demonstrated 322 kt (596 km/h; 370 mph) at 10,060 m (33,000 ft), powered by IO-540-AA1B5 uprated with Honeywell turbocharger to 261 kW (350 hp) at 11,275 m (37,000 ft) and with Hartzell four-blade propeller. Predicted maximum speed of 350 kt (648 km/h; 403 mph). Has enlarged rudder, extra fuel capacity and highly modified cowling. Public debut at Sun 'n' Fun 1999.

Glasair III Turbine: One 313 kW (420 shp) Rolls-Royce 250-B17 turboshaft. First UK example, built by Glen Waters, first flew (G-ICBM) July 2006.

CUSTOMERS: Over 500 kits delivered by October 2006; 250 flying by May 2004; 174 on US civil register October 2006.

COSTS: Kit: USD48,321 without engine, propeller, instruments and avionics; jumpstart options for wing (USD9,670) and fuselage (USD9,670) offered (all 2006).

DESIGN FEATURES: Similar configuration to earlier Glasairs, but designed to offer better performance, constructional simplicity and economical kit price. Larger fuselage for increased baggage space, payload capacity and comfort, also improving the longitudinal and directional stability for better cross-country and IFR performance; windows to rear of cockpit doors. Thicker windscreen to improve protection against bird strikes at higher speeds, and additional glass fibre laminates, integral longerons, and lay-up schedule which provides structurally stronger and torsionally stiffer fuselage. Quoted build time 1,800 working hours with 'jumpstart' options.

Wing section LS(I)-0413; wing incidence 2° 18', dihedral 3°; strengthened; carries more fuel than previous models. Optional wingtip extensions for 8.32 m (27 ft 3½ in) or 7.86 m (25 ft 9½ in) spans.

FLYING CONTROLS: As Glasair Super II. Slotted flaps optional.

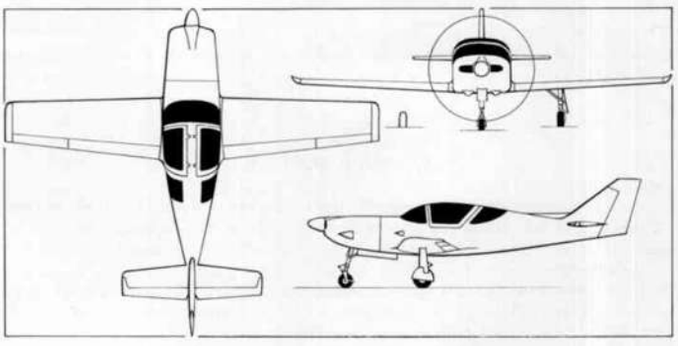
LANDING GEAR: Retractable tricycle only, otherwise as Super II-RG but with 13 cm (5 in) longer landing gear legs to accommodate larger diameter propeller; oleo strut shock absorption. Mainwheels size 5.00-5; nosewheel 4.00-5. Differential Cleveland disc brakes on mainwheels.

POWER PLANT: One 224 kW (300 hp) Textron Lycoming IO-540-K1H5 flat-six piston engine driving a two-blade constant-speed propeller. Usable fuel capacity in wings 235 litres (62.0 US gallons; 51.6 Imp gallons). Fuselage header tank, capacity 30 litres (8.0 US gallons; 6.7 Imp gallons). Optional tanks in wingtip extensions, combined capacity 41.6 litres (11.0 US gallons; 9.2 Imp gallons).

ACCOMMODATION: As for Super II.

Data below refer to standard wing span Glasair III.

Glasair III Turbine *(Glen Waters)* 1158805



General arrangement of the Glasair III *(James Goulding)* 0093599

DIMENSIONS, EXTERNAL:	
Wing span: standard	7.11 m (23 ft 4 in)
optional	8.33 m (27 ft 4 in)
Wing chord: at root	1.28 m (4 ft 2½ in)
at tip	0.84 m (2 ft 9 in)
Wing aspect ratio: standard	6.7
optional	8.2
Length overall	6.52 m (21 ft 4 in)
Height overall	2.29 m (7 ft 6 in)
Tailplane span	2.64 m (8 ft 8 in)
Wheel track	3.10 m (10 ft 2 in)
DIMENSIONS, INTERNAL: As for Glasair Super II	
AREAS:	
Wings, gross: standard	7.55 m^2 (81.3 sq ft)
optional	8.50 m^2 (91.5 sq ft)
Fin	1.06 m^2 (11.40 sq ft)
Rudder	0.57 m^2 (6.10 sq ft)
Tailplane	1.51 m^2 (16.30 sq ft)
Elevator	0.53 m^2 (5.70 sq ft)
WEIGHTS AND LOADINGS:	
Weight empty	737 kg (1,625 lb)
Max baggage weight	45 kg (100 lb)
Max T-O weight: without wingtip extensions	1,089 kg (2,400 lb)
with wingtip extensions	1,134 kg (2,500 lb)
Max wing loading: standard	144.1 kg/m^2 (29.52 lb/sq ft)
optional	133.4 kg/m^2 (27.32 lb/sq ft)

Glasair III displaying this variant's extended landing gear legs *(Paul Jackson)* 1158795

Max power loading: standard ..... 4.86 kg/kW (8.00 lb/hp)
optional ..... 5.07 kg/kW (8.33 lb/hp)
PERFORMANCE (standard wings):
Never-exceed speed (VNE) ..... 291 kt (539 km/h; 335 mph)
Max level speed at S/L ..... 252 kt (466 km/h; 290 mph)
Cruising speed at FL80:
at 75% power ..... 242 kt (448 km/h; 278 mph)
at 65% power ..... 230 kt (426 km/h; 265 mph)
Stalling speed: pilot only, plain flaps down ..... 68 kt (126 km/h; 79 mph)
at max T-O weight, slotted flaps down ..... 63 kt (117 km/h; 73 mph)
Max rate of climb at S/L ..... 911 m (2,990 ft)/min
Max rate of roll: standard wing ..... 140°/s
extended wing ..... 90°/s
Service ceiling: Glasair III ..... approx 7,315 m (24,000 ft)
Glasair Super III ..... 9,144 m (30,000 ft)
T-O run ..... 274 m (900 ft)
Landing run ..... 305 m (1,000 ft)
Range at 55% power:
standard fuel ..... 1,076 n miles (1,994 km; 1,239 miles)
with tip tanks ..... 1,263 n miles (2,340 km; 1,454 miles)
g limits at AUW of 962 kg (2,120 lb): all ..... +6/–4
..... +9/–6 ultimate

GLASAIR GLASTAR

TYPE: Side-by-side kitbuilt.

PROGRAMME: Designed by Arlington Aircraft Developments and produced until 2000 by Stoddard-Hamilton. Then to New GlaStar LLC; ownership to Glasair Aviation in 2005.

Prototype (N824G) first flew 29 November 1994; deliveries of kits started 1995. Over 1,400 hours flown by December 1998. Prototype converted to tailwheel configuration and then back to tricycle. Chosen by EAA as flagship aircraft for Young Eagle junior pilot scheme; first customer-built aircraft completed in July 1996. Early examples had a 93 kW (125 hp) Teledyne Continental IO-240. 'Jumpstart' kits introduced in 2003, reducing build time by estimated 400 hours. 'Two weeks to taxi' programme introduced August 2006, allowing amateur builders to attend Glasair's Customer Assembly Centre and complete aircraft to pre-flight stage, omitting only weight and balance, official paperwork and painting.

FAA certified version originally built in Germany as OMF Symphony, later produced in Canada by Symphony Aircraft. Four-seat, Four Winds versions produced in US.

CURRENT VERSIONS: **GlaStar:** Basic model; *as described.*

Sportsman 2+2: Introduced August 2003; strengthened wings, safety cage and landing gear. First kit delivered October 2003 to builder in New Hampshire.

CUSTOMERS: Over 900 GlaStar and 140 Sportsman kits sold in 16 countries up to October 2006; over 400 flying by that time. Total of 308 registered in USA alone by October 2006.

COSTS: Sportsman 2+2 USD39,950 per kit, excluding engine, instruments, upholstery and paint. 'Jumpstart' fuselage adds USD4,895; wing adds USD9,495 to these prices; tail kit adds USD3,195 (all prices 2006).

DESIGN FEATURES: Conceived as inexpensive two-seat personal lightplane with wide performance envelope. Convertible landing gear, float compatible. Wings fold (one-person, three-minute task) and horizontal tail surfaces removable for compact hangarage or for trailer mounting. Quoted build time 1,500 to 2,000 hours. 'Jumpstart' options introduced in November 1998 to reduce time by half; wing kits for this option are assembled in the Philippines.

Braced, high wing of constant chord, unswept. Tailplane has root extensions; tall, sweptback fin. Wing section LS(I)-0413.

FLYING CONTROLS: Conventional and manual. Frise ailerons; Fowler flaps. Elevator tab for pitch trim. Aileron servo tab and trim. Two-position flaps: 15 and 35°. Vortex generators added to wings in front of ailerons and at wingroots, and root strakes to horizontal stabiliser. Optional electric elevator trim.

STRUCTURE: Fuselage construction of GFRP with 4130 steel tube frame surrounding cockpit section. Wings and tail surfaces of 2024-T3 aluminium. Two-spar wings have six full ribs per side, plus stiffeners.

LANDING GEAR: Fixed. Fuselage-mounted spring cantilever mainwheel legs with wheel fairings; option of nosewheel or steerable tailwheel. Both GlaStar and Sportsman have option of Aerocet 2200, Wipline, Bilmar and Montana float; no differences in airframe among landing gear alternatives. Tailwheel (15 cm; 6 in tyre) conversion effected in 3 hours; choice of three mainwheel sizes: 5.00-5 (with speed fairings), 6.00-6 and 8.00-6. Optional Scott 3200 20 cm (8 in) tailwheel with larger mainwheels.

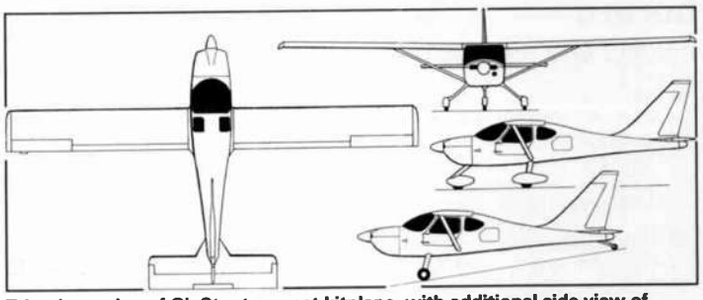
POWER PLANT: *GlaStar:* One 119 kW (160 hp) Textron Lycoming O-320-D1F flat-four, driving a Sensenich fixed-pitch or Hartzell constant-speed two-blade propeller; or 112 kW (150 hp) O-320-E1A and 134 kW (180 hp) O-360; power plants in the range 93–168 kW (125–225 hp) are in use, with around 100 aircraft fitted with Subaru 2.2 and 2.5 litre motorcar engine conversions. Usable fuel capacity 104 litres (27.6 US gallons; 23.0 Imp gallons). Optional 66 litre (17.5 US gallon; 14.6 Imp gallon) auxiliary tank.

Sportsman 2+2: Prototype has one 134 kW (180 hp) Textron Lycoming O-360 engine driving two-blade Hartzell constant-speed propeller. Usable fuel capacity 189 litres (50.0 US gallons; 41.6 Imp gallons).

ACCOMMODATION: Two persons side by side; seats adjust for pilot heights between 1.52 and 1.98 m (5 ft 0 in and 6 ft 6 in). Door each side. Baggage compartment behind crew with separate baggage door on port side; larger on Sportsman 2+2.

SYSTEMS: Electrical system: 12 V 30 Ah battery; alternator fit appropriate to engine.

Glasair GlaStar used in EAA Young Eagles air experience programme *(Paul Jackson)* 1158800



Tricycle version of GlaStar two-seat kitplane, with additional side view of tailwheel version *(Paul Jackson)* 0093597

AVIONICS: To customer's specification.

DIMENSIONS, EXTERNAL (A: GlaStar; B: Sportsman):
Wing span: A, B ..... 10.67 m (35 ft 0 in)
Wing chord, constant A, B ..... 1.12 m (3 ft 8 in)
Wing aspect ratio: A 9.6
B 9.4
Length: fuselage: A ..... 6.81 m (22 ft 4 in)
wings folded: A ..... 7.47 m (24 ft 6 in)
Lycoming O-320 ..... 7.62 m (25 ft 0 in)
B ..... 7.01 m (23 ft 0 in)
Height overall:
tricycle: A ..... 2.77 m (9 ft 1 in)
B ..... 2.84 m (9 ft 4 in)
tailwheel: A, B ..... 2.11 m (6 ft 11 in)
Tailplane span ..... 3.28 m (10 ft 9 in)
Propeller diameter ..... 1.83 m (6 ft 0 in)
Doors (each): Height ..... 0.80 m (2 ft 7½ in)
Width ..... 0.94 m (3 ft 1 in)
Height to sill ..... 0.84 m (2 ft 9 in)

DIMENSIONS, INTERNAL:
Cabin max width: A, B ..... 1.17 m (3 ft 10 in)
Baggage compartment volume: A ..... 0.91 m^3 (32.0 cu ft)
B ..... 1.05 m^3 (37.0 cu ft)

AREAS:
Wings, gross: A ..... 11.89 m^2 (128.0 sq ft)
B ..... 12.17 m^2 (131.0 sq ft)
Ailerons (total) ..... 0.37 m^2 (3.97 sq ft)
Trailing-edge flaps (total) ..... 0.65 m^2 (6.95 sq ft)
Fin ..... 1.29 m^2 (13.92 sq ft)
Rudder ..... 0.47 m^2 (5.08 sq ft)
Tailplane ..... 1.11 m^2 (12.00 sq ft)
Elevators (total) ..... 0.99 m^2 (10.67 sq ft)

WEIGHTS AND LOADINGS:
Weight empty: A ..... 544 kg (1,200 lb)
B ..... 612 kg (1,350 lb)
Max baggage weight ..... 113 kg (250 lb)
Max T-O weight:
landplane: A ..... 889 kg (1,960 lb)
B ..... 1,066 kg (2,350 lb)
floatplane: A ..... 952 kg (2,100 lb)
B ..... 1,134 kg (2,500 lb)
Max wing loading:
landplane: A ..... 74.8 kg/m^2 (15.31 lb/sq ft)
B ..... 87.6 kg/m^2 (17.94 lb/sq ft)
floatplane: A ..... 80.1 kg/m^2 (16.41 lb/sq ft)
B ..... 93.2 kg/m^2 (19.08 lb/sq ft)
Max power loading: landplane:
A ..... 7.46 kg/kW (12.25 lb/hp)
B ..... 7.95 kg/kW (13.06 lb/hp)
floatplane: A ..... 7.99 kg/kW (13.13 lb/hp)
B ..... 8.45 kg/kW (13.89 lb/hp)

PERFORMANCE (A: 119 kW, 160 hp, engine, constant-speed propeller B: 134 kW, 180 hp engine, constant-speed propeller):
Never-exceed speed (VNE):
A, B ..... 162 kt (300 km/h; 186 mph)
Max level speed: A, B ..... 145 kt (269 km/h; 167 mph)
Max cruising speed at 75% power:
A ..... 140 kt (259 km/h; 161 mph)
B ..... 137 kt (254 km/h; 158 mph)
Econ cruising speed at 65% power:
A ..... 133 kt (246 km/h; 153 mph)
B ..... 134 kt (248 km/h; 154 mph)
Stalling speed, power off:
flaps up: A ..... 49 kt (91 km/h; 56 mph)
B ..... 51 kt (94 km/h; 58 mph)
flaps down: A ..... 43 kt (79 km/h; 49 mph)
B ..... 42 kt (78 km/h; 48 mph)
Max rate of climb at S/L: A ..... 632 m (2,075 ft)/min
B ..... 564 m (1,850 ft)/min
Service ceiling: A, B ..... 6,096 m (20,000 ft)
T-O run: A ..... 88 m (290 ft)
B ..... 107 m (350 ft)
T-O to 15 m (50 ft) ..... 155 m (510 ft)
Landing from 15 m (50 ft) ..... 168 m (550 ft)
Landing run: A, B ..... 79 m (260 ft)
Range:
with standard fuel: A ..... 481 n miles (891 km; 554 miles)
B ..... 720 n miles (1,333 km; 828 miles)
with max fuel: A ..... 828 n miles (1,533 km; 953 miles)
Endurance with max fuel ..... 6 h
g limits: A, B ..... +3.8/–1.5

GOLDEN

GOLDEN AVIATION INC

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Web: www.goldenaviation.com
PRESIDENT: David Gouldsmith
CHIEF ENGINEER: Noel Gouldsmith
OFFICE MANAGER: Marlene Gouldsmith

MARKETING COMPANY:: US Aircraft Corporation
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Golden specialises in restoring and custom-building historic aircraft and warbirds. In 2006, the company opened a second, 2,787 m² (30,000 sq ft) premises at Monett Municipal Airport, Monett, Missouri.

GOLDEN/US AIRCRAFT A-67 DRAGON

TYPE: Basic turboprop trainer/attack lightplane.
PROGRAMME: Conceived by US Aircraft Corporation, subsidiary of US Technology Corporation; development began 2003; proof-of-concept prototype built by Golden Aviation and registered N906US in June 2005; first flight 6 October 2006 from Cassville, Missouri, to Monett, where starboard landing gear failed on landing, causing slight damage.
COSTS: USD3.5 million (2006). Prototype built with USD5 million investment by US Aircraft Corporation.
DESIGN FEATURES: Turboprop replacement for Cessna A-37 Dragonfly in counter-insirgency, close air support, reconnaissance and trainer roles–and with same side-by-side seating for **crew–employing commercially available, off-the-shelf components.**
Low wing and tailplane; narrow-chord, sweptback fin.
STRUCTURE: All metal. Fuselage structure of torque tubes. Wing leading-edges incorporate "stealth polymer".
LANDING GEAR: Tricycle type; retractable. Mainwheels retract inward; nosewheel, rearward.
POWER PLANT: One 895 kW (1,200 shp) Pratt & Whitney Canada PT6A-67A turboprop driving a Hartzell four-blade propeller.
EQUIPMENT: Ballistic recovery parachute.
ARMAMENT: Five weapon pylons, plus provision for internal weapons.
DIMENSIONS, EXTERNAL:
Wing span ..... 11.43 m (37 ft 6 in)
Length overall ..... 10.36 m (34 ft 0 in)
WEIGHTS AND LOADINGS:
Weight empty ..... 1,474 kg (3,250 lb)
Max weapon load ..... more than 1,361 kg (3,000 lb)
Max T-O weight ..... 4,536 kg (10,000 lb)
PERFORMANCE (estimated):
Max level speed ..... more than 300 kt (556 km/h; 345 mph)
Stalling speed ..... 67 kt (124 km/h; 78 mph)
g limits ..... +12

Maiden flight of COIN-optimised Golden A-67 Dragon turboprop 1159797

GREAT PLAINS

GREAT PLAINS AIRCRAFT SUPPLY CO INC

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e-mail: gpasc@earthlink.net
Web: www.greatplainsas.com; www.easyeagle1.com
PRESIDENT: Steve Bennett

Formed in 1982 and specialising in supply of Volkswagen engines and components for homebuilt aircraft, Great Plains took over production of kits for the Grosso Easy Eagle I in May 2004; the Easy Eagle II is no longer available. The company also supplies kits and plans for the Sonerai.

GREAT PLAINS EASY EAGLE

TYPE: Single-seat ultralight biplane kitbuilt.
PROGRAMME: Construction began 1996; single-seat Easy Eagle first displayed at Oshkosh 1998. Two-seat Easy Eagle II introduced in 1999 but discontinued in 2004. First customer complete aircraft finished in 2005.
CURRENT VERSIONS: **Easy Eagle**: Single-seat version.
CUSTOMERS: Four Easy Eagles complete by October 2005.
COSTS: Kit USD10,000 (Easy Eagle) (2005).
DESIGN FEATURES: Classic open-cockpit, single-bay biplane with steel tube cabane and flying struts and steel landing wires. Modified Clark Y aerofoil. No aerofoil on tailplane. Quoted build time 300 to 500 hours.
FLYING CONTROLS: Conventional and manual. Large ailerons on lower wings only.
STRUCTURE: Fabric-covered 4130 steel tube fuselage with metal-covered fuselage forward of cockpit and two-spar wooden wings with aluminium leading-edge.
LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted spring aluminium cantilever mainwheel legs. Azusa wheels and cable brakes; tyres 5.00-5. Solid tailwheel.
POWER PLANT: One 1,914 cc Volkswagen four-cylinder air-cooled motorcar engine; design accepts engines to 63.4 kW (85.0 hp). Wooden propeller. Fuel capacity 45.4 litres (12.0 US gallons; 10.0 Imp gallons).

Great Plains (Grosso-built) Easy Eagle I *(Paul Jackson)* 0126879

DIMENSIONS, EXTERNAL:
Wing span ..... 5.59 m (18 ft 4 in)
Length overall ..... 4.37 m (14 ft 4 in)
Height overall ..... 1.78 m (5 ft 10 in)
AREAS:
Wings, gross ..... 8.36 m² (90.0 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 206 kg (454 lb)
Max T-O weight ..... 328 kg (725 lb)
PERFORMANCE:
Max operating speed ..... 95 kt (177 km/h; 110 mph)
Normal cruising speed ..... 83 kt (153 km/h; 95 mph)
Stalling speed ..... 40 kt (73 km/h; 45 mph)
Max rate of climb at S/L ..... 213 m (700 ft)/min
T-O and landing run ..... 137 m (450 ft)
Range with max fuel ..... 260 n miles (482 km; 300 miles)

GROEN

GROEN BROTHERS AVIATION INC

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Web: www.gbagyros.com
PRESIDENT AND CEO: David Groen
VICE-PRESIDENT: James P Mayfield III
SENIOR VICE-PRESIDENT AND HEAD OF BUSINESS DEVELOPMENT: Robin H H Wilson
CHIEF FINANCIAL OFFICER: Dennis Gauger

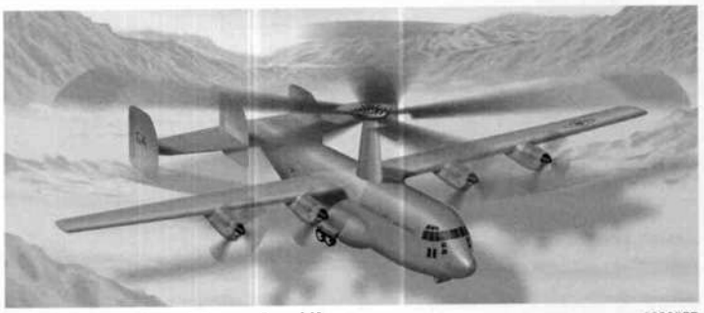
Groen Brothers has been working on its Hawk Gyroplane family since 1986. Prototypes leading up to the Hawk 4 include the Hawk I and H2X, as described in previous editions of *Jane's*. The Hawk 4 Gyroplane is the first in a series of near VTOL-capable aircraft and is initially being developed and marketed to government agencies under Public Use regulations, with FAA certification not expected for at least two years. The RevCon 6G technology demonstrator uses the fuselage of a Cessna 337 as the basis of its fuselage and will be progressively modified into a gyrodyne by the addition of rotor blade mounted tipjets; Groen has offered its GyroLifter gyrodyne to the US Department of Defense. The company has a flight test facility at Buckeye, Arizona, where, on 12 July 2000, the prototype Jet Hawk 4T/Hawk 4 made its initial flight.

In July 2001, Groen announced plans to move to a new 18,580 m² (200,000 sq ft) facility at Phoenix, Arizona. The plant, which will cost USD14 million and employ 425, was intended to become operational by end 2002 and have the capacity to produce four aircraft per day, however this has lapsed.

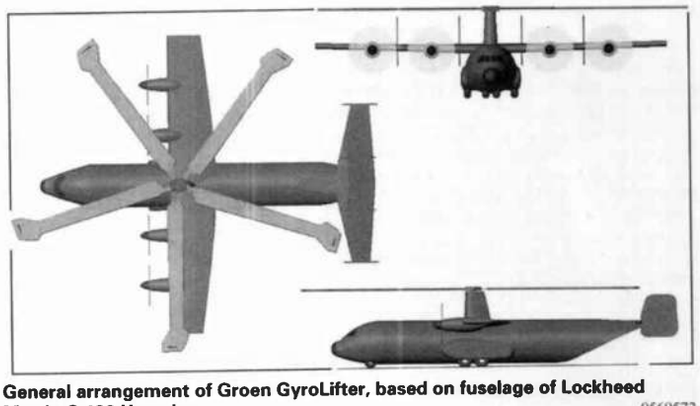
In August 2001, the company concluded a joint venture with Al-Obayya Corporation to produce and market gyroplanes in Saudi Arabia. However, economic downturn of late 2001 resulted in 85 of 130-strong workforce being laid off. Earlier plans for Chinese assembly also appear to have lapsed, although negotiations with an investment group continued throughout 2005.

Groen is also the parent of American Autogyro (AAI), whose SparrowHawk is described elsewhere; on 1 November 2004, Groen took over marketing, sales and manufacturing for the SparrowHawk, pending a planned merger of the two company components before the end of 2004.

Chairman Jay Groen died 9 October 2006.



Artist's impression of Groen GyroLifter 1022977



General arrangement of Groen GyroLifter, based on fuselage of Lockheed Martin C-130 Hercules 0569572

GROEN HAWK 4

TYPE: Four-seat autogyro.

PROGRAMME: Based on proof-of-concept Hawk One (N4379X) first flown 26 September 1992; design started April 1996 and prototype two-seat H2X (N4412X) first flew 4 February 1997; later converted to three-seat Hawk III standard. First deliveries had been due June 1998, but design changes to H2X and later Hawk III in October 1998 resulted in Hawk 4. Initial aircraft (N402GB) first flew 29 September 1999, powered by a Continental piston engine, and made first vertical take-off on 9 December 1999; had flown 120 hours in 200 sorties by early April 2000. In September 2000 company switched certification effort to turbine-powered Hawk 4T (N403GB), which was renamed Hawk 4 at this time following abandonment of piston-engined version; the following October Groen changed its focus to seek government contracts for Hawk 4, slowing certification process for both piston- and turbine-powered versions until it sees market upturn.

On 28 December 2001, Groen announced contract with Utah Olympic Public Safety Command for lease of Hawk 4, beginning 20 January 2002, for security patrols at Salt Lake International Airport, equipped with video downlink system, Spectrolab SX-5 searchlight and additional radios; aircraft flew 75 hours in 67 operations.

In 2005, negotiations were underway for a further cash injection to enable the project to progress.

GROEN GYROLIFTER

TYPE: Convertiplane.

PROGRAMME: Response to request of US Defense Advanced Research Projects Agency (DARPA) for proposals to meet requirement for Advanced Maneuver Transport (AMT) with VTOL and heavy lift capability. Proposal is based upon the integration of a large-diameter rotor powered by tipjets with an existing fixed-wing turboprop freighter, a concept previously used by the Fairey Rotodyne.

Groen is proposing to DARPA that it be designated to undertake the necessary research and development to produce an intermediate scale technology demonstrator leading to full-scale prototype based on the Lockheed C-130 aircraft.

In November 2005, DARPA awarded a 15-month, USD6.4 million first-phase contract to test a heliplane concept: later contracts could see further testing, leading to the construction and flight testing of a prototype and total expenditure of USD40 million. The prototype is to be smaller than a C-130 and more the size of a 6-8 seat commuter aircraft.

CURRENT VERSIONS: **Gyrolifter:** Proposed initial version, *as described.*

Monsoon: Proposed firefighting version; intended to be fitted with US Fire Service roll-on/roll-off Advanced Aerial Firefighting System.

DESIGN FEATURES: Heavy lift gyrodyne with tipjets for rotor drive; large fuselage with passenger accommodation and rear freight doors; VTOL capability; four turboprop engines; stub-wings to share flight load, to reduce rotor speed and increase aircraft airspeed; and mostly composites construction with metal engine attachments. Complete cargo handling system. Tipjets provide a highly efficient power/weight ratio to enable vertical take-off and landing with a 18,144 kg (40,000 lb) payload, but are shut down in other flight modes, permitting the aircraft to achieve a range of up to 1,000 n miles (1,850 km; 1,150 mile) using the efficiencies of turboprop operation in cruise. Rotor system incorporates five mission-adaptive blades incorporating Westland BERP (British Experimental Rotor Programme) paddle blade tips, which optimise rotor performance during all flight regimes, thereby increasing airspeeds above that of any contemporary helicopter, while reducing fuel consumption.

FLYING CONTROLS: Fly-by-wire, fully integrated flight, engine tipjet and rotor management system.

STRUCTURE: Mainly composites structure for fuselage and wings, and metal inserts for landing gear and engine mounting points. Composites rotor blades and unique rotor head design.

LANDING GEAR: Tricycle retractable landing gear with steerable dual-wheel nose landing gear and bogie-type main gear.

POWER PLANT: One Rolls-Royce AD2100 or Rolls-Royce AE 1107 C upgraded from 4,586 kW (6,150 shp) to about 6,711 kW (9,000 shp). Fuel capacity 11,340 kg (25,000 lb).

ACCOMMODATION: Pilot and navigator; or two pilots plus loadmaster.

SYSTEMS: Electrical and hydraulic systems, including APU.

AVIONICS: Fully integrated battlefield systems.

All data are provisional.

DIMENSIONS, EXTERNAL:

Rotor diameter	34.14 m (112 ft 0 in)
Rotor blade chord: at root	1.82 m (5 ft 11½ in)
at tip before BERP	1.21 m (3 ft 11½ in)
Length of fuselage	33.53 m (110 ft 0 in)
Height: overall	7.62 m (25 ft 0 in)
to top of fuselage	5.64 m (18 ft 6 in)
Wheel track	5.18 m (17 ft 0 in)
Wheelbase	12.80 m (42 ft 0 in)
Passenger doors (each):	
Width	1.22 m (4 ft 0 in)
Height to sill	1.07 m (3 ft 6 in)

DIMENSIONS, INTERNAL:

Cabin: Length	12.50 m (41 ft 0 in)
Max width	4.05 m (13 ft 3½ in)

AREAS:

Rotor disc	914.8 m² (9,847.0 sq ft)
Vertical tails (total)	40.13 m² (432.0 sq ft)
Horizontal tail	57.6 m² (620.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	24,948 kg (55,000 lb)
Max T-O weight	59,875 kg (132,000 lb)

PERFORMANCE (estimated):

Never-exceed speed (VNE)	270–330 kt (500–611 km/h; 310–379 mph)
Cruising speed at 75% power	250–300 kt (463–556 km/h; 288–345 mph)
Max rate of climb at S/L	366 m (1,200 ft)/min
Service ceiling	5,486 m (18,000 ft)
T-O and landing run (powered rotor in gyroplane mode)	zero
Range at 75% power	500–1,000 n miles (926–1,852 km; 575–a1,150 miles)

GULFSTREAM

GULFSTREAM AEROSPACE CORPORATION

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SENIOR VICE-PRESIDENT, PROGRAMS, ENGINEERING AND TEST: Preston Henne
SENIOR VICE-PRESIDENT, GOVERNMENT PROGRAMS: Buddy Sams
SENIOR VICE-PRESIDENT, FINANCE AND PLANNING AND CHIEF FINANCIAL OFFICER: Dan Clare
SENIOR VICE-PRESIDENT, ADMINISTRATION AND GENERAL COUNSEL: Ira Berman
VICE-PRESIDENT, DESIGNATED CERTIFICATION OFFICE: William Whitton
VICE-PRESIDENT, ENGINEERING: Richard L Johnson
VICE-PRESIDENT, GOVERNMENT PROGRAMMES: Nicholas D Lappos
DIRECTOR OF CORPORATE COMMUNICATIONS: Robert Baugniet

Originally an offshoot of Grumman Corporation; passed through several owners before purchase by General Dynamics for US$4.8 billion in May 1999; deal completed 31 July 1999.

Corporate HQ and production centre is at Savannah, Georgia. Subassembly and support locations are at Brunswick, Georgia; Long Beach, California; Dallas, Texas; Appleton, Wisconsin, Mexicali, Mexico; and Luton, UK. Total employment stood at 6,800 worldwide in

GULFSTREAM DELIVERIES

	2000	2001	2002	2003	2004	2005
G 100/G150/G200		13	85	24	22	26
G IV/G V	71	71				
G300/G350/G400/G450/G500/G550				50	56	63
Totals	**71**	**84**	**85**	**74**	**78**	**89**

2004. In early 2001, Gulfstream exchanged its engine overhaul service in Dallas with units of BBA Aviation, acquiring five regional maintenance centres in Dallas, Las Vegas, Minneapolis, Westfield and West Palm Beach; the service operation was rebranded as General Dynamics Aviation Services as a result.

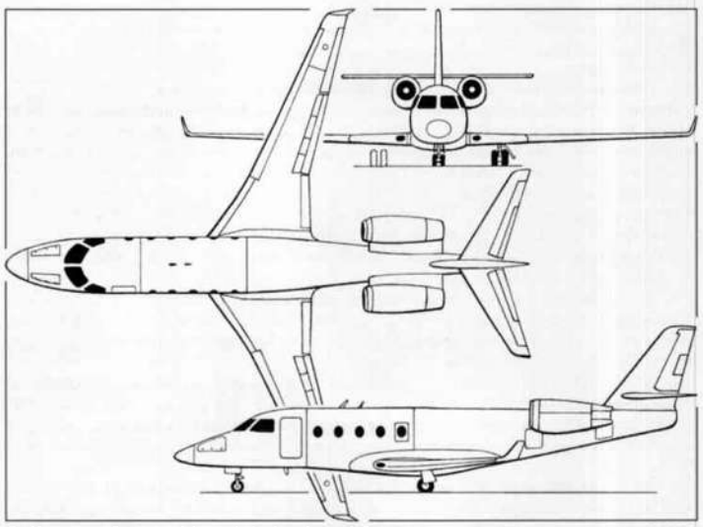
The 1,000th Gulfstream, a Gulfstream V, was delivered to the company's Long Beach completion centre in September 1997. During 1998, Gulfstream and Lockheed Martin's Skunk Works were revealed to be undertaking preliminary studies into the potential of a supersonic business jet; however Skunk Works withdrew from the project in 2000, following financial difficulties.

Following the purchase of Galaxy Aerospace of Israel by General Dynamics on 5 June 2001, the former's Astra and Galaxy business jets were incorporated into the Gulfstream product line as the Gulfstream 100 and 200 respectively. Production of the Gulfstream 150 (which see, replacing Gulfstream 100, and Gulfstream 200 continues at Tel Aviv with 'green' aircraft flown to Love Field, Dallas, Texas for outfitting by Gulfstream.

On 9 September 2002, Gulfstream announced revised aircraft designations, the G IV becoming G300 and G400; G V becoming G500 and G550; and a widened G100 being launched as the G150. At the October 2003 NBAA Convention, the G450 was revealed following its previously unannounced maiden flight, and on 23 February 2004 Gulfstream announced the G350.

By October 2006 the then in-service fleet of 141 G350s, G450s, G500s and G550s had jointly logged a total of more than 100,000 flight hours and 50,000 take-offs and landings.

Gulfstream delivered 113 'green' aircraft in 2006.



Gulfstream G150, widened derivative of G100 *(James Goulding)* 1154670

GULFSTREAM G100

US Air Force designation: C-38A

TYPE: Business jet.

PROGRAMME: Descendant of US Aero Commander 1121 Jet Commander (first flight 27 January 1963), acquired by IAI 1967 and developed successively as 1121 Commodore Jet, 1123 and 1124 Westwind and 1124A Westwind 2; sales of 1121/23/24/24A models by Aero Commander and IAI totalled 441 by end of 1987; 1125 model launched at NBAA Convention October 1979, renamed Astra 1981.

Construction of two prototypes and one static/fatigue test aircraft started April 1982; roll-out 1 September 1983; first flight (4X-WIN, c/n 001) 19 March 1984; first flight 4X-WIA (c/n 002) August 1984; first flight production Astra (4X-CUA) 20 March 1985; FAR Pts 25 and 36 certification 29 August 1985; first delivery 30 June 1986. Astra SP introduced at NBAA Convention October 1989; first delivery of this version (N60AJ) late 1990.

Astra SPX announced at NBAA Convention 1994 and certified by FAA 8 January 1996; type certificate acquired by Gulfstream Aerospace in June 2001, renamed Gulfstream 100 and formally unveiled as such at Paris on 17 June 2001; Gulfstream G100 name adopted from September 2002. G100 was replaced by the G150 in early 2006. At 30 September 2005, total fleet time, including Astras, Astra SPs and Astra SPxs, stood at 508,639 flight hours, with 99.73% despatch reliability. Final aircraft was 4X-CVJ/N995GA which departed Israel 27 February 2006 for outfitting in US and became EC-JXE of Executive Airlines SL in August 2006.

CUSTOMERS: Production totalled 151 (including prototypes, but not one static test airframe) of all designations; final customer delivery in 2006. Annual production reduced to some three/four in 2003 and 2004. Combined production of Astra and Astra SP totalled 68 (plus two prototypes), of which approximately 80 per cent to US customers.

GULFSTREAM G150

TYPE: Business jet.

PROGRAMME: Announced on eve of NBAA Convention at Orlando, Florida, 8 September 2002. Deliveries to launch customer NetJets were scheduled to begin in second quarter of 2005, but by early 2003 programme amended to include May 2005 first flight, certification in first quarter 2006 and first deliveries in third quarter 2006. Prototype (4X-TRA, c/n 201) rolled out 18 January 2005; first flight 3 May 2005; Second aircraft (4X-WID, c/n 202) first flown 2 September 2005; public debut (4X-TRA) at NBAA Convention at Orlando, 9 November 2005; joint Civil Aviation Administration of Israel and FAA certification (as extension to 1125 Westwind Astra certificate) achieved 10 weeks ahead of schedule on 7 November 2005 after 475-hour flight test programme involving two aircraft. FAA RVSM approval and ICAO Stage 4 noise requirements certification achieved in August and October 2006 respectively.

Production deliveries began when c/n 203 (4X-CVK/N528GA) departed Israel for outfitting in Dallas US. First receipt by customer was on 19 September 2006 when N373ML (c/n 204) delivered to Houston for Mary Rose Aviation Services.

CUSTOMERS: Launch customer NetJets Inc ordered 50, plus 50 options, on 9 September 2002, for delivery between 2005 and 2010.

COSTS: USD13.5 million (2006). Direct operating cost USD580 per hour (estimated, 2006).

DESIGN FEATURES: Wide-cabin version of G100; compared to which has new, shorter nose, but rear fuselage stretched aft of pressure bulkhead by 0.41 m (1 ft 4 in) and recontoured to blend with new cabin; wing identical to that of G200 outboard of rib 4 but with addition of 13 vortex generators at mid-span at wingtip/winglet juncture; relocated main landing gear; four stiffened airbrakes per wing; elevator trim tab increased in span by 50%; inboard leading-edge fuel tank deleted; up to 6 per cent additional engine thrust; max internal dimensions increased by 31 cm (12¼ in) in width and 5 cm (2 in) in height, uprated engines, increased (5.5 per cent MTOW) weights, but same range and cruising speed, G200-style windscreen (for improved crew visibility) and oval cabin windows, latter reduced in number from six to five, Rockwell Collins Pro Line 21 avionics, digital steer-by-wire nosewheel steering, two-position speedbrakes with automatic ground spoiler function.

FLYING CONTROLS: Conventional, with hydraulically powered ailerons, manually actuated elevators and rudder. Control surfaces operated by pushrods; tailplane incidence controlled by three motors running together to protect against runaway or elevator disconnect; ailerons

Gulfstream G150 second prototype and US demonstrator 1040391

can be separated in case of jam; spoiler/lift dumper panels ahead of Fowler flaps; elevators and horn-balanced rudder each have geared tab; flaps interconnected with outboard leading-edge slats, both electrically actuated.

Control surface movements: ailerons ±15°; rudder ±22°; elevators + 22° 30'/–12° 30'; flaps 40°; airbrakes 45° (up); slats 25° (down).

STRUCTURE: One-piece, two-spar wing with machined ribs and skin panels, attached by four main and five secondary frames; wing/fuselage fairings, elevator and fin tips and tailcone of GFRP; ailerons, spoilers, inboard leading-edges and wingtips of Kevlar and Nomex honeycomb; nose avionics bay door and nosewheel doors of Kevlar; Kevlar-reinforced nacelle doors and panels; chemically milled fuselage skins; some titanium fittings; heated windscreens of laminated polycarbonate with external glass layer to resist scratching.

LANDING GEAR: SHL hydraulically retractable tricycle type, with oleo-pneumatic shock-absorber and twin wheels on each unit. Trailing-link main units retract inward, nosewheels forward. Tyre sizes 23×7.00–12 (10 ply) (main), 16×4.4–10 (6 ply) deflector type (nose), pressures 8.55 bar; 124 lb/sq in and 6.90 bar; 100 lb/sq in respectively. Hydraulic extension, retraction and nosewheel steering (±58°); hydraulic multidisc anti-skid mainwheel brakes. Compressed nitrogen cylinder provides additional power source for emergency extension.

POWER PLANT: Two 19.66 kN (4,420 lb st) Honeywell TFE731-40AR-200G turbofans, with FADEC. Nordam thrust reversers. Tailcone-mounted Honeywell RE100 APU standard, flight operable to FL350.

Fuel in two wing tanks, each 1,020.5 litres (269.5 US gallons; 224.5 Imp gallons), fuselage tank of 3,016 litres (796 US gallons; 664 Imp gallons) and 814 litres (215 US gallons; 179 Imp gallons) in collectors; total 5,879 litres (1,550 US gallons; 1,292 Imp gallons, of which 5,855 litres (1,546 US gallons; 1,288 Imp gallons) usable. Single pressure refuelling point in lower starboard side of fuselage aft of wing, or single gravity point in upper fuselage, allow refuelling of all tanks from one position. Fuel sequencing automatic.

ACCOMMODATION: Two crew and between six and eight passengers in cabin, with galley forward on starboard side opposite entrance door, and lavatory, vanity unit with mirror and closet at rear, separated from cabin by sliding door. Typical Executive 6 arrangement is four seats in club pairs at forward end of cabin with two forward-facing seats at rear, each with executive pull-out table, drinks holder and headphones outlet. Alternative Universal 7 layout has club four seating at rear of cabin, individual forward-facing seat at front (starboard) and two- or three-seat (Hallmark 8) sideways-facing divan to port. Cabin has 100% fresh air ventilation, three 110 V power outlets, master control for lighting, entertainment and passenger information systems, and MagnaStar dual-channel telephone system with three handsets.

SYSTEMS: Honeywell RE100 APU, flight rated to FL300, standard. Honeywell environmental control system, using engine bleed air, with normal pressure differential of 0.61 bar (8.8 lb/sq in). Two independent hydraulic systems, each at pressure of 207 bar (3,000 lb/sq in). Primary system operated by two engine-driven pumps for actuation of anti-skid brakes, landing gear, nosewheel steering, spoilers/lift dumpers and primary control surfaces. Back-up system, operated by electrically driven pump, provides power for emergency/parking brake, primary control surfaces and thrust reversers.

Electrical system comprises two Lucas Aerospace 300 A 30 V DC engine-driven starter/generators, with two 1 kVA single-phase solid-state inverters operating in unison to supply single-phase 115 V AC power at 400 Hz and 26 V AC power for aircraft instruments. Two 24 V 24 Ah Ni/Cd batteries for engine starting and to permit operation of essential flight instruments and emergency equipment. 28 V DC external power receptacle standard.

Pneumatic de-icing of wing leading-edge slats and tailplane leading-edges; thermal anti-icing of engine intakes. Oxygen system for crew (pressure demand) and passengers (drop-down masks) supplied by 2.18 m^3 (77 cu ft) cylinder, with second cylinder of same capacity optional. Two-bottle Freon-type engine fire extinguishing system standard.

AVIONICS: Rockwell Collins Pro Line 21 as core system, with four-tube EFIS featuring 30.5 cm (12 in) × 25.4 cm (10 in) portrait format LCDs with PlaneView type features. Dual FMS-6000, dual AHS-3000 AHRS, TCAS, EGPWS and TWR-850 Doppler colour weather radar with turbulence detection, all standard. Options include dual VHF and HF transceivers, Honeywell Laseref V IRS, Honeywell AFIS, -3 Stormscope, Class III electronic flight bag (EFB), Honeywell FDR, CVR and satcom. Gulfstream cursor control device (CCD) standard.

EQUIPMENT: Standard equipment includes electric windscreen wipers, electric (warm air) windscreen demisting, wing ice inspection lights, landing light in each wingroot, taxying light inboard of each mainwheel door, navigation and Precise Flight pulse lights at wingtips and tailcone, rotating beacons under fuselage and on top of fin, provision for DeVore logo light, wing/tailplane static wicks and exterior paint comprising single base colour and up to five accent stripes.

DIMENSIONS, EXTERNAL:

Wing span	16.94 m (55 ft 7 in)
Mean aerodynamic chord	2.19 m (7 ft 2¼ in)
Length overall	17.25 m (56 ft 7 in)
Height overall	5.94 m (19 ft 6 in)

DIMENSIONS, INTERNAL:

Cabin: Length	5.38 m (17 ft 8 in)
Max width	1.75 m (5 ft 9 in)
Max height	1.75 m (5 ft 9 in)
Max aisle width	0.41 m (1 ft 4 in)
Volume	13.17 m^3 (465 cu ft)
Baggage volume:	
external	1.3 m^3 (45 cu ft)
internal	0.25 m^3 (9 cu ft)

WEIGHTS AND LOADINGS:

Basic operating weight (including two pilots)	6,849 kg (15,100 lb)
Payload: max	1,111 kg (2,450 lb)
with max fuel	386 kg (850 lb)
Max baggage weight (external)	499 kg (1,100 lb)
Max fuel weight	4,604 kg (10,150 lb)
Max T-O weight	11,838 kg (26,100 lb)
Max ramp weight	11,906 kg (26,250 lb)
Max landing weight	9,843 kg (21,700 lb)
Max zero-fuel weight	7,938 kg (17,500 lb)
Max power loading	301 kg/kN (2.95 lb/lb st)

PERFORMANCE:

Max operating speed: S/L to FL80	310 kt (574 km/h; 357 mph)
FL80 to FL292	330 kt (611 km/h; 380 mph)
Max operating Mach No. (MMO)	0.85
Normal cruising speed	459 kt; (850 km/h; 528 mph)
Long-range cruising speed	430 kt (796 km/h; 495 mph)
Initial cruise altitude	12,495 m (41,000 ft)
Max certified altitude	13,715 m (45,000 ft)
FAR Pt 25 T-O balanced field length	1,600 m (5,250 ft)
FAR Pt 25 landing distance at MLW	1,052 m (3,450 ft)
Max range, with two crew, four passengers, NBAA IFR reserves	2,950 n miles (5,463 km; 3,394 miles)

GULFSTREAM G200

TYPE: Business jet.

PROGRAMME: Initiated as IAI 1126 derivative of Astra SP; design (then called Astra IV) finalised late 1992 in anticipation of 1993 launch; co-production with Yakovlev of Russia discussed during early part of 1993; formal announcement of launch as Galaxy, with minor design changes, announced 20 September 1993 just before NBAA Convention in Atlanta, Georgia, USA, followed next day by news that Yakovlev to be risk-sharing partner; other partners to be Rockwell Collins (avionics supplier) and eventual engine manufacturer (P&WC since selected). Replacement for Yakovlev sought in 1995, and Sogerma (France) contracted August 1996 to build production aircraft fuselages and tail units, but latter contract terminated mid-2001.

Four prototypes (003 and 004 flying plus 001 static and 002 fatigue test); first flight rescheduled for fourth quarter 1996 (later changed to second quarter 1997 and later still to fourth quarter 1997); 003 rolled out 4 September 1997 and made first flight (4X-IGA) 25 December 1997. Static testing of 001 completed September 1998. Second flight test aircraft (4X-IGO, c/n 004) made first flight 21 May 1998; 005 (company demonstrator 4X-IGB/N505GA) first flew on 23 September 1998; combined total of 750 hours in 260 flights by three aircraft by December 1998. Israeli CAA and US FAA certification to FAR Pt 25 Amendment 25 and FAR Pts 34 and 36 awarded 16 December 1998.

First customer delivery, to TTI of Fort Worth, Texas, made in January 2000. Production rate two per month in mid-2000. Type certificate acquired by Gulfstream Aerospace in June 2001, aircraft renamed Gulfstream 200 and formally unveiled as such at Paris on 17 June 2001; name Gulfstream G200 adopted in September 2002 although Type Certificate had been amended with new designation on 16 January 2002. G200 applies to c/n 057 and subsequent aircraft, although retrospective redesignation is permissible under US rules. Civil Aviation Administration of China certification achieved 10 September 2002. 100th Galaxy/G200 airframe (98th flying) rolled out in 'green' condition 30 August 2004, and delivered to fractional ownership operator NetJets on 20 December 2004. Total fleet time logged by 108 aircraft then in service stood at more than 112,000 flight hours and 70,000 cycles at 24 August 2005, with more than 90% despatch reliability. EASA certification granted 7 September 2004.

Unofficial reports in 2006 suggested that a wide-fuselage version, designated G250, was then under development.

CURRENT VERSIONS: Seen as four/eight-passenger business/executive (standard model), with option of alternative interior seating up to 18 passengers for regional transport operation.

CUSTOMERS: Between 45 and 50 commitments by October 1999, of which about 35 per cent from non-US operators in Canada, Europe, Israel, Mexico and South America. First bulk order, for seven, plus option on 15 more, placed mid-1999 by charter operator ILI Aviation of Zurich, Switzerland. IAI estimates break even at 100 sales and potential market for 200. Orders include 50 firm and 50 options by NetJets Inc, three each by Hainan Airlines of Beijing, China, and MetroJet of Hong Kong. Total 150 delivered to completion centres by end of 2006.

GALAXY/G200 PRODUCTION
(at 1 January 2007)

Variant	Qty	Remarks
Prototypes (flying)	2	
Galaxy	52	Eligible for change of designation
G200	96	
Total	**150**	

COSTS: Approximately USD20.8 million flyaway (May 2004); total development programme cost forecast at approximately USD152 million (1993).

Detailed description applies to Gulfstream G200 from c/n 40 onwards.

DESIGN FEATURES: Designed for transatlantic range (non-stop Paris to New York). Essentially same wing as Gulfstream 150, except for 34° 30' inboard leading-edge sweep and addition of Krueger flaps; new wide-body fuselage is longer and has more headroom.

FLYING CONTROLS: All-hydraulic dual actuation except for rudder (manual); aileron movement 10° up/15° down, elevators 27° up/20° down, rudder 20° left/right; tailplane and rudder tab have electric trim. Wings fitted with outboard leading-edge slats (25° fully out), inboard Krueger leading-edge flaps (110°), four-segment upper surface airbrakes/lift dumpers (45° fully up) and Fowler single-slotted inboard and outboard trailing-edge flaps (settings 0, 12, 20 and 40°). Ailerons and elevators can be operated manually in event of hydraulic failure.

Gulfstream G200 business jet *(Paul Jackson)* 1040377

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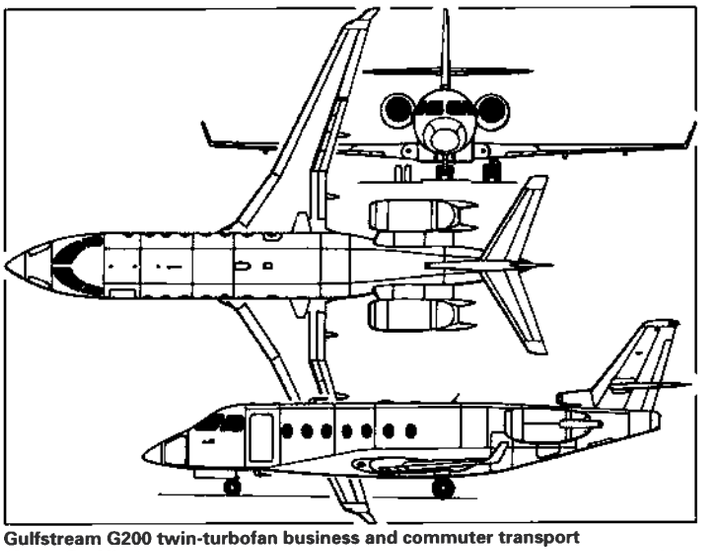


Gulfstream G200 twin-turbofan business and commuter transport
(James Goulding) 1154669

STRUCTURE: Generally similar to that described for G150. Sogerma (France) produced tail units, doors, access panels, tailcones and wing/fuselage fairings for prototypes. Flight Environments cabin flame protection and sound attenuation system.

LANDING GEAR: Hydraulically retractable tricycle type; twin wheels and oleo-pneumatic shock-absorbers on each unit. Nose unit has electrohydraulic steering (± 60°) and retracts forward. Trailing-link mainwheel units retract inward and are equipped with Aircraft Braking System Corporation (ABSC) multidisc anti-skid carbon brakes.

POWER PLANT: Two FADEC-equipped Pratt & Whitney Canada PW306A turbofans, each flat rated at 26.9 kN (6,040 lb st), pylon-mounted on sides of rear fuselage. Nordam nacelles and thrust reversers. Fuel in seven tanks; right and left wing, each 1,334 litres (352.5 US gallons); 293-5 Imp gallons); right and left feed each 102 litres (26.9 US gallons; 22.4 Imp gallons); centre 1,533 litres (405 US gallons; 337 Imp gallons); forward upper and lower/, combined capacity 267 US gallons; 222 Imp gallons); and fuselage 3,115 litres (823 US gallons, 685 Imp gallons). Total fuel 8,532 litres (2,254 US gallons; 1,877 Imp gallons), of which 8,479 litres (2,240 Us gallons 1,865 Imp gallons) are usable.

ACCOMMODATION: Crew of two, with provision for jump-seat for third crew member. Standard accommodation in cabin for nine passengers, four in club layout at front of cabin, two in club pair at rear starboard, and three on sideways-facing berthable divan at rear (port), with executive pull-out tables between each pair of club seats; closet and galley forward; lavatory, vanity unit with mirror, and coat closet at rear, separated from cabin by sliding door. Alternative arrangement for eight passengers, comprising two sets of club-four seats, or for 10 passengers, comprising club-four forward, two pairs of facing seats at rear (port), and sideways-facing three-seat berthable divan at rear (starboard). Last named configuration requires installation of flight data recorder.

Cabin amenities include manual window shades; passenger service units comprising reading and table lights, swivel air outlets, audio system speakers and individual headphone controls; 38 cm (15 in) LCD monitor in forward cabin bulkhead; MagnaStar digital telephone system; four 110 V power outlets; and Airshow Network passenger flight information system. High speed data system (HSDS) for internet and e-mail capability available as option and retrofit from February 2005. Baggage compartment in rear fuselage, accessed by external airstair door. Entire accommodation, including baggage compartment, is pressurised.

SYSTEMS: Dual hydraulic systems, each 207 bar (3,000 lb/sq in). Electrical system comprises three (including one on APU) Lucas Aerospace 28 V 400 Ah engine-driven starter/generators, two 24 V 43 Ah Ni/Cd batteries and a Honeywell GTCP36-150 APU. Third (24 V 27 Ah) battery for back-up powering of essential flight instruments and emergency systems. Pneumatic system for emergency extension of landing gear, actuation of wheel brakes and thrust reversers, and de-icing of wing leading-edges. Cabin pressurisation and air conditioning system, differential 0.61 bar (8.8 lb/sq in). One (optionally two) oxygen bottles. Safe Flight Instrument Corporation Enhanced AutoPower automatic throttle system (ATS) optional from July 2004, and available as retrofit.

AVIONICS: Rockwell Collins Pro Line 4 suite standard.

Comms: Dual VHF-422C radios, RTU-4220 radio tuners, TDR-94D transponders, Bendix/King KHF 950 HF and Baker B1045-F512 audio systems; triple Magnastar Flightphones; single Avtech Selcal, Artex ELT and Universal CVR-30B CVR.

Radar: TWR-850 colour weather radar with turbulence detection and WXP-4220 control panel. BFGoodrich StormScope optional.

Flight: Dual Rockwell Collins 6100 FMS with embedded GPS, Rockwell Collins FCC-4005 autopilots, AHS-3000 AHRS, ADC-850C air data systems, VIR-432 VOR/ILS/GS/markers and DME-442; single ADF-462 (second optional), ALT-4000 radio altimeter, TCAS-4000 and EGPWS Mk V, Honeywell Laseref IV IRS, Universal Aero 1 three-channel satcom, and FDR optional.

Instrumentation: Rockwell Collins EFD-4077 EFIS displays all flight and EICAS information on five 18.4 cm (7¼ in) screens; dual Davtron M850A digital clocks; Flight Line 8047-10 standby altimeter, 8059-2B standby ASI, Jet AI-804CE standby AI, Precision PAI-700-04 standby compass and Hobbs 15007 hour meter.

DIMENSIONS, EXTERNAL:

Wing span	17.70 m (58 ft 1 in)
Length overall	18.97 m (62 ft 3 in)
Wing aspect ratio	9.1
Height overall	6.53 m (21 ft 5 in)
Tailplane span	6.86 m (22 ft 6 in)
Wheel track	3.30 m (10 ft 10 in)
Wheelbase	7.39 m (24 ft 3 in)
Passenger door: Height	1.83 m (6 ft 0 in)
Width	0.84 m (2 ft 9 in)
Baggage compartment door:	
Height	1.14 m (3 ft 9 in)
Width	0.89 m (2 ft 11 in)

DIMENSIONS, INTERNAL:

Cabin: Length: incl flight deck	9.30 m (30 ft 6 in)
excl flight deck	7.44 m (24 ft 5 in)
Max width	2.18 m (7 ft 2 in)
Max height	1.91 m (6 ft 3 in)
Volume, excl flight deck	24.6 m^3 (868 cu ft)
Baggage compartment volume: external	3.5 m^3 (125 cu ft)
internal	0.71 m^3 (25 cu ft)

AREAS:

Wings, gross	34.28 m^2 (369.0 sq ft)

WEIGHTS AND LOADINGS:

Basic operating weight	9,049 kg (19,950 lb)
Max usable fuel weight	6,804 kg (15,000 lb)
Max payload	1,837 kg (4,050 lb)
Baggage compartment capacity	898 kg (1,980 lb)
Payload with max fuel	295 kg (650 lb)
Max ramp weight	16,148 kg (35,600 lb)
Max T-O weight	16,079 kg (35,450 lb)
Max landing weight	13,608 kg (30,000 lb)
Max zero-fuel weight	10,886 kg (24,000 lb)
Max wing loading	469.1 kg/m^2 (96.07 lb/sq ft)
Max power loading	299 kg/kN (2.93 lb/lb st)

PERFORMANCE:

Max operating Mach No. (MMO)	0.85
Max operating speed (VMO):	
S/L to FL100	310 kt (574 km/h; 356 mph) IAS
FL100-FL200	310–330 kt (574–611 km/h; 356–379 mph) IAS
FL200-FL250	360 kt (667 km/h; 414 mph) IAS
Max cruising speed (VMC) at FL310, mid-cruise weight of 12,247 kg (27,000 lb)	494 kt (915 km/h; 568 mph)
Normal cruising speed	459 kt (850 km/h; 528 mph)
Long-range cruising speed	430 kt (797 km/h; 495 mph)
Stalling speed, flaps and gear down, at MLW	112 kt (208 km/h; 129 mph) IAS
Initial cruising altitude	11,885 m (39,000 ft)
Max certified altitude	13,715 m (45,000 ft)
T-O distance (S/L, ISA)	1,855 m (6,080 ft)
Landing distance at MLW (S/L, ISA)	1,000 m (3,280 ft)
Range with four passengers, NBAA IFR reserves	3,400 n miles (6,297 km; 3,912 miles)
g limits, flaps and gear up	+2.63/–1.0

OPERATING NOISE LEVELS (FAR Pt 36 Stage 3):

T-O	81.4 EPNdB
Sideline	85.8 EPNdB
Approach	92.7 EPNdB

GULFSTREAM G300 and G400

Swedish Air Force designations: S 102B Korpen and Tp 102
US military designations: C-20F/G/H
JASDF designation: U-4
Engineering designation: G-1159C

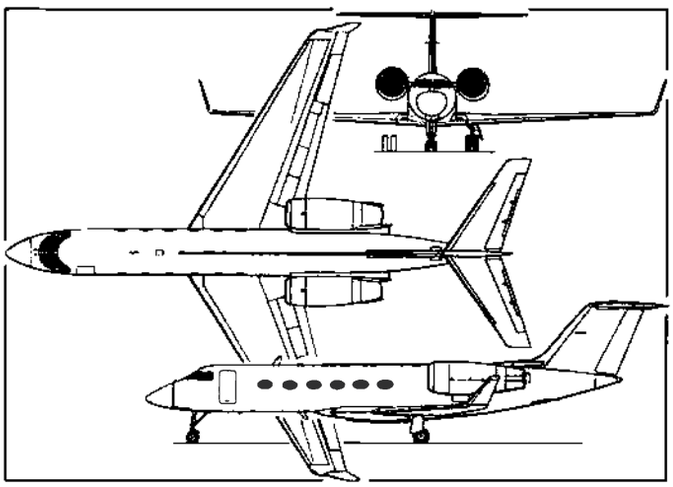
TYPE: Long-range business jet.

PROGRAMME: Design of Gulfstream IV started March 1983; manufacture of four production prototypes (one for static testing) began 1985; first aircraft (N404GA) rolled out 11 September 1985; first flight 19 September 1985; first flight of second prototype 11 June 1986 and third prototype August 1986; FAA certification 22 April 1987 after 1,412 hours' flight testing; certificate is extension of original Gulfsteam II, first approved on 19 October 1967. Westbound round-the-world flight from Le Bourget Airport, Paris, on 12 June 1987, covering 19,887.9 n miles (36,832.44 km; 22,886.6 miles), took 45 hours 25 minutes at average speed of 437.86 kt (811.44 km/h; 504.2 mph) and set 22 world records; eastbound round-the-world flight in N400GA from Houston, Texas, on 26 and 27 February 1988 covered 20,028.68 n miles (37,093.1 km; 23,048.6 miles) in 36 hours 8 minutes 34 seconds at average speed of 554.15 kt (1,026.29 km/h; 637.71 mph), setting 11 records.

In March 1993, Gulfstream IV-SP N485GA set new world speed and distance records in class, at 503.57 kt (933.21 km/h; 579.87 mph) and 5,139 n miles (9,524 km; 5,918 miles) respectively, on routine business flight from Tokyo, Japan, to Albuquerque, USA. Russian Federation and Associated States (CIS) certification achieved in June 1996. FAA approval for RVSM operation of Gulfstream IV series granted 11 August 1997. European JAA validation of FAA certification of Gulfstream IV and IV-SP achieved 16 October 2001. Gulfstream IV-SP holds 75 flight records; by September 2003 fleet had accumulated more than two million flying hours, with a 99.7 per cent despatch reliability rate.

G300/G400 introduced from January 2003 on common production line; G400 completed to full specification; G300 as baseline aircraft, with only those avionics and fittings specified by customer and lavatory location only at rear. G400 assembly includes 360 items installed on production line which previously were part of outfitting. JAA validation of FAA certification achieved for G300 and G400 in July 2003.

Final aircraft of this series was N825T, which was delivered to Columbus, Indiana, on 8 March 2005 for lease by Toyota Industreis North America.



Gulfstream IV twin-turbofan business transport *(Dennis Punnett)* 1158929

0130573

Gulfstream IV-SP (Special Performance)

CURRENT VERSIONS: **Gulfstream G300:** Mid-range (basic specification) version, announced on the eve of the NBAA Convention at Orlando, Florida, 8 September 2002; First aircraft A6-RJA (c/n 1503) delivered 6 August 2003 to Royal Jet of Abu Dhabi, which has ordered two, in miltipurpose aircraft (MPA) configuration.

Gulfstream G400: New (full specification) version, announced on the eve of the NBAA Convention at Orlando, Florida, 8 September 2002. Generally as IV-SP except HUD standard. First aircraft N520GA (c/n 1500) exhibited at EBACE, Geneva, 7 to 9 May 2003 (as N400GA).

CUSTOMERS: Total production 536, comprising 500 Gulfstream IV and IV-SPs built up to 2002 (c/n 1000 to 1499); and 17 G300s and 19 G400s produced in parallel up to early 2005. Deliveries totalled 22 in 1997, 32 in 1998, 39 in 1999, 37 in 2000, 36 in 2001 and 17 in the first six months of 2002 (no further announcements).

GULFSTREAM G450 and G350

TYPE: Long-range business jet.

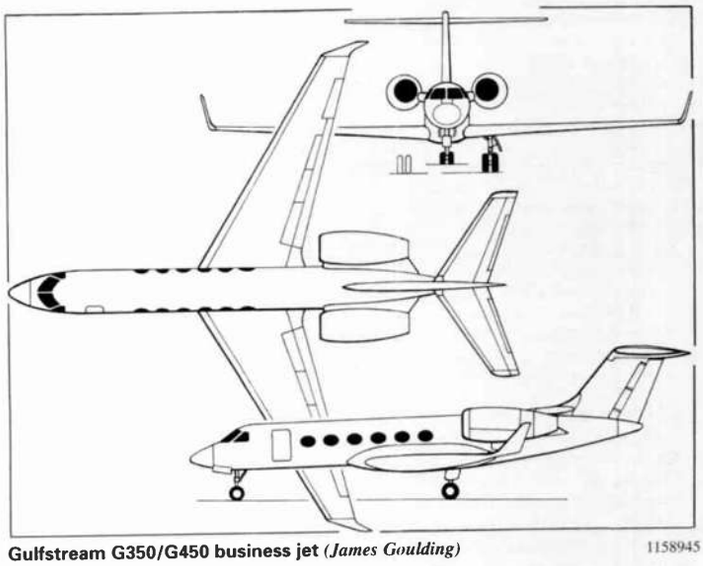
PROGRAMME: Development of G450, then as GIV-X and unannounced, started 2001; first of four development aircraft (c/n 4001/N401SR) flew 30 April 2003, followed by c/n 4002/N442SR on 21 June, c/n 2003/N403SR on 22 June and c/n 4004/N450GA on 18 September; formal announcement and public debut (N450GA) at NBAA Convention in Orlando, Florida 6 October 2003. FAA certification granted 12 August 2004 after more than 1,850 hours of flight testing in 753 sorties; EASA certification granted 19 November 2004; FAA production certificate 29 November 2004; first customer delivery, 7 May 2005, was N97FT (c/n 4008), owned by Bank of America.

On 15 May 2005, a Gulfstream G450 established a new intercontinental city-pair speed record, flying from Chicago DuPage Airport to London-Luton, a distance of 3,550 n miles (6,575 km; 4,085 miles) in 7 hours, 19 minutes at a average speed of Mach 0.85.

CURRENT VERSIONS: **G450:** *As described.* Engineering and certification designation Gulfstream **GIV-X**. Generally as Gulfstream GIV except Honeywell advanced flight deck display suite (common with the GV-SP) to improve flight crew situational awareness and operational capabilities; airframe aerodynamic improvements and engine improvements for increased range and payload; cabin main door relocated aft; fuselage 12 inch extension incorporated; Tay 611 engine replaced with derivative Tay 611-8C; added engine FADEC; and redesigned thrust reverser, nacelle and pylon. System improvements include electrical power generation (common with G550); dual digital cabin temperature control and pressurisation (common with G550); nose landing gear (common with G550); Honeywell 36-150 APU; redesigned flap/stab actuation system with digital control; redesigned main landing gear wheels and brakes; and added flight control system hard-over protection system.

Commonwealth of Independent States certification achieved in January 2006.

G350: Announced at Asian Aerospace, Singapore, 23 February 2004. Variant of G450 (also GIV-X) for operators not requiring this aircraft's long-range. Typical performance is



1158945

Gulfstream G350/G450 business jet ***(James Goulding)***

1040376

Gulfstream G450 long-range business jet

200 n miles (370 km; 230 miles) further than G300; but 550 n miles (1,018 km; 632 miles)less than G450. Shares physical dimensions, flight control systems, engines, principal systems and cabin and baggage space with G450. Common crew rating. FAA type certification 1 November 2004 as extension of G450 certification. G450 and G350 built on common production line; first G350, N502GM (c/n 4011) delivered to Vesey Air in Guatemala on 21 July 2005; total seven G350s included in first 40 off common line.

Commonwealth of Independent States certification achieved in January 2006.

CUSTOMERS: Announced customers include Speed Jet Chartered Ltd of Hong Kong, which took delivery of one G450 in September 2005. Total of some 60 G450s and G350s delivered to completion centres by November 2006.

COSTS: USD33.5 million (2004).

DESIGN FEATURES: Combines wing and tail unit of former G400 with a fuselage stretched by 0.30 m (1 ft 0 in), cabin door repositioned, G550 flight deck and nose section, and Rolls-Royce Tay Mk 611-8C turbofans housed in G550-type nacelles with improved pylons and composites fixed-nozzle thrust reversers. Common pilot type rating with G350/G500/G550 approved by FAA 24 May 2004.

FLYING CONTROLS: Control surface deflections: elevators +24°, −13°; rudder ±22°; ailerons ±10°; spoilers maximum +55°; flaps maximum −39°.

POWER PLANT: Two Rolls-Royce Tay Mk 611-8C turbofans with FADEC, each rated at 61.6 kN (13,850 lb st) for T-O and 55.2 kN (12,420 lb st) max continuous. Max fuel capacity: G350 14,471 litres (3,823 US gallons; 3,183 Imp gallons); G450 16,602 litres (4,386 US gallons; 3,652 Imp gallons). Hurel-Dubois target type thrust reversers standard. Honeywell RE220 APU.

SYSTEMS: Honeywell 36-150GIV APU, with air-start and run capability up to 11,280 m (37,000 ft). Pressurisation system maintains a 1,830 m (6,000 ft) cabin altitude to 13,716 m (45,000 ft).

AVIONICS: Honeywell Primus Epic PlaneView cockpit, as described for G550, with HUD and EVS standard. Ultra high-speed broadband multi-link (BBML) Internet capability approved by FAA in May 2005.

DIMENSIONS, EXTERNAL:

Wing span	23.72 m (77 ft 10 in)
Length overall	27.23 m (89 ft 4 in)
Height	7.67 m (25 ft 2 in)

DIMENSIONS, INTERNAL:

Cabin: Length	13.74 m (45 ft 1 in)
Max width	2.23 m (7 ft 4 in)
Max height	1.88 m (6 ft 2 in)
Volume	43.2 m^3 (1,525 cu ft)
Baggage compartment volume	4.8 m^3 (169 cu ft)

WEIGHTS AND LOADINGS, INCL CREW:

Basic operating weight: G450	**19,504 kg (43,000 lb)**
G350	**19,368 kg (42,700 lb)**
Payload: max: G450	2,722 kg (6,000 lb)
G350	2,858 kg (6,300 lb)
with max fuel: G450	816 kg (1,800 lb)
G350	1,179 kg (2,600 lb)
Max fuel weight, usable: G450	13,381 kg (29,500 lb)
G350	11,793 kg (26,000 lb)
Max T-O weight: G450	33,520 kg (73,900 lb)
G350	32,159 kg (70,900 lb)
Max ramp weight: G450	33,702 kg (74,300 lb)
G350	32,341 kg (70,900 lb)
Max landing weight: G450, G350	29,937 kg (66,000 lb)
Max zero-fuel weight: G450, G350	**22,226 kg (49,000 lb)**
Max wing loading: G450	**379.6 kg/m^2 (77.76 lb/sq ft)**
G350	**364.2 kg/m^2 (74.60 lb/sq ft)**
Max power loading: G450	272 kg/kN (2.67 lb/lb st)
G350	261 kg/kN (2.56 lb/lb st)

PERFORMANCE:

Max operating Mach No. (MMO): G450, G350	M0.88
Normal cruising speed: G450, G350	M0.80 (459 kt; 850 km/h; 528 mph)
Time to climb to FL410: G450	23 min
Initial cruising altitude: G450, G350	12,500 m (41,000 ft)
Maximum certified altitude: G450, G350	13,716 m (45,000 ft)
T-O run: G450	1,661 m (5,450 ft)
G350	1,539 m (5,050 ft)
Landing run: G450	972 m (3,190 ft)
G350	994 m (3,260 ft)
Range with eight passengers at Mach 0.80, NBAA IFR reserves:	
G450	4,350 n miles (8,056 km; 5,006 miles)
G350	3,800 n miles (7,037 km; 4,373 miles)

GULFSTREAM G500 and G550

US military designation: C-37

Israel Defence force names: Shavit (Comet) and Eitam (Fish Eagle)

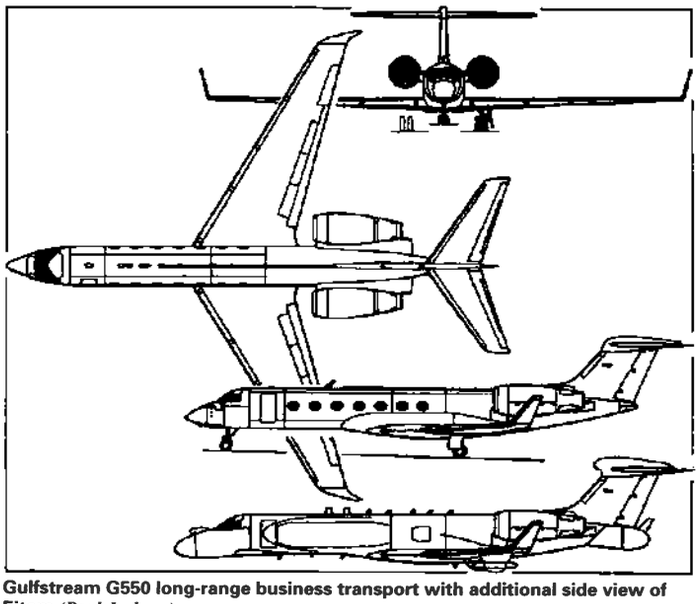
TYPE: Long-range business jet.

PROGRAMME: Study (then as Gulfstream V) announced at NBAA Convention, Houston, in October 1991. Go-ahead commitment and engine selection (BR710) announced at Farnborough Air Show in September 1992. Risk-sharing agreement with wing designers/manufacturers (Vought and ShinMaywa) announced at Paris Air Show in June 1993, and with tail (and later floor panel) manufacturer (Fokker) at NBAA Convention in September 1993.

Prototype (N501GV) rolled out 22 September 1995; first flight 28 November 1995; second aircraft, c/n 502 (N502GV) was structural test article before completion as company demonstrator; c/n 503 (N503GV), first flown 10 March 1996, used for systems testing; c/n 504 (N504GV), first flown May 1996, for engine, flight loads and environmental trials and JAA certification testing; c/n 505 (N505GV), first flown August 1996, outfitted in standard production configuration for operational testing and HIRF evaluation. Public debut (N502GV) at NBAA Convention at Orlando, Florida, in November 1996.

Provisional FAA certification achieved 16 December 1996 after more than 1,100 hours of flight testing in 550 sorties. Full FAA type certification (extension of Gulfstream II) granted on 11 April 1997, and FAA production certificate awarded on 11 June. First fully completed aircraft for a customer (c/n 507) delivered to Walter Annenberg, former US Ambassador to UK, on 1 July 1997. RVSM approval January 2000. JAA certification eventually granted on 31 October 2002.

From 2003, original versions discontinued and replaced by Gulfstream G500 and G550. Former is baseline version, with customers specified additions only; G550 to full specification with PlaneView avionics, more cabin volume and increased range.



Gulfstream G550 long-range business transport with additional side view of Eitam *(Paul Jackson)* 1158946

By 30 January 2007 the 116 G500s and G550s then in service had jointly logged more than 100,000 flight hours and 40,000 take-offs and landings, with the fleet leader, operated by G5 Executive AG of Switzerland having logged more than 4,000 hours.

CURRENT VERSIONS: **Gulfstream G500:** Reduced-range version of Gulfstream V, announced on the eve of the NBAA Convention at Orlando, Florida, 8 September 2002; provisional type certificate granted by FAA 11 December 2002; followed by type certification 8 December, and JAA/EASA approval on 11 January 2005. First delivery in May 2004 to venture capitalist Danny Pettit of California.

Gulfstream G550: New version of Gulfstream V-SP, which had been announced on eve of NBAA Convention, 8 October 2000, having larger cabin, enhanced performance and better range by reason of aerodynamic refinement of previous GV. Redesigned as G550 and announced on the eve of the NBAA Convention at Orlando, Florida, 8 September 2002; FAA certification 14 August 2003. First aircraft N702GA (c/n 5001); initial public appearance at EBACE, Geneva, 7 to 9 May 2003 by N812GA (c/n 5012); JAA and EASA certification 9 March 2004. G550 development team was awarded the 2003 Collier Trophy for the technical and safety advances incorporated into the aircraft's design. Commonwealth of Independent States certification achieved in January 2006.

Flight deck uses Honeywell Primus Epic suite with Gulfstream PlaneView cockpit, comprising four 360 mm (14 in) LCDs, including HUD and EVS, latter was certified in August 2001 and first became operational, on a USAF C-37A, on 15 May 2002. First customer was Executive Jets, which ordered 20 for delivery up to 2008, at cost of USD800 million; unit cost with most popular options USD24.9 million. Other customers include GATX Leasing (two).

Shavit: SIGINT version developed by US-Israeli consortium including; Bedek Aviation (equipment installation); Elta Systems (prime contractor and EL/I-3001 AISIS mission architecture); Gulfstream Aerospace (airframe manufacture/modification); and Lockheed Martin (airframe modification, including development of ventral fairing). Equipped with Elta Systems EL/I-3001 Airborne Integrated SIGINT System, capable of both communications (20 to 1,200 MHz) and electronic (0.5 to 18 GHz) (COMINT/ELINT) functions. Internal features include: two cockpit crew; provision for up to 12 mission crew (divided between forward Command and Control (C2) 'war room' and aft equipment operator's workspace); onboard liquid equipment cooling system; communications suite including microwave datalink, satcom and HF/VHF/UHF; and flight/mission crew intercommunications system.

Externally identified by 'canoe' fairing beneath forward fuselage; pairs of circular, overwing cabin windows on both sides of fuselage; ventral 'teardrop' fairing (possibly with direction-finding antenna) aft of wing trailing-edges; additional ventral fin at rear; equipment fairings both sides of platform's centre-section; fin-top line-of-sight datalink/SATCOM antenna housing; apparent interferometric COMINT blade array beneath the aircraft's centre section; and communications aerial provision including at least three swept blades and two horizontal dipoles. Operating parameters include cruising altitude of 15,240 m (50,000 ft) and typical mission duration of 10 hours.

Israeli Ministry of Defence programme initiated in December 2001 for three Shavits, all late production Gulfstream Vs. Airframes c/n 676, 679 and 684 received structural modifications by Gulfstream in US. First aircraft flew as such 26 March 2005. First delivery was N679GA (c/n 679), collected by crew from 122 'Nachshon' (Pioneer) Squadron at Lod air base and ferried to Israel between 23 and 26 May 2005; formal acceptance 27 June 2005; followed by local installation of equipment and re-numbering as '679'. Delivery of '684' followed in February 2006 and '676' in August 2006.

Eitam: Commercially marketed as CAEW (Conformal Airborne Early Warning). Equipped with Elta Systems EL/W-2085 mission suite including phased array AEW radar; integrated IFF subsystem; electronic support (ES)/electronic intelligence (ELINT) and communications intelligence (COMINT) subsystems; and at least six operator stations.

Externally characterised by forward-facing ES system antenna believed in fairing above nose radome (also for weather radar); array of nine dorsal blade antennas; port and starboard conformal antenna housings for EL/W-2085 on sides of forward fuselage; aft-facing radome (EL/W-2085 rear hemisphere array) on tailcone; ventral (rear fuselage) and fin-top datalink/satellite communications system antenna fairings; fin-top deployable wire aerial; three ventral blade aerials; ES/ELINT system antenna pods beneath both wingtips; provision for underwing stores pylons; and provision for "advanced self-protection systems".

Mission modifications include satellite communications/data link; Gulfstream Aerospace-developed, low-drag, liquid cooling system that provides an 'optimum' environment for mission avionics; two additional (when compared with standard G550) electrical power generators mounted each side with combined output of 240 kVA; increased max zero-fuel weight facilitated by mid-wing ejectors that pump fuel from inboard to outboard wing fuel cells to reduce wing loading at the fuselage.

On 20 August 2003, Israel ordered four (plus two options) Gulfstream G550s for USD473 million. Airframes c/n 5014, 5037, 5044 and 5069 modified by Lockheed Martin

1158998

First Gulfstream Eitam for Israel, accompanied by Shavit version of G550

1040374

Gulfstream G550 business jet ***(Paul Jackson)***

with appropriate structural changes before installation of mission avionics in Israel. First aircraft retained in US; initial delivery was N637GA (c/n 5037), ferried to Israel by 122 Squadron between 18 and 19 September 2006, becoming '537'.

MARS^2: Promotion began in February 2006 of Israel's third Gulfstream-based special missions aircraft in form of the EL/I-3150 Multimission Airborne Reconnaissance and Surveillance System (MARS2). Envisaged as "fast-deployment, all-in-one task force" capable of ground surveillance/early warning, conflict situation intelligence, surveillance and reconnaissance and C^3 for military and paramilitary agencies. Sensor suite would include synthetic aperture and ground moving target indication radars (SAR/GMTI), electro-optic (EO) and infra-red (IR) imaging sensors and ELINT/radar-band ESM and COMINT/communications-band ES/direction-finding subsystems. Has common operator station hardware, application-specific software, a modular design, a flexible mission driven configuration and flight/mission crew of up to 10: two pilots, and mission crew of one to three C3, one to three imagery intelligence and one or two SIGINT operators.

External features include ventral 'canoe' fairing which appears to house forward-looking and lateral antennas for SAR and GMTI radars; ventral 'dustbin' fairing (associated either with EO/IR payload or SIGINT DF); fore and aft box fairings each side forward fuselage and tail cone; dorsal and ventral blade antenna groups and, possibly, chaff/IR decoy flare dispensers in ventral stabilising fin.

C-37A/B: Military version, initially of GV; two (plus four options, one of which converted to firm order in 1998, another in April 1999 and a third subsequently, with fourth converted in 2001) ordered by USAF as part of VCX requirement to replace Boeing VC-137s of 89th Airlift Wing, Andrews AFB, Maryland. Announced 5 May 1997. First (97-0400) delivered 14 October 1998; second in January 1999 and third (for C-in-C USAF) 21 February 2000. US Army's Priority Air Transport Squadron operates one example. Five C-37As leased by US Air Force for delivery between August 2001 and September 2003, first aircraft handed over 28 August 2001. Further contract awarded 13 March 2002 for up to 20 for delivery between 2002 and 2012; first firm order under this contract is for one C-37A for the USAF. US Navy requires five VC-37As as replacements for VP-3A Orions; deliveries began 2002 and extend to 2009. In December 2000 US Coast Guard ordered a C-37A which was delivered in May 2002. Military variant of G550 is designated **C-37B**, of which first two were delivered to the US Army and US Navy 24 January 2005 and 18 February 2005 respectively.

EC-37A: Proposed airborne combat support aircraft; Gulfstream announced at RIAT 2000, Cottesmore, UK, that it was looking for funding during late 2000 and partner to develop systems. Aimed at two roles: standoff electronic jammer and intelligence gathering, using interchangeable underwing and underfuselage pods and in-flight workstation reconfiguration.

RQ-37A: Designation ascribed to Gulfstream's G550-based candidate as surrogate UAV in US Navy Broad Area Maritime Surveillance (BAMS) competition; Gulfstream V N916GA (later N924H of Honeywell) undergoing conversion as testbed in mid-2003 to be capable of remote control from ground, though carrying an onboard safety pilot. Features would include measurement and signal intelligence (MASINT) equipment; electro-optical/infrared payload; SIGINT antenna array; ELINT; common datalink; ECM suite including chaff/flare dispensers and early warning radar; ballistic/theatre missile defence sensors; spinner antenna; Ku/Ka-band and UHF satcom; synthetic aperture radar; underwing aerial refuelling pods; and aerial refuelling probe.

Tanker: Formulation of an aerial refuelling tanker was under way in late 2006 in a joint project with Israel Aerospace Industries.

CUSTOMERS: Three GVs produced in 1996, 29 in 1997, 25 in 1998, 31 in 1999, 34 in 2000, 35 in 2001 and 16 in the first six months of 2002.

Manufacture of Gulfstream V completed in 2003 with 193 aircraft (c/n 501 to 665, 667 to 693, and 699); G500/G550 followed immediately. Recent customers included the German Aerospace Centre (DLR) which has ordered on G550 special mission high altitude long range (HALO) aircraft for delivery in 2008. Total 130 G500/G550s delivered to completion centres by November 2006.

COSTS: G500 USD38.0 million; G550 USD43.75 million (both 2004). Israel; Ministry of Defence order for four G550s in Nachshon configuration valued at USD473 million (2003).

DESIGN FEATURES: Gulfstream IV fuselage re-engineered to increase length by 2.13 m (7 ft 0 in); larger wing of same basic shape and interior structure, but 10 per cent more efficient than Gulfstream IV's; larger vertical and horizontal tail surfaces; flight deck volume increased by moving bulkhead 0.30 m (1 ft) aft to provide more space for pilots and to accommodate full-size jump seat; cockpit layout and instrumentation generally similar to Gulfstream IV-SP, but redesigned to incorporate human engineering changes in system control functions; airstair door moved aft by 1.52 m (5 ft); avionics bay relocated. Computational fluid dynamics and CATIA design system used extensively in development.

FLYING CONTROLS: As G350/G450, but incorporating hand-over protection system (HOPS) for aileron and elevator quick disconnect in event of control system 'runaway'.

LANDING GEAR: As G350/G450. Turning circle about wingtip 17.07 m (56 ft 0 in); about nosewheel 14.15 m (46 ft 5 in).

POWER PLANT: Two 68.4 kN (15,385 lb st) Rolls-Royce Deutschland BR710C4-11 turbofans with FADEC. Fuel capacity of G550 23,417 litres (6,186 US gallons; 5,151 Imp gallons) in integral wing tanks, of which 22,993 litres 6,074 US gallons; 5,058 Imp gallons) are usable. G500 capacity 19,957 litres (5,272 US gallons; 4,390 Imp gallons) usable.

ACCOMMODATION: Crew of two/three plus cabin attendant. G500 standard cabin configurations provide for 14 passengers with up to five berths (AMP Model 900 berthable single seats and four-place berthable divan) with forward or aft galley and aft lavatory. Optional floor plans include 16 passenger/six berth and 18 passenger/six berth configurations with forward or aft galley and aft lavatory. All cabin configurations feature 64 x 58 cm (25 x 23 in) work tables between each set of club configuration single seats; 38 x 58 cm (15 x 23 in) work table at each single seat; credenza across from sideways facing divan seats incorporating cabin entertainment equipment, fax machine and miscellaneous storage; magazine storage on forward and aft cabin bulkheads; audio-visual entertainment suite comprising CD, VHS video and DVD players, 43 cm (17 in) LCD monitor in forward cabin bulkhead, 38 cm (15 in) LCD monitor in panel above credenza (43 cm; 17 in monitor optional), cabin audio system with individual headphone controls at each passenger seat; Airshow Network passenger flight information with worldwide maps; MagnaStar radio telephone handsets at four cabin locations functional with terrestrial or satcom systems; electrical outlet at each seat grouping; plain paper fax machine; master control for lighting, entertainment system and cabin temperature at VIP seat; electric window shades; decorative continuous window overlays; passenger service units comprising reading and table lights, swivel air outlets, audio system speakers, general cabin lighting and passenger oxygen outlets.

Cockpit privacy door, crew refreshment centre and crew lavatory with vacuum toilet standard. Galley features hot/cold meal beverage service, high temperature oven, dual coffee makers, cold food storage, solid surface counter top, large sink with hot/cold water supply, storage, waste receptacle and Customs-sealed alcohol storage. Options include 14 cm (5.6 in) LCD monitors in sidewalls at each single seat, four additional data ports, three-camera SecuraPlane camera system, second VIP control panel with split audio and lighting, and DirecTV, Gulfstream-supplied glassware, chinawear and flatwear, and water sterilisation system, optional. G550 cabin can be divided into three or four seating area to customer's choice, including most of G500 cabin features plus 64 x 58 cm (25 x 23 in) work table between each set of single seats, 31 x 58 cm (12 x 23 in) work table at single seat, 109

x 79 cm (43 x 31 in) conference table at four-place grouping, mid-cabin bulkhead with pocket doors or privacy curtain. Customised interiors according to requirements.

SYSTEMS: Digitally controlled automatic cabin pressurisation system; maximum pressure differential 0.703 bar (10.2 lb/sq in). Hamilton Sundstrand electrical power generating system profile integrated with the flight management system (FMS), and will maintain equivalent of 1,830 m (6,000 ft). Honeywell RE220 APU, provides engine-starting capability up to 13,110 m (43,000 ft), 40 kVA of electrical power for ground and flight use up to 13,715 m (45,000 ft), and ground air conditioning, with almost twice the cooling airflow rate of the Gulfstream IV's APU.

AVIONICS: Honeywell Primus Epic as core system.

Comms: Honeywell MCS-7000 satcom; ELT.

Flight: Three VHF nav/com systems; airborne flight information system (AFIS) with satcom link and cockpit printer; dual 24-channel GPS; TCAS 2000; and enhanced GPWS with windshear detection.

Instrumentation: Gulfstream PlaneView cockpit comprising four 355 mm (14 in) landscape format flat panel multifunction LCD screens. G550 also features as standard Gulfstream Enhanced Vision System (EVS) with head-up display/visual guidance system.

Mission: SecuraPlane 500 security system with three cameras, and Sanders AN/ALQ-204 Matador IRCM system, optional.

Data applicable to both versions, except where stated.

DIMENSIONS, EXTERNAL:

Wing span: basic	27.69 m (90 ft 10 in)
over winglets	28.50 m (93 ft 6 in)
Length overall	29.39 m (96 ft 5 in)
Height overall	7.87 m (25 ft 10 in)
Tailplane span	10.72 m (35 ft 2 in)
Wheel track (c/l shock-absorbers)	4.37 m (14 ft 4 in)
Wheelbase	13.72 m (45 ft 0 in)

DIMENSIONS, INTERNAL:

Cabin: Length, aft of flight deck	15.57 m (50 ft 1 in)
Max width	2.24 m (7 ft 4 in)
Max height	1.88 m (6 ft 2 in)
Volume	47.3 m^3 (1,669 cu ft)
Baggage compartment volume	6.4 m^3 (226 cu ft)

AREAS:

Wings, gross	105.63 m^2 (1,137.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, 'green'	17,917 kg (39,500 lb)
Operating weight empty, incl crew:	
G500	21,772 kg (48,000 lb)
G550	21,909 kg (48,300 lb)
Allowance for outfitting	3,856 kg (8,500 lb)
Baggage capacity	1,134 kg (2,500 lb)
Payload: max: G500	2,948 kg (6,500 lb)
G550	2,812 kg (6,200 lb)
with max fuel: G500	1,043 kg (2,300 lb)
G550	816 kg (1,800 lb)
Max fuel weight: Gross	
G500	15,966 kg (35,200 lb)
G550	18,733 kg (41,300 lb)
usable: G500	15,966 kg (35,200 lb)
G550	18,733 kg (41,300 lb)
Payload with max fuel: G500	1,134 kg (2,500 lb)
G550	816 kg (1,800 lb)
Max T-O weight: G500	38,600 kg (85,100 lb)
G550	41,277 kg (91,000 lb)
Max landing weight	34,155 kg (75,300 lb)
Max zero-fuel weight	24,721 kg (54,500 lb)
Max wing loading: G500	365.4 kg/m^2 (74.85 lb/sq ft)
G550	390.8 kg/m^2 (80.04 lb/sq ft)
Max power loading: G500	282 kg/kN (2.77 lb/lb st)
G550	302 kg/kN (2.96 lb/lb st)

PERFORMANCE (at max T-O weight, except where indicated):

Max operating Mach No. (VMO)	M0.885
Cruising speed: max	499 kt (924 km/h; 574 mph)
normal	488 kt (904 km/h; 562 mph) or M0.85
long-range	459 kt (850 km/h; 528 mph) or M0.80
Initial cruising altitude: G500	13,105 m (43,000 ft)
G550	12,500 m (41,000 ft)
Max certified altitude	15,545 m (51,000 ft)
T-O run: G500	1,570 m (5,150 ft)
G550	1,801 m (5,910 ft)
T-O balanced field length	1,862 m (6,110 ft)
Landing distance, S/L, max landing weight	844 m (2,770 ft)
Range, eight passengers and four crew: M0.80, NBAA IFR reserves:	
G500	5,800 n miles (10,741 km; 6,774 miles)
G550	6,750 n miles (12,501 km; 7,767 miles)
G550 at M0.85	6,000 n miles (11,112 km; 6,904 miles)
G550 at M0.87	5,000 n miles (9,260 km; 5,754 miles)

GULFSTREAM ADVANCED FLIGHT CONTROLS DEMONSTRATOR

In July 2006, Gulfstream announced its Advanced Flight Controls (AFC) proof-of-concept research programme, which had been in development since 2004. The AFC programme is using a modified Gulfstream V to evaluate the technical feasibility of fly-by-wire, fly-by-light and fly-by-wireless advanced actuator technology. First flight 26 September 2006. Initial tests, which had been completed by 16 October 2006, focused on FBW wing spoilers. The second phase involved modifications to the GV's elevator control system by installing an electrical backup hydraulic actuator prior to further flight testing of the electronically commanded elevators. Gulfstream's partners in the AFC programme are Parker Aerospace (rotary electromechanical actuator for the outer wing spoiler and electrical backup hydraulic actuator for the elevators), Smiths (electromechanical actuators), and Thales (flight control computer).

GULFSTREAM 'FUTURE LARGE CABIN AIRCRAFT'

At the National Business Aviation Association Convention in Orlando, Florida in October 2006, reports circulated (though were not confirmed by the manufacturer) that Gulfstream is developing a longer range, widebody cabin derivative of the G550, variously referred to as the 'G600', G6000' and 'Fat 5'. Features would include derivative Rolls-Royce BR710 engines in the 71.2-75.6 kN (16,000-17,000 lb st) thrust range and range of 7,200 n miles (13,334 km; 8,286 miles), with launch occurring around 2009.

GULFSTREAM SBJ

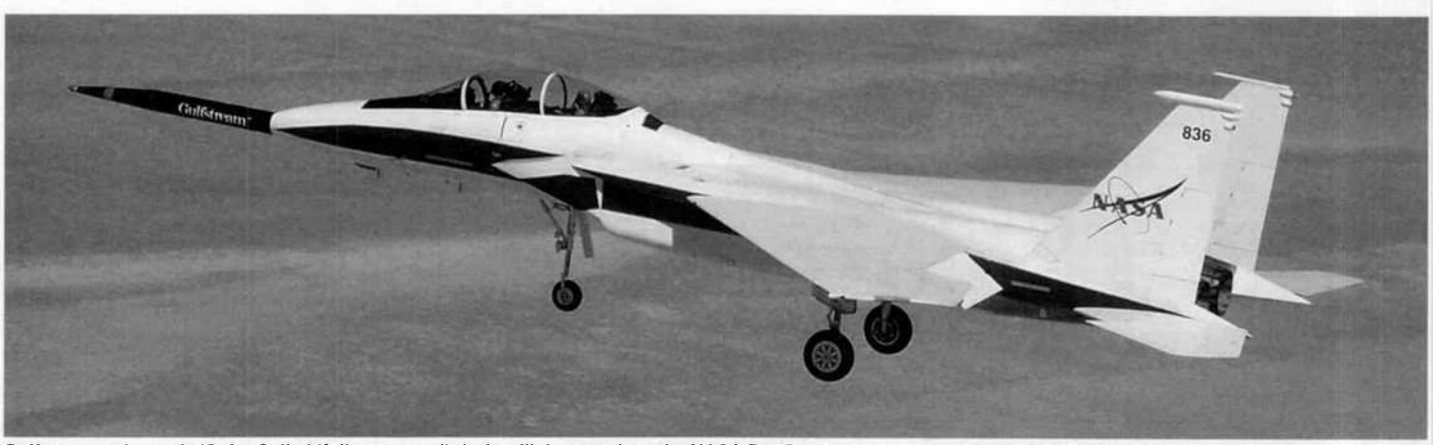
TYPE: Supersonic business jet.

PROGRAMME: Gulfstream Aerospace and Lockheed Martin (which see) revealed at the Farnborough Air Show on 7 September 1998 that they were jointly conducting an 18 to 24 month feasibility study into an SBJ. As then envisaged, the aircraft, similar in size to the Gulfstream II, would have featured a stand-up-headroom cabin accommodating eight passengers, and would cruise at M1.6 to M2.0 over a range of more than 4,000 n miles (7,408 km; 4,603 miles). Key design goals were the ability to operate out of existing business aviation airfields; take-off noise compatible with anticipated future emissions regulations; fuel-efficient operation at subsonic speeds; and an initial cruising altitude above that of subsonic traffic.

The feasibility phase of the project, completed in mid-2000, was followed by a further two years of wind-tunnel testing and project definition; studies carried out by the company confirmed that there is a market, but sonic boom suppression, engine emissions and noise present technological challenges. Gulfstream and Lockheed Martin, through its Advanced Development Projects division, defined the SBJ, and lobbied the US government for support via the Defense Advanced Research Projects Agency which received USD15 million for its quiet supersonic aircraft technology (QSAT) budget. However, Lockheed Martin has since withdrawn from the programme. In 2000, patents were filed with different layouts including tailplane mounted at tail fintip and drooping to attach to engine nacelles; further patents included one with large delta wing shape plus nose canard; in October Gulfstream displayed, at NBAA, the Quiet Supersonic Jet (QSJ) which had swept wing and wingtip-mounted swept tail.

By late 2003, the QSJ had evolved into a variable-geometry wing, T-tail aircraft with two pod-mounted engines on the rear fuselage, each side of the fin and featuring a Gulfstream patented telescopic 'Quiet-Spike' that extends in supersonic flight from 4.27 m (14 ft) to 7.31 m (24 ft) to reduce sonic boom amplitude by distributing the pressure disturbance over a greater length. Design goals include maximum take-off weight of 45,359 kg (100,000 lb), cruising speed of Mach 1.8, take-off field length of 1,981 m (6,500 ft), range of 4,800 n miles (8,889 km; 5,523 miles) and airport noise level 10 EPNdB quieter than Stage 4 requirements. Initial testing of 'Quiet Spike', mounted on a NASA-operated Boeing F-15B (NASA 836), began in mid-July 2006; first flight with spike extended to maximum and retracted again took place on 25 September 2006 from the NASA Dryden Flight Research Center, subsequently expanding the flight envelope to FL350 and Mach 0.80.

Estimated unit cost is in the region of USD70 million to USD80 million (2002), based on 200 produced. The proposed aircraft is not related to the abortive Gulfstream-Sukhoi SSBJ project from which Gulfstream withdrew in 1992. Executive Jet Aviation, which operates the NetJets fractional ownership programme, is reportedly interested in the concept of supersonic business jets.



Gulfstream telescopic 'Quiet Spike' (fully retracted) during flight test aboard a NASA F-15B on 10 August 2006 *(NASA/Lori Losey)* 1158997

HAWKER

RAYTHEON AIRCRAFT COMPANY

At the September 2002 NBAA Convention, held in Orlando, Florida, Raytheon Aircraft announced its intention to revert to separate marketing of its Beechcraft and Hawker lines of private and executive aircraft, reducing the emphasis on its corporate name.

Raytheon had acquired British Aerospace's Corporate Jets division for US$372 million on 6 August 1993; founded Raytheon Corporate Jets Inc at Little Rock, Arkansas, with responsibility for design, development, production and support of renamed Hawker family of corporate jets. Hawker name derived by Raytheon from Hawker Siddeley, parent company of de Havilland at conception of DH/HS/BAe 125 twin-jet, which forms basis of the current Hawker line. Raytheon Corporate Jets included in Raytheon Aircraft Company upon its foundation on 15 September 1994. Former Beechjet 400A added to Hawker line as Hawker 400XP in May 2003. Hawker 750 and 900XP series announced in October 2006.

Long planned sale of Raytheon Aircraft by parent company was heralded on 21 December 2006 when Hawker Beechcraft Corporation—formed for the purpose by GS Capital Partners, an affiliate of Goldman Sachs, and Onex Partners—named as new owner, subject to regulatory approval expected by mid 2007. Transaction, worth some USD3.3 billion, includes Raytheon Aircraft facilities and other assets in Wichita and Salina, Kansas; Little Rock, Arkansas; Dallas, Texas; as well as its fixed based operations network across the United States, United Kingdom and Mexico. At that time Raytheon Aircraft had more than 8,500 employees an approximately 100 authorized service centres worldwide.

HAWKER 400

US Air Force designation: T-1A Jayhawk
JASDF designation: T-400

TYPE: Business jet.

PROGRAMME: Conceived as Mitsubishi MU-300 Diamond; first flight 29 August 1978; two prototypes; FAR Pt 25 certification awarded 6 November 1981; production aircraft fabricated in Japan and assembled at San Angelo, Texas; deliveries totalled 63 Diamond Is (JT15D-4 engines), 27 Diamond IAs (JT15D-4D) and one Diamond II (JT15D-5).

Beech acquired rights to Diamond II from Mitsubishi Heavy Industries and Mitsubishi Aircraft International, December 1985; made improvements to aircraft and renamed it Beechjet 400. First Beech-assembled Beechjet rolled out 19 May 1986; initial 64 used Japanese components. During 1989, Beech moved entire manufacturing operation to Wichita. Announced new Beechjet 400A November 1989, featuring certification to 13,715 m (45,000 ft), larger and more comfortable cabin, all Collins avionics with digital EFIS; customer deliveries began November 1990. Transferred to Raytheon's Hawker marque in May 2003.

CURRENT VERSIONS: **Beechjet 400:** Initial production version (65 built; superseded by 400A.

Beechjet 400A: Announced at 1989 NBAA show; production 400A first flight 22 September 1989; FAA certification received 20 June 1990; MTOW 7,302 kg (16,100 lb); deliveries began November 1990. Also certified by July 1993 in Australia, Canada, France, Germany, Italy and UK; Brazilian and Pakistani type approval April 1994; Civil Aviation Authority of China certification achieved in second quarter of 1999; superseded by Hawker 400XP.

Hawker 400XP: Current version (XP=eXtra Payload), announced at European Business Aviation Convention and Exhibition at Geneva 6 May 2003; first aircraft thus named was N400XP (c/n RK-356), but Beechcraft records amended to show RK-354 as first, while initial aircraft with increased MTOW as standard was actually RK-347 (all previous being retrofittable). Hawker 400A engineering designation remains unchanged. Features 90.7 kg (200 lb increase in payload and thrust reversers, vapour-cycle air-conditioning, TCAS II and electronic ELT as standard; FAA certification granted in April 2003. Upgrades announced at the NBAA Convention in Las Vegas on 12 October 2004, and applicable to RK-393 onwards, include: XM satellite radio; Honeywell C Series cabin entertainment system; Teledyne AvVisor cabin information system, separate external panel access for oxygen refill, with gauge; and ground-level-accessible push-button external oil quantity check, replacing dipsticks on top of the engine nacelles.

Description applies to Hawker 400XP, except where indicated.

Beechjet T-1A Jayhawk: US Air Force selected McDonnell Douglas, Beech and Quintron to supply Tanker Transport Training System (TTTS) on 21 February 1990, including requirement for 180 Beechjet 400Ts, valued at US$755 million and designated T-1A Jayhawk; represents missionised version of 400A, sharing many components and characteristics with commercial counterpart; differences include cabin-mounted avionics, increased air conditioning capability, greater fuel capacity with single-point refuelling, and strengthened windscreen and leading-edges for low-level birdstrike protection. Certified 27 November 1991 for two crew and one observer; max certified altitude 12,495 m (41,000 ft). First production aircraft (90-0400) delivered 17 January 1992; deliveries at approximately three per month; final delivery 23 July 1997. By then total fleet time exceeded 182,000 flying hours, with 90 per cent operational availability, and more than 680 pilots had been trained on the Jayhawk.

IOC for USAF Jayhawks January 1993, for Air Education and Training Command Specialised Undergraduate Pilot Training (SUPT) programme at Reese AFB (52nd FTS/64th FTW) where establishment of 41 received by October 1993; Reese closed in 1997. Second recipient was 99th FTS/12th FTW at Randolph AFB, Texas, where 16 delivered for instructor training in 1993; third unit was 86th FTS/47th FTW at Laughlin AFB, Texas, from late 1993 with training courses beginning May 1994; fourth was 71st FTW at Vance AFB, Oklahoma (first aircraft December 1994); fifth was 14th FTW at Columbus AFB, Mississippi (early 1996). T-1A used for training crews for KC-10, KC-135, C-5 and C-17, with total fleet experience of more than 376,000 hours and more than 733,000 landings by October 1999.

In February 1997 Raytheon Aircraft and its subsidiary Raytheon Aerospace were awarded a contract, valued at US$6.2 million, to retrofit 62 Jayhawks with GPS; two further options to retrofit the entire fleet would bring the total value of the GPS upgrade to about US$25.3 million.

Beechjet 400T: JASDF T-400 version, Model 400TX, differing from USAF 400T/T-1A and featuring thrust reversers, long-range inertial navigation and direction-finding systems; interior changes. Weights as for 400A; engine T-O rating as for max continuous. Two crew, one observer and four passengers. Meets TC-X trainer requirement; three, three, two and one ordered in 1992–95, plus one in 1998, two in 2000 and one each in 2002 and 2003. First (41-5051) delivered 31 January 1994; 13th in December 2003.

CUSTOMERS: Refer to deliveries table. Total 502 produced up to end of 2005, including 53 delivered in that year, plus 35 400XPs in the first nine months of 2006. 400th 400A/400XP rolled out in January 2005. Recent customers include Hainan Airlines of China, which took delivery of one aircraft in February 1999, NetJets Inc, which ordered 50 in December 2003 for delivery between 2004 and 2009, and a further 20 ordered in June 2004 for delivery in 2005–07 to NetJets Europe, and Talon Air of Rochester, New York, which took delivery of two 400XPs in mid-2005. US Air Force 180 T-1As ordered, of which delivery completed 23 July 1997. JASDF had received 10 by December 1999 and ordered further two in 2000; operated by 41 Hikotai at Miho. 500th 400XP delivered in December 2006 to Slam LavoriAerei Srl of Naples, Italy. By December 2006, 512 civil 400As had been registered, in addition to 65 Model 400s, 180 Jayhawks, 13 400Ts and 93 Diamonds, or 863 in all.

BEECH AND HAWKER 400 CIVIL PRODUCTION

	400	400A	400XP
1986	16		
1987	18		
1988	19		
1989	12		
1990		1	
1991		30	
1992		31	
1993		20	
1994		14	
1995		10	
1996		26	
1997		38	
1998		41	
1999		49	
2000		41	
2001		27	
2002		16	
2003		11	8
2004			34
2005			40
Totals	**65**	**355**	**82**

Notes: Not including 180 USAF T-1A Jayhawks (1991–97) and 13 JASDF 400Ts.
Further aircraft built by Mitsubishi in Japan.
Year is 'production year', of delivery.

COSTS: Jayhawk programme cost USD1.3 billion; Beech contracts for 180 aircraft, USD755 million. Hawker 400XP USD6.741,890 (2004).

DESIGN FEATURES: Typical low-wing, T tail, rear-engined small business jet, with sweptback wings and empennage, plus small underfin. Compared to Diamond, Beechjet has increased payload and certified ceiling, greater cabin volume achieved by moving rear-fuselage fuel tank forward under floor (balanced by moving lavatory to rear of cabin), improved soundproofing, and emergency door moved one window forward to facilitate forward club seating.

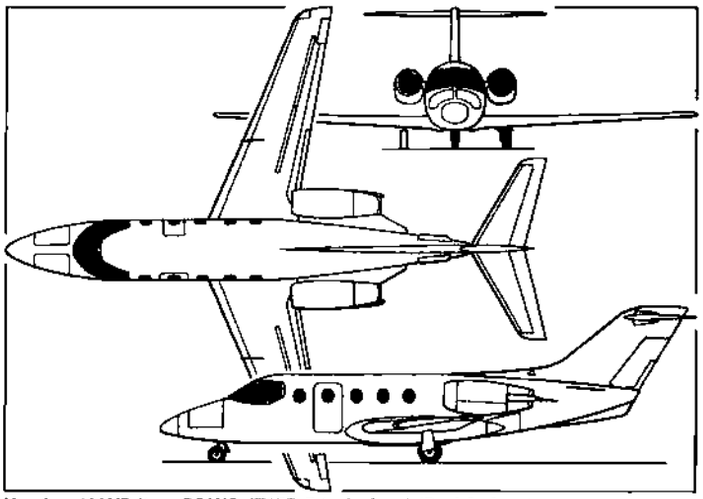
Wing has computer-designed three-dimensional Mitsubishi MAC510 aerofoil; thickness/chord ratio 13.2 per cent at root, 11.3 per cent at tip; dihedral 2° 30'; incidence 3° at root, –3° 30' at tip; sweepback 20° at quarter-chord. Horizontal tail sweepback 26°, vertical tail 46° 24', both at 25 per cent.

T-1A Jayhawk features include student pilot in left seat, instructor on right and pupil/observer behind instructor; more bird-resistant windscreen and leading-edges; fewer cabin windows; strengthened wing carry-through structure and engine attachment points to meet low-level flight stresses; rails for four passenger seats in cabin for personnel transport; avionics relocated from nose to rack in cabin to facilitate nose installation of air conditioning; emergency door moved forward to position opposite main cabin door to allow straight-through egress; improved brakes; additional fuel tank; single-point pressure refuelling; Rockwell Collins five-tube EFIS; digital autopilot; weather radar; central diagnostic and maintenance system; Tacan with air-to-air capability.

FLYING CONTROLS: Conventional and manual. Variable incidence tailplane and elevators for pitch axis; lateral control by small ailerons and almost full semi-span, narrow chord spoilers (divided inboard and outboard) used also as airbrakes and lift dumpers; rudder with trim tab;

1040398

Hawker 400XP business jet *(Paul Jackson)*



Hawker 400XP (two P&WC JT15D-5 turbofans) *(Paul Jackson)* 1154671

narrow chord Fowler-type flaps, double-slotted inboard and single-slotted outboard, occupy most of Trailing-edges and are hydraulically actuated; mid-span leading-edge fences on wing; small horizontal strakes on fuselage at base of fin; small ventral fin. Control surface movements: inboard spoiler +68/–14°, outboard spoiler +72/–14°, elevator +25/–12°, rudder ±30°, flaps 30° and speed brake 36°.

STRUCTURE: Wings include integrally machined metal upper and lower skins joined to two box spars forming integral fuel tank; tailplane and fin similar. Wing, fuselage and tail unit certified fail-safe for unlimited life (with periodic inspections and maintenance).

LANDING GEAR: Retractable tricycle type, with single wheel and oleo-pneumatic shock-absorber on each unit. Hydraulic actuation, controlled electrically. Emergency free-fall extension. Main tyres 24×7.7 (16 ply) tubeless; nose tyre 18×4.4 (10 ply) tubeless. Nosewheel, which is steerable by rudder pedals, retracts forward; mainwheels retract inward into fuselage. Goodyear wheels and tyres; Aircraft Braking Systems brakes.

POWER PLANT: Two Pratt & Whitney Canada JT15D-5 turbofans, each rated at 13.19 kN (2,965 lb st) for take-off and 13.17 kN (2,900 lb st) max continuous. Nordam thrust reversers standard on 400XP, but not fitted to T-1A. Fuel in two wing tanks, each 822 litres (217 US gallons; 181 Imp gallons), and six fuselage tanks totalling 1,162 litres (307 US gallons; 256 Imp gallons); total 2,806 litres (741 US gallons; 618 Imp gallons), of which 2,775 litres (733 US gallons; 610 Imp gallons); usable in 400A and 400XP. Military versions have optional pressure refuelling of two wing and four fuselage tanks for T-1A pressurised total of 2,949 litres (779 US gallons; 649 Imp gallons), of which 2,918 litres (771 US gallons; 642 Imp gallons) usable; and 400TX pressurised total of 3,047 litres (805 US gallons; 670 Imp gallons), of which 3,017 litres (797 US gallons; 664 Imp gallons) usable. 2,998 litres (792 US gallons; 656 Imp gallons). One refuelling point in top of each wing, and one in rear fuselage for fuselage tank, capacity 1,158 litres (306 US gallons; 255 Imp gallons). (T-1A, single-point refuelling.) Oil capacity 7.7 litres (2.0 US gallons; 1.7 Imp gallons).

ACCOMMODATION: Crew of two on vertically and horizontally adjustable reclining seats with five-point safety harnesses; T-1A has seats for trainee pilot, co-pilot/instructor and observer. Improved interior introduced 1996, featuring redesigned trim panels, enhanced acoustic panels and vibration-damping engine mounts.

Standard 'centre club' layout of 400A seats eight passengers in pressurised cabin. Of these, seven are on tracking, 360° swivelling, reclining seats: four in facing pairs, two forward-facing and one aft-facing; each with integral headrest, armrest and shoulder harness. Fold-out writing table between each pair of seats. Private flushing lavatory at rear with sliding doors and optional illuminated vanity unit and hot water supply. With seat belts, this compartment can serve as eighth passenger seat.

Interior options for up to nine passengers; these include substitution of carry-on baggage compartment for one of the forward centre seats, and hot and cold service refreshment centre with integral stereo entertainment system. Independent temperature control for flight deck and cabin heating systems standard. In-flight telephone optional. Tailcone baggage compartment with external access. Optional four passenger seats in main cabin of T-1A. The 400T has an aft club arrangement with swivel chairs.

SYSTEMS: Pressurisation system, with normal differential of 0.63 bar (9.1 lb/sq in) maintaining sea level cabin environment to 7,315 m (24,000 ft) and 2,286 m (7,500 ft) cabin environment to 13,715 m (45,000 ft). back-up pressurisation system, using engine bleed air, for use in emergency. Hydraulic system, pressure 103.5 bar (1,500 lb/sq in), for actuation of flaps, landing gear and other services. Each variable volume output engine-driven pump has a maximum flow rate of 14.76 litres (3.9 US gallons; 3.25 Imp gallons)/min, and one pump can actuate all hydraulic systems. Reservoirs, capacity 4.16 litres (1.1 US gallons; 0.9 Imp gallon), pressurised by filtered engine bleed air at 1.03 bar (15 lb/sq in). All systems are, wherever possible, of modular conception: for example, entire hydraulic installation can be removed as a single unit. Stick shaker as back-up stall warning device.

AVIONICS: Rockwell Collins Pro Line 4 as core system.

Comms: VHF-422C radio and RTU-870C tuning units. CDU-5000 control display unit. Dual TDR-94D Mode S transponders. L-3 Communications FA2100-1-20-00 voice recorder. Artex C406-2 ELT. Dual DB System 430 audio systems.

Radar: TWR-850 weather radar.

Flight: FCS-850 flight control system. Dual ADC-850D air data computer/altitude encoder, FMS-5000 flight management system, VIR-432 nav receiver, DME-442 and AHC-85E AHRS. Single ALT-55B radio altimeter, ADF-462 and GPS-4000A. TCAS-4000 TCAS II. Honeywell Mk V EGPWS.

Instrumentation: EFIS-871 152 × 178 mm (6 × 87 in) primary flight display screen for pilot and co-pilot, plus third PFD-871 multifunction display for pilot. Dual SDU-640D sensor display units for backup instruments.

DIMENSIONS, EXTERNAL:

Wing span	13.25 m (43 ft 6 in)
Wing mean aerodynamic chord	1.86 m (6 ft 1 in)
Wing aspect ratio	7.8
Length overall	14.75 m (48 ft 5 in)
Fuselage: Length	13.15 m (43 ft 2 in)
Max width	1.68 m (5 ft 6 in)
Max depth	1.85 m (6 ft 1 in)
Height overall	4.24 m (13 ft 11 in)
Tailplane span	5.00 m (16 ft 5 in)
Wheel truck	**2.84 m (9 ft 4 in)**
Wheelbase	5.86 m (19 ft 3 in)
Crew/passenger door: Height	1.24 m (4 ft 1 in)
Width	**0.71 m (2 ft 4 in)**

DIMENSIONS, INTERNAL:

Cabin:	
Length: incl cockpit	**6.32 m (20 ft 9 in)**
excl cockpit	4.72 m (15 ft 6 in)
Max width	1.50 m (4 ft 11 in)
Max height	1.45 m (4 ft 9 in)
Volume: incl flight deck	11.3 m^3 (400 cu ft)
excl flight deck	8.6 m^3 (305 cu ft)
Baggage compartment volume:	
cabin	0.57 m^3 (20.0 cu ft)
tailcone	0.75 m^3 (26.4 cu ft)

AREAS:

Wings, net	**22.43 m^2 (241.4 sq ft)**
Trailing-edge flaps (total)	**4.22 m^2 (45.40 sq ft)**
Spoilers (total)	**0.57 m^2 (6.20 sq ft)**
Fin, incl dorsal fin	**5.91 m^2 (63.60 sq ft)**
Rudder, incl yaw damper	**0.99 m^2 (10.70 sq ft)**
Tailplane	**5.25 m^2 (56.50 sq ft)**
Elevators, incl tab	**1.55 m^2 (16.70 sq ft)**

WEIGHTS AND LOADINGS:

Weight empty	4,785 kg (10,550 lb)
Basic operating weight, incl crew, avionics and interior fittings	4,967 kg (10,950 lb)
Max baggage weight: total	431 kg (950 lb)
tailcone	204 kg (450 lb)
Max fuel weight	2,228 kg (4,912 lb)
Fuel with max payload	1,588 kg (3,500 lb)
Payload with max fuel	289 kg (638 lb)
Max T-O weight	7,393 kg (16,300 lb)
Max ramp weight	7,484 kg (16,500 lb)
Max landing weight	7,121 kg (15,700 lb)
Max zero-fuel weight	5,896 kg (13,000 lb)
Max wing loading	329.67 kg/m^2 (67.52 lb/sq ft)
Max power loading	280 kg/kN (2.75 lb/lb st)

PERFORMANCE:

Max operating speed (VMO):	
S/L to FL80	264 kt (489 km/h; 304 mph) IAS
above FL110	320 kt (592 km/h; 368 mph) IAS
Max operating Mach No.	0.78
Max level speed at FL270	465 kt (861 km/h; 535 mph)
Cruising speed:	
high, at FL390	450 kt (834 km/h; 518 mph)
intermediate, at FL410	420 kt (778 km/h; 483 mph)
long-range, at FL 430	414 kt (767 km/h; 476 mph)
Stalling speed, flaps down, idling power	92 kt (171 km/h; 106 mph) CAS
Max rate of climb at S/L	1,149 m (3,770 ft)/min
Rate of climb at S/L, OEI	218 m (715 ft)/min
Service ceiling	**13,243 m (43,450 ft)**
Time to FL370	**18 min**
Service ceiling, OEI	**6,279 m (20,600 ft)**
Max certified altitude	13,715 m (45,000 ft)
FAA (FAR Pt 25) T-O field length at S/L, ISA	1,191 m (3,905 ft)
FAA landing distance at MLW	**1,071 m (3,515 ft)**
Range: with NBAA IFR reserves:	
with max fuel	1,500 n miles (2,778 km; 1,726 miles)
with max payload	874 n miles (1,618 km; 1,005 miles)
ferry	1,687 n miles (3,124 km; 1,941 miles)

OPERATIONAL NOISE LEVELS:

T-O	88.8 EPNdB
Approach	91.7 EPNdB

HAWKER 800 and 850

JASDF designation: U-125

TYPE: Business jet.

PROGRAMME: Derived from the de Havilland/Hawker Siddeley/British Aerospace 125, which was built in the UK from 1962 onwards, progressing through Srs 1 to 3 and 400 to 700. Prototype Srs 800 first flew (G-BKTF) 26 May 1983; type certificate gained 4 May 1984 and Public Transport Category C of A on 30 May 1984; FAA certification 7 June 1984; Russian certification May 1993; Canadian certification (800XP) awarded in third quarter of 1997. Adopted Hawker nomenclature when programme purchased by Raytheon in 1993, at which time some 850 aircraft had been sold in 44 countries.

Final assembly of Hawker 800XP gradually transferred to Wichita; first US-assembled aircraft flew on 5 November 1996, being N297XP, the 297th Series 800; second (N1105Z; No. 301) followed on 24 November 1996; transition complete with flight of last UK-assembled aircraft, No. 337, 29 April 1997; FAA production certificate awarded to Raytheon in May 1997. One thousandth 125/Hawker series aircraft, an 800XP, was delivered as the 'Millennium Hawker' to Gainey Corporation of Grand Rapids, Michigan (N984GC), October 1998. Winglets available as option on new aircraft, or as retrofit, from 2003.

CURRENT VERSIONS: **800:** Original version superseded by 800XP in late 1995; 275 built in main series, of which last delivered December 1995. Follow-on manufacture exclusively for Japanese military contracts.

800XP: (XP=eXtended Performance) Announced March 1995, when prototype (G-BVYW, modified from 800) completed; this and preproduction 800XP used in development programme, culminating in CAA and FAA certification on 28 July 1995; first delivery (to Green Tree Financial of St Paul, Minnesota) October 1995 after public debut at National Business Aviation Association Convention in Las Vegas during previous month.

Changes from 800 included Dee Howard thrust reversers as standard; increased weights; vortillons replacing wing fences; re-geared aileron servo tab; addition of Mach trim system; and 38 litre (10.0 US gallons; 8.4 Imp gallon) TKS de-icing fluid tank. Initially fitted with Honeywell SPZ 8000 avionics as standard. Collins Pro Line 21 fitted to c/n 258541 and as standard from 258554, delivered 2002 onwards. Superseded by Hawker 800XPi.

800XPi: Improved version, announced at the European Business Aviation Convention and Exhibition in Geneva 18 May 2005 and available from mid-2005. Features Rockwell Collins integrated flight information system (IFIS) and Pro Line 21 communication, navigation and surveillance (CNS) suite as standard, plus an upgraded cabin that includes

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Hawker 850XP company demonstrator *(Paul Jackson)*

LED lighting; new tailoring for cabin seats and divan; redesigned and larger forward baggage area; flush-fitting galley doors with invisible hinges; FAA-approved latches on all cabinetry; Collins Airshow 21 cabin management system with LCD touch-screens at each seat and one on each divan armrest; 38 cm (15 in) video monitors recessed into cabin bulkheads; and improved cabin sound system. Superseded by Hawker 850XP, although designation remains current for aircraft of customers specifying omission of winglets on their 850s.

800SP: Winglet modification of 800/800XP devised by Aviation Partners Inc and shown at NBAA Convention, Orlando, Florida, September 2002; available from early 2003. Height 107 cm (3 ft 6 in); 7 per cent consequential drag reduction translates into M0.03 speed increase (18 kt; 33 km/h; 21 mph) and range extension of 180 n miles (333 km; 207 miles).

800FI, SM, RA and SIG: Special missions versions; produced as required.

U-125A: Modification undertaken by KAC for Japanese military service.

850XP: Announced at NBAA Convention, Orlando, Florida, 9 November 2005. Replacement for 800XPi from c/n 258750 onwards. Hawker-designed winglets increase range by 4 per cent, or 100 n miles (185 km; 115 miles); decrease time-to-climb by up to 8 per cent. Further features include increase of scheduled maintenance interval from 300 to 600 hours and LED position lights in winglets. Pro Line 21 and Airshow 21 equipment of 800XPi retained. First delivery 15 March 2006 to CES Wholesale Grocers, following FAA certification on 28 February 2006. *Detailed description applies to this version.*

Hawker 750 and 900XP: *Described separately.*

CUSTOMERS: Refer to table. Total 792 Series 800/800XPs/XPis/850XPs delivered by 30 September 2006. Largest contract for 125/Hawker placed in May 1997 when Executive Jet Inc ordered 20 800XPs, followed in September 1998 by order for a further 20, plus 16 options for NetJets fractional ownership scheme; deliveries between 1997 and 2004; further eight ordered in December 2003 for delivery from that month until 2005, and a further 20 ordered in June 2004 for delivery 2005–07 to NetJets Europe. Recent customers include National Air Service (NAS) of Jeddah, Saudi Arabia, which ordered 14 in November 1999 for its NetJets Middle East fractional ownership programme, five of these being delivered in 2000, including the first (HZ-KSRA) at the Farnborough International Air Show on 24 July 2000, and three per year thereafter until 2003; Hainan Airlines of China, which took delivery of one aircraft on 19 July 1999; and Talon Air of Rochester, New York, which ordered an 800XPi for delivery in September 2005. Contender for US Navy Undergraduate Military Flying Officer Training System (UMFOTS) requirement, for which 16 aircraft are required initially.

HS 125 AND HAWKER 800 PRODUCTION

	125-1	125-3	125-400	125-600	125-700	800	800XP	800XP/PL	800XPi
1962	2								
1963	2								
1964	8	1							
1965	33								
1966	41	7							
1967	1	21							
1968		26	4						
1969		9	24						
1970			38						
1971		1	25	2					
1972			17	4					
1973			7	22					
1974			1	15					
1975				12					
1976				13					
1977				4	17				
1978				1	34				
1979					28				
1980					40				
1981					35				
1982					33				
1983					17	3			
1984					9	17			
1985					2	28			
1986						26			
1987						32			
1988						29			
1989						26			
1990						40			
1991						11			
1992						15			
1993						17			
1994						10			
1995						19	6		
1996						1	21		
1997						2	44		
1998						3	38		
1999						4	48		
2000						3	52		
2001						2	51		
2002						2		44	
2003								43	
2004						2		53	
2005								26	29
Totals	**87**	**65**	**116**	**73**	**215**	**292**	**260**	**166**	**29**

Notes: Data do not include 20 Dominie T. Mk 1 navigation trainers (125 Srs 2) delivered to the RAF in 1965 (10) and 1966 (10).

COSTS: 800XPi USD13.45 million; 850XP USD13.65 million (2006).

DESIGN FEATURES: Classic small business jet; sweptback wing mounted below cabin floor; podded engines on rear fuselage sides; and high tailplane.

Improvements of baseline Series 800, compared with earlier 700 variant, include curved windscreen, sequenced nosewheel doors, extended fin leading-edge, larger ventral fuel tank, and increased wing span which reduces induced drag, enhances aerodynamic efficiency and carries extra fuel; outboard 3.05 m (10 ft) of each wing redesigned.

In XP version, TFE731-5BR-1H turbofans boost performance, including 14 kt (26 km/h; 16 mph) increase in cruising speed at 11,800 kg (26,015 lb) at 11,890 m (39,000 ft); 225 kg (496 lb) payload increase with eight passengers; 15 to 23 per cent reduction in time to cruising altitude, to reach 11,280 m (37,000 ft) in 23 minutes at maximum take-off weight in ISA + 10°C conditions; and enhanced take-off performance. Other improvements include installation of vortillons in place of wing fences, permitting lower V-speeds and reducing drag; enhanced TKS de-icing system with increased fluid capacity; improved high-energy brakes; restyled cabin interior to maximise use of available volume; and improved environmental control system; and redesigned interior, with increased headroom by relocating oxygen dropout units to sidewall panels, and 12.2 cm (4.8 in) extra width at shoulder level by sculpturing sidewall panels around fuselage frame. Interior further improved in 1998 — see Accommodation paragraph.

Wing thickness/chord ratio 14 per cent at root, 8.35 per cent at tip; dihedral 2°; incidence 2° 5′ 42″ at root, −3° 5′ 49″ at tip; sweepback 20° at quarter-chord; small fairings on tailplane undersurface eliminate turbulence around elevator hinge cutouts. Tailplane sweep 20°, fin 54° 20′, both at quarter-chord.

FLYING CONTROLS: Conventional and manual. Each control surface with geared tab; port aileron tab trimmed manually via screw-jack. Hydraulically actuated four-position double-slotted flaps; mechanically operated hydraulic cutout prevents asymmetric flap operation; upper and lower airbrakes, with interconnected controls to prevent asymmetric operation, form part of flap shrouds and provide lift dumping. Fixed incidence tailplane. Flap positions 15, 25 and 45°.

STRUCTURE: All-metal. One-piece wings, dished to pass under fuselage and attached by four vertical links, side link and drag spigot; two-spar fail-safe wings, with partial centre spar of approximately two-thirds span, to form integral fuel tankage; single-piece skins on each upper and lower wing semi-spans; detachable leading-edges; fail-safe fuselage structure of mainly circular cross-section, incorporating Redux bonding.

LANDING GEAR: Retractable tricycle type, with twin wheels on each unit. Hydraulic retraction: nosewheels forward, mainwheels inward into wings. Oleo-pneumatic shock-absorbers. Fully castoring nose unit, steerable ±45°. Dunlop mainwheels size 23×7–12 (12 ply) tubeless tyres. Dunlop nosewheels size 18×4.25–10 (6 ply) tubeless tyres. Dunlop triple-disc hydraulic brakes with Maxaret anti-skid units on all mainwheels. Minimum ground turning radius about nosewheel 9.14 m (30 ft 0 in).

POWER PLANT: Two 20.73 kN (4,660 lb st) Honeywell TFE731-5BR-1H turbofans, mounted on sides of rear fuselage in pods designed and manufactured by Northrop Grumman. Dee Howard TR5000BR thrust reversers. Integral fuel tanks in wings, with combined capacity of 4,818 litres (1,273 US gallons; 1,060 Imp gallons). Rear underfuselage tank of 882 litres (233 US gallons; 194 Imp gallons) capacity, giving total capacity of 5,700 litres (1,506 US gallons; 1,254 Imp gallons). Single pressure refuelling point at rear of ventral tank. Overwing refuelling point near each wingtip.

ACCOMMODATION: Flight deck crew of two. Dual controls standard. Seat for third crew member. Executive layout has forward baggage compartment, forward galley comprising automatic coffee maker, microwave oven, and miscellaneous storage. Seats swivel through 360°. Seating for eight passengers, with club four seating at the front of the cabin, three-place settee on the right side rear cabin and single seat opposite. Airliner style lavatory at rear with external servicing as standard. Maximum seating for 14. Cabin equivalent altitude 2,286 m (7,500 ft) at FL410. Interior options include differing seating layouts; microwave oven; entertainment system including CD player and video LCD screen. New interior introduced at National Business Aviation Association Convention at Las Vegas, Nevada, in October 1998 features oval internal window frames, additional sidewall lighting and restyled side panels and work tables.

SYSTEMS: Honeywell air conditioning and pressurisation system. Maximum cabin differential 0.59 bar (8.60 lb/sq in), maintains sea level cabin environment to 6,767 m (22,200 ft).

Oxygen system, capacity 1,500 litres (396 US gallons; 330 Imp gallons), standard, with dropout masks for passengers. Hydraulic system, pressure 186 to 207 bar (2,700 to 3,000 lb/sq in), for operation of landing gear, mainwheel doors, flaps, spoilers, nosewheel steering, mainwheel brakes and anti-skid units. Two accumulators, pressurised by engine bleed air, one for main system pressure, other providing emergency hydraulic power for wheel brakes in case of main system failure. Independent auxiliary system for lowering landing gear and flaps in event of main system failure.

DC electrical system utilises two 28.5 V 12 kW engine-driven starter/generators and two 24 V 23 Ah Ni/Cd batteries. A 24 V 4 Ah battery provides separate power for standby instruments. AC electrical system includes two 1.25 kVA static inverters, providing 115 V 400 Hz single-phase supplies, one 250 VA standby static inverter for avionics, and two engine-driven 208 V 7.4 kVA frequency-wild alternators for windscreen anti-icing. Ground power receptacle on starboard side at rear of fuselage for 28 V external DC supply. Honeywell 36-150 W APU. TKS liquid system de-icing/anti-icing on leading-edges of wings and tailplane. Engine ice protection system supplied by engine bleed air. Kidde-Graviner triple FD Firewire fire warning system and two BCF engine fire extinguishers. Stall warning and stick pusher system fitted.

AVIONICS: Collins Pro Line 21 as core system.

Comms: Dual Collins VHF-422C com with 8.33 kHz frequency spacing; dual TFR-94D transponders; Collins HF-9000 HF com with Coltech CSD-714 Selcal; dB Systems Dual Model 700 cockpit audio system; Universal Avionics CVR-120 cockpit voice recorder; and Artex C406-2 satellite-capable ELT, all standard. Second HF-9000; Honeywell Airborne Flight Information System, and Magnastar C2000 terrestrial-based flight phone or Universal Avionics Aero M or Aero I satcom phone, all optional.

Radar: Collins TWR-850 colour weather radar with turbulence detection as standard.

Flight: Dual Collins FMS-6000 flight management systems; dual AHC-3000 quartz AHRS; dual ADC-3000 digital air data systems; FGC-3000 AFCS; dual GPS-4000A; dual VIR-432 VOR/ILS/marker receivers; ADF-462; dual DME-442; ALT-4000 radio altimeter; TCAS-4000 TCAS II (Change 7 compliant); MDC-3000 maintenance diagnostic system; and SafeFlight AoA system, all standard. Second ADF-462, and L3 Communications F1000 FDR or JAR-OPS compliant Honeywell FDR with Teledyne FDAU, optional.

Instrumentation: Four 203 × 254 mm (8 × 10 in) active matrix LCDs for PFD, MFD and EICAS functions; and Meggitt Avionics Mark II secondary flight display system, standard. Options include 3-D mapping for MFDs; Goodrich WX-1000 lightning detection system with display on AMLCDs; Collins CDU-6200 graphics capable display; and Airshow 400 or Airshow Network cabin display systems.

DIMENSIONS, EXTERNAL:

Wing span	16.56 m (54 ft 4 in)
Wing chord, mean	2.41 m (7 ft 11 in)
Wing aspect ratio	7.7
Length overall	15.60 m (51 ft 2 in)
Height overall	5.51 m (18 ft 1 in)
Fuselage max diameter	1.93 m (6 ft 4 in)
Tailplane span	6.10 m (20 ft 0 in)
Wheel track (c/l of shock-absorbers)	2.79 m (9 ft 2 in)
Wheelbase	6.41 m (21 ft 0½ in)
Door (fwd, port): Height	1.33 m (4 ft 4 in)
Width	0.69 m (2 ft 3 in)
Height to sill	1.07 m (3 ft 6 in)
Emergency exit (overwing, stbd):	
Height	0.91 m (3 ft 0 in)
Width	0.51 m (1 ft 8 in)

DIMENSIONS, INTERNAL:

Cabin (excl flight deck): Length	6.50 m (21 ft 4 in)
Width: max	1.83 m (6 ft 0 in)
at floor	1.30 m (4 ft 3 in)
Max height	1.75 m (5 ft 9 in)
Floor area	5.11 m² (55.0 sq ft)
Volume	17.1 m³ (604 cu ft)
Baggage compartments: forward	0.93 m³ (33.0 cu ft)
rear incl lavatory	0.42 m³ (15.0 cu ft)
pannier (optional)	0.79 m³ (28.0 cu ft)

AREAS:

Wings, gross	35.40 m² (381.0 sq ft)
Ailerons (total)	2.05 m² (22.10 sq ft)
Airbrakes: upper (total)	0.74 m² (8.00 sq ft)
lower (total)	0.46 m² (5.00 sq ft)
Trailing-edge flaps (total)	4.83 m² (52.00 sq ft)
Fin (excl dorsal fin)	6.43 m² (69.20 sq ft)
Rudder	1.32 m² (14.20 sq ft)
Horizontal tail surfaces (total)	9.29 m² (100.00 sq ft)

WEIGHTS AND LOADINGS:

Basic operating weight	7,407 kg (16,330 lb)
Max payload	962 kg (2,120 lb)
Payload with max fuel	812 kg (1,790 lb)
Max fuel	4,536 kg (10,000 lb)
Max T-O weight	12,701 kg (28,000 lb)
Max ramp weight	12,755 kg (28,120 lb)
Max landing weight	10,591 kg (23,350 lb)
Max zero-fuel weight	8,369 kg (18,450 lb)
Max wing loading	365.5 kg/m² (74.86 lb/sq ft)
Max power loading	306 kg/kN (3.00 lb/lb st)

PERFORMANCE:

Max operating speed (VMO) at FL290 with ventral tank empty	335 kt (620 km/h; 385 mph) IAS
Max operating Mach No. MMO)	0.80
High cruising speed at FL370	448 kt (830 km/h; 515 mph)
Intermediate cruising speed at FL410	428 kt (793 km/h; 493 mph)
Long-range cruising speed at FL390	402 kt (745 km/h; 463 mph)
Stalling speed in landing configuration at typical landing weight	92 kt (170 km/h; 106 mph)
Max rate of climb at S/L	945 m (3,100 ft)/min
Rate of climb at S/L, OEI	143 m (470 ft)/min
Time to FL390 at MTOW	20 min
Max certified altitude	12,497 m (41,000 ft)
Service ceiling	11,887 m (39,000 ft)
Service ceiling, OEI	5,730 m (18,800 ft)
T-O balanced field length at MTOW	1,533 m (5,030 ft)
Landing run at MLW	808 m (2,650 ft)
Range with six passengers, NBAA IFR reserves:	
at max cruising speed, FL370 to FL410:	2,111 n miles (3,909 km; 2,429 miles)
at intermediate cruising speed, FL390 to FL410	2,350 n miles (4,352 km; 2,704 miles)
at long-range cruising speed, FL390 to FL410	2,598 n miles (4,811 km; 2,989 miles)
g limits	+2.73/–1.0

OPERATIONAL NOISE LEVELS:

T-O	79.3 EPNdB
Approach	93.3 EPNdB

HAWKER 900XP and 750

TYPE: Business jet.

PROGRAMME: Announced on eve of NBAA Convention, Orlando, Florida, 16 October 2006; further development of Hawker 800 series. Service entry in early 2007, replacing Hawker 800.

Derived from the de Havilland/Hawker Siddeley/British Aerospace 125, which was built in the UK from 1962 onwards, progressing through Srs 1 to 3 and 400 to 700. Prototype Srs 800 first flew (G-BKTF) 26 May 1983; type certificate gained 4 May 1984 and Public Transport Category C of A on 30 May 1984; FAA certification 7 June 1984. Adopted Hawker nomenclature when programme purchased by Raytheon in 1993, at which time some 850 aircraft had been sold in 44 countries.

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CURRENT VERSIONS: **750:** Shorter range version with TFE731BR engines; based on Hawker 850XP but without winglets and with ventral fuel tank replaced by externally-accessed baggage space.

900XP: Longer range version with TFE731-50 engines and winglets; compared with Hawker 800XP has 250 n miles (463 km; 288 miles) further range.

CUSTOMERS: Launched with orders from NetJets for 18 Hawker 900XPs and 30 Hawker 750s; NetJets Middle East for eight Hawker 750s; plus one 900XP for Voyager Jet Center of Pittsburgh.

COSTS: USD11.95 million Hawker 750; USD13.95 million Hawker 900XP (both 2007).

DESIGN FEATURES: Intended to compete with Cessna Sovereign, Gulfstream G150, Learjet 45 and Cessna Citation XLS by offering two products derived from core Hawker 800.

Sweptback wing mounted below cabin floor; podded engines on rear fuselage sides; and cruciform empennage. Hawker 900XP has Hawker composites winglets sized to provide performance improvements while not affecting airframe inspection schedules.

Wing thickness/chord ratio 14 per cent at root, 8.35 per cent at tip; dihedral 2°; incidence 2° 5'/ 42″ at root, 3° 5'/ 49″ at tip; sweepback 20° at quarter-chord. Tailplane sweepback 20°; fin 54° 20' (both at quarter-chord).

FLYING CONTROLS: Conventional and manual. Actuation by cables, push-pull rods and mechanical linkages. Secondary control system provides mechanical trim through tabs in each elevator; port aileron and rudder.

Each aileron extends from approximately two-thirds span to wingtip (750) or winglet root (900XP) and are both mass- and aerodynamically balanced. Each aileron supported by three hinges, with inboard hinge locating the aileron laterally.

Double-slotted flaps hinged on two external fixed arms below the wing and extend from fuselage side to approximately half of semi-span; flaps hydraulically operated with one actuator per side and interconnected by cable system to ensure symmetrical operation. Flap actuation by main hydraulic system, backed by independent fluid supply from the auxiliary hydraulic system in the event of main system failure. Flap has four positions: 0°, 15°, 25° and 45°.

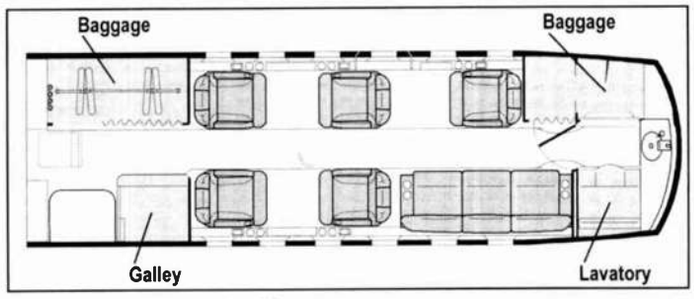
Airbrakes on the top and bottom surfaces of wing, forward of flaps, each attached to rear spar by two hinges. Airbrake selector is interconnected with the input lever to the flap control unit; during landing roll, with flaps selected 45° (landing), lifting the airbrake selector and moving it rearwards into the 'lift dump' position automatically lowers the flaps to a 75° angle and also opens airbrakes further.

Rudder bias system comprises two air powered struts between fuselage and rudder torque tube quadrant to provide an automatic application of rudder bias to counteract asymmetric

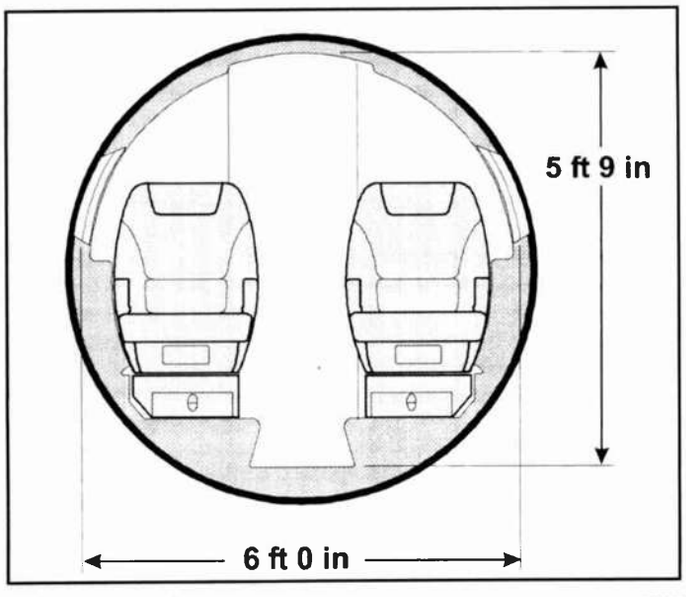
Retouched image showing Hawker 900XP 1158829

Retouched image of Hawker 750 1158838

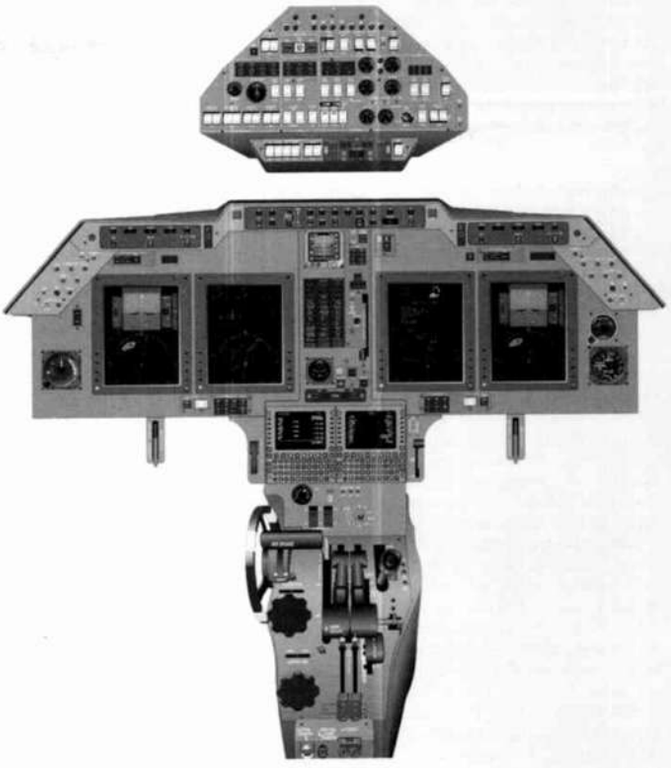
Typical interior of Hawker 750/900XP 1158830



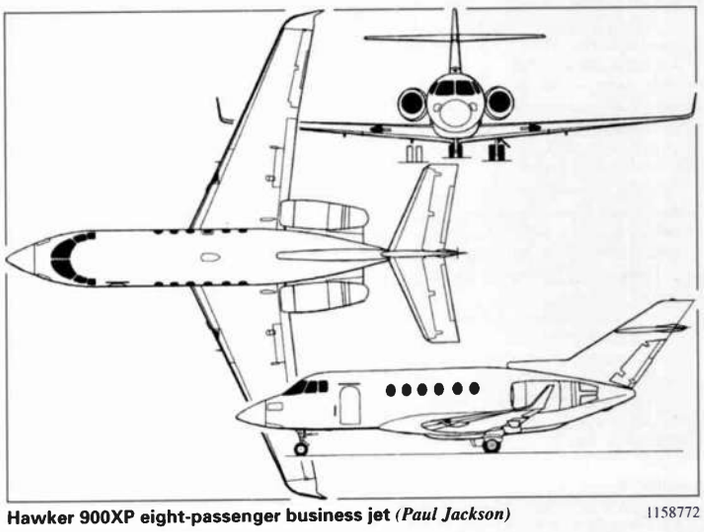
Floor plan of Hawker 750/900XP 1158770



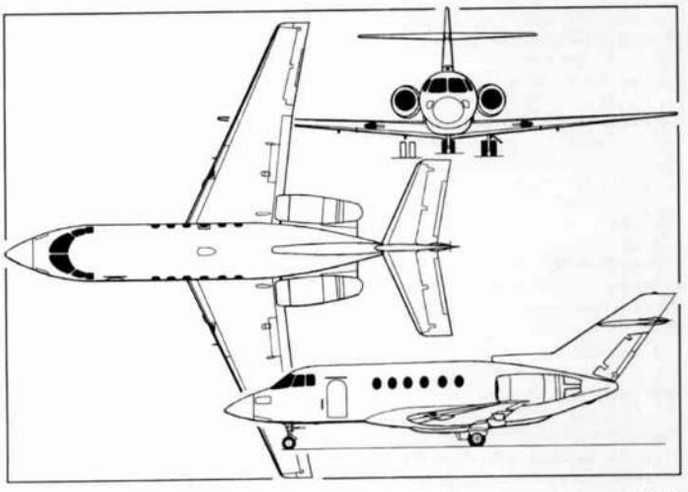
Hawker 750/900XP fuselage cross-section 1158771



Hawker 750/900XP instrument panel 1158831



Hawker 900XP eight-passenger business jet *(Paul Jackson)* 1158772



Hawker 750 shorter-range version of 900XP *(Paul Jackson)* 1158773

thrust. Engine bleed air system is interconnected to the struts so that each engine supplies air to opposing sides of the strut positions; imbalance within the pistons will bias the rudder to appropriate side.

STRUCTURE: All metal. Fuselage is semi-monocoque of high strength aluminum-copper alloy, with appropriate use of steel and other materials, consisting of three main sections: unpressurised nose; pressurised flight deck and cabin: and unpressurised rear.

Hinged radome of composites, forward of nose gear bay, housing weather radar; nose section also contains auxiliary hydraulic system and some avionic components.

Pressure cabin, comprising flight deck and passenger compartment, has skin supported by transverse frames and longitudinal stringers. Both Redux bonding and riveted jointing employed. All aperture surrounds and seam joints are reinforced to ensure low stress levels. Wing attachments of high tensile steel which connect to heavy duty fabricated frames at front and rear spars. Rear underside of Hawker 750 fuselage incorporates Nomex honeycomb baggage compartment.

Wing structure consists of the port and starboard wings and a centre section.

Wing box incorporates front and rear spars, ribs and wing skins. Fabricated centre spar extends for two-thirds of span. Front spars, rear spars and ribs machined from aluminum-copper alloy billets. Wing skins are single contour milled panels, reinforced by bonded closed section stringers; skin terminates at root rib and incorporates eight detachable panels for maintenance and inspection. Bottom skin extends to the aircraft centerline and incorporates six access panels, plus small detachable panels to permit maintenance. Top skins and stiffeners of aluminum-zinc alloy; bottom skins and stiffeners from aluminum-copper alloy. On Hawker 900XP, metal wing leading edge continues along entire polished leading edge of the winglet providing seamless interface; position lights, along with the conventional strobe assembly, are integrated within the contour of the winglet leaving the external surface of the winglet uninterrupted.

Wing centre section of wing ribs and five machined beams; front and rear beams form continuation of front and rear wing spars. Integral fuel tanks extend from each side of centre line rib to within 0.63 m (25 in) of wing tip. Each tank sub-divided into six anti-surge compartments. Tanks are sealed with Thiokol. Attachment to fuselage by four high tensile steel vertical links located at intersection of root rib and front and rear spars. High-tensile steel side stay link at forward port position and shear spigot on rear spar, along aircraft centreline. Centre-section is dished on its top surface to allow the entire wing structure to pass beneath the fuselage.

Fuselage aft of pressure dome consists of skin supported by transverse frames and longitudinal riveted stringers. Engine main attachment points are located at each end of a fabricated beam mounted transversely on fuselage. Aft attachment is mounted on reinforced frames. Fin structure attaches to four heavy-duty frames in rear fuselage.

Empennage of vertical stabiliser and a fixed incidence horizontal stabiliser. Main (below tailplane) fin structure incorporates front and rear spars, ribs and skins, stiffened by Redux-bonded stringers, and is bolted to rear fuselage structure. Overfin is self-contained unit of mixed metal/glass reinforced plastic; has three main fixing points to the horizontal stabiliser.

LANDING GEAR: Tricycle type; retractable. Oleo-pneumatic struts with twin wheels on all legs; mainwheels retract inboard into wingroots; nosewheel forward into fuselage. Hydraulic actuation; all units enclosed by mechanically and hydraulically actuated doors. Emergency extension by auxiliary hydraulic system handpump. Mainwheels size 23x7-12 (12 ply) tubeless tyres; nosewheels size 18x4.25-10 (6 ply) tubeless tyres. Nosewheel steering mechanically actuated by hydraulically operated pilot's handwheel. Maximum steering angle is 45° each side; free rotation for towing. Minimum ground taxying radius about nosewheel 9.14 m (30 ft 0 in). Meggitt power brakes on mainwheels; hydraulic system power is used to operate caliper-type disc brakes via Maxaret anti-skid units.

Skid under wing and (where installed) ventral fuel tank, enclosed within a fairing. Underwing section of beryllium-copper rubbing strip and light alloy pivoted arm, faced with a beryllium-copper pad. Ventral tank skid section consists of a light alloy pivoted arm and beryllium copper pad. Both skid pads supported on energy absorbing metal honeycomb.

POWER PLANT: *Hawker 900XP:* Two Honeywell TFE 731-50R turbofans. Each engine flat-rated to 20.73 kN (4,660 lb st) from nominal 22.24 kN (5,000 lb st); maximum continuous thrust 20.73 kN (4,660 lb st); cruise thrust at FL400 and M0.8 typically 4.96 kN (1,116 lb st). Target-type thrust reversers, hydraulically operated. Engine synchronizer automatically synchronizes the speed of either the fan or the turbine of the 'slave' engine to that of the 'master' engine. Closed loop fire detection system. Accessory gearbox on lower side of the engine's intermediate case is driven from the high pressure (N2) spool to power accessories for engine and aircraft systems.

Fuel system provides independent supply to each engine. Integral fuel tanks in wings, with combined capacity of 4,819 litres (1,273 US gallons; 1,060 Imp gallons), plus rear underfuselage tank of 882 litres (233 US gallons; 194 Imp gallons) capacity; total capacity of 5,701 litres (1,506 US gallons; 1,254 Imp gallons). System has both a wing-tank to wing-tank transfer capability and a cross-feed capability from either wing tank to one or both engines; also transfer from the ventral tank into either or both wing tanks. Gravity- and a single-point pressure refuelling/defuelling.

Hawker 750: Generally as for Hawker 900XP, except engine version and omission of ventral fuel tank. Two Honeywell TFE731-5BR turbofans, each 20.73 kN (4,660 lb st); wing fuel tanks only, combined capacity 4,819 litres (1,273 US gallons; 1,060 Imp gallons).

ACCOMMODATION: Two pilots and eight passengers, plus one cabin attendant, in standard layout; optionally up to 12 passengers. Certified for two-pilot operation. Front windscreen is single curvature, with forward and rear side panels of double curvature. Rear side panels can be opened. Front windscreen and forward side panels are electrically heated.

Eight-passenger layout features five individual seats, plus three-place divan, latter with hinged doors to two Kydex tubs used for cushion stowage. Passenger seats capable of side-tracking and reclining; inboard seat rails supported on continuous beams each side of aisle; each outboard seat rail is mounted on a continuous member attached to fuselage side. Cabin includes lavatory at rear.

Cabinetry consists of large galley on forward port side, next to door. Access to TKS pump/filter is under galley. Opposite entry door is baggage compartment. Executive writing tables at each individual seat position stow in sidewall panels. A 110 V AC outlet in a recessed box with sliding cover is provided at the centre seat positions on each side. Additional baggage compartment at rear of cabin, starboard side, extends into an area behind lavatory mirror. Lavatory features flushing toilet with external servicing; metal plated wash basin; 110 V AC outlet; and smoke detector.

Hawker 750 has unpressurised, but heated, ventral baggage compartment with external access.

Six cabin windows each side. Windows are fail-safe design of stretched acrylic and dry air 'sandwich' construction. Inner pane is capable of sustaining full cabin differential pressure in the event of outer pane failure. Outward opening, spring-counterbalanced,drop-down door with integral airstairs on port side of the fuselage, forward of wing. Emergency exit on starboard side, over wing, incorporates passenger window.

Cabin max pressure differential of 0.59 bar (8.55 lb/sq in) provides 2,285 m (7,500 ft) environment at max operating height of 12,495 m (41,000 ft).

SYSTEMS: Honeywell 36-150[W] APU provides air conditioning and electrical power independently of engines or ground power units; capacity 28 V 300 A; approved for in-flight operation up to 9,145 m (30,000 ft). Starter/generator and generator control unit are interchangeable with those of aircraft's engines.

Main hydraulic system, approximately 207 bar (3,000 lb/sq in), powered by two pumps, one on each engine; reservoir capacity approximately 9 litres (2.4 U.S gallons: 2.0 Imp gallons). Provides power for landing gear, flaps, airbrakes, nosewheel steering, brakes/anti-skid, stall prevention and thrust reversers. Auxiliary hydraulic system for landing gear extension and flaps is hand operated and, when selected, independent of main system.

Electrical power from two 28.5 V DC engine-driven starter generators, one on each engine. Two 24 V DC, 23 Ah sealed lead-acid batteries for engine starting and emergencies; 28V DC external power receptacle starboard side of fuselage. Third starter/generator, driven by APU, is available. Each generator output supplies its own busbar; bus-tie contactor, controlled by voltage protector, enables these busbars to be joined together after generator power is available. Automatic splitting of the two busbars occurs when the busbar detection unit detects an under/over voltage. Either generator is capable of supplying both busbars. AC power from two static inverters, 115 V, 400 Hz AC, with an apparent power rating of 1,500 VA each.

Pressurisation and environmental systems use engine bleed air. Air conditioning pack incorporating a three-wheel air cycle machine is employed. Independent cockpit supply from starboard engine provides additional heat for crew's feet and for demisting the windscreens, while also serving as emergency pressurisation supply.

Oxygen supply for crew and passengers in two 750 litre (26.5 cu ft) cylinders in the rear equipment bay; additional oxygen capacity optional. Quick-donning emergency masks for pilots; emergency supply for passengers through drop-out mask units and one supplemental outlet; masks are delivered automatically if cabin altitude rises above 3,660 m (12,000 ft).

Ice protection system allows flight through continuous and intermittent icing and is available with one engine inoperative. Rotary ice detector is fitted on port side of nose; TKS anti-icing fluid system protects leading edges of wing and tailplane; hot air from final stage of engine compressor used for anti-icing in nacelle inlet cowling. Air is bled from two stages of engine compressor to provide supplies for nacelle inlet cowl anti-icing and pressurisation and environmental systems. Ram air ventilates area of cowling surrounding engine compressor stages between front and rear firewalls. Anti-icing of windscreens and forward side panels provided by electrically conductive transparent film heating layers. Electric heating of two pitot heads, forward static plates and each rudder bias strut.

Maintenance diagnostic system includes MDC3110 computer. Majority of avionics LRUs can perform self-monitoring functions and are capable of reporting any failures to the MDC3110. Selection of the MDC to diagnostic mode is not accessible in flight. Maintenance information can be viewed on aircraft's MFDs on ground, or may be downloaded to diskette.

Collins flight director/autopilot provides automatic three-axis control, drawing data from dual attitude heading reference systems (AHRSs) and dual air data computers (ADCs). With the AHRS systems monitoring the autopilot system, the autopilot is considered to be fail passive, having no adverse effect on aircraft controllability if inadvertently disconnected. Automatic flight guidance system (AFGS) provides an integrated fail-passive three-axis autopilot with flight guidance operations, automatic pitch trim, yaw damper, and Mach trim. System consists of two identical FGC-3000 flight guidance computer modules (FGCs), three primary servos, a pitch trim servo, and FGP-3010 flight guidance panel. System controlled through FGP-3010 panel. Mach trim is engaged automatically and requires no pilot action.

AVIONICS: Rockwell Collins Pro Line 21 integrated avionics system. Integrated avionics processor system (IAPS) is central feature; located in nose compartment; serves as housing for a number of modules; also provides for lightning and HIRF (high intensity radiated fields) protection and data concentration/distribution. Modules in the IAPS are used to control flight guidance/autopilot, flight management, and maintenance diagnostic functions.

Comms: Dual Collins CNS VHF-4000 digital VHF; and in Hawker 950XP only, HF-9000 HF, including Coltech CSD-714 SELCAL decoder. Radio equipment controlled through keyboard operation on either of two CDU-6200s; single CTL-23C COM/NAV backup tuner on copilot's side console. dB Systems dual audio system with Model 700 audio amplifiers and six speakers. Artex C406-N SAR-type ELT. Universal Avionics CVR-120 (2 hour) cockpit voice recorder.

Radar: Collins TWR-850 turbulence detection weather radar. RTA-858 receiver/transmitter antenna with controls integrated with Pro Line 21 display system. Detects and displays precipitation-related turbulence up to a 50 n miles (93 km; 58 miles); returns can be displayed on any of the four main displays.

Flight: Dual digital Collins ADC-3000 air data computers with functions including provision of data for RVSM. Dual ARC-3000 attitude/heading computers; Collins NAV-4000/4500 digital navigation receivers with ADF display on PFD and MFD; dual Collins DME-4000 DME; dual Collins TDR-94D solid-state enhanced surveillance (including flight ID) diversity transponders with dual antennas. Collins ALT-4000 radio altimeter. Collins TCAS-4000 TCAS II; Honeywell Mark V EGPWS. Dual Collins FMS-6000 flight management systems, including two CDU-6200 control display units, two FMC-6000 flight management computers and two GPS-4000As simultaneously processing transmissions of up to twelve GPS satellites.

Instrumentation: Four 203 x 254 mm (8 x 10 in) active matrix liquid crystal displays, comprising two AFD-3010 PFDs and two AFD-3010E MFDs. Engine indicating system (EIS); single flight guidance panel (FGP); two control display units (CDUs) for FMS and communication/navigation radios. Display system controlled by two DCP-3020 display control panels. Meggitt Mark II secondary flight display system, with emergency batteries, incorporates independent air data unit and displays attitude, altitude, airspeed, heading, course deviation and glideslope deviation information. Electronic charts, enhanced map overlays, graphical weather (optional) and three-dimension FMS mapping (optional) can be displayed on both MFDs; system includes single FSU-5010 file server unit and dual CCP-3000 cursor control panels Engine indicating system (EIS) has four DCU-3001 data concentrator units (DCUs), two interfaced with each engine.

EQUIPMENT: Lighting includes rotating beacon on top of overfin; white tail light on the top rearmost section of the fuselage. Tail floodlights in lower surface of horizontal stabiliser illuminate vertical stabiliser.

DIMENSIONS, EXTERNAL:

Wing span: 900XP	16.56 m (54 ft 4 in)
Wing chord, mean	2.41 m (7 ft 11 in)
Wing aspect ratio: 900XP	7.7
750	7.1
Length overall	15.60 m (51 ft 2 in)
Height overall	5.51 m (18 ft 1 in)
Fuselage max diameter	1.93 m (6 ft 4 in)
Tailplane span	6.10 m (20 ft 0 in)
Wheel track (c/l of shock-absorbers)	2.79 m (9 ft 2 in)
Wheelbase	6.41 m (21 ft 0½ in)
Door (fwd, port): Height	1.32 m (4 ft 4 in)
Width	0.69 m (2 ft 3 in)
Height to sill	1.07 m (3 ft 6 in)
Emergency exit (overwing, stbd): Height	0.91 m (3 ft 0 in)
Width	0.51 m (1 ft 8 in)

DIMENSIONS, INTERNAL:

Cabin (excl flight deck): Length	6.50 m (21 ft 4 in)
Width: max	1.83 m (6 ft 0 in)
at floor	1.30 m (4 ft 3 in)
Max height	1.75 m (5 ft 9 in)
Floor area	5.11 m^2 (55.0 sq ft)
Volume	17.1 m^3 (604 cu ft)
Baggage compartments:	
forward; 900XP	0.95 m^3 (33.4 cu ft)
750	0.87 m^3 (30.6 cu ft)
rear: 900XP	0.46 m^3 (16.1 cu ft)
750	0.47 m^3 (16.7 cu ft)
pannier: 750	0.91 m^3 (32.0 cu ft)

AREAS:

Wings, gross: 900XP	35.40 m^2 (381.0 sq ft)
750	34.75 m^2 (374.0 sq ft)
Ailerons (total)	2.05 m^2 (22.10 sq ft)
Airbrakes: upper (total)	0.74 m^2 (8.00 sq ft)
lower (total)	0.46 m^2 (5.00 sq ft)
Trailing-edge flaps (total)	4.83 m^2 (52.00 sq ft)
Vertical fin	5.81 m^2 (62.50 sq ft)
Horizontal tail surfaces	9.29 m^2 (100.00 sq ft)

WEIGHTS AND LOADINGS:

Basic operating weight: 900XP	7,448 kg (16,420 lb)
750	7,348 kg (16,200 lb)
Max baggage weight: forward	113 kg (250 lb)
rear	66 kg (145 lb)
pannier (750)	227 kg (500 lb)
Max usable fuel weight: 900XP	4,536 kg (10,000 lb)
750	3,856 kg (8,500 lb)
Max T-O weight: 900XP	12,700 kg (28,000 lb)
750	12,247 kg (27,000 lb)
Max ramp weight: 900XP	12,755 kg (28,120 lb)
750	12,301 kg (27,120 lb)
Max landing weight (both)	10,591 kg (23,350 lb)

Max wing loading: 900XP	358.8 kg/m² (73.49 lb/sq ft)
750	352.4 kg/m² (72.19 lb/sq ft)
Max power loading: 900XP	306 kg/kN (3.00 lb/lb st)
750	295 kg/kN (2.90 lb/lb st)

PERFORMANCE:

Max operating speed (VMO) at FL290	310 kt (574 km/h; 357 mph) IAS
Max operating Mach No. (MMO)	0.80
High cruising speed at FL370 (both)	447 kt (828 km/h; 514 mph)
Max certified altitude	12,497 m (41,000 ft)
T-O balanced field length; 900XP	1,533 m (5,030 ft)
750	1,433 m (4,700 ft)
Landing run at MLW (both)	808 m (2,650 ft)
Range with four passengers, NBAA IFR reserves:	
900XP	2,850 n miles (5,278 km; 3,279 miles)
750	2,100 n miles (3,889 km; 2,416 miles)
g limits	+2.73/-1.0

HAWKER 4000

TYPE: Business jet.

PROGRAMME: Design started in 1993; initially thought to have had preliminary designation PD1000Y, but now known to have been PD376; briefly identified as Horizon 1000; announced at NBAA Convention, Orlando, Florida, 19 November 1996; full-size cabin mockup exhibited at NBAA Convention, Dallas, Texas, September 1997. First production wing delivered to Wichita from Fuji Heavy Industries in December 1998; first three fuselage sections mated in October 2000 and mated to wing on 16 January 2001. Prototype (c/n RC-1/N4000R) rolled out 17 April 2001; first flight 11 August 2001; second aircraft (c/n RC-2/N802HH) first flew 10 May 2002; public debut (c/n RC-3/N803HH) at NBAA Convention, Orlando, Florida, 10 September 2002; three aircraft had completed 1,400 hours of test flying by August 2004, fourth aircraft (c/n RC-4/N804HH) first flew 28 April 2004, and following certification undertook a six-month operational evaluation to validate and 'de-bug' systems. Provisional FAA certification granted 23 December 2004, followed by handover of first customer aircraft (RC-5/N805HH) to Jack DeBoer. Deletion of name announced on eve of NBAA Convention at Orlando, Florida, 8 November 2005, aircraft becoming Hawker 4000. FAA certification achieved 21 November 2006.

CUSTOMERS: More than 30 ordered by August 2004, spilt approximately equally between US and International customers, including 27 for Raytheon Travel Air. By November 2006, only five aircraft (including prototypes) had gained individual airworthiness certificates.

COSTS: USD18.2 million (2004).

DESIGN FEATURES: All-new design sharing only slight family resemblance with the BAe 125-derived Hawker 800 and (discontinued) 1000. An 'advisory council' of business jet operators assisted RAC in defining the aircraft, a major requirement being a flat-floor stand-up cabin. Conventional swept-wing, T-tail design with small 'overfin' housing antenna for optional satellite communications system. Wing of supercritical, aft-loaded aerofoil section designed using computational fluid dynamics (CFD) techniques; CFD also used to design area-ruled aft fuselage to minimise engine nacelle drag and to reprofile Hawker 1000-based nose section.

Wing sweepback 28° 22' at 25 per cent chord; dihedral 4°; tailplane sweepback 33° 30' at 25 per cent chord; fin sweepback 45° at 25 per cent chord.

FLYING CONTROLS: Supercritical section ailerons and elevators, manually operated via pushrods and cables. Pitch trim via electrically actuated, variable incidence tailplane; geared trim tabs on ailerons, fly-by-wire hydraulically powered rudder with boost for asymmetric thrust. Electrically signalled, hydraulically powered, three-segment spoilers on upper surface of each wing augment aileron roll control; outboard and middle panels provide roll and speed brake functions, with maximum deflection 35°; lift dump function provided by all spoilers at 60° deflection. Four-segment, electrically controlled and powered double-slotted flaps, deflections 0, 12, 20 and 35°. Dual controls standard.

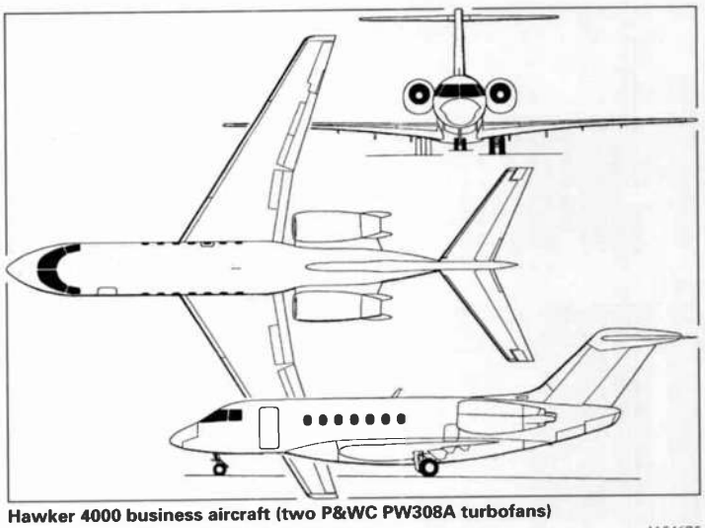
STRUCTURE: Fuselage of graphite/epoxy laminate and honeycomb core sandwich; 25 mm (1 in) thick shell is formed by Cincinnati Milacron Viper automatic fibre-placement machines over aluminium mandrel in three sections: nose, centrebody and tailcone, including dorsal fairing and engine pylons mated using aluminium splice plates in a Nova-Tech Engineering Inc fuselage automated splice tool which automatically seals the joints and installs some 1,800 hi-shear fasteners. Wing, designed using CFD, has a supercritical aerofoil and is manufactured by Fuji Heavy Industries at Utsunomiya, Japan, as a complete unit including all systems, integral fuel tanks and leading-edge bleed-air anti-icing, and shipped to Wichita for final assembly. Horizontal stabiliser is of light alloy, two-spar construction with graphite/epoxy composites sandwich skins; vertical stabiliser has three alloy spars and graphite/epoxy composites sandwich skins.

Risk-sharing partners include: Eaton Corporation (hydraulic system); Fokker Elmo BV (wiring harness); Fuji Heavy Industries (wing); Honeywell (avionics integration); Meggitt Avionics (fire and overheat protection and standby instrumentation); Messier-Dowty (landing gear); Moog (flight controls and flap actuators); Pratt & Whitney Canada (propulsion system); Smiths Industries (fuel system); and Hamilton Sundstrand Corporation (utility systems management integration).

LANDING GEAR: Retractable tricycle type by Messier-Dowty; landing gear electrically signalled and hydraulically actuated, with free-fall emergency extension system; twin wheels on each unit. Trailing-link suspension on main units, which retract inwards; nosewheel forwards. Steer-by-wire nosewheel, maximum deflection 70°, with disconnect for towing. Mainwheel size 26x6.6 (14 ply), nosewheel size 18x4.4 (10 ply). Hydraulic carbon disc brakes with digital brake-by-wire and electric anti-skid systems.

POWER PLANT: Two pod-mounted Pratt & Whitney Canada PW308A turbofans with FADEC, each flat-rated at 30.7 kN (6,900 lb st) at ISA + 20°C. Nordam target-type thrust reversers. Fuel in two integral wing tanks, maximum usable capacity 8,251 litres (2,180 US gallons; 1,815 Imp gallons). Single point fuelling/defuelling; gravity filler ports in top of each wing.

ACCOMMODATION: Crew of two, plus eight passengers in double 'club four' arrangement on reclining and side tracking seats, each pair having stowable writing table. Observer's seat on flight deck optional. Two closets and a galley immediately aft of flight deck; lavatory and flight accessible (via secondary pressurised bulkhead up to FL410) baggage compartment at rear of cabin with external door on port side aft of wing. Accommodation is air conditioned and pressurised (FL60 equivalent altitude) and includes Airshow entertainment system. Door on port side aft of flight deck; single plug-type emergency exit on starboard side over wing; Four-panel windscreen; seven cabin windows per side.



Hawker 4000 business aircraft (two P&WC PW308A turbofans) *(Paul Jackson)* 1154675

First Hawker 4000 delivered to a customer, N805HH *(Paul Jackson)* 1133717

SYSTEMS: Digitally controlled pressurisation system, maximum pressure differential 0.68 bar (9.80 lb/sq in), maintains a sea level cabin environment to 7,693 m (25,240 ft) and a 1,830 m (6,000 ft) cabin environment to 13,715 m (45,000 ft). Engine bleed air anti-icing for wing leading-edges and engine inlet lips; electromagnetic expulsive de-icing of tailplane, none on fin leading-edge; electrically heated pitot and static masts, AoA and TAT probes; windscreen anti-icing and demisting and cabin window demisting via electrically conductive transparent film embedded between panels. Automatically controlled electrical power generation and distribution system (EPGDS) comprises two high-speed, variable frequency, engine-driven AC generators, one APU-driven AC generator and two 43 Ah lead acid batteries. AC/DC external power receptacles standard. Two independent hydraulic systems, operating pressure 206.85 bar (3,000 lb/sq in), for normal and emergency landing gear operation, braking, thrust reversers, spoilers, rudder, nosewheel steering and emergency electrical generation. Two-bottle oxygen system, total capacity 4,080 litres (144 cu ft), with quick-donning diluter-demand masks for crew and auto-deploy constant flow masks in overhead boxes for passengers. Tailcone-mounted Honeywell AE-36-150(HH) APU approved for in-flight operation from sea level to 10,670 m (35,000 ft) and for main engine starting from sea level to 7,925 m (26,000 ft).

AVIONICS: Honeywell Primus Epic lightweight modular avionics system based on Virtual Backplane Network architecture, which combines the cabinet-based modular capabilities of Honeywell's 777 AIMS system with the aircraft-wide network capabilities of its Primus 2000 system and built-in maintenance recording with portable access terminal. The system has 'point and click' capability via two Cursor Control Devices (CCDs) which include touchpad, numeric control and on-screen 'soft keys'. Voice Command will be a future option for some Epic functions.

The Horizon's avionics system provides functions which Raytheon states have never previously been offered in a super-mid-size business jet, including digital circuit breaker control, automatic refuelling control, and full-authority autothrottle. All avionics boxes are installed in a cabinet behind the co-pilot's seat, in an environmentally controlled, pressurised area with easy access for maintenance.

Comms: Dual VHF comms; single Collins HF-9000 HF with Selcal; dual Mode S Diversity transponders; dual audiophone/interphone/PA systems; airborne telephone.

Radar: Primus 880 colour weather radar.

Flight: Primus Epic AFCS and FMS with integrated performance computer; dual VHF nav VOR/LOC/GS/Markers; dual DME; dual IRU; dual GPS; EGPWS; TCAS II; solid-state FDR and CVR.

Instrumentation: Five 203 × 254 mm (8 × 10 in) colour, active, flat panel LCD screens comprising two PFDs, two MFDs and one EICAS, plus two smaller multifunction control and display units (MCDUs).

DIMENSIONS, EXTERNAL:

Wing span	18.82 m (61 ft 9 in)
Mean aerodynamic chord	2.92 m (9 ft 7 in)
Wing aspect ratio	7.2
Length overall	21.08 m (69 ft 2 in)
Height overall	5.97 m (19 ft 7 in)
Tailplane span	7.90 m (25 ft 11 in)
Wheel track	2.79 m (9 ft 2 in)
Wheelbase	8.53 m (28 ft 0 in)
Door: Height	1.58 m (5 ft 6 in)
Width	0.76 m (2 ft 6 in)

DIMENSIONS, INTERNAL:

Cabin (excl flight deck):	
Length: excl baggage compartment	7.62 m (25 ft 0 in)
incl baggage compartment	8.99 m (29 ft 6 in)
Width: max	1.97 m (6 ft 5½ in)
at floor	1.27 m (4 ft 2 in)
Max height	1.83 m (6 ft 0 in)
Volume (excl flight deck)	21.6 m³ (762 cu ft)
Baggage volume: forward cabin	0.55 m³ (19.5 cu ft)
aft cabin	2.69 m³ (95 cu ft)

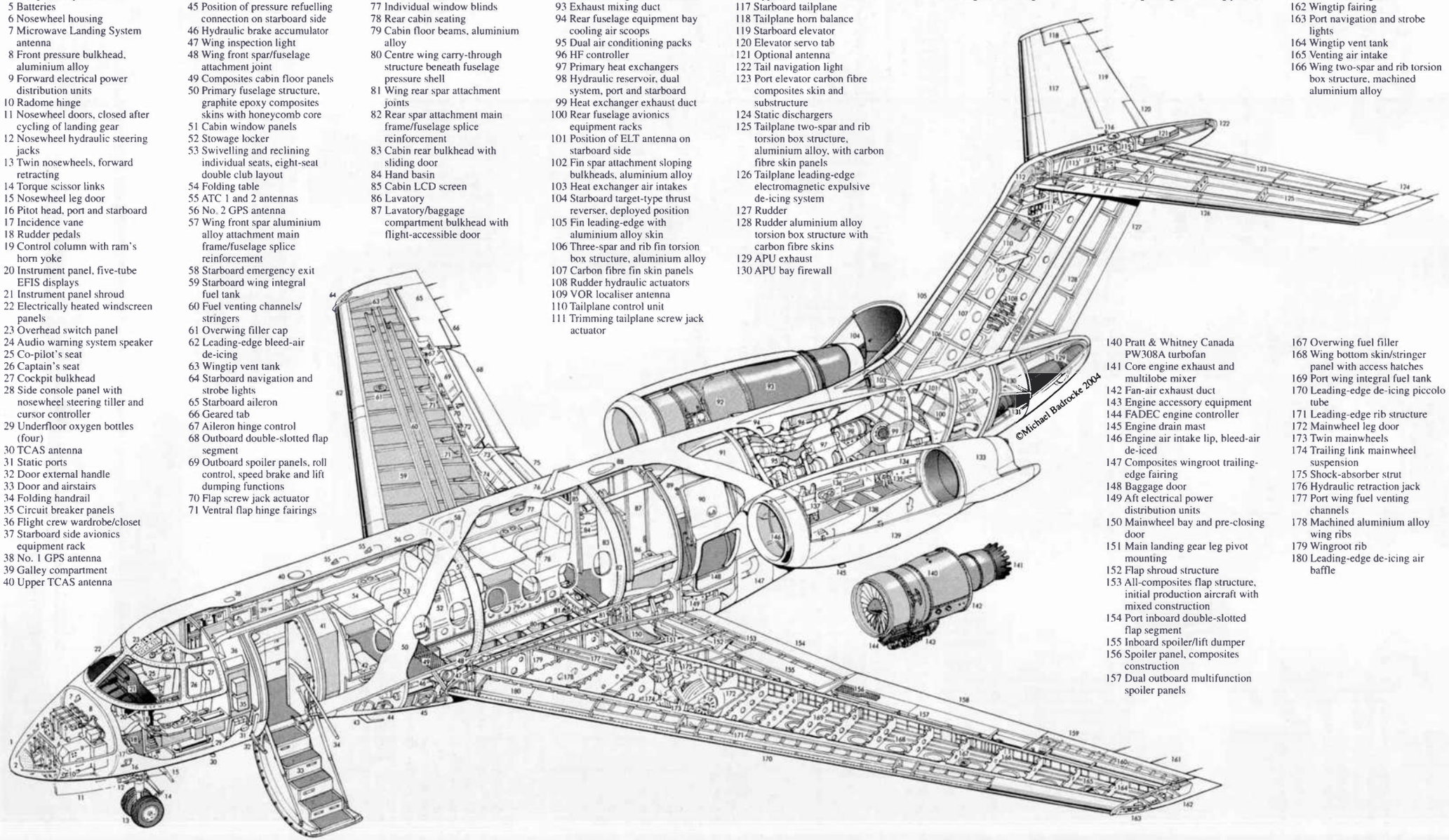
AREAS:

Wings, gross	49.3 m² (531.0 sq ft)
Ailerons (total)	1.35 m² (14.52 sq ft)
Fin, excl dorsal fairing	10.26 m² (110.40 sq ft)
Rudder	2.40 m² (25.87 sq ft)
Horizontal tail surfaces (total)	13.01 m² (140.00 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	9,596 kg (21,155 lb)

1 Forward-hinged radome with lightning protection strips
2 Weather radar scanner
3 Scanner mounting bulkhead, machined aluminium alloy
4 ILS glidescope antenna
5 Batteries
6 Nosewheel housing
7 Microwave Landing System antenna
8 Front pressure bulkhead, aluminium alloy
9 Forward electrical power distribution units
10 Radome hinge
11 Nosewheel doors, closed after cycling of landing gear
12 Nosewheel hydraulic steering jacks
13 Twin nosewheels, forward retracting
14 Torque scissor links
15 Nosewheel leg door
16 Pitot head, port and starboard
17 Incidence vane
18 Rudder pedals
19 Control column with ram's horn yoke
20 Instrument panel, five-tube EFIS displays
21 Instrument panel shroud
22 Electrically heated windscreen panels
23 Overhead switch panel
24 Audio warning system speaker
25 Co-pilot's seat
26 Captain's seat
27 Cockpit bulkhead
28 Side console panel with nosewheel steering tiller and cursor controller
29 Underfloor oxygen bottles (four)
30 TCAS antenna
31 Static ports
32 Door external handle
33 Door and airstairs
34 Folding handrail
35 Circuit breaker panels
36 Flight crew wardrobe/closet
37 Starboard side avionics equipment rack
38 No. 1 GPS antenna
39 Galley compartment
40 Upper TCAS antenna
41 Passenger wardrobe/closet
42 Cabin audio/video individual control unit
43 VHF 2 antenna
44 Landing/taxying lights, two per side
45 Position of pressure refuelling connection on starboard side
46 Hydraulic brake accumulator
47 Wing inspection light
48 Wing front spar/fuselage attachment joint
49 Composites cabin floor panels
50 Primary fuselage structure, graphite epoxy composites skins with honeycomb core
51 Cabin window panels
52 Stowage locker
53 Swivelling and reclining individual seats, eight-seat double club layout
54 Folding table
55 ATC 1 and 2 antennas
56 No. 2 GPS antenna
57 Wing front spar aluminium alloy attachment main frame/fuselage splice reinforcement
58 Starboard emergency exit
59 Starboard wing integral fuel tank
60 Fuel venting channels/stringers
61 Overwing filler cap
62 Leading-edge bleed-air de-icing
63 Wingtip vent tank
64 Starboard navigation and strobe lights
65 Starboard aileron
66 Geared tab
67 Aileron hinge control
68 Outboard double-slotted flap segment
69 Outboard spoiler panels, roll control, speed brake and lift dumping functions
70 Flap screw jack actuator
71 Ventral flap hinge fairings
72 Spoiler hydraulic actuators
73 Inboard spoiler/lift dumper
74 Flap drive torque shaft
75 Inboard double-slotted flap segment
76 VHF 1 antenna
77 Individual window blinds
78 Rear cabin seating
79 Cabin floor beams, aluminium alloy
80 Centre wing carry-through structure beneath fuselage pressure shell
81 Wing rear spar attachment joints
82 Rear spar attachment main frame/fuselage splice reinforcement
83 Cabin rear bulkhead with sliding door
84 Hand basin
85 Cabin LCD screen
86 Lavatory
87 Lavatory/baggage compartment bulkhead with flight-accessible door
88 ADF antenna
89 Baggage compartment
90 Up-and-over baggage door
91 Rear pressure bulkhead, graphite/epoxy composites
92 Starboard engine installation
93 Exhaust mixing duct
94 Rear fuselage equipment bay cooling air scoops
95 Dual air conditioning packs
96 HF controller
97 Primary heat exchangers
98 Hydraulic reservoir, dual system, port and starboard
99 Heat exchanger exhaust duct
100 Rear fuselage avionics equipment racks
101 Position of ELT antenna on starboard side
102 Fin spar attachment sloping bulkheads, aluminium alloy
103 Heat exchanger air intakes
104 Starboard target-type thrust reverser, deployed position
105 Fin leading-edge with aluminium alloy skin
106 Three-spar and rib fin torsion box structure, aluminium alloy
107 Carbon fibre fin skin panels
108 Rudder hydraulic actuators
109 VOR localiser antenna
110 Tailplane control unit
111 Trimming tailplane screw jack actuator
112 Scissor linkage
113 Trimming tailplane sealing plate
114 Tailplane pivot mounting
115 Elevator hinge control linkage
116 Upper anti-collision beacon
117 Starboard tailplane
118 Tailplane horn balance
119 Starboard elevator
120 Elevator servo tab
121 Optional antenna
122 Tail navigation light
123 Port elevator carbon fibre composites skin and substructure
124 Static dischargers
125 Tailplane two-spar and rib torsion box structure, aluminium alloy, with carbon fibre skin panels
126 Tailplane leading-edge electromagnetic expulsive de-icing system
127 Rudder
128 Rudder aluminium alloy torsion box structure with carbon fibre skins
129 APU exhaust
130 APU bay firewall
131 Honeywell 36-150(HH) APU
132 APU starboard side intake duct
133 Port engine thrust-reverser, closed
134 Engine pylon
135 Rear engine mounting
136 Bleed-air connections and pylon-mounted pre-cooler
137 Main engine mounting yoke
138 Aft fuselage hinged ventral access hatch with integral steps
139 Hinged engine cowling panels
140 Pratt & Whitney Canada PW308A turbofan
141 Core engine exhaust and multilobe mixer
142 Fan-air exhaust duct
143 Engine accessory equipment
144 FADEC engine controller
145 Engine drain mast
146 Engine air intake lip, bleed-air de-iced
147 Composites wingroot trailing-edge fairing
148 Baggage door
149 Aft electrical power distribution units
150 Mainwheel bay and pre-closing door
151 Main landing gear leg pivot mounting
152 Flap shroud structure
153 All-composites flap structure, initial production aircraft with mixed construction
154 Port inboard double-slotted flap segment
155 Inboard spoiler/lift dumper
156 Spoiler panel, composites construction
157 Dual outboard multifunction spoiler panels
158 Port outboard double-slotted flap segment
159 Aileron servo tab
160 Port aileron all-composites construction
161 Static dischargers
162 Wingtip fairing
163 Port navigation and strobe lights
164 Wingtip vent tank
165 Venting air intake
166 Wing two-spar and rib torsion box structure, machined aluminium alloy
167 Overwing fuel filler
168 Wing bottom skin/stringer panel with access hatches
169 Port wing integral fuel tank
170 Leading-edge de-icing piccolo tube
171 Leading-edge rib structure
172 Mainwheel leg door
173 Twin mainwheels
174 Trailing link mainwheel suspension
175 Shock-absorber strut
176 Hydraulic retraction jack
177 Port wing fuel venting channels
178 Machined aluminium alloy wing ribs
179 Wingroot rib
180 Leading-edge de-icing air baffle



Basic operating weight (incl crew) ..... 10,194 kg (22,475 lb)
Max fuel weight ..... 6,622 kg (14,600 lb)
Payload with max fuel ..... 837 kg (1,845 lb)
Fuel with max payload ..... 5,761 kg (12,700 lb)
Max T-O weight ..... 17,010 kg (37,500 lb)
Max ramp weight ..... 17,100 kg (37,700 lb)
Max landing weight ..... 15,195 kg (33,500 lb)
Max zero-fuel weight ..... 11,340 kg (25,000 lb)
Max wing loading ..... 344.8 kg/m^2 (70.62 lb/sq ft)
Max power loading ..... 277 kg/kN (2.72 lb/lb st)
PERFORMANCE (provisional):
Max operating Mach No. 0.84
High cruising speed at FL410 ..... M0.82/470 kt (870 km/h; 541 mph)
Intermediate cruising speed at FL410 ..... M0.78/447 kt (828 km/h; 514 mph)
Long-range cruising speed at FL450 ..... M0.75/430 kt (796 km/h; 495 mph)
Approach speed ..... 132 kt (244 km/h; 152 mph)
Time to climb to FL370 ..... 13 min
Max rate of climb at S/L, OEI ..... 176 m (576 ft)/min
Max certified ceiling ..... 13,716 m (45,000 ft)
Service ceiling ..... 13,076 m (42,900 ft)
Service ceiling, OEI ..... 8,534 m (28,000 ft)
T-O field length ..... 1,375 m (4,510 ft)
Landing run ..... 730 m (2,395 ft)
Range, two crew, 544 kg; 1,200 lb payload, IFR NBAA reserves:
at M0.82 ..... 3,011 n miles (5,576 km; 3,465 miles)
at M0.75 ..... 3,207 n miles (5,939 km; 3,690 miles)

HELIO

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VICE PRESIDENT, BUSINESS DEVELOPMENT: Samuel Haviland
VICE PRESIDENT, ENGINEERING: David R Ellis

Messrs Dwight and Maytag formed Helio Enterprises Inc in 1992 in order to acquire assets of the previous Helio company, including FAA Type Certificates for all Helio aircraft, significantly the Courier and Stallion. Both have performed a substantial amount of work towards re-introducing the Helio aircraft, including market studies, engineering work, manufacturing feasibility studies and strategy.

Helio completed its first round of funding in August 2004. The Helio Aircraft team is working with its fleet of Helio Courier and Helio Stallion aircraft to develop prototypes which will incorporate all-new instrument panels and avionics, new quality interiors, new rugged tricycle landing gear and a new power plant for the Courier. In October 2004, manufacturing business, Helio Aircraft (formerly Alliance Aircraft Group) completed the purchase of a Helio Courier H-700 and a Helio Stallion HST-550A (N550HZ), both to be used as prototypes for new productions.

The Stallion is being used for installation of an all-new interior, new 'glass' instrument panel and, eventually, new tricycle landing gear, while the H-700 Courier will serve as a platform for improvements including a new firewall-forward engine package and reversion to the H-295 style of conventional landing gear. Several 224 to 298 kW (300 to 400 hp) geared engines of both Avgas and Diesel types are being evaluated. Interior and landing gear improvements of the new Stallion will also be introduced. Helio also owns a Courier H-800 (N400HE) that is currently flying with a 294 kW (394 hp) VOKBM M-14PF radial which is being tested for potential use in Helios that are sold to Eastern Europe, CIS and China where this engine is readily accepted.

Helio Aircraft acquired three Type Certificates from Helio Enterprises on 13 October 2005, comprising 1A8 (issued 5 August 1953) for Model 391/700/800 Courier, 295/395 Super Courier, 250 Courier II; A2EA (issued 11 June 1963) for Helio 500 Twin; and A4EA (issued 26 August 1965) for HST-550/550A Stallion (military AU-24A). Previous (and attempted) production runs of Helio aircraft were described in *Jane's All the World's Aircraft* up to and including the 1987-88 edition.

Helio Stallion from previous production *(Jason Paur, Helio)* 1159301

Helio H-800 with M-14 radial engine as prototype 'H-295C' 1159302

HELOWERKS

HELOWERKS

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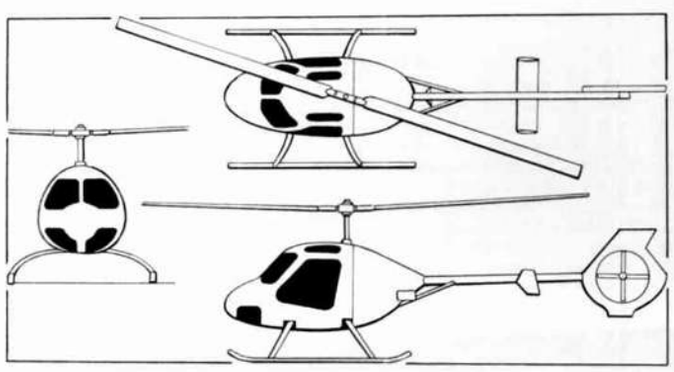
HeloWerks was formed to develop and market the HX-1 Wasp light helicopter. Also offers JFS-100 turbine as alternative power plant for ASII Ultrasport 496 light helicopter.

HELOWERKS HX-1 WASP

TYPE: Two-seat ultralight helicopter kitbuilt.
PROGRAMME: Prototype (N636WP) registered 1 February 2006; received FAA flight approval in Experimental category on 1 March 2006 and first flew on unspecified date around that time. Exhibited at Sun 'n' Fun, Lakeland, Florida, 4 to 10 April 2006. Production then scheduled to begin in 2007 as kitbuilt, with flyaway version to follow.
COSTS: Kit USD70,000 including engine and tax (2006).
DESIGN FEATURES: Pod-and-boom configuration employing 'infinite life' main and tail rotor systems from ASII Ultrasport 496 light helicopter. No drive belts. Cabin size and payload comparable to Robinson R22. Two-blade, teetering-type main rotor with conventional swashplate. Main and 90° transmission gearboxes have oil pumps and coolers; ratios 4.18:1 and 1:1 respectively. Tail rotor speed 6,000 rpm.
Quoted kit build time 350 hours.
FLYING CONTROLS: Conventional and manual.
STRUCTURE: Monocoque pod of glass fibre and Nomex honeycomb with moulded doors, windows and hatches. Metal tube tailboom with composites tailplane, fins and rotor surround 'ring tail'. Main rotors of carbon fibre D spar with undirectional glass fibre and honeycomb filling aft of spar, plus carbon fibre trailing-edge; tail rotor similar.
LANDING GEAR: Skid type; fixed. Foam core carbon fibre cantilever spring legs with tubular metal skid.



HeloWerks HX-1 Wasp *(James Goulding)* 1159816

POWER PLANT: One Garrett JFS-100-13A turboshaft rated at 67.1 kW (90 shp) in prototype, with increase scheduled to 93.2 kW (125 shp) for production version. Fuel in two tanks attached to rear of cabin bulkhead, combined capacity 76 litres (20.0 US gallons; 16.7 Imp gallons).
DIMENSIONS, EXTERNAL:
Main rotor diameter ..... 7.01 m (23 ft 0 in)
Tail rotor diameter ..... 0.71 m (2 ft 4 in)
Length of fuselage, excl ring tail ..... 5.79 m (19 ft 0 in)
Height overall ..... 2.51 m (8 ft 3 in)
Skid track ..... 2.13 m (7 ft 0 in)
DIMENSIONS, INTERNAL:
Cabin max width ..... 1.24 m (4 ft 1 in)
WEIGHTS AND LOADINGS:
Weight empty ..... 318 kg (700 lb)
Max T-O weight ..... 544 kg (1,200 lb)

HeloWerks HX-1 Wasp prototype flying with engine cowling removed ***(Paul Jackson)*** 1037979

PERFORMANCE (provisional):
Max level speed ..... 98 kt (182 km/h; 113 mph)
Normal-cruising speed ..... 70 kt (129 km/h; 80 mph)
Hovering ceiling: IGE ..... 2,440 m (8,000 ft)
OGE ..... 1,220 m (4,000 ft)
Service ceiling ..... 3,050 m (10,000 ft)
Range with 10% reserves ..... 110 n miles (204 km; 127 miles)

HENSLEY

HENSLEY AIRCRAFT INC

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e-mail: info@hensleyaircraft.com
Web: www.hensleyaircraft.com
CEO: Robert Hensley
CORPORATE ADMINISTRATOR: Susan Kinkle

The H-1 Wolf is Hensley's initial offering with final funding for construction and testing of the prototype put in place during 2003. The company's manufacturing plant is under construction at Grand Forks, North Dakota, and is scheduled to be completed by end 2005. In July 2004, the company had four employees and was planning a further increase by early 2005.

On 22 June 2005 a separate company, Hensley Aerospace, was formed to develop and market the H-2, a certified, twin-engine amphibian.

HENSLEY H-1 WOLF

TYPE: Four-seat kitbuilt twin.

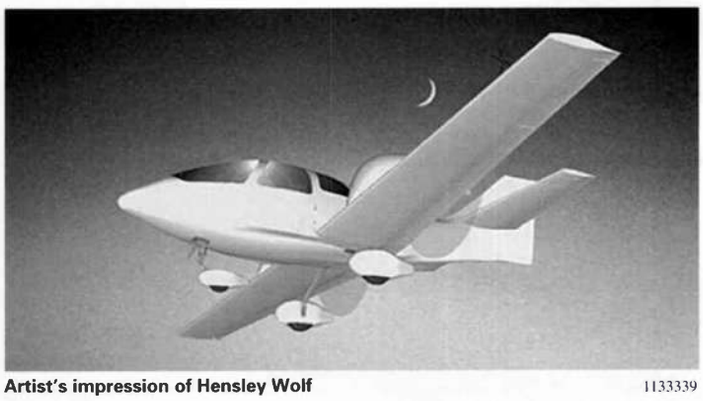
PROGRAMME: Design began in 1991, initially as part-time venture. Construction of prototype started in 1998; exhibited, unflown, at AirVenture, Oshkosh, July 2001; maiden flight then scheduled for December 2001 and kit deliveries for second quarter of 2002; this has slipped and first flight had not taken place by October 2003. In June 2004 the first Centurion power plants were delivered and a first flight before the end of 2004 was expected, although not, apparently, achieved. Registrations N447HC, N447HM and N447HN were reserved for first three aircraft in 2004, but allowed to lapse. No further progress reports by late 2005, except for change to Eggenfelner conversion of Subaru engine.

CURRENT VERSIONS: **Wolf:** Baseline version.

Wolf GT: Possible future higher-powered, long-range version, with two cabin doors and increased MTOW.

CUSTOMERS: First aircraft sold October 2001. No further information received.

COSTS: Wolf USD99,900 including engines (2005).



Artist's impression of Hensley Wolf 1133339

DESIGN FEATURES: Intended as manoeuvrable twin, able to operate into remote, short airstrips; affordable; easy to build and maintain.

Low-drag fuselage; constant-chord, low-mounted wings, with winglets; pusher engines located close inboard and above wings.

Wing section VH-1 Twin Turbo, purpose developed by Jeff Viken for high lift, low drag laminar flow.

FLYING CONTROLS: Conventional and manual. Fowler flaps immediately outboard of engines. Horn-balanced rudder and elevator.

STRUCTURE: Composites throughout.

LANDING GEAR: Tricycle type; fixed. Mainwheels, 6.00-6, on aluminium sprung legs; trailing-link nosewheel, 11×4.00–5, with rubber-in-compression suspension. Hydraulic brakes on mainwheels. Speed fairings on all wheels.

Wolf GT will have retractable landing gear.

POWER PLANT: Initially, prototype was due to be powered by two Quantum Powermills engines (based on Honda VTEC) with pusher propellers and dual fuel system with baseline aircraft having 101 kW (135 hp) Q-135s; this changed in second quarter 2003 to two FADEC-equipped 101 kW (135 hp) Thielert Centurion turbocharged Diesel engines driving three-blade constant-speed MT propellers, and in 2005 to two 123 kW (165 hp) Eggenfellner four-cylinder liquid-cooled supercharged engines with same propellers. Initial fuel capacity 189 litres (50.0 US gallons; 41.6 Imp gallons); later changed to 379 litres (100 US gallons; 83.3 Imp gallons), optional 303 litre (80.0 US gallon; 66.6 Imp gallon) tank can be added.

ACCOMMODATION: Four persons in two pairs of seats. Door, port side. Dual sidestick controls. Two doors on GT version.

SYSTEMS: Dual electrical system.

AVIONICS: Chelton Electronics EFIS system coupled with Garmin radios and TruTrak autopilot under consideration.

DIMENSIONS, EXTERNAL:
Wing span ..... 10.34 m (33 ft 11¼ in)
Wing chord: at root ..... 1.34 m (4 ft 4¾ in)
at tip ..... 0.82 m (2 ft 8¼ in)
Wing aspect ratio 9.6
Length overall ..... 6.78 m (22 ft 3 in)
Height overall ..... 2.68 m (8 ft 9½ in)

DIMENSIONS, INTERNAL:
Cabin max width ..... 1.22 m (4 ft 0 in)

AREAS:
Wings, gross ..... 11.15 m² (120.0 sq ft)
Horizontal tail surfaces (total) ..... 2.87 m² (30.86 sq ft)
Vertical tail surfaces (total) ..... 2.04 m² (21.98 sq ft)

WEIGHTS AND LOADINGS:
Weight empty ..... 953 kg (2,100 lb)
Max T-O weight: standard fuel ..... 1,360 kg (3,000 lb)
optional fuel ..... 1,587 kg (3,500 lb)
Wing loading: standard fuel ..... 122.1 kg/m² (25.00 lb/sq ft)
optional fuel ..... 142.4 kg/m² (29.17 lb/sq ft)
Power loading: standard fuel ..... 5.53 kg/kW (9.09 lb/hp)
optional fuel ..... 6.46 kg/kW (10.61 lb/hp)

PERFORMANCE (estimated):
Normal cruising speed at FL80 at 75% power ..... 173 kt (321 km/h; 200 mph)
Stalling speed ..... 54 kt (100 km/h; 62 mph)
Max rate of climb at S/L ..... 579 m (1,900 ft)/min
single engine ..... 152 m (500 ft)/min
T-O run ..... 239 m (785 ft)
Landing run ..... 206 m (675 ft)
Range: standard fuel ..... 1,303 n miles (2,414 km; 1,500 miles)
optional fuel ..... 2,259 n miles (4,184 km; 2,600 miles)
g limits ..... +6.0/–3.0

HENSLEY H-2

TYPE: Twin-engine amphibian biplane.

PROGRAMME: Announced 2005; final design details not released by end 2005. FAA certification will be sought. Patents were filed in 2004 for certain design criteria. A single-engined turboprop cargo version is also envisaged. However, no further information received by October 2006.

COST: Estimated project cost USD50 million.

DESIGN FEATURES: Available in turbofan, turboprop and Diesel variants. Design will eliminate a symmetrical thrust and offer increased sea-state stability. Extensive use of carbon graphite.

POWER PLANT: Choice of engines will include Pratt & Whitney PW600 turbofan; 231 kW (310 hp) Thielert Centurion Diesel; and 503 kW (675 shp) P&WC PT-6 turboprop.

ACCOMMODATION: Seating for 14 is envisaged within a pressurised cabin.

All data provisional.

DIMENSIONS, EXTERNAL:

Wing span	12.80 m (42 ft 0 in)

PERFORMANCE:

Max cruising speed: propeller versions	175 kt (324 km/h; 201 mph)
turbofan	300 kt (555 km/h; 345 mph)
Stalling speed, flaps down	61 kt (113 km/h; 71 mph)
Range with max fuel: turbo diesel	2,259 n miles (4,184 km; 2,600 miles)
turbofan and turboprop	1,216 n miles (2,253 km; 1,400 miles)

HIGHER CLASS AVIATION

HIGHER CLASS AVIATION

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Web: www.flyhornet.com
PRESIDENT: Robert Gaither

Higher Class Aviation purchased the US Light Aircraft Corporation in 2005 and took over production of the Hornet kitbuilt.

HIGHER CLASS HORNET AND SUPER HORNET

TYPE: Tandem-seat lightplane/kitbuilt.

PROGRAMME: Design began in 1991 and construction of Hornet prototype in 1992; first flight June 1993. Winner of 15 awards at Copperstate, Oshkosh and Sun 'n' Fun between 1993 and 1999. Qualifies under FAR Pt 21.191 as 51 per cent experimental kit. Super Hornet added to range in 2005.

CURRENT VERSIONS: **Hornet:** Original kitbuilt version; no longer marketed.

Super Hornet: Introduced in 2005; intended to be LSA compliant but not achieved by end 2006. Now sole version marketed.

Data apply to this version, unless otherwise specified.

CUSTOMERS: Total of 58 of both versions flying by November 2005.

COSTS: Super Hornet kit USD22,000, including engine; USD49,995 ready to fly (2006).

DESIGN FEATURES: Kit has 400 parts, including 7,500 factory-installed rivets. Quoted build time 300 hours.

FLYING CONTROLS: Conventional and manual. Electrically operated flaps with maximum deflection of 30°. Horizontal stabiliser trimmed electrically. Mass-balanced elevator.

STRUCTURE: Fabric-covered fuselage of 3 cm (1.25 in) 6063-T8 aluminium tube with tapered-base tubular longitudinal structure. Fabric-covered dual-spar wings with single bracing struts.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring cantilever mainwheel legs with 15 cm (6 in) Goodyear Airspring pneumatic suspension on mainwheels and 7.5 cm (3 in) Airspring on nosewheel; hydraulic brakes on mainwheels with aluminium Hegar wheels and 15x6-6 Cheng Shin tyres; nose tyre 13x5-6.

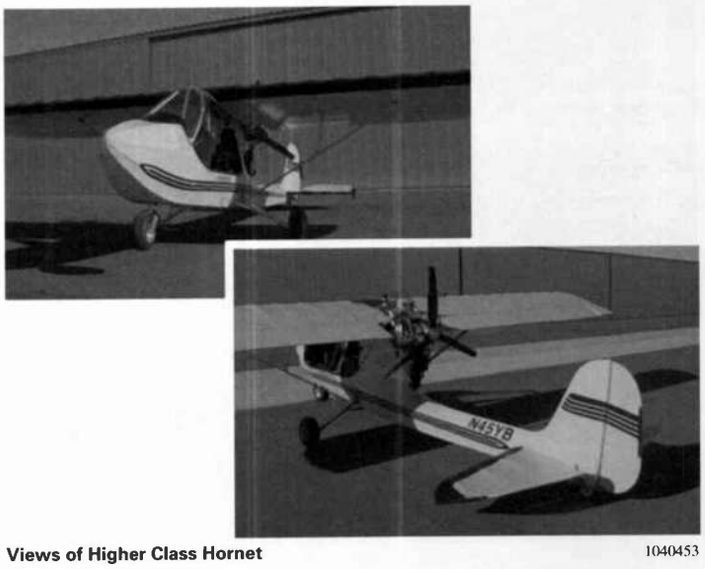
POWER PLANT: *Hornet:* One 41.0 kW (55 hp) Hirth 2703 engine with electric start is standard, driving Tennessee two-blade, wooden pusher propeller of diameter up to 1.52 m (5 ft 0 in); 48.5 kW (65 hp) Hirth 2706 optional.

Super Hornet: One 73.5 kW (98.6 hp) Rotax 912 ULS driving three-blade IVO propeller. Fuel capacity 68 litres (18.0 US gallons; 15.0 Imp gallons) in two tanks between spars in both models; oil capacity 3 litres (0.8 Imp gallons; 0.67 Imp gallons).

EQUIPMENT: Optional BRS VLS 1050 ballistic parachute.

DIMENSIONS, EXTERNAL:

Wing span	8.38 m (27 ft 6 in)
Length overall	6.10 m (20 ft 0 in)
Height overall	1.83 m (6 ft 0 in)



Views of Higher Class Hornet 1040453

AREAS:

Wings, gross	12.82 m² (138.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: Hornet	215 kg (475 lb)
Super Hornet	286 kg (630 lb)
Max T-O weight: Hornet	454 kg (1,000 lb)
Super Hornet	598 kg (1,320 lb)

PERFORMANCE (Hornet: 41.0 kW; 55 hp engine; Super Hornet: 73.5 kW; 98.6 hp engine):

Never-exceed speed (VNE): Hornet	108 kt (201 km/h; 125 mph)
Max level speed: Hornet	104 kt (193 km/h; 120 mph)
Super Hornet	120 kt (222 km/h; 138 mph)
Normal cruising speed at 75% power: Hornet	61 kt (113 km/h; 70 mph)
Super Hornet	95 kt (176 km/h; 109 mph)
Stalling speed, flaps down: Hornet	35 kt (65 km/h; 40 mph)
Super Hornet	34 kt (63 km/h; 40 mph)
Max rate of climb at S/L: Hornet	305 m (1,000 ft)/min
T-O run: Hornet	114 m (375 ft)
Super Hornet	92 m (300 ft)
Landing run: Hornet	76 m (250 ft)
Super Hornet	107 m (350 ft)
Range, 10% reserves: Hornet	304 n miles (563 km; 350 miles)

HONDA

HONDA AIRCRAFT COMPANY

c/o Atlantic Aero Inc, Piedmont Triad International Airport, Greensboro, North Carolina 27425
Web: world.honda.com/HondaJet
PRESIDENT AND CEO: Michimasa Fujino
SENIOR CHIEF ENGINEER: Osamu Kubota

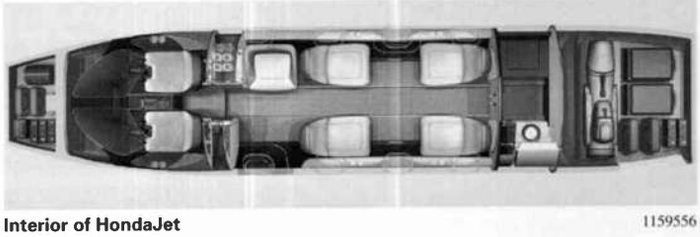
Honda's first business jet was the MH02, designed and built in the late 1980s/early 1990s with the aid of Mississippi State University. This aircraft (N3079N) first flew on 5 March 1993, but the programme lapsed some three years later without entering production, the aircraft having flown some 170 hours.

More recently, Honda R & D has developed a successor, known simply as the HondaJet, together with the HF-118 engines which power it. This took place at a 2,787 m² (30,000 sq ft) facility on the Greensboro leasehold site of Atlantic Aero Inc, with whom Honda R & D teamed in 2000. The HondaJet prototype flew in December 2003 and did not reserve a public debut until shown at EAA AirVenture Oshkosh in July 2005. Announced marketing and production plans in July 2006. Honda Aircraft Company Inc formed August 2006.

HONDA HA-420 HONDAJET

TYPE: Light business jet.

PROGRAMME: Development began in 2000; first brief details revealed in mid-2000; originally intended HF-118 engine made first flight 10 June 2002 in Cessna CitationJet testbed; wing aerofoil tested 1997 as 'glove' section on T-33 testbed; wind tunnel tests conducted at Honda low-speed wind tunnel, the University of Washington, NASA NTF, ONERA (France), Boeing's transonic wind tunnel and Japanese National Aeronautics Laboratory's transonic flutter wind tunnel. Static testing of prototype (N420HA/c/n P001) under way by mid-2003; first flight undertaken in secrecy at Piedmont Triad Airport, North Carolina, 3 December 2003 and announced on 16 December 2003. Public debut at EAA AirVenture at Oshkosh 28 July 2005, at which time it had completed more than 156 flight hours and achieved a maximum speed of 393 kt (728 km/h; 452 mph) and a maximum altitude of 13,106 m (43,000 ft). Had increased to 412 kt (763 km/h; 474 mph) and 256 hours by October 2006.



Interior of HondaJet 1159556

Marketing plans announced at AirVenture 25 July 2006; orders accepted from 17 October 2006 when pricing (and change from Honda HF118 engine) announced at NBAA Convention, Orlando, Florida; certification process began 11 October 2006 and first deliveries due in 2010; production in US; partnership with Piper Aircraft to provide sales and service.

COSTS: USD3.65 million (2006).

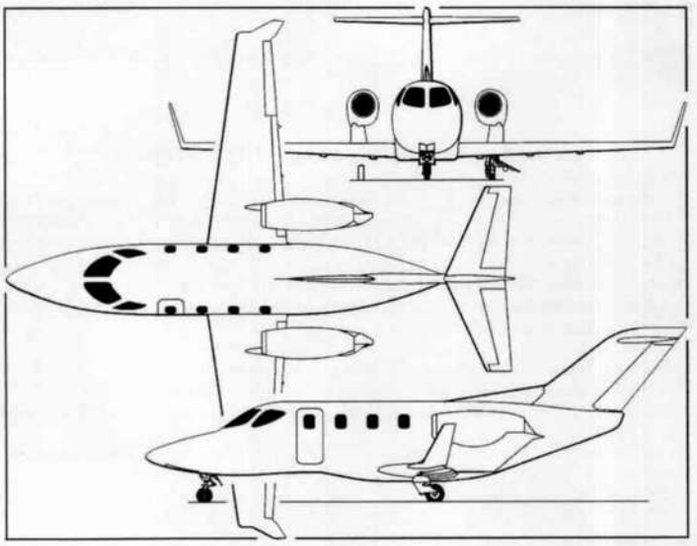
DESIGN FEATURES: Low-mounted, moderately tapered wings of natural laminar flow section, with wing cabane-mounted engines and winglets. T tail with sharply swept fin and rudder, plus dorsal fin; tailplane has sweptback leading-edges and elevator cut-outs for rudder movement. Primary design considerations were large cabin size and range/fuel consumption economics. Engine position allows increase of 30 per cent in fuselage available volume without penalty. Nose shape optimised for generation of fuselage laminar flow, which also achieved on wings despite their relative thickness.

Laminar flow Honda SMH-1 wing section. Washout 5.1°.

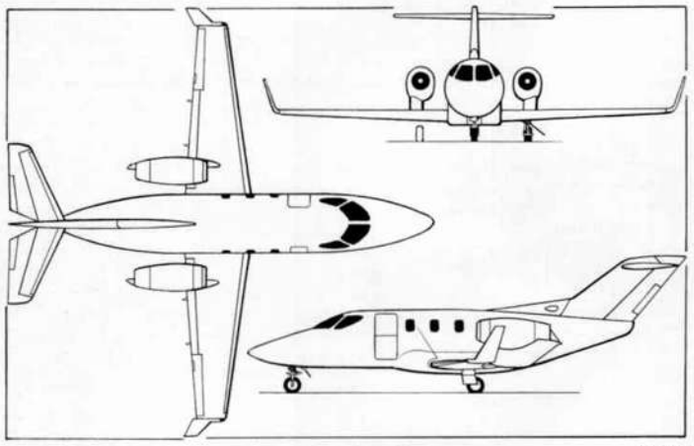
FLYING CONTROLS: Conventional and manual. Actuation by pushrods and cables. Electrically actuated flaps with mechanical linkage (settings 15.7° for T-O, 50° for landing). Stall characteristics said to be 'docile' in both cruise and climb.

Prototype HondaJet light business jet *(Paul Jackson)* 1159371

HondaJet instrument panel 1159557



Production version of HondaJet *(Paul Jackson)* 1158954



Honda R & D HondaJet prototype *(James Goulding)* 1159395

STRUCTURE: Fuselage entirely of graphite composites in combination of honeycomb sandwich and co-cured stiffened panels. Aluminium alloy for three-spar wings and for two-spar fin and tailplane.

LANDING GEAR: Tricycle type; retractable. Single wheel on each unit. Trailing-link main units, retracting inwards into underside of wing centre-section; nosewheel retracts forward and is steer-by-wire (±10° for take-off, ±50° for taxying). Hydraulic retraction. Tyres 16×4.4-8 (prototype 14.5×5.5-6) nose; 17.5×5.75-8 main.

POWER PLANT: Two 8.36 kN (1,880 lb st) GE-Honda HF120 podded turbofans, mounted on sweptback overwing pylons and equipped with Honda-developed FADEC.

Fuel in four tanks (one in each outer wing, one in wing centre-section, and one rear fuselage bladder tank). Single-point refuelling at rear on starboard side.

ACCOMMODATION: Standard seating for two crew and five passengers (club four, plus one sideways, facing door) and rear lavatory; optional two-plus-six air taxi layout. Four (prototype three) passenger cabin windows per side; cabin door on port side immediately aft of flight deck; emergency hatch opposite door, starboard.

SYSTEMS: Cabin pressurised to 0.60 bar (8.7 lb/sq in), giving 2,440 m (8,000 ft) equivalent environment at altitude of 13,400 m (44,000 ft). Wing leading-edge and engine air intake anti-icing; windscreen electrically heated. Hydraulic system pressure 207 bar (3,000 lb/sq in).

AVIONICS: Garmin G1000 integrated modular suite with three-screen EFIS comprising two PFDs and one MFD.

Instrumentation: EFIS, comprising PFD for each crew member and single central MFD.

Preliminary details as follows:

DIMENSIONS, EXTERNAL:

Wing span over winglets	12.15 m (39 ft 10½)
Length overall	12.71 m (41 ft 8½ in)
Height overall	4.03 m (13 ft 2½ in)

DIMENSIONS, INTERNAL:

Cabin: Length between pressure bulkheads	5.43 m (17 ft 9¾ in)
Max height	1.51 m (4 ft 11½ in)
Max width	1.52 m (5 ft 0 in)
Baggage volume: nose	0.25 m^3 (9.0 cu ft)
aft	1.6 m^3 (57 cu ft)

WEIGHTS AND LOADINGS:

Useful load	1,532 kg (3,378 lb)
Max payload	726 kg (1,600 lb)

PERFORMANCE (estimated):

Max level speed at FL300	420 kt (777 km/h; 483 mph)
Max rate of climb at S/L	1,216 m (3,990 ft)/min
Optimum cruising altitude	12,500 m (41,000 ft)
Max certified altitude	13,105 m (43,000 ft)
T-O to 11 m (35 ft)	951 m (3,120 ft)
Landing run	762 m (2,500 ft)
Range: VFR, 292 kg; 644 lb payload	1,400 n miles (2,592 km; 1,611 miles)
IFR, pilot and three passengers, 45 min reserves, FL410	1,180 n miles (2,185 km; 1,357 miles)

HPA

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CHIEF DESIGNER: Petr Varadi

The M1 SpeedCruiser is being developed by International High Performance Aircraft of Lobecek 732, CZ-728 01 Kralupy nad Vlatava, Czech Republic (www.hpai.com), and Venice, Florida. M1 is related to Team Rocket F1 and F1EVO.

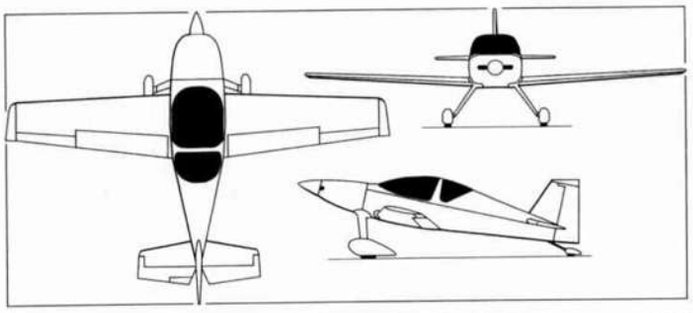
In addition to aircraft kits, HPA also manufactures parts for warbirds such as the FW 190 and P-63 King Cobra, quick-build kits of the Stewart S-51 Mustang scale replica, and other Czech-built ultralight designs.

HPA M1 SPEEDCRUISER

TYPE: Side-by-side kitbuilt.

PROGRAMME: Announced at Oshkosh in July 2002 as the Team Rocket F2, then based on major components from the F1EVO, including wings, tail and landing gear. By July 2003, had become M1. Development continues; prototype had not flown by October 2006.

COSTS: Estimated kit price USD25,000; fast-build kit USD35,000 (2003).



International High Performance M1 Speedcruiser *(Paul Jackson)* 1047841

DESIGN FEATURES: Intended to combine high performance and low price. Low-wing monoplane with closely cowled engine. Tapered wings and tailplane. Meets FAA's '51 per cent' rule. Quoted build time 1,000 hours for fast-build kit.

FLYING CONTROLS: Conventional and manual. Flaps. Horn-balanced rudder and elevators.

STRUCTURE: Principally of aluminium, primed with epoxy chromate for corrosion resistance. Titanium mainwheel legs; glass fibre engine cowling and wingtips.

LANDING GEAR: Fixed; option of tailwheel or nosewheel. Fuselage-mounted spring titanium cantilever mainwheel legs. Mainwheels 5.00-5.

POWER PLANT: One 224 kW (300 hp) Textron Lycoming IO-540 flat-six and MT-Propeller MTV-9-B-C/C193-109 three-blade, constant-speed propeller. Fuel capacity 227 litres (60.0 US gallons; 50.0 Imp gallons).

ACCOMMODATION: Two persons side by side beneath rearward-sliding canopy. Fixed windscreen.

DIMENSIONS, EXTERNAL:

Wing span	8.20 m (26 ft 10¾ in)
Wing aspect ratio	6.6
Length overall	6.40 m (21 ft 0 in)

DIMENSIONS, INTERNAL:

Cabin: Length	1.28 m (4 ft 2½ in)
Max width	1.14 m (3 ft 9 in)
Max height	1.12 m (3 ft 8 in)
Baggage hold volume	0.42 m³ (15.0 cu ft)

AREAS:

Wings, gross	10.22 m² (110.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	590 kg (1,300 lb)
Max T-O weight	952 kg (2,100 lb)
Max wing loading	93.2 kg/m² (19.09 lb/sq ft)
Max power loading	4.26 kg/kW (7.00 lb/hp)

PERFORMANCE:

Max operating speed	230 kt (426 km/h; 265 mph)
Normal cruising speed at 75% power	209 kt (386 km/h; 240 mph)
Stalling speed, power off, flaps down	44 kt (81 km/h; 50 mph)
Max rate of climb at S/L	1,067 m (3,500 ft)/min
T-O run	91 m (300 ft)
Landing run	213 m (700 ft)
Range at 55% power	1,099 n miles (2,035 km; 1,265 miles)

HUNT

HUNT AVIATION CORPORATION

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Web: www.fuellessflight.com
FOUNDER: Robert D Hunt
PRESIDENT: Gene Cox
SENIOR VP AND CHIEF FINANCIAL OFFICER: Joseph A Chomko

Last described in 2005-06. *Jane's All the World's Aircraft.*

INDEPENDENT

INDEPENDENT AIRCRAFT

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Web: www.independentaircraft.com
PRESIDENT: John Brown

Independent has produced the first all-composites amphibious aircraft optimised for the US LSA category.

INDEPENDENT JB1 SEADRAGON

TYPE: Two-seat amphibian/kitbuilt.

PROGRAMME: Manufacture began in 2002. Prototype X-JB1 apparently flying by July 2005, when exhibited at AirVenture, Oshkosh, although unregistered.

COSTS: USD64,000 flyaway (2006).

DESIGN FEATURES: Optimised for US LSA seaplane category. High-wing pusher with stabilising sponsons each side of forward fuselage. Rounded fin and rectangular rudder; low tailplane with auxiliary fins at tip. Limited aerobatic capability.

Option of external fuel tanks; STOL kit; trimmable rudder; folding wing; and alternative aerofoil.

FLYING CONTROLS: Conventional and manual. In-flight elevator trim. No flaps. Lower portion of rudder used as water rudder.

STRUCTURE: Composites throughout. Carbon fibre spar.

LANDING GEAR: Optional nosewheel or tailwheel landing gear as standard. Method of retraction not disclosed.

POWER PLANT: One Hirth F30 piston engine of 78.3 kW (105 hp) driving a ground-adjustable pitch, pusher propeller. Fuel capacity 114 litres (30.0 US gallons; 25.0 Imp gallons).

ACCOMMODATION: One or two persons in tandem beneath single-piece canopy/windscreen.

DIMENSIONS, EXTERNAL:

Wing span	7.67 m (25 ft 2 in)
Wing aspect ratio	4.7
Length overall	8.03 m (26 ft 4 in)
Height overall	2.24 m (7 ft 4 in)

AREAS:

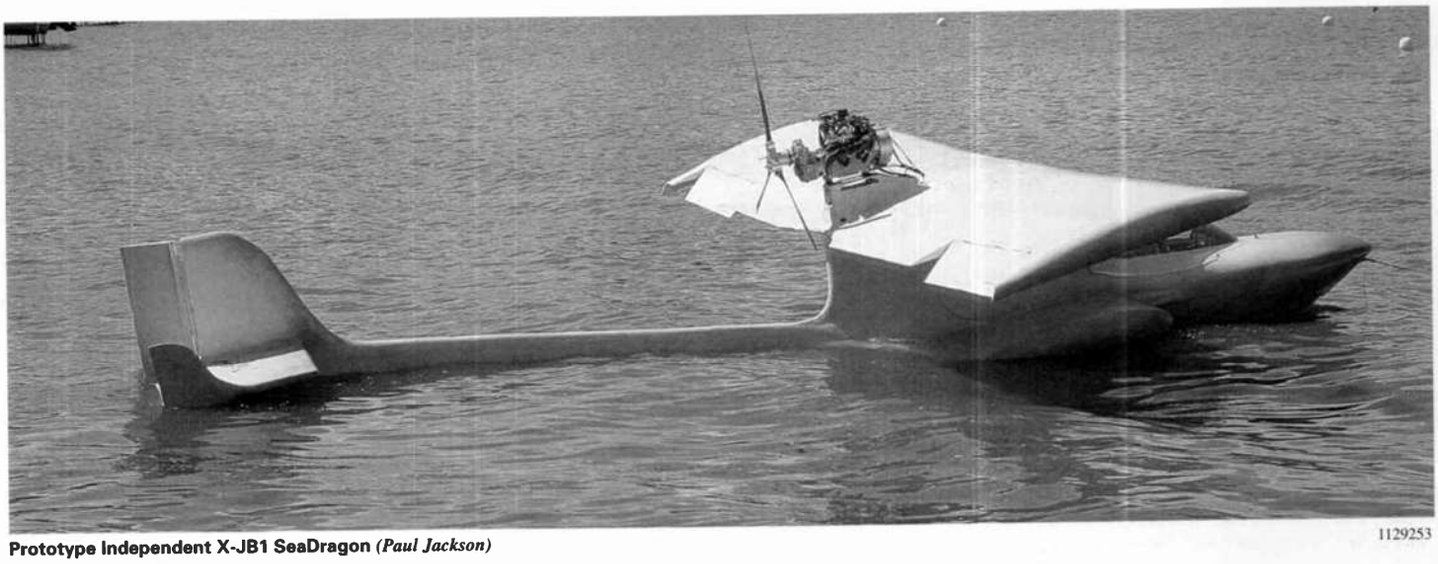
Wings, gross	12.31 m² (132.5 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	354 kg (780 lb)
Max baggage weight	45 kg (100 lb)
Max T-O weight	650 kg (1,435 lb)
Max wing loading	52.9 kg/m² (10.83 lb/sq ft)
Max power loading	8.32 kg/kW (13.67 lb/hp)

PERFORMANCE:

Max level speed	160 kt (296 km/h; 184 mph)
Cruising speed	120 kt (222 km/h; 138 mph)
Stalling speed: flaps down	38 kt (71 km/h; 44 mph)
Max rate of climb at S/L	396 m (1,300 ft)/min
T-O and landing run: land	107 m (350 ft)
water	122 m (400 ft)
Range: with max fuel	417 n miles (772 km; 480 miles)
Endurance	3 h 45 min



Prototype Independent X-JB1 SeaDragon *(Paul Jackson)* 1129253

INDUS

INDUS AVIATION INC

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898/1, 80 Feet Road, 6th Block, Koramangala, Bangalore 560095
Tel: (+91 80) 51 50 15 21
Fax: (+91 80) 51 50 15 23
MANAGER, INDIA OPERATIONS: Kiran Kota

IndUS was formed in 1994 and in 2002 bought the type certificate, production certificate and tooling for the Thorp T-211, previously produced by Venture Light Aircraft Resources, renaming the aircraft as the Sport E in the process; further renamed Thorpedo in 2005. IndUS has chosen TAAL of India to build the aircraft, and also to handle non-US marketing; the tooling shipped there to facilitate this.

INDUS THORPEDO and SKY SKOOTER

TYPE: Side-by-side lightplane kitbuilt.

PROGRAMME: Originated in T-11 Sky Skooter, designed by John Thorp and first flown 15 August 1946; certified 22 December 1948, certificate A-791. T-211 certified 20 April 1964 by Tubular Aircraft Products of Los Angeles, which produced parts for 100 aircraft; rights passed to Adams Industries of Detroit, then Thorp Aero Inc at Sturgis, Kentucky, which acquired components in stock; production rights passed to Phoenix Aircraft at Mesa, Arizona, in 1992, but that company declared bankrupt in mid-1994. Acquired by AD Aircraft in the UK; market launch (and first sale, to Ken Fowler) of kits at PFA International Air Rally & Exhibition at Cranfield, Bedfordshire, in July 1998. AD sold six homebuild kits supplied from the USA by Venture Light Aircraft Resources (the previous owner); Venture production began with c/n 104. UK production of complete aircraft planned, but cancelled in 1999.

IndUS took over rights in 2002 (and parts stock sufficient for some 20 aircraft, all 'production' since 1970s having been from original stock of 100, from which requests for spare parts were also deducted by subsequent owners); initially named Sport E, this changing to Thorpedo in 2005. In December 2003, IndUS announced that TAAL of India had started work on assembling the first two aircraft, components coming from the aforementioned parts stock; the first aircraft was due for delivery in May 2004; by August 2005, eight had been completed.

On 8 June 2005, LSA approval received; first LSA compliant aircraft is N211LS.

CURRENT VERSIONS: **T-211 Thorpedo:** Factory-built version.

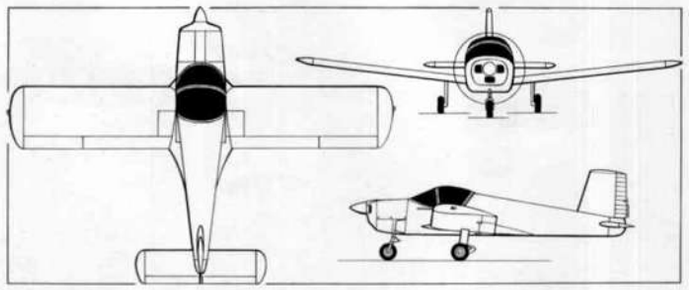
Data refer to this version.

T-11 Sky Skooter: As Thorpedo, but with Jabiru 2200 engine. US development by "T-211 Sky Skooter" N211TH. First US T-11 built by IndUS was N211YY in 2006.

Sport Experimental: Continental-engined kitbuilt version, supplied complete, or in eight sub-kits for stage-by-stage assembly.

CUSTOMERS: Five kits sold during PFA International Air Rally in July 1999, increasing total to six. (At least nine built in USA by Tubular Aircraft, one; Aircraft Engineering Associates, one; and Venture.) Two further kits sold after Sun 'n' Fun, April 2004 for completion under Light Sport Aircraft regulations plus one Part 23 certified example for flight training. By October 2006, 24 had been produced by Indus.

IndUS-built Thorp T-11 Sky Skooter *(Paul Jackson)* 1158796



IndUS T-211 Thorpedo two-seat kitbuilt *(James Goulding)* 0084388

COSTS: Basic kit USD24,995, excluding engine, propeller and avionics; Builder assistance available; LSA compliant aircraft USD79,995 for Sky Skooter, USD84,995 for Thorpedo LSA compliant ready-to-fly respectively (2006). FAA Pt 23 certified USD96,200 and USD111,950 respectively (2005).

DESIGN FEATURES: Economic, simple design for recreational market.

FLYING CONTROLS: Manual; pushrod operated controls except for rudder and trims which are cable-operated. Plain ailerons; all-moving tailplane with anti-balance tab occupying 90 per cent span; wide-span manually operated three-position trailing-edge flaps with maximum deflection of 20°.

STRUCTURE: All aluminium fuselage; wing with main spar, false spar and externally stiffened (ribbed) skin; ailerons, flaps, tailplane and rudder have externally stiffened skin. IndUS investigating possibility of fitting 'smooth' wing, subject to satisfactory resolving of structural issues.

LANDING GEAR: Tricycle type; fixed. Wing-mounted, faired, cantilever mainwheel legs with integral oleo-pneumatic shock-absorbers; all three wheels size 5.00-5; steerable nosewheel; Cleveland wheels; Cleveland 30-9 brakes on main units.

POWER PLANT: One 74.6 kW (100 hp) Teledyne Continental O-200A flat-four, driving a Sensenich 69CK two-blade fixed-pitch propeller; IndUS fitting 89 kW (120 hp) Jabiru 3300 flat-six (Thorpedo) and 63.4 kW (85 hp) Jabiru 2200 flat-four (Sky Skooter) to machines in Light Sport Aircraft category. Fuel tank aft of cabin, capacity 91 litres (24.0 US gallons; 20.0 Imp gallons), of which 79.5 litres (21.0 US gallons; 17.5 Imp gallons) are usable; oil capacity 5.7 litres (1.5 US gallons; 1.25 Imp gallons).

ACCOMMODATION: Two seats side by side beneath rearward-sliding transparent canopy; fixed windscreen. Baggage compartment behind seats, max weight 8.1 kg (17.8 lb).

SYSTEMS: 12 V 60A alternator.

DIMENSIONS, EXTERNAL:

Wing span	7.92 m (26 ft 0 in)
Wing aspect ratio	5.9
Length overall	5.87 m (19 ft 3 in)
Height overall	1.90 m (6 ft 2¾ in)
Propeller diameter	1.70 m (5 ft 7 in)

DIMENSIONS, INTERNAL:

Cabin max width	1.02 m (3 ft 4 in)

AREAS:

Wings, gross	10.68 m² (115.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: T-211	302 kg (665 lb)
T-11	286 lb (630 lb)
Max baggage weight	18 kg (40 lb)
Max T-O weight	576 kg (1,270 lb)
Max wing loading	53.9 kg/m² (11.04 lb/sq ft)
Max power loading: T-211	6.44 kg/kW (10.58 lb/hp)
T-11	9.09 kg/kW (14.94 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE): both	138 kt (255 km/h; 158 mph)
Max level speed: T-211	115 kt (213 km/h; 132 mph)
T-11	100 kt (185 km/h; 115 mph)
Cruising speed at 75% power: T-211	107 kt (198 km/h; 123 mph)
Stalling speed, flaps down, power on: T-211	41 kt (76 km/h; 48 mph)
T-11	39 kt (71 km/h; 44 mph)
Max rate of climb at S/L	311 m (1,020 ft)/min
Service ceiling: T-211	4,663 m (15,300 ft)
T-11	2,620 m (8,600 ft)
T-O run: T-211	107 m (350 ft)
T-11	110 m (360 ft)
Landing run: T-211	122 m (400 ft)
T-11	115 m (375 ft)
Max range: both	325 n miles (603 km; 375 miles)

INTERSTATE

INTERSTATE ENGINEERING & TYPE DESIGN COMPANY INC

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Web: www.InterStateAircraft.com
PRESIDENT: Bart Miller

Trading as Interstate Aircraft Company, this firm was established to relaunch production of the Arctic Tern two-seat bushplane. First aircraft was built in 2006.

INTERSTATE S-1B2 ARCTIC TERN

TYPE: Two-seat lightplane.

PROGRAMME: Interstate Aircraft and Engineering Corporation S-1A built at El Segundo, California, from 1940 with 48.5 kW (65 hp) Continental flat-four; certified 26 February 1941; later with Franklin engines of various ratings (S-1A-65F, -85F and -90F); became L-6 Cadet observation and liaison version for USAAF upon rear extension of cockpit glazing and addition of flaps; this version certified as S-1B1 on 19 August 1942, powered by Franklin O-200 engine of 84.3 kW (113 hp). Type certificates of S-1A and S-1B to Harlow Aircraft Company, 23 July 1945; to Call Aircraft Company 15 July 1950 for production (possibly rebuild) of small number of modified aircraft; to Nikiski Marine Corporation on 14 May 1969 (no known production); then to Arctic Aircraft Company, owned by Bill Diehl and based at Anchorage, Alaska, 15 May 1970.

Re-engineered by Arctic, using more modern materials; Lycoming O-320 engine; certified 25 July 1975 as Arctic S-1B2 Tern; floatplane certified 20 January 1981. Prototype N50AA built 1974; further 28 production aircraft up to 1985.

Certificate transferred to current owner on 23 June 1999, together with all tools and jigs from Arctic company. Modifications to present version, undertaken in conjunction with Alaska Aircraft Engineering, meet FAR Pt 23 criteria and include aluminium spars (replacing wood) and wing struts (replacing steel): constant-speed propeller: new avionics; expanded CG envelope; and MTOW increased from 748 kg (1,650 lb) for landplane. Process involved 500 drawing changes and 250 new drawings.

CUSTOMERS: Previous production accounted for 321 civilian S-1As up to 1942 (including eight L-8A Cadets for Bolivia); one XO-63 prototype; 250 L-6 (S-1B1) Cadets; and 29 Terns (c/n 1001 to 1029), of which 22 remained on US Civil Register in 2004, with 132 S-1As, and 46 S-1B1s/L-6s. Current production begins at c/n 2001, which registered N801AT in May 2006 and exhibited at AirVenture, Oshkosh in July 2006.

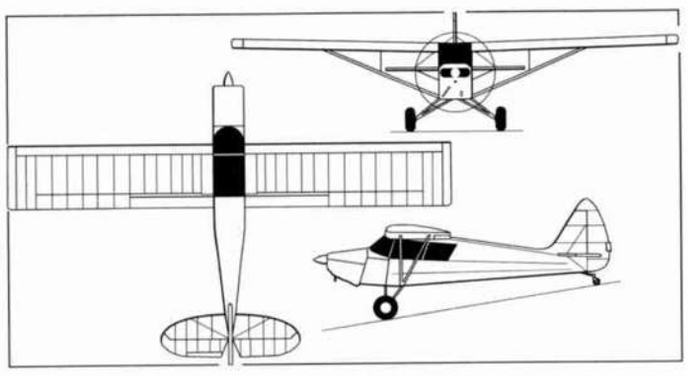
COSTS: USD156,750 (2006).

DESIGN FEATURES: Current aircraft is rugged 'bushplane' design with short-field performance bestowed by large flaps.

Constant-chord wing attached to upper longerons and braced with V struts and intermediate struts each side. Tall, curved fin.

Wing section NACA 23012; dihedral 2°; incidence 4°

First Interstate S-1B2 Arctic Tern from current production *(R W Simpson)* 1159303



Interstate S-1B2 Arctic Tern tandem-seat bushplane *(Paul Jackson)* 1159396

FLYING CONTROLS: Conventional and manual. Horn-balanced elevators and rudder; mass-balanced ailerons. Trim tab in port elevator. Control surface deflections: ailerons +19/–20°; elevators ±30°; rudder ±30°; flaps 50°.

STRUCTURE: Welded steel tube fuselage and aluminium wing, both with fabric covering, apart from wing leading-edge and glass fibre engine cowling. Factory airframe corrosion protection standard.

LANDING GEAR: Tailwheel type; fixed. Two side Vs attached to lower longerons, plus half-axles attached to single hydraulic/helical spring oleo shock-absorber mounted internally on centreline. Cleveland wheels and brakes; main tyres 8.50-6 standard; 8.50-6 tundra tyres optional; Scott 3200 steerable tailwheel. Provision for Wipline 2100 floats or skis.

POWER PLANT: One 119 kW (160 hp) Textron Lycoming O-320-D1A flat-four driving a Hartzell constant-speed (McCauley governor) propeller. Fuel in two wing tanks; total usable capacity 151 litres (40.0 US gallons; 33.3 Imp gallons). Optional belly tank with additional 121 litres (32.0 US gallons; 26.7 Imp gallons).

ACCOMMODATION: Two seats in tandem; rear seat foldable; crew door starboard. Leather upholstery standard. Two rear storage bins with external door, starboard. Cockpit ventilated and heated.

AVIONICS: *Comms:* Garmin GNC 250XL GPS/com, GTX 320A transponder, PS Engineering PM-1000 intercom and lightweight ELT, all standard.

Instrumentation: Low-range ASI, altimeter, VSI, electric turn co-ordinator, directional gyro, compass, artificial horizon, suction gauge, recording tachometer, oil temperature and oil pressure gauges, manifold pressure gauge, ammeter and four-cylinder switchable CHT/EGT gauge, all standard.

EQUIPMENT: Whelen anti-collision and position lights, landing light, panel red spotlight, cockpit dome light and baggage compartment loading light, all standard. Optional towing hook.

DIMENSIONS, EXTERNAL:

Wing span	10.94 m (35 ft 10 ¾ in)
Wing chord (constant)	1.57 m (5 ft 2 in)
Wing aspect ratio	7.0
Length overall	7.32 m (24 ft 0 in)
Height overall	2.13 m (7 ft 0 in)
Tailplane span	3.35 m (11 ft 0 in)
Propeller diameter	2.03 m (6 ft 8 in)

DIMENSIONS, INTERNAL:

Cockpit: Max width	0.66 m (2 ft 2 in)
Volume	1.38 m^3 (48.7 cu ft)
Baggage volume	0.92 m^3 (32.5 cu ft)

AREAS:

Wings, gross	17.24 m^2 (185.6 sq ft)
Trailing-edge flaps (total)	1.77 m^2 (19.02 sq ft)
Fin	0.74 m^2 (7.98 sq ft)
Rudder, incl tab	0.75 m^2 (8.10 sq ft)
Horizontal tail surfaces (total)	2.67 m^2 (28.75 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, equipped	522 kg (1,150 lb)
Max baggage weight	181 kg (400 lb)
T-O weight: Normal	861 kg (1,900 lb)
Utility	975 kg (2,150 lb)
floatplane	1,066 kg (2,350 lb)
Max wing loading: Utility	56.6 kg/m^2 (11.58 lb/sq ft)
Max power loading: Utility	8.18 kg/kW (13.44 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	122 kt (227 km/h; 141 mph)
Max level speed	137 kt (254 km/h; 158 mph)
Cruising speed at 75% power	109 kt (201 km/h; 125 mph)
Stalling speed, flaps down	34 kt (63 km/h; 39 mph)
Max rate of climb at S/L	457 m (1,500 ft)/min
T-O run	99 m (325 ft)
T-O to 15 m (50 ft)	152 m (500 ft)
Landing from 15 m (50 ft)	138 m (450 ft)
Landing run	77 m (250 ft)

ION

ION AIRCRAFT

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PRESIDENT: Steve Schulz
SALES MANAGER: Stephen Sacks

DreamWings Valkyrie advanced ultralight first flew 1999, but company suffered bankruptcy in mid-2001. By that time, 145 potential customers had lodged deposits worth USD1.5 million, all of which was lost. Maintaining their enthusiasm for the aircraft, this group formed Ion Aircraft to continue development and launch production. Completion of the prototype was postponed from 2005 to 2006.

ION ION

TYPE: Two-seat lightplane.

PROGRAMME: Re-engineered DreamWings Valkyrie; prototype exhibited, partly assembled, at AirVenture, Oshkosh, in July 2005; first flight due later that year; initial deliveries due mid-2006. However, rollout of prototype (N5510N) delayed until June 2006.

Engineering by Air Boss of Reno, Nevada; CFD work by AMI of Redmond, Washington.

CURRENT VERSIONS: **Ion 100:** Kit version to LSA rules; fixed landing gear.

Ion 105: Kit version to Experimental rules; retractable landing gear and extended 'cruise' wings.

Ion 110: Kit version to European 450 kg rules.

Ion 120: Factory-built version to LSA rules.

DESIGN FEATURES: Twin-boom pusher configuration; tailplane mounted at top of fins. Optional 'cruise' wings of longer span, adding some 20 kt, but increasing stalling speed to 49 kt. Compared with Valkyrie, dispenses with canard; tailplane raised.

FLYING CONTROLS: Conventional and manual. Plain 'piano hinged' ailerons and flaps. Controls cable actuated, except electric flaps.

STRUCTURE: Pod, wing centre-section, booms and empennage of pre-impregnated carbon fibre/epoxy composites; wings outboard of booms are bonded aluminium; engine cowling of glass fibre.

Prototype Ion and its building team in June 2006 1158277

LANDING GEAR: Tricycle type. Fixed for LSA category; retractable gear optional. Fixed gear comprises fuselage-mounted spring 2024 aluminium cantilever legs; hydraulic brakes. Castoring nosewheel.

POWER PLANT: One piston engine driving a Warp Drive three-blade, carbon fibre pusher propeller. Option of 73.5 kW (98.6 hp) Rotax 912S, 84.6 kW (113.4 hp) Rotax 914.89 kW (120 hp) Jabiru 3300 or 1.3 litre B2 Engines motorcar power plant conversion. Fuel capacity 76 litres (20.0 US gallons; 16.7 Imp gallons).

ACCOMMODATION: Two persons in tandem beneath single-piece canopy/windscreen. Rear seat raised 22 cm (8½ in).

EQUIPMENT: Provision for ballistic recovery parachute.

DIMENSIONS, EXTERNAL:

Wing span: LSA	9.90 m (32 ft 6 in)
Length overall	7.32 m (24 ft 0 in)

DIMENSIONS, INTERNAL:

Cockpit max width	0.81 m (2 ft 8 in)

WEIGHTS AND LOADINGS:

Useful load	250 kg (552 lb)

PERFORMANCE (Rotax 912S engine; estimated):

Cruising speed at 75% power	132 kt (244 km/h; 152 mph)
Stalling speed, flaps down	37 kt (69 km/h; 43 mph)
Max rate of climb at S/L	491 m (1,610 ft)/min
T-O run	118 m (385 ft)
g limits	+4.4/–2.2

JP AEROSPACE

JP AEROSPACE LLC

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PRESIDENT: John Powell

This company, formed in 1979, has conceived an ambitious project, known as Airship To Orbit (ATO), which would use airships as the first and third stages in a three-stage method of attaining Earth orbit. The first craft, named Transatmospheric Ascender, would climb from Earth to 42,670 m (140,000 ft), where it would dock with a Dark Sky Station (DSS) suborbital space station - a permanent, crewed facility that would serve as the construction base and also as the departure port for a very much larger Orbital Ascender. As of early 2006, the ATO project had been more than two decades in development, with over 80 'real hardware' test flights; the Transatmospheric Ascender prototype was complete and awaiting test flights; and four unmanned DSSs had been built and flown, with five more to follow and the first crewed DSS then due to fly by the end of 2006. It is also described as a 'pay as you go' system, with each component having its own business application and funding source. For example, funding for the Transatmospheric Ascender was provided by the US Defense Department and the DSS has multiple customers in the telecommunications community. Project completion is forecast for 2012.

JP AEROSPACE ASCENDER

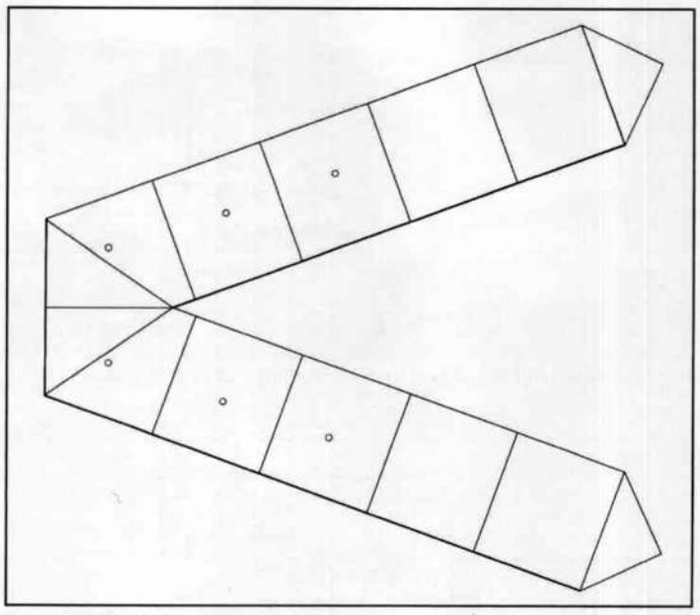
TYPE: Hybrid semi-rigid air vehicle.

PROGRAMME: Begun in 1980s. Prototype DSS platform first flown 29 January 2000. Two subscale prototypes of Ascender (6.1 m; 20 ft and 28.3 m; 93 ft long) built and flown; designations Ascender 20 and Ascender 90, respectively; full size version nearing completion mid-2006.

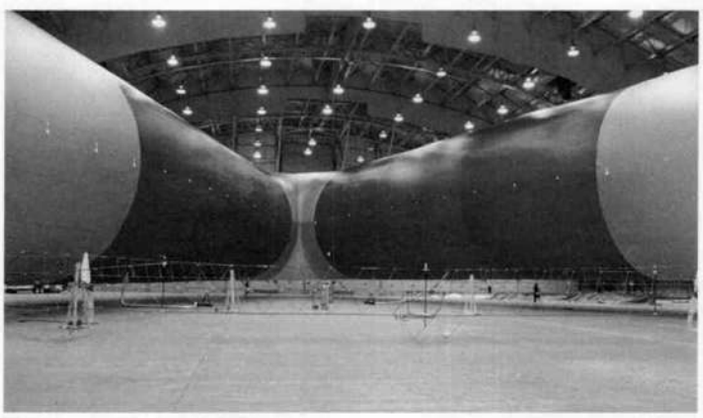
CURRENT VERSIONS: **Transatmospheric Ascender:** V-shaped atmospheric airship, for mainly vertical flight in DSS stationed at 42,670 m (140,000 ft). Each arm 53.3 m (175 ft) long and 12.8 m (42 ft) high, braced by 30.5 m (100 ft) carbonfibre cross-truss. Hybrid vehicle, using combination of buoyancy and aerodynamic lift and driven by 2.00 m (6 ft 6¾ in), two-blade composites (carbon fibre, Kevlar and glass fibre) propellers designed to operate in near vacuum. Operated by a crew of three; can be configured for cargo or passengers.

Orbital Ascender: Huge, V-shaped airship/dynamic vehicle, launched from DSS and using buoyancy to climb to 60,960 m (200,000 ft). From there, it uses solar electric propulsion to accelerate slowly and climb dynamically until, after about five days, it reaches orbital velocity. Initial test vehicle has 1,829 m (6,000 ft) arms; a 36,575 m (120,000 ft) flight test for the ion engine was scheduled by the end of 2005.

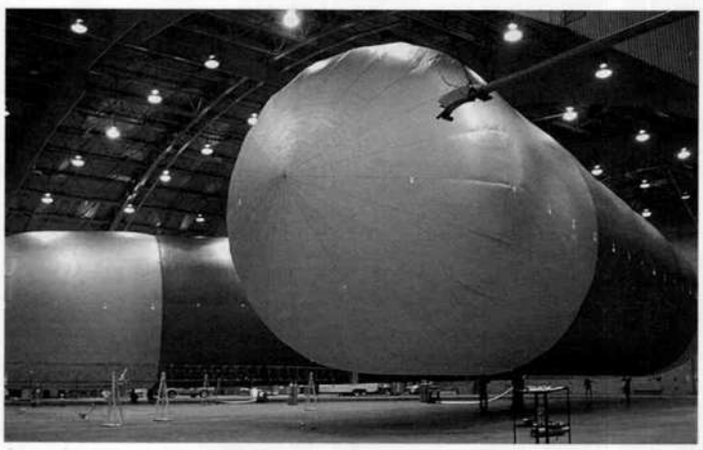
NSMV: Near Space Manoeuvring Vehicle, version of Orbital Ascender built for US Air Force Space Battlelab as communications relay asset. Management transferred to GSSL Inc, but after two unsuccessful flight tests concept was abandoned in 2005. Arm lengths (each) 53.91 m (176 ft 10¼ in); arm angle 40°.



Ascender NSMV plan view *(Paul Jackson)* 1158949



The 54 m (177 ft) long NSMV 1165232



Ascender 175 under construction 1040442

JUST

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Just has worked in collaboration with Reality Aircraft of the UK to market the Easy Raider and Escapade lightplanes in both countries. An Escapade variant, the Highlander, while described in the former entry, is not available in the UK. In 2004, Just announced the Summit, although marketing had not formally begun a year later.

JUST SUMMIT

TYPE: Tandem-seat ultralight kitbuilt.

PROGRAMME: Announced in 2004 as US version of Reality Sky Raider, although known specification shows several differences to the UK-certified aircraft, most noticeably the adsence of a fin fillet. By mid-2006, marketing had not formally begun.

DESIGN FEATURES: High, constant-chord, foldable wing supported by V-struts and intermediate struts. Quoted build time 400 hours.

FLYING CONTROLS: Conventional and manual. Ailerons and elevator actuated by pushrods; rudder by cables. Three-position flaps.

STRUCTURE: Chrome-moly 4130 welded steel tube fuselage and empennage with fabric covering. Wing built on 6061 aluminium spar with wooden ribs and fabric covering. Glass fibre engine cowling.

LANDING GEAR: Tailwheel type; fixed. Two faired-in side Vs hinged to lower longerons, plus half-axles with bungee cord shock-absorbers attached to compression frame. Brakes. Matco steerable tailwheel. Optional spring aluminium cantilever main legs.

Prototype Just Summit 1159030

POWER PLANT: One piston engine between 37 and 89 kW (50 and 120 hp). Rotax 503, 582, 912 and 912S or Jabiru 2200 and 3300 all suitable. Fuel in wings, capacity 38 litres (10.0 US gallons; 8.3 Imp gallons) standard; 76 litres (20.0 US gallons; 16.7 Imp gallons) optional.

DIMENSIONS, EXTERNAL:

Wing span	9.83 m (32 ft 3 in)
Length: overall	5.79 m (19 ft 0 in)
wings folded	6.71 m (22 ft 0 in)
Height overall	1.73 m (5 ft 8 in)

AREAS:

Wings, gross	11.23 m^2 (120.9 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	204 kg (450 lb)
Max T-O weight	449 kg (990 lb)

PERFORMANCE:

No details available

KAMAN

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VICE-PRESIDENT, SUBCONTRACTING AND BUSINESS DEVELOPMENT, KAMAN AEROSPACE CORPORATION, HELICOPTER DIVISION: William D Brown

Founded 1945 by Charles H Kaman. Developed servo-flap control of helicopter main rotor, initially in contrarotating two-blade main rotors, and still used in SH-2G Super Seasprite four-blade main rotor and on the K-MAX. R&D programmes sponsored by US Army, Air Force, Navy and NASA include advanced design of helicopter rotor systems, blades and rotor control concepts, component fatigue life determination and structural dynamic analysis and testing. In late 2001, company was said to be in early conceptual stages for a multirole helicopter of similar size to the NH 90, with a cabin wide enough to admit stretchers stowed widthways; no further details of this had emerged by fourth quarter 2006.

Kaman has also undertaken helicopter drone programmes since 1953; is continuing advanced research in rotary-wing unmanned aerial vehicles (UAVs). Its intermeshing rotor system design was a key ingredient in the Northrop Grumman candidate for the (subsequently cancelled) DARPA/US Army Unmanned Combat Armed Rotorcraft (UCAR) programme. Kaman is however pursuing US Army interest in an unmanned logistics UAV. Following a USMC demonstration of the K-MAX/BURRO (Broad-area Unmanned Responsive Resupply Operations) in 2001, a demonstration to the US Army was completed in June 2003; a second, for the aviation community, took place in September 2003; BURRO development and promotion was continuing in 2006. See *Jane's Unmanned Aerial Vehicles and Targets* for further details.

Kaman Aerospace has a workforce of about 1,200 and is major subcontractor on many aircraft and space programmes, including design, tooling and fabrication of components in metal, metal honeycomb, bonded and composites construction, using techniques such as filament winding, braiding and RTM. Participates in programmes including Northrop Grumman E-2C, Bell Boeing V-22, Boeing 737, 747, 757, 767, 777 wing trailing-edge, KC-135 and C-17, Sikorsky H-60 and NASA Space Shuttle Orbiter main fuel tank. Sikorsky contract (approximately USD27.7 million initially), announced 27 January 2005, is for 84 cockpit sets for UH-60L, UH-60M, MH-60S and S-70A in 2005-06; has multi-year options for up to 349 units. It was announced in April 2006 that Kaman Aerospace had signed an agreement with Boeing to support the latter's entry in the proposed HH-47 combat search and rescue (CSAR-X) programme for the US Air Force, by manufacturing the aircraft's 9.14 m (30 ft) aerial refuelling probe. Kaman also designs and produces fuzes for a range of weaponry.

Kaman designed and, since 1977, has been producing all-composites rotor blades for Bell AH-1 Cobras for US and foreign forces. Appointed in April 2000 to build fuselages for MD Helicopters' single-engine line (MDH 500, 520, 530 and 600) under 10-year contract; a further contract to build MDH Explorer rotor blade systems was awarded in July 2000, but work was suspended in the second quarter of 2003 due to falling sales and a USD21 million MDHI debt written off in the third quarter of 2004. With restoration of MDHI's fortunes, MD 500/520/530/600 fuselage work placed elsewhere, but Explorer rotor blade systems production resumed under new multiyear agreement signed in early 2006.

KAC's activities were reorganised in early 2002 into three new business units, of which Helicopter Programs has responsibility for the Super Seasprite and K-MAX described in the following entries. Aerostructures Subcontracting, in Bloomfield and Jacksonville, focuses on non-rotary-wing aircraft programmes including commercial airliner wing structures and components; major structural assemblies for military transports; aircraft thrust reversers; and business jet subassembly components. Helicopter Subcontracting, also with operations in Bloomfield and Jacksonville, undertakes work on helicopter airframes, composites rotor blades and components, including manufacture (until 2003) of MD 500 and MD 600 fuselages for MD Helicopters. In early 2002, Kaman acquired Plastic Fabrication Company of Wichita, Kansas, a manufacturer of composites parts and assemblies for aerospace applications.

Kaman Aerospace International Corporation was established in 1995 as the international affiliate of Kaman Aerospace with offices in Canberra and Nowra, Australia; Kuala Lumpur, Malaysia; Cairo, Egypt; and Bloomfield, Connecticut.

KAMAN (K894) SH-2G SUPER SEASPRITE

TYPE: Naval combat helicopter.

PROGRAMME: Available as either SH-2F remanufactured airframe or as new-build helicopter. Sales promotion continues, with a new (2004) campaign based on BAE Systems Avionics' mission system and sensor suite, aimed at potential NATO customers such as Portugal and Romania.

CURRENT VERSIONS: **SH-2G(E):** Ten for Egypt, ordered 22 February 1995 and delivered between October 1997 and November 1998. Remanufactured from SH-2F.

SH-2G(A): Eleven for Royal Australian Navy, selected in January 1997. Remanufactured from SH-2F. Deliveries began on a pre-acceptance basis in March 2001; provisional acceptance October 2003; 10 delivered by July 2004. Kaman reported "completing delivery" in March 2005; eight aircraft then operational in ITH (interim training helicopter) configuration, with handover of first fully operational machine then targeted for mid-year. However, by October 2005 date had slipped again, due to need for additional testing of ITAS software. Aircraft grounded 'indefinitely' 15 May 2006 pending resolution of ITAS software problems; at that time, 10 aircraft in Australia (including nine with 805 Squadron, HMAS *Albatross*, at Nowra, New South Wales), and one with Kaman for formal qualification testing (started 8 June 2006) and acceptance trials (due to begin in 3Q06); this aircraft expected to be handed over to RAN March 2007.

SH-2G(NZ): Five new-build aircraft for Royal New Zealand Navy, delivered between August 2001 and February 2003.

SH-2G: Four stored US Navy aircraft reactivated, with minor modifications, and delivered to Polish Navy between September 2002 and August/September 2003.

CUSTOMERS: Australia (11), Egypt (10), New Zealand (five) and Poland (four), as described above.

Australian Navy Kaman SH-2G(A) *(Paul Jackson)* 1040421

KAMAN K-1200 K-MAX

TYPE: Light lift helicopter.

PROGRAMME: First flight (N3182T) 23 December 1991; first public showing 22 March 1992; first flights of second prototype (N131KA) 18 September 1993 and first production aircraft (N132KA) 12 January 1994; third prototype is static and drop test aircraft to prove 20 year life at 1,000 hours per year and with 30 return logging sorties per hour. Certification to FAR Pts 27 and 133 achieved 30 August 1994 after 800 hour/32 month programme. N133KA of Scott Paper (now Kimberly-Clark) achieved 1,000 hours in eight months, 22 June 1995, as first K-MAX to reach this total. Canadian certification awarded 23 November 1994; now certified in Australia, Austria, Canada, Ecuador, Germany, Japan, New Zealand, Switzerland, Taiwan and USA. Uses include logging, firefighting, agricultural spraying, constructing and surveying.

A USD690,000 contract to demonstrate Vertrep (Vertical Replenishment) to US Navy awarded August 1995: two month demonstration period saw two K-MAXs (c/n 0010 and 0013) lift 453,592 kg (1,000,000 lb) with follow-on assessment in Guam during May 1996 during which 142 hours were flown and 2,449,400 kg (5,400,000 lb) was lifted. Two helicopters then began USD5.7 million six-month deployment in Arabian Gulf on 3 June 1996 aboard USS *Niagara Falls*. During late August 1998, the prototype K-MAX was involved in trials for Magic Lantern mine detection systems. FAA Pt 27 IFR certification received 14 May 1999 as part of bid for US Navy Vertrep contract. Kaman received certification for an external seat in June 1999; up to two may be fitted. On 14 July 1999 USMC placed contract worth USD4.2 million for remote piloting package and another worth USD2.7 million to May 2000: development of unmanned version continuing in 2006: for further details see *Jane's Unmanned Aerial Vehicles and Targets*. In November 2001, on behalf of the US Naval Undersea Warfare Center at Newport, Rhode Island, a manned K-MAX recovered more than two dozen torpedoes used during exercises in local waters.

K-MAX production suspended after completion of 38th aircraft in 2003; seven sales or leases by the end of July 2004, including delivery of the last 'white tail' during that month to Grizzly Mountain Aviation. Marketing continues, but no further production or orders until 6 February 2005, when Kaman announced delivery of a previously leased aircraft to Lucky Air of South Korea.

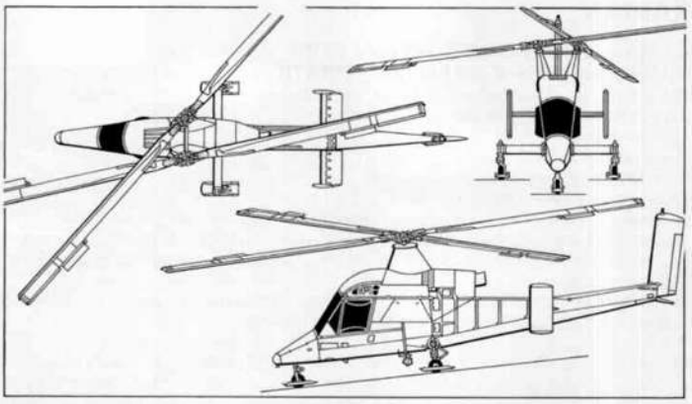
On same date, company revealed dedicated firefighting version, named **Fire Max**, equipped with a 2,650 litre (700 US gallon; 583 Imp gallon) fixed, conformal, carbon fibre tank with hydraulically powered hover refill pumps designed by Isolair. The system, known as Eliminator II, began flight testing 11 July 2005. At the time of the Fire Max announcement, Kaman stated that there were 27 K-MAXs in service. Launch customer for the Eliminator II system is Rainier Heli-Lift of Kirkland, Oregon. A similar system has been

KAMAN K-MAX PRODUCTION

c/n	Registration(s)	Current operator
0001	N3182T	Kaman
0002	N131KA	Kaman
0003	-	
0004	N132KA	Mountam West Helicopters
0005	N133KA	Crashed 12 Mar 06
0006	N134KA, N134WC	Woody Contracting
0007	N135KA, C-FXFT	HeliQwest Aviation
0008	N136KA, HB-XQA	Crashed 11 Oct 04
0009	N161KA, HB-XHJ	Crashed 4 Sep 98
0010	N162KA	Crashed 12 May 04
0011	C-GMHJ, N202MW	HeliQwest Aviation
0012	JA6184	Akagi Helicopter
0013	N163KA, C-FMGM	Mackenzie Helicopter Services
0014	N164KA, HB-ZEH	Eagle Helicopter
0015	N165KA, C-GMHO, N314KA, B-55589, N314KA	Crashed 25 Jul 03
0016	N161KA	Superior Helicopters
0017	N311KA	Crashed 11 Jul 00
0018	D-HFZA	Crashed 13 Sep 99
0019	N313KA, HC-CAG, N313KA	Rainier Helilift
0020	JA6200	Akagi Helicopter
0021	N21MX, OE-XKM, D-HMAX	Helog Lufttransport
0022	N224GM	Crashed 21 Apr 98
0023	N135KA	Crashed 27 Jan 98
0024	N312KA	Superior Helicopters
0025	N317KA	Mountain West Helicopters
0026	N3289T, D-HFZA, HB-ZGK	Rotex Helicopter
0027	N472PH, B-55588, N120PH, HL-9168	Lucky Air
0028	N482PH, N357KA	Peruvian National Police[1]
0029	N358KA, EJC500	Colombian Army[1]
0030	N359KA, EJC501	Colombian Army[1]
0031	N360KA	Peruvian National Police[1]
0032	N361KA	Peruvian National Police[1]
0033	N363KA	Crashed 17 Mar 06
0034	N264KA, HL-9167	Crashed 28 Apr 05
0035	N265KA	Horizon Helicopters
0036	N266KA, JA6236	Akagi Helicopter
0037	N267KA	Superior Helicopters
0038	N268KA	Superior Helicopters

[1] Owned by US State Department

Kaman K-MAX single-seat helicopter 1040424



Production version of Kaman K-MAX intermeshing rotor helicopter *(Mike Keep)* 0507267

developed by Kawak Aviation Technologies. By the time of the maiden flight, Kaman reported 'significant' interest in the Fire Max, sufficient to implement a production restart by the end of 2005, but no orders reported by November 2006.

CUSTOMERS: Refer to table for current users. Kaman moved from its original helicopter lease programme to a sales programme, but reinstated leasing arrangements in 2002, with Eagle Helicopters (Switzerland) and Superior Helicopters (Oregon) becoming lease customers shortly afterwards. Current operators (at July 2003) include Mountain West, Woody Contracting, Superior Helicopter (four), Petroleum Helicopters, Rainier Heli-Lift and Midwest Helicopters in USA; Cariboo Chilcotin and MacKenzie Heli Services in Canada; Helog of Switzerland; Japan Royal Helicopters (two); Rotex Helicopters AG of Lichtenstein; and Wucher Helikopter of Austria.

A K-MAX operated by Woody Contracting was the first to exceed 10,000 flying hours (increased to more than 14,000 hours by mid-2003). In December 2000, US State Department ordered five; these delivered in 2002, and in mid-2003 were performing logistics support for anti-drug operations in Colombia. Total of 37, plus one static test airframe. Of these, 11 lost in accidents by mid-2006, at which time 26 in operation.

KIMBALL

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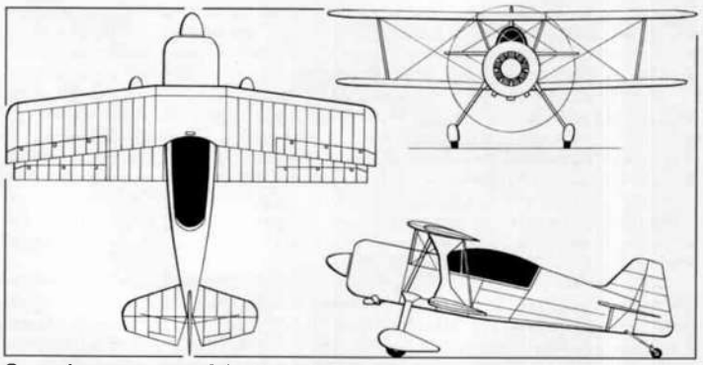
Web(3): www.dr109.com
PRESIDENT: Jim Kimball
VICE-PRESIDENT: Kevin Kimball

Jim Kimball Enterprises was founded in 1980 and offers kits of the Pitts Model 12 after purchasing design rights from Mid-America Aircraft. Plans are also marketed (as Model 12 Inc) by the company.

Recent additions to the Kimball range are the Raptor, McCullocoupe, DR 109 and Pitts Python development of the Model 12.



General arrangement of the Kimball (Pitts) Model 12 (VOKBM M-14P radial engine) *(James Goulding)* 0079018

KIMBALL (PITTS) MODEL 12

TYPE: Tandem-seat biplane/kitbuilt.

PROGRAMME: Designed by Curtis Pitts and prototype originally named Macho Stinker. Design started in 1992; construction of prototype began 1994; first flight March 1996; first delivery April 1997. A 'high-performance' version has been replaced by the Pitts Python.

CURRENT VERSIONS: **Model 12:** Baseline version, *as described.*

Model 12-540: As Model 12, but with 224 kW (300 hp) Textron Lycoming AEIO-540 or 246 kW (330 hp) Textron Lycoming AEIO-580 engine. General dimensions as Model 12.

Python: Introduced in 2006, as Model 12, but with increased use of titanium and lightweight landing gear to reduce empty weight to 647 kg (1,427 lb). Front cockpit and controls, wing fuel tank and onboard airstart systems all removed. Prototype N112PP. Currently only available to special order.

High Performance: Strengthened version with shorter fuselage and wing spans. As standard Model 12, except where noted; replaced by Python.

CUSTOMERS: Total of 64 under construction in nine countries: Australia, Canada, Finland, Germany, Iceland, Lithuania, South Africa, Sweden and the US; plus 300 sets of plans sold in a further six countries. Total of 32 flying by June 2006, including one each in Australia, Canada and South Africa and two in Germany.

COSTS: Model 12 kit USD49,150; complete aircraft USD187,000 (2006). Model 12-540 kit USD49,150; complete aircraft USD215,000 (2006).

DESIGN FEATURES: Traditional Pitts design, optimised for aerobatics; contours dictated by M-14P radial engine. Wire- and strut-braced wings of unequal span; upper wing mounted on cabane; single interplane strut each side; wire-braced tailplane and fin. Quoted build time 2,500 hours.

FLYING CONTROLS: Conventional and manual. Rod-connected ailerons on upper and lower wings. Flight-adjustable trim tab in each elevator.

Pitts Python, awarded Sun 'n' Fun Grand Champion plans homebuilt 2006 *(Paul Jackson)* 1040399

STRUCTURE: 4130 steel tube fuselage; wooden spars and wooden truss ribs; fabric covering with aluminium cockpit sides. Metal interplane struts and cabane, composites engine cowling. Upper wing section NACA 639_2-015, lower wing section NACA0012.

LANDING GEAR: Tailwheel type; non-retractable. Optional composites mainwheel fairings. Aluminium sprung main legs; mainwheels 6.00-6 in; Cleveland disc brakes.

POWER PLANT: One 265 kW (355 hp) VOKBM M-14P or 294 kW (394 hp) P.14PF (in Python) nine-cylinder radial engine driving an MT MTV-9-K-C/CL260-9 three-blade constant-speed propeller. In 2003, the option of fitting a 224 kW (300 hp) Textron Lycoming AEIO-540 or 246 kW (330 hp) Textron Lycoming AEIO-580 flat-six was added. Fuel capacity 204 litres (54.0 US gallons; 45.0 Imp gallons) in 68 litre (18.0 US gallon; 15.0 Imp gallon) wing tank and 136 litre (36.0 US gallon; 30.0 Imp gallon) fuselage tank; latter deleted in Python. Oil capacity 15 litres (4.0 US gallons; 3.3 Imp gallons).

ACCOMMODATION: Pilot and passenger in enclosed cockpit under one-piece Perspex canopy hinged on right side. Fixed windscreen.

SYSTEMS: 14 V or 28 V battery.

DIMENSIONS, EXTERNAL (A: Model 12; B: Python; C: Model 12-540):

Wing span: upper	6.71 m (22 ft 0 in)
lower	6.40 m (21 ft 0 in)
Wing chord at tip	1.07 m (3 ft 6 in)
Length overall	5.99 m (19 ft 8 in)
Max width of fuselage	1.07 m (3 ft 6 in)
Height: overall	2.97 m (9 ft 9 in)
to top of upper wing	2.51 m (8 ft 3 in)
Tailplane span	2.44 m (8 ft 0 in)
Wheel track	2.29 m (7 ft 6 in)
Wheelbase	4.42 m (14 ft 6 in)
Propeller diameter: A, C	2.49 m (8 ft 2 in)
B	2.59 m (8 ft 6 in)
Propeller ground clearance: A, C	0.36 m (1 ft 2 in)

AREAS:

Wings, gross	14.01 m^2 (150.8 sq ft)
Ailerons (total)	1.88 m^2 (20.21 sq ft)
Fin	0.34 m^2 (3.69 sq ft)
Rudder, incl tab	0.63 m^2 (6.82 sq ft)
Elevators, incl tab	0.68 m^2 (7.30 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: A	703 kg (1,550 lb)
B	647 kg (1,427 lb)
C	624 kg (1,375 lb)
Max baggage weight	18 kg (40 lb)
Max T-O weight: A, B	1,043 kg (2,300 lb)
C	1,020 kg (2,250 lb)
Max wing loading: A	74.5 kg/m^2 (15.25 lb/sq ft)
B	74.8 kg/m^2 (15.32 lb/sq ft)
C	72.8 kg/m^2 (14.92 lb/sq ft)
Max power loading: A	3.94 kg/kW (6.47 lb/hp)
B	3.55 kg/kW (5.84 lb/hp)
C: AEIO-540	4.56 kg/kW (7.50 lb/hp)
AEIO-580	4.15 kg/kW (6.82 lb/hp)

PERFORMANCE:

Never-exceed and max operating speed (VNE, VMO)	207 kt (384 km/h; 239 mph)
Max cruising speed	178 kt (330 km/h; 205 mph)
Econ cruising speed, 75% power	152 kt (282 km/h; 175 mph)
Stalling speed, power off	56 kt (103 km/h; 64 mph)
Roll rate: A	220°/s
B	300°/s
Max rate of climb at S/L	More than 914 m (3,000 ft)/min
T-O run	76 m (250 ft)
T-O to 15 m (50 ft)	91 m (300 ft)
Landing from 15 m (50 ft)	274 m (900 ft)
Range with max fuel	525 n miles (972 km; 604 miles)

KIMBALL MODEL 15 RAPTOR A S

TYPE: Tandem-seat sportplane kitbuilt.

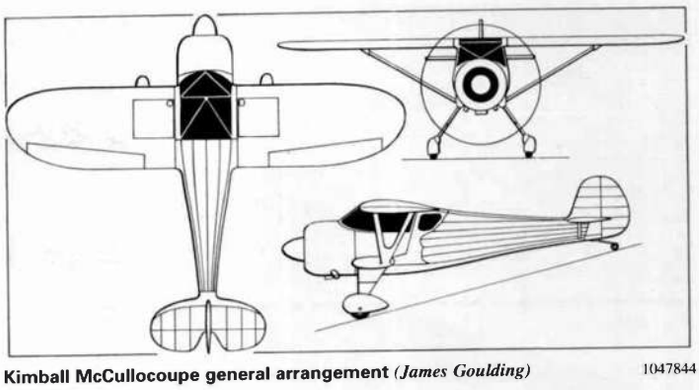
PROGRAMME: Work began late 1999 and project details revealed early 2001; construction start date still not finalised by late-2006.

KIMBALL MCCULLOCOUPE

TYPE: Side-by-side sportplane kitbuilt.

PROGRAMME: Design initiated late 2000. Construction of prototype began in mid-2001, with intended completion date of end 2002. First flight (N511) achieved 1 March 2004 and aircraft made public debut at Sun 'n' Fun in April 2004.

Kimball McCullocoupe prototype at its public debut, April 2004 *(Paul Jackson)* 1047400



Kimball McCullocoupe general arrangement *(James Goulding)* 1047844

All data are provisional.

CUSTOMERS: One flying by October 2006; had achieved more than 200 hours' flying.

DESIGN FEATURES: Similar to clip-wing Monocoupe designs of 1930s.

FLYING CONTROLS: Conventional and manual. Pushrod-actuated ailerons and elevators; cable-operated rudder and tailwheel steering. Mechanisms fully contained within wings to eliminate drag.

STRUCTURE: Fabric-covered tubular steel fuselage. Strut-braced, two-piece wood-covered wing with two Douglas fir main spars and mahogany plywood ribs. Compared to original Monocoupe 110 Special, has larger tail surfaces to improve handling. Strut-braced tailplane. Airfoil Clark Y.

LANDING GEAR: Fuselage-mounted spring aluminium cantilever mainwheel legs (as Kimball-built Pitts Model 12) encased in two-part, telescoping trouser, lower section of which is protected from friction damage when compressed within upper portion. Glass fibre wheel fairings. Tyres 6.00-6.

POWER PLANT: One 294 kW (394 hp) VOKBM M-14PF nine-cylinder radial engine driving a specially designed three-blade constant-speed MT propeller. Fuel capacity 288 litres (76.0 US gallons; 63.3 Imp gallons) in two 98 litre (26.0 US gallon; 21.6 Imp gallon) wing tanks and one 91 litre (24.0 US gallons; 20.0 Imp gallon) tank positioned under seats.

ACCOMMODATION: Pilot and passenger side by side.

DIMENSIONS, EXTERNAL:

Wing span	7.92 m (26 ft 0 in)
Wing chord at root	1.52 m (5 ft 0 in)
Wing aspect ratio	5.4
Length overall	6.86 m (22 ft 6 in)
Height to top of wing	2.44 m (8 ft 0 in)
Propeller diameter	2.49 m (8 ft 2 in)

AREAS:

Wings, gross	11.57 m^2 (124.6 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	635 kg (1,400 lb)
Max baggage weight	36 kg (80 lb)
Max T-O weight	1,134 kg (2,500 lb)
Max wing loading	98.0 kg/m^2 (20.06 lb/sq ft)
Max power loading	3.86 kg/kW (6.35 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	234 kt (434 km/h; 270 mph)
Normal cruising speed	182 kt (338 km/h; 210 mph)
Stalling speed	57 kt (105 km/h; 65 mph)
Endurance	6 h 0 min

KIMBALL DR109

TYPE: Tandem-seat sportplane kitbuilt.

PROGRAMME: Designed by Dan Rihn as two-seat version of his DR 107 One Design. Added to Kimball product line in 2003. Prototype N109DR first flown 1996.

CUSTOMERS: At least 11 sold with 10 on US Register by September 2006.

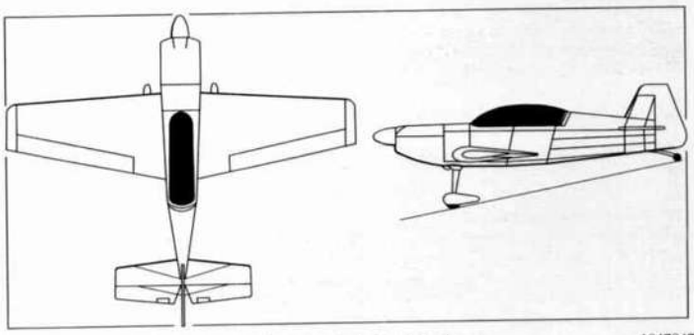
COSTS: Kit USD50,000 (2006).

DESIGN FEATURES: Low-wing monoplane with a specially designed 16% symmetrical aerofoil, conic nose and flat sides. Roll rate 360°/s.

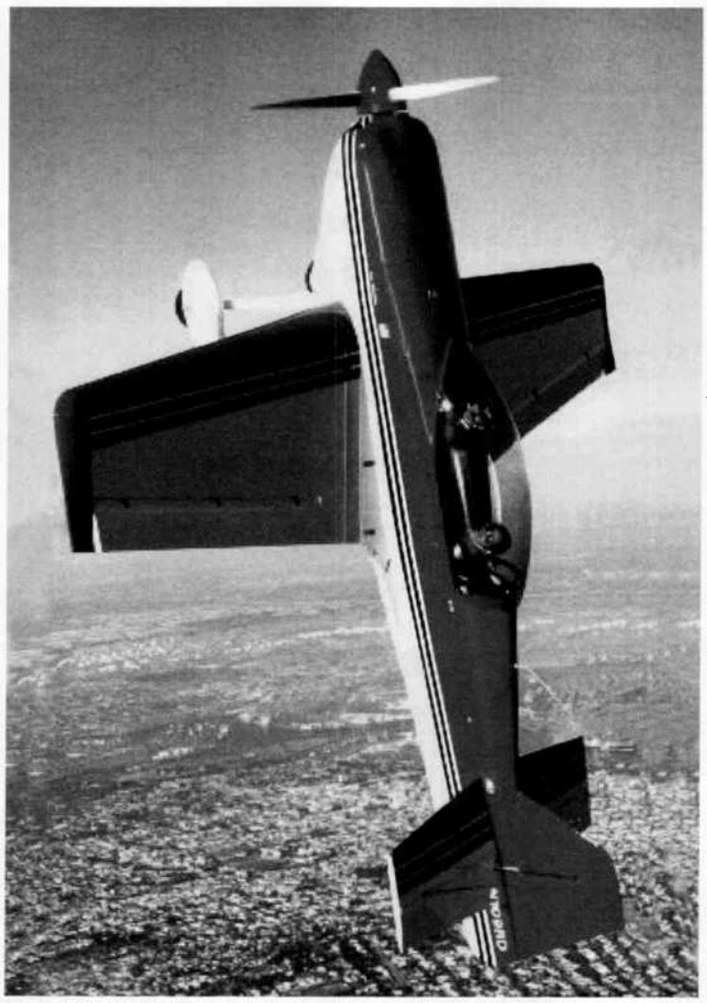
FLYING CONTROLS: Conventional and manual. Pushrod-actuated ailerons and elevator, cable-actuated rudder. Large, symmetrical, constant-chord ailerons extend to 75 per cent of wing length and are mass balanced and aerodynamically counterbalanced; each fitted with spade ground-adjustable balances. Trim tab on each elevator also acts as a servo tab to reduce stick forces.

STRUCTURE: Fuselage of welded steel tube, sheet metal-covered from firewall aft to cockpit; fabric-covered from rear cockpit aft to empennage. Aluminium sheet metal turtledeck. Fabric-covered, wire-braced tail surfaces have steel tube spars and bent-up steel sheet metal ribs. One-piece wing has Douglas fir main and subsidiary box spars and plywood covering. All-wood ailerons. Two-piece glass fibre engine cowling.

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted spring aluminium cantilever mainwheel legs; steerable swivel-mounted aluminium spring tail unit. Mainwheels 5.00-5; hydraulic disc brakes.



Two aspects of the Kimball (Rihn) DR 109 *(Paul Jackson)* 1047847



Kimball (Rihn) DR 109 1047444

POWER PLANT: One Textron Lycoming piston engine. Option of 149 kW (200 hp) AEIO-360-AIE6 flat-four; or 194 kW (260 hp) AEIO-540-D4A5; or 224 kW (300 hp) AEIO-540-L1B5 flat-six; all drive an MTV-9 three-blade variable-pitch constant-speed propeller; prototype has AEIO-540-D4A5. Fuel capacity 114 litres (30.0 US gallons; 25.0 Imp gallons) in main tank ahead of cockpit; total auxiliary fuel capacity 61 litres (16.0 US gallons; 13.3 Imp gallons) in two wing tanks.

ACCOMMODATION: Pilot and passenger in tandem cockpits under single-piece side-opening canopy; each seat has adjustable back nominally reclined to 30° and five-point aerobatic seat belt system. Can be flown solo from rear seat. Dual controls.

SYSTEMS: 12 V electrical system; electric engine starter.

AVIONICS: *Comms:* Terra VHF radio, transponder with encoder; Sigtronics voice-activated intercom.

Flight: Grand Rapids Technology engine information system.

DIMENSIONS, EXTERNAL:

Wing span	7.32 m (24 ft 0 in)
Wing aspect ratio	5.1
Length overall	6.71 m (22 ft 0 in)
Height overall	1.88 m (6 ft 2 in)

DIMENSIONS, INTERNAL:

Cabin max width	0.61 m (2 ft 0 in)

AREAS:

Wings, gross	10.59 m² (114.0 sq ft)

WEIGHTS AND LOADINGS (A: AEIO-360-A1E6, B: AEIO-540-D4A5, C: AEIO-540-L1B5):

Weight empty	612 kg (1,350 lb)
Max T-O weight	1,020 kg (2,250 lb)
Max wing loading	96.4 kg/m² (19.74 lb/sq ft)
Max power loading: A	6.85 kg/kW (11.25 lb/hp)
B	5.27 kg/kW (8.65 lb/hp)
C	4.56 kg/kW (7.50 lb/hp)

PERFORMANCE (A, B, C as above):

Max operating speed: A	167 kt (309 km/h; 192 mph)
B	178 kt (330 km/h; 205 mph)
C	187 kt (346 km/h; 215 mph)
Normal cruising speed: A	146 kt (270 km/h; 168 mph)
B	155 kt (286 km/h; 178 mph)
C	161 kt (298 km/h; 185 mph)
Stalling speed: A, B, C	53 kt (97 km/h; 60 mph)
Max rate of climb at S/L	853 m (2,800 ft)/min
T-O run	183 m (600 ft)
Landing from 15 m (50 ft)	549 m (1,800 ft)
Range (45 min reserves): A	351 n miles (650 km; 404 miles)
B	391 n miles (724 km; 450 miles)
C	373 n miles (692 km; 430 miles)
g limits	±10

KINETIC

KINETIC AVIATION

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KITFOX

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Kitfox programme inaugurated by Denney Aerocraft Company and taken over by SkyStar Aircraft Corporation in 1993. By October 2004, more than 4,500 Kitfox kits had been sold in 42 countries and by August 2005, 5,000 had been delivered. In 1998, the Kitfox Lite was added and in the following year the company streamlined its range. The Series 6 Kitfox and Kitfox Lite² were added in January 2000; the Series 7 was introduced in early 2002 to replace the Series 6; the Kitfox Lite² was completed in 2003.

Rights to Aero Designs Pulsar purchased by SkyStar in late 1996, but in July 1999 the design was sold to the Pulsar Aircraft Corporation.

In early 2001, Skystar opened a spare parts shop at Caldwell and launched an Internet retailing operation. In January 2004, in advance of the Light Sport Aircraft category, SkyStar reorganised into two separate divisions: Sport Plane and Experimental/Manufacturing; the former headed by former President and CEO Ed Downs; the latter by Frank Miller.

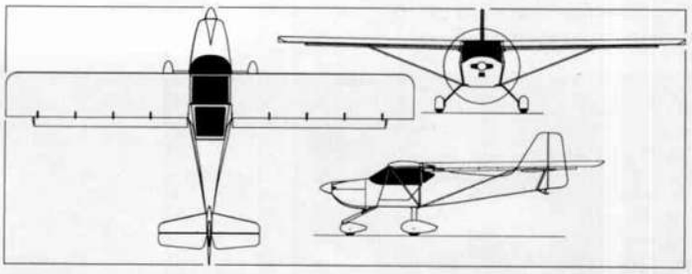
On 14 October 2005, Skystar filed for Chapter 7 bankruptcy; the tooling and intellectual assets were purchased by Sports Plane LLC in early April 2006 and Kitfox Aircraft formed to sell kits. The company is building a 929 m² (10,000 sq ft) factory at Homedale Airport, Idaho. In July 2006, it introduced the Kitfox SuperSport, which was the only available version at that time.

KITFOX KITFOX

TYPE: Side-by-side kitbuilt.

PROGRAMME: Prototype Kitfox first flown 7 May 1984. Initial variants, now discontinued, had MTOW below US 544 kg (1,200 lb) ultralight limit; kit production totalled 257 Model 1s, 491 Model 2s, and 467 Model 3s. Series IV (retrospectively renamed Classic IV) introduced 1991; 323 kits of 476 kg (1,050 lb) MTOW version produced before introduction of current version. First certified version was Series 5, introduced April 1994, but replaced by Series 6 in January 2000; itself replaced by Series 7 in early 2002.

Kitfox 3 two-seat kitbuilt *(Paul Jackson)* 1040500



Kitfox Series 7, showing folded wing position in profile *(Paul Jackson)* 1047848

CURRENT VERSIONS: **Classic IV:** Ultralight version, introduced in 1992. Engines up to 74.6 kW (100 hp) can be fitted under helmeted engine cowling. MTOW 544 kg (1,200 lb). **Speedster** option includes short-span wings and improved streamlining for up to 17 kt (32 km/h; 20 mph) additional speed. Still available in 2005; quoted build time 900 hours.

Kitfox 4B: Biplane version. One only built (N95FX).

Kitfox 6 Convertible: Introduced 2000; tailwheel and nosewheel subvariants. Considerably refined design, with only 5 per cent parts commonality with Kitfox V. Now discontinued.

Kitfox 7: Public debut at Sun 'n' Fun, April 2002; modifications include different struts and redesigned cowling, plus wing technology developed for Kitfox Lite. Longer cargo area introduced in 2005, with external access, by adding dorsal fin.

Kitfox Sport: Intended to meet Sport Pilot category; empty weight of 318 kg (700 lb). Prototype (N702KS) built 2002; one further completed by October 2005.

Kitfox Super Sport: Made public debut at AirVenture '06, at which time only Kitfox available from new owners. Based on Kitfox 7 with additional refinements to be LSA compliant.

Detailed description applies to above version except where indicated.

Kitfox Lite: *Described separately.*

CUSTOMERS: Some 4,500 Kitfox aircraft kits delivered to 42 countries, and over 2,500 built.

COSTS: Kitfox Super Sport kit USD17,985; with engine component package and Rotax 912ULS USD36,239 (2006).

DESIGN FEATURES: Designed to have good short-field performance. Constant-chord, high wing with V strut bracing each side; braced tailplane, mid-mounted. With Kitfox IV, introduced in 1991, new wing with laminar flow section and all-metal hinge brackets for full-span flaperons became standard; windscreen material thickened and given increased slope and, with other changes, resulted in increase in cruising speed; stalling and landing speeds decreased, former due to use of flaperons; wing folding standard. Optional agricultural spray pods. Quoted build time 1,000 hours.

FLYING CONTROLS: Manual. Junkers-type differential flaperons have been redesigned for Series 7; rudder and elevators with anti-balance tab each side. Variable incidence tailplane.

STRUCTURE: Wings of aluminium alloy, plywood ribs and glass fibre tips, with fabric covering overall. Steel tube fuselage and tail unit, with fabric covering.

LANDING GEAR: Fixed. Fuselage-mounted spring aluminium cantilever mainwheel legs with optional speed fairings. Option of tailwheel or trailing link, castoring nosewheel; can be converted after completion; hydraulic disc brakes; optional floats, amphibious floats and skis.

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS driving a Hoffmann HO-V352F two-blade constant-speed propeller; options include 74.6 kW (100 hp) Teledyne Continental O-200, 93.2 kW (125 hp) Teledyne Continental IO-240B and 86.5 kW (116 hp) Textron Lycoming O-235. Fuel in two wing tanks, total capacity 102 litres (27.0 US gallons; 22.5 Imp gallons) of which 98 litres (26.0 US gallons; 21.7 Imp gallons) are usable.

ACCOMMODATION: Two, side by side, can have 0.24 m³ (8.5 cu ft) storage space behind seat. Optional drop tank style cargo pod. Clear Lexan doors can be opened in flight.

DIMENSIONS, EXTERNAL:

Wing span: normal	9.75 m (32 ft 0 in)
optional (Speedster and Sport)	8.84 m (29 ft 0 in)
Wing aspect ratio: normal	7.8
optional (Speedster and Sport)	7.0
Width, wings folded	2.44 m (8 ft 0 in)
Length: overall	5.99 m (19 ft 8 in)
wings folded: Series 7, Super Sport	6.88 m (22 ft 7 in)
Sport	6.71 m (22 ft 0 in)
Max width of fuselage	1.08 m (3 ft 6½ in)
Height overall: tailwheel	1.73 m (5 ft 8 in)
nosewheel	2.44 m (8 ft 0 in)
Tailplane span	2.41 m (7 ft 11 in)
Wheel track	2.03 m (6 ft 8 in)
Propeller diameter	1.83 m (6 ft 0 in)

DIMENSIONS, INTERNAL:

Cabin max width	1.09 m (3 ft 7 in)

AREAS:

Wings, gross (normal): Series 7, Super Sport	12.26 m² (132.0 sq ft)
Speedster and Sport	11.15 m² (120.0 sq ft)

WEIGHTS AND LOADINGS (Rotax 912 ULS):

Weight empty: Series 7	363 kg (800 lb)
Super Sport	340 kg (750 lb)
Sport	318 kg (700 lb)
Max baggage weight	68 kg (150 lb)
Max T-O weight: Series 7	703 kg (1,550 lb)
Super Sport	598 kg (1,320 lb)
Sport	558 kg (1,232 lb)
Max wing loading: Series 7	57.3 kg/m² (11.74 lb/sq ft)
Super Sport	48.8 kg/m² (10.00 lb/sq ft)
Sport	50.1 kg/m² (10.27 lb/sq ft)
Max power loading: Series 7	9.57 kg/kW (15.72 lb/hp)
Super Sport	8.15 kg/kW (13.39 lb/hp)
Sport	7.60 kg/kW (12.49 lb/hp)

PERFORMANCE (Super Sport, two crew, Rotax 912 ULS, unless stated otherwise):

Never-exceed speed (VNE)	121 kt (225 km/h; 140 mph)
Max level speed	111 kt (205 km/h; 125 mph)
Cruising speed	104 kt (193 km/h; 120 mph)
Stalling speed	36 kt (66 km/h; 41 mph)
Max rate of climb at S/L	396 m (1,300 ft)/min
Service ceiling	4,875 m (16,000 ft)
T-O run	89 m (290 ft)
Landing run	83 m (270 ft)
Range, with reserves:	
Series 7	664 n miles (1,231 km; 765 miles)
Super Sport	531 n miles (984 km; 612 miles)
Sport	573 n miles (1,062 km; 660 miles)
Endurance	5 h 24 min
g limits, pilot only	+3.8/−1.52

KOLB

NEW KOLB AIRCRAFT COMPANY INC

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GENERAL MANAGER: Donnie Sizemore
PLANT MANAGER: Ray Brown
CHIEF DESIGNER: Izek Therrien

EUROPEAN DISTRIBUTOR:
Silver Fern Microlights (Aircraft Sales) Limited
46 Roxby Road, Winterton, Scunthorpe, DN15 9SX, UK
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Web: www.sfmicrolights.com

The New Kolb Aircraft Company purchased design rights to Homer Kolb's series of light aircraft in 1999. FireStar continues to be marketed; the Laser was not put into production in kit built form, while in 2004, Kolb discontinued production of the Sling Shot but reinstated it in 2006. Kolbra launched at EAA convention, Oshkosh, July 2000. Total sales of all products exceed 3,000. In its 1,347 m² (14,500 sq ft) factory, Kolb has 18 employees and also produces assemblies for other kit manufacturers, including Rihn Aircraft. In 2005, the new generation Laser 2 was under development, intended for the LSA market.

In April 2002, Kolb announced that it had been appointed US assembly centre and distributor for the Ultravia Pelican Sport (which see) which is marketed as the Kolb Sport 600; on 28 June 2006 it acquired Ultravia's assets. A strategic alliance with Flyer Industria Aeronautica Ltda of Sao Paulo, Brazil, has seen work begin on the Kolb Flyer Super Sport, due to have been revealed at the Sebring Air show in January 2007.

In June 2005, company owner Norm Labhart was killed in the crash of a Kolb Mk III Xtra.

KOLB FIREFLY

TYPE: Single-seat ultralight kitbuilt.

PROGRAMME: Introduced at Sun 'n' Fun 1995.

CUSTOMERS: Over 100 flying by mid-2002 (latest information).

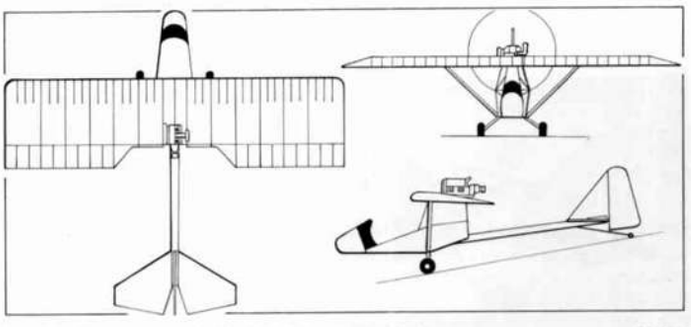
COSTS: Kit USD8,315 excluding engine. Quick-build option, extra USD2,895 (both 2006).

DESIGN FEATURES: High, constant-chord wing and boom-mounted empennage, based on FireStar; meets FAR Pt 103.7. Folding wings and tail for easy storage. Quoted build time 400 hours.

Modified NACA 4412 series aerofoil.

FLYING CONTROLS: Full-span flaperons.

Single-seat Kolb FireFly *(Paul Jackson)* 1040395



Kolb FireFly single-seat ultralight *(James Goulding)* 0045105

STRUCTURE: Welded 4130 chromoly steel fuselage cage; 127 mm (5 in) rear fuselage tube and wing spar. Glass fibre nosecone; aluminium tube, fabric-covered wings.

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted spring cantilever mainwheel legs; speed fairings and brakes optional.

POWER PLANT: One 29.5 kW (39.6 hp) Rotax 447 UL two-cylinder piston engine with Rotax 2.58:1 reduction unit, driving WarpDrive three-blade ground adjustable wooden propeller (three-blade IVO propeller optional). Fuel capacity 18.9 litres (5.0 US gallons; 4.2 Imp gallons).

ACCOMMODATION: Optional full enclosure cockpit.

DIMENSIONS, EXTERNAL:

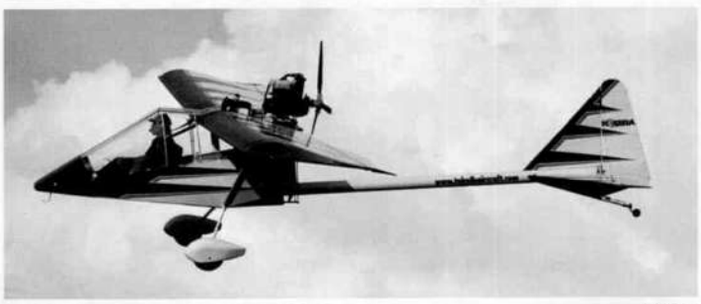
Wing span	6.71 m (22 ft 0 in)
Width, wings folded	1.75 m (5 ft 9 in)
Length overall	5.94 m (19 ft 6 in)

For details of the latest updates to *Jane's All the World's Aircraft* online and to discover the additional information available exclusively to online subscribers please visit
jawa.janes.com

Height overall ..... 1.75 m (5 ft 9 in)
Wheel track ..... 1.45 m (4 ft 9 in)
AREAS:
Wings, gross ..... 10.87 m² (117.0 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 115 kg (253 lb)
Max T-O weight ..... 226 kg (500 lb)
PERFORMANCE:
Never-exceed speed (VNE) ..... 69 kt (128 km/h; 80 mph)
Max operating speed ..... 60 kt (112 km/h; 70 mph)
Stalling speed ..... 24 kt (44 km/h; 27 mph) CAS
Max rate of climb at S/L ..... 305 m (1,000 ft)/min
T-O and landing run ..... 46 m (150 ft)
g limits ..... +4/–2

KOLB KOLBRA

TYPE: Tandem-seat ultralight kitbuilt.
PROGRAMME: First flown 7 May 2000 and publicly announced July 2000. Debut at Oshkosh that month. Prototype N718KA.
CURRENT VERSIONS: **Kolbra:** Ultralight trainer version, meeting FAR Pt 103.
King Kolbra: Experimental version, meeting FAR Pt 23.
CUSTOMERS: Over 50 kits sold and 12 aircraft flying by mid-2006, including 10 Kolbras.
COSTS: Kolbra kit USD12,179 excluding engine and covering (2006).
DESIGN FEATURES: Comprises Mark III wings and tail, FireStar nose and Sling Shot-style landing gear; resulting hybrid then optimised for training role. Quoted build time 450 hours.
FLYING CONTROLS: Manual. Full-span flaperons.
STRUCTURE: Welded 4130 chromoly steel fuselage cage; 152 mm (6 in) diameter rear fuselage tube and wing spar. Glass fibre nosecone; aluminium tube wings, fabric-covered.
LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted spring chromoly cantilever mainwheel legs with Matco wheels and high flotation or tundra tyres. Optional hydraulic disc brakes and wheel fairings.
POWER PLANT: One 47.8 kW (64.1 hp) Rotax 582 UL two-cylinder piston engine with 'B' type 2.58:1 ratio gearbox, or 'C' or 'E' type 3.47:1 ratio gearbox, driving a two- or three-blade IVO or three-blade Warp Drive propellers in Kolbra. One 59.6 kW (79.9 hp) Rotax 912 UL, 73.5 kW (98.6 hp) Rotax 912 ULS or 59.7 kW (80 hp) Jabiru 2200 can be fitted driving 1.83 m (6 ft 0 in) two- or 1.63 m (5 ft 4 in) three-blade IVO or Warp Drive propeller in King Kolbra.
Fuel capacity (both) 37.9 litres (10.0 US gallons; 8.3 Imp gallons).
SYSTEMS: Optional electric starter and dual Magnum strobes.
EQUIPMENT: Optional BRS ballistic parachute.
DIMENSIONS, EXTERNAL:
Wing span ..... 8.64 m (28 ft 4 in)
Length overall ..... 7.32 m (24 ft 0 in)
Height overall, three-blade propeller ..... 2.03 m (6 ft 8 in)
AREAS:
Wings, gross ..... 14.31 m² (154.0 sq ft)
WEIGHTS AND LOADINGS (A: Kolbra Trainer with Rotax 582, B: King Kolbra with Jabiru):
Weight empty: A ..... 225 kg (496 lb)
B ..... 249 kg (550 lb)
Max T-O weight: A, B ..... 454 kg (1,000 lb)
PERFORMANCE:
Never-exceed speed (VNE):
A, B ..... 95 kt (177 km/h; 110 mph)
Normal cruising speed: A ..... 65 kt (121 km/h; 75 mph)
B ..... 74 kt (137 km/h; 85 mph)
Stalling speed, flaps down: A ..... 31 kt (57 km/h; 35 mph)
B ..... 40 kt (73 km/h; 45 mph)
Max rate of climb at S/L: A, B ..... 335 m (1,100 ft)/min
T-O run: A, B ..... 46 m (150 ft)
Landing run: A, B ..... 76 m (250 ft)
Range: A ..... 160 n miles (296 km; 184 miles)
B ..... 250 n miles (463 km; 287 miles)
g limits ..... +4/–2



Kolb Kolbra tandem-seat ultralight *(Paul Jackson)* 1047411

KOLB MARK III XTRA

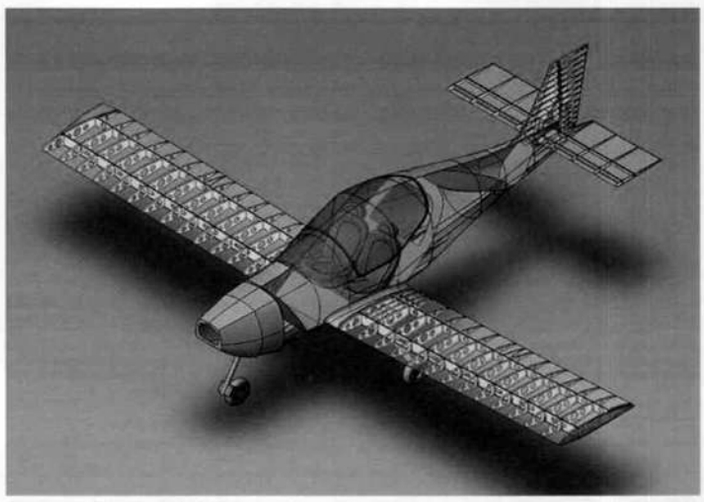
TYPE: Side-by-side ultralight kitbuilt.
PROGRAMME: Based on the TwinStar of 1984 and its 1990 Mark III Classic derivative with further aerodynamic alteration by Barnaby Wainfan.
CUSTOMERS: Over 50 kits sold by June 2004 (plus over 300 of Classic); by October 2005 42 Xtras and 304 Classics were flying.
COSTS: USD11,889 excluding engine, propeller, instruments, upholstery and covering (2006).
DESIGN FEATURES: Xtra incorporates aerodynamic refinements to fuselage, including chisel nose, devised by Barnaby Wainfan. Wings and tail fold for transportation and storage. Quoted build time 450 hours.
FLYING CONTROLS: Manual. Dual controls optional. Flaperons.
STRUCTURE: Welded 4130 chromoly steel fuselage cage. Glass fibre nosecone; fabric-covered aluminium tube wings.
LANDING GEAR: Tailwheel type; fixed. As Kolb Kolbra.
POWER PLANT: Choice of either 47.8 kW (64.1 hp) Rotax 582 or 59.6 kW (79.9 hp) Rotax 912 UL driving a three-blade propeller. Fuel capacity 37.9 litres (10.0 US gallons; 8.3 Imp gallons).

Kolb Mk III Xtra registered in UK *(Paul Jackson)* 1133243

ACCOMMODATION: Pilot and passenger in side-by-side seating. Doors open forward and are removable.
EQUIPMENT: Optional BRS ballistic parachute.
DIMENSIONS, EXTERNAL:
Wing span ..... 9.14 m (30 ft 0 in)
Length overall ..... 7.32 m (24 ft 0 in)
Height overall ..... 1.93 m (6 ft 4 in)
AREAS:
Wings, gross ..... 14.87 m² (160.0 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 204 kg (450 lb)
Max T-O weight ..... 453 kg (1,000 lb)
PERFORMANCE (A: Rotax 582; B: Rotax 912):
Never-exceed speed (VNE) ..... 86 kt (160 km/h; 100 mph)
Normal cruising speed: A ..... 70 kt (129 km/h; 80 mph)
B ..... 78 kt (145 km/h; 90 mph)
Stalling speed: A ..... 33 kt (62 km/h; 38 mph)
B ..... 36 kt (66 km/h; 41 mph)
Max rate of climb at S/L: A ..... 305 m (1,000 ft)/min
B ..... 396 m (1,300 ft)/min
T-O run: A, B ..... 46 m (150 ft)
Landing run: A ..... 61 m (200 ft)
B ..... 53 m (175 ft)
Range: A ..... 200 n miles (370 km; 230 miles)
g limits ..... +4/–2

KOLB LASER 2

TYPE: Side-by-side ultralight kitbuilt.
PROGRAMME: Announced 2005; loosely based around Kolb Laser of mid-1990s, development of which was abandoned in 2000. It is intended to be LSA compliant.
LANDING GEAR: Fixed tricycle layout.
All data are provisional.
DIMENSIONS, EXTERNAL:
Wing span ..... 9.14 m (30 ft 0 in)
Length overall ..... 6.71 m (22 ft 0 in)
Height overall ..... 2.03 m (6 ft 8 in)
DIMENSIONS, INTERNAL:
Cabin max width ..... 1.17 m (3 ft 10 in)
PERFORMANCE:
Max cruising speed ..... 120 kt (222 km/h; 138 mph)
Stalling speed: flaps up ..... 40 kt (75 km/h; 46 mph)
flaps down ..... 35 kt (65 km/h; 41 mph)
Max rate of climb at S/L ..... 335 m (1,100 ft)/min
Range ..... 600 n miles (1,111 km; 690 miles)

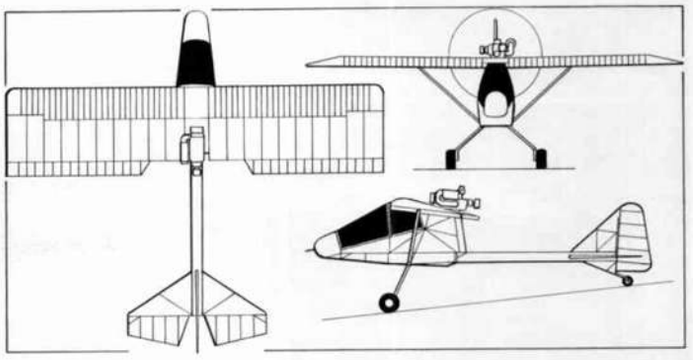


Cutaway drawing of Kolb Laser 2 1133313

KOLB SLING SHOT

TYPE: Tandem-seat ultralight.
PROGRAMME: First flown July 1996.
CUSTOMERS: Over 30 flying by November 2006.
COSTS: Kit USD12,339; quick-build option adds USD3,195 (2006).
DESIGN FEATURES: Generally as for FireFly. Quoted build time 400 hours.
FLYING CONTROLS: Full-span flaperons.
STRUCTURE: Welded 4130 chromoly steel fuselage cage; 127 mm (5 in) rear fuselage tube and wing spar. Glass fibre nosecone and steel-reinforced, aluminium tube, fabric-covered wings.
LANDING GEAR: Tailwheel type; fixed; hydraulic disc brakes optional.
POWER PLANT: One 47.8 kW (64.1 hp) Rotax 582 using 2.58:1 or 3.47:1 reduction unit driving IVO two- or three-blade wooden propeller (metal propeller optional); further options are

Kolb Sling Shot *(Paul Jackson)* 0089501



Kolb Sling Shot two-seat ultralight *(James Goulding)* 0045107

37.0 kW (49.6 hp) Rotax 503 with 2.58:1 reduction unit; 59.6 kW (79.9 hp) Rotax 912 and 59.7 kW (80 hp) Jabiru 2200. Fuel capacity 37.0 litres (10.0 US gallons; 8.3 Imp gallons). Electric starter optional.

EQUIPMENT: Optional ballistic parachute and strobe lighting.

DIMENSIONS, EXTERNAL:

Wing span	6.71 m (22 ft 0 in)
Width, wings folded	1.91 m (6 ft 3 in)
Length overall	5.79 m (19 ft 0 in)
Height overall	2.08 m (6 ft 10 in)

AREAS:

Wings, gross	10.22 m² (110.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	179 kg (395 lb)
Max T-O weight	385 kg (850 lb)

PERFORMANCE (Rotax 582 engine):

Max operating speed	100 kt (185 km/h; 115 mph)
Normal cruising speed	78 kt (145 km/h; 90 mph)
Stalling speed, power off	36 kt (66 km/h; 41 mph)
Max rate of climb at S/L	396 m (1,300 ft)/min
T-O and landing run	61 m (200 ft)
g limits	+4/–2

LANCAIR

LANCAIR INTERNATIONAL

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CEO: Joseph Bartels
CUSTOMER SUPPORT: Kim Lorentzen
GENERAL MANAGER: Tim Ong

More than 2,000 Lancairs (including out-of-production Model 235) sold to customers in 40 countries; around 800 are currently flying.

Lancair International is part of Lancair Group, which also owns Columbia Aircraft Manufacturing Company (known as Lancair Company until 2005). Both companies had been sold to Joseph Bartels on 30 January 2003 but remained at Redmond with same employees.

Lancair is also US distributor for HeliSport CH-7 Kompress light helicopter.

LANCAIR LANCAIR IV, IV-P and SENTRY

TYPE: Four-seat kitbuilt.

PROGRAMME: Kit deliveries began 1990. On 20 February 1991, prototype set NAA world speed record between San Francisco and Denver of 314.7 kt (583.2 km/h; 362.4 mph). First kit completed July 1991.

CURRENT VERSIONS: **Lancair IV:** Standard version.

Description mainly applies to Lancair IV.

Lancair IV-P: Pressurised version; first flight 1 November 1993. Provides 0.34 bar (5.0 lb/sq in) differential; equipment from Dukes Research of California.

Lancair Propjet IV-P: Powered by 560 kW (751 shp) Walter M 601E turboprop; prototype (N750TL, registered as a **IV-TP**) first flown 9 July 2001. Available as option to standard IV-P at cost of US$7,500; completed aircraft can be retrospectively converted; main structural alteration is repositioning of firewall.

On 11 September 2002, a Lancair IV-P Propjet flown by Wesley E Behel Jr claimed a Class C-1c Group 2 speed record over a 3 km course at restricted altitude by flying at 307 kt (568 km/h; 352 mph).

Lancair Sentry: Tandem-seat version based on Lancair IV and retaining wing and lower fuselage, with redesigned upper fuselage and vertical tail, latter of 10 per cent increased area. Prototype (N806EY) first flown 7 September 2002. Power supplied by same engine as Propjet IV-P, but with larger fuel tank. Intended for military training and civil air racing markets.

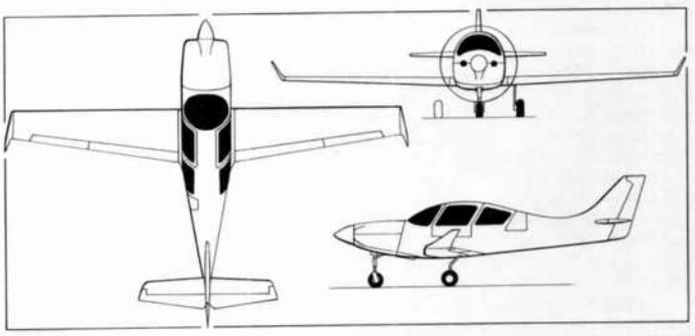
CUSTOMERS: Total of 580 kits sold; more than 270 flying by mid-2006, including 24 Propjets. The Mexican Navy assessing Sentry to augment its Aermacchi Redigo fleet.

COSTS: Fastbuild USD92,500. Pressurised version: Fastbuild USD117,500. Firewall fastbuild options and two-week builder workshop programmes available. Turbine IV-P USD129,500; Walter engine USD84,000. Sentry USD119,900 (2006).

DESIGN FEATURES: Conventional seating for four persons in airframe of new design, but following Lancair formula for high cruising speeds. Optional winglets. Quoted fastbuild construction time 1,000 hours.

FLYING CONTROLS: Conventional and manual. Fowler flaps. Sidestick controllers for both pilots. Trim tabs in port aileron and port elevator. Optional speed brakes.

Lancair IV with landing gear retracting *(Paul Jackson)* 1040400



Lancair IV four-seat light aircraft *(James Goulding)* 0106496

STRUCTURE: Carbon fibre/epoxy airframe, with Nomex honeycomb cores.

LANDING GEAR: Tricycle layout; retractable. Mainwheels 15×6.00-6; nosewheel is 5.00-5. Cleveland dual-piston caliper brakes. Hydraulic actuation.

POWER PLANT: One 261 kW (350 hp) Teledyne Continental TSIO-550-E1B,-E2B or -E3B twin-turbocharged flat-six engine driving a three-blade Hartzell HC-H3YF-1RF/F7693DF or HC-H3YF-2UF/FC7693DF constant-speed propeller or four-blade MTV-14D/195-30a constant-speed propeller. Walter M 601E turboprop can also be fitted; as described above, with three-blade Avia V-508E/2134 propeller or Hartzell HC-B3TW-3X/T8290NX three-blade propeller with Walter-installed governor. Two versions of PT-6A turboprop tested during 1999, but apparently not proceeded with. Lancair IV-P N540LM flew September 2000 as testbed for 485 kW (650 hp) Eagle 540 piston engine. Fuel in integral wing tanks; total standard usable capacity in IV-P 341 litres (90.0 US gallons; 74.9 Imp gallons); long-range tanks, total capacity 416 litres (110 US gallons; 91.6 Imp gallons); in Propjet IV-P 473 litres (125 US gallons; 104 Imp gallons), optional long-range tanks increasing this to 549 litres (145 US gallons; 121 Imp gallons). Oil capacity 11.4 litres (3.0 US gallons; 2.5 Imp gallons).

SYSTEMS: Thermoelectric de-icing system tested during 2001.

DIMENSIONS, EXTERNAL:

Wing span: plain tips	9.19 m (30 ft 2 in)
winglets	9.93 m (32 ft 7 in)
Wing chord: at root	1.18 m (3 ft 10½ in)
at tip	0.77 m (2 ft 6¼ in)
Wing aspect ratio	9.3
Width, wings removed	2.41 m (7 ft 11 in)
Length overall: IV-P	7.62 m (25 ft 0 in)
Propjet IV-P	7.92 m (26 ft 0 in)
Height overall	2.44 m (8 ft 0 in)
Tailplane span	3.35 m (11 ft 0 in)
Wheel track	2.13 m (7 ft 0 in)
Wheelbase	1.88 m (6 ft 2 in)
Propeller diameter	1.93 m (6 ft 4 in)
Propeller ground clearance	0.25 m (10 in)

DIMENSIONS, INTERNAL:

Cabin: Length	3.20 m (10 ft 6 in)
Max width	1.17 m (3 ft 10 in)
Max height	1.22 m (4 ft 0 in)

AREAS:

Wings, gross: plain tips	9.10 m² (98.0 sq ft)
winglets	10.03 m² (108.0 sq ft)
Winglets, total	1.30 m² (14.00 sq ft)
Flaps, total	1.12 m² (12.07 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: IV	907 kg (2,000 lb)
IV-P	998 kg (2,200 lb)
Propjet IV-P	1,043 kg (2,300 lb)
Max baggage weight	68 kg (150 lb)
Max T-O weight: IV, IV-P	1,610 kg (3,550 lb)
Propjet IV-P	1,723 kg (3,800 lb)

Turboprop Lancair Propjet IV-P *(Paul Jackson)* 1040401

Max landing weight	1,451 kg (3,200 lb)
Max wing loading: IV, IV-P	176.9 kg/m² (36.22 lb/sq ft)
Propjet IV-P	189.3 kg/m² (38.78 lb/sq ft)
Max power loading: IV-P	6.17 kg/kW (10.14 lb/hp)
Propjet IV-P	3.08 kg/kW (5.06 lb/shp)
PERFORMANCE:	
Never-exceed speed (VNE)	274 kt (507 km/h; 315 mph)
Cruising speed at 75% power at 7,315 m (24,000 ft):	
IV-P	291 kt (539 km/h; 335 mph)
Propjet IV-P	322 kt (595 km/h; 370 mph)
Stalling speed:	
IV-P standard wing	66 kt (121 km/h; 75 mph)
IV-P with winglets	64 kt (118 km/h; 73 mph)
Propjet IV-P	65 kt (120 km/h; 74 mph)
Max rate of climb at S/L: IV-P	792 m (2,600 ft)/min
Propjet IV-P	2,134 m (7,000 ft)/min
Service ceiling	8,840 m (29,000 ft)
T-O run: IV, IV-P	457 m (1,500 ft)
Propjet IV-P	366 m (1,200 ft)
T-O to 15 m (50 ft)	549 m (1,800 ft)
Landing run: IV, IV-P	518 m (1,700 ft)
Propjet IV-P	427 m (1,400 ft)
Range, with max fuel, no reserves:	
IV-P	1,347 n miles (2,494 km; 1,550 miles)
Propjet IV-P	1,216 n miles (2,253 km; 1,400 miles)
Endurance: IV-P	6 h 0 min
Propjet IV-P	4 h
g limits: IV-P	+4.4/–2.3 (allowable), +8/–4 ultimate
Propjet IV-P	+3.8/–1.9

LANCAIR LANCAIR ES and SUPER ES

TYPE: Four-seat kitbuilt.

PROGRAMME: Prototype unveiled at Oshkosh in 1992; flight testing completed 1995. Certification of Fastbuild kit granted early 1996 under simplified version of FAR Pt 23 governing light aircraft. Further improvements to Fastbuild kit introduced in early 2002.

CURRENT VERSIONS: **ES**: Baseline version.

ES-P: Pressurised version; introduced 3 March 2004; carbon fibre wings and fuselage.

Super ES: Higher-powered version.

Description applies mainly to this version.

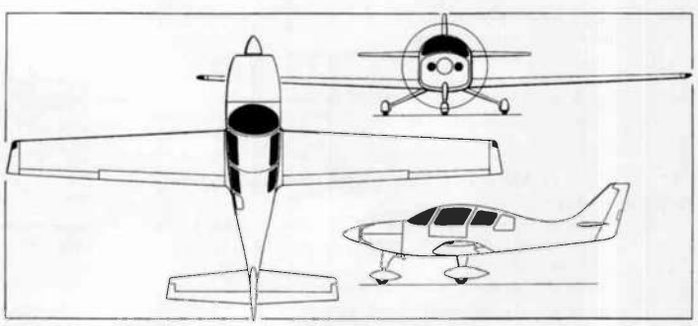
CUSTOMERS: Total of 254 kits sold by September 2006, of which 55 flying by that date. Production continues.

COSTS: Standard Fastbuild USD76,500; ES-P USD112,500. Estimated completion cost of ES USD138,000 (2006).

DESIGN FEATURES: Generally as for earlier Lancairs; hardtop cabin with paired side-by-side seats. Sidestick controls. Quoted Fastbuild kit construction time 1,800 hours; with new 2002 improvements reduced to quoted time of 700 hours.

FLYING CONTROLS: Generally as for Lancair IV.

Lancair ES four-seat kitbuilt *(Paul Jackson)* 1040397



Lancair Super ES general arrangement *(James Goulding)* 1158953

STRUCTURE: All-composites.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring cantilever mainwheel legs with wheel fairings. Nosewheel steerable through 90°. Main tyres 6.00–15×6; nose 5.00-5.

POWER PLANT: *ES:* One 149 kW (200 hp) Teledyne Continental IO-360-ES1B flat-six engine; three-blade MTV-12-D/188-17 constant-speed propeller.

Super ES: One 209 kW (280 hp) Teledyne Continental IO-550-G or 231 kW (310 hp) IO-550-N19B or -N20B with choice of three-blade Hartzell PHC-J3YF-1RF/F7693DF or

Lancair Super ES *(Paul Jackson)* 1040396

MTV-9-D/198-58 constant-speed propeller. Standard fuel capacity 360 litres (95.0 US gallons; 79.1 Imp gallons), in two wing tanks. Oil capacity 7.6 litres (2.0 US gallons; 1.7 Imp gallons).

ES-P: One 231 kW (310 hp) Teledyne Continental TSIO-550C or IO-550-N19B or -N20B and propellers as above. Fuel capacity 397 litres (105 US gallons; 87.4 Imp gallons).

ACCOMMODATION: Pilot and three passengers in two pairs of seats. Optional second door introduced 2004.

DIMENSIONS, EXTERNAL:

Wing span	10.82 m (35 ft 6 in)
Wing chord: at root	1.50 m (4 ft 11 in)
at tip	0.91 m (3 ft 0 in)
Wing aspect ratio	9.0
Width, wings removed	2.41 m (7 ft 11 in)
Length overall	7.62 m (25 ft 0 in)
Height overall	2.34 m (7 ft 8 in)
Tailplane span	4.01 m (13 ft 2 in)
Wheel track	2.36 m (7 ft 9 in)
Wheelbase	1.88 m (6 ft 2 in)
Propeller diameter	1.93 m (6 ft 4 in)

DIMENSIONS, INTERNAL:

Cabin: as Lancair IV	
Baggage hold volume	1.0 m^3 (35 cu ft)

AREAS:

Wings, gross	13.01 m^2 (140.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty:	
ES, Super ES with IO-550-G	862 kg (1,900 lb)
Super ES with IO-550N	907 kg (2,000 lb)
Max baggage weight	79 kg (175 lb)
Max T-O weight: Normal	1,451 kg (3,200 lb)
Utility	1,361 kg (3,000 lb)
ES-P	1,587 kg (3,500 lb)
Max wing loading: Normal	111.60 kg/m^2 (22.86 lb/sq ft)
Utility	104.6 kg/m^2 (21.43 lb/sq ft)
ES-P	122.1 kg/m^2 (25.00 lb/sq ft)
Max power loading: Normal:	
ES	9.74 kg/kW (16.00 lb/hp)
Super ES	6.96 kg/kW (11.43 lb/hp)
Utility: ES	9.13 kg/kW (15.00 lb/hp)
Super ES	6.52 kg/kW (10.71 lb/hp)
ES-P	6.87 kg/kW (11.29 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	220 kt (467 km/h; 253 mph)
Cruising speed at 75% power at FL100:	
ES	174 kt (332 km/h; 200 mph)
Super ES	196 kt (362 km/h; 225 mph)
Cruising speed at 75% power at FL240: ES-P	255 kt (472 km/h; 293 mph)
Stalling speed: ES	50 kt (92 km/h; 57 mph)
Super ES	57 kt (105 km/h; 65 mph)
Rate of climb at S/L: ES	381 m (1,250 ft)/min
Super ES	610 m (2,000 ft)/min
Service ceiling: ES, Super ES	5,490 m (18,000 ft)
ES-P	7,315 m (24,000 ft)
T-O run	183 m (600 ft)
Landing run	244 m (800 ft)
Range, max fuel, no reserves:	
ES	1,260 n miles (2,333 km; 1,450 miles)
Super ES	1,277 n miles (2,365 km; 1,470 miles)
ES-P	1,042 n miles (1,931 km; 1,200 miles)
Endurance: ES	7 h
Super ES	6 h
g limits: Normal	+4.4/−2.3
Utility	+9.0/−4.5

LANCAIR LEGACY

TYPE: Side-by-side kitbuilt.

PROGRAMME: Prototype (N199L) first flown 16 July 1999, publicly displayed at Oshkosh 28 July 1999. First kitbuilt example (N540L) first flown 15 May 2001. Early aircraft were marked "Legacy 2000".

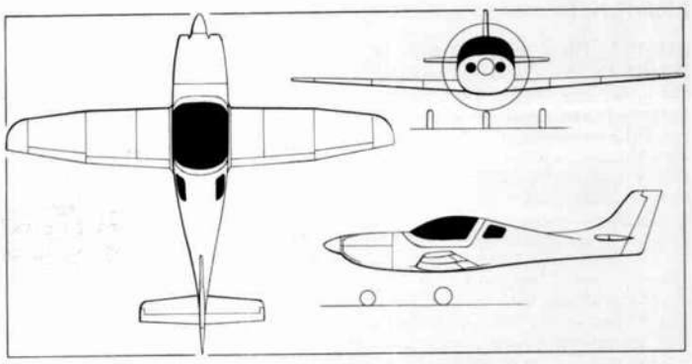
At Reno, Nevada, on 13 September 2002, a Legacy flown by Frederick E Schrameck claimed a Class C-1c Group 1 record for speed, over a 3 km course at restricted altitude, of 297 kt (550 km/h; 342 mph).

CURRENT VERSIONS: **Legacy:** Retractable landing gear version, *as described.*

Legacy FG: Fixed landing gear version introduced at Sun 'n' Fun 2003; as standard Legacy, but built mainly of glass fibre, rather than carbon fibre. Prototype N359L.

CUSTOMERS: Ten sold during Oshkosh debut; 16 by end of 1999, 150 by May 2001; by September 2002, over 100 had been delivered. Sales exceeded 290 kits by September 2006, by which time 113 aircraft were registered in the US; Legacy FG numbered eight at this time.

Lancair Legacy kitbuilt *(Paul Jackson)* 1040402



Lancair Legacy general arrangement *(James Goulding)* 0126950

COSTS: Legacy USD55,500; Legacy FG USD38,500. Estimated completion cost USD119,000 (Legacy) and USD91,000 (Legacy FG) (2006).

DESIGN FEATURES: Improved version of Lancair series of two-seat kitbuilts, offering increased cabin area, new wing and better performance; only part common to Lancair 360 is horizontal stabiliser. Quoted build time under 1,000 hours.

Streamlined design. Sweptforward wing trailing-edge, tapered tailplane and sweptback fin; low wing and mid-mounted horizontal tail.

Wing section NLF(1)-0215F; incidence 1°; dihedral 3°; twist 1° 30'; thickness/chord ratio 15 per cent.

FLYING CONTROLS: Conventional and manual. Fowler flaps. Aileron and elevator electric trim system included. Optional rudder trim and speedbrakes.

STRUCTURE: Carbon fibre airframe.

LANDING GEAR: Tricycle type; retractable. Mainwheels retract inwards; nosewheel rearwards. Hydraulic actuation. Cleveland 5.00-5 in wheels and brakes.

POWER PLANT: *Legacy:* Initially offered with one 149 kW (200 hp) Textron Lycoming IO-360-C1D6 flat-four driving a two-blade Hartzell or three-blade MTV-12B constant-speed propeller. Hartzell introduced 7694-4T two-blade propeller specifically for Legacy in February 2002. By 2003 this had been upgraded to a 231 kW (310 hp) Teledyne Continental IO-550-N driving a three-blade constant-speed propeller. Optional engines include 134 kW (180 hp) Lycoming IO-360-B1F and -M1A and 194 kW (260 hp) Lycoming IO-540. Standard fuel capacity 250 litres (66.0 US gallons; 55.0 Imp gallons).

Experimental example with supercharger displayed at Sun 'n' Fun 2002, offering 295 kt (547 km/h; 340 mph) at 4,570 m (15,000 ft).

Legacy FG: One 149 kW (200 hp) Textron Lycoming IO-360-A1B6 flat-four driving a Hartzell HC-F2YR-1FX/F7496X Scimitar two-blade propeller. Alternatively a 134kW (180 hp) Superior TNIO-360 Turbo Normalised XP-360 can be fitted. Standard fuel capacity 246 litres (65.0 US gallons; 54.1 Imp gallons).

ACCOMMODATION: Pilot and passenger in 25° reclined side-by-side seats beneath forward-hinging, one-piece canopy.

DIMENSIONS, EXTERNAL:

Wing span	7.77 m (25 ft 6 in)
Wing aspect ratio	7.9
Length overall	6.71 m (22 ft 0 in)
Height overall	2.54 m (8 ft 4 in)
Tailplane span	2.54 m (8 ft 4 in)
Wheelbase	1.37 m (4 ft 6 in)

DIMENSIONS, INTERNAL:

Cabin: Length	1.60 m (5 ft 3 in)
Max width	1.10 m (3 ft 7½ in)
Max height	1.17 m (3 ft 10 in)
Baggage area	1.49 m^3 (16.0 cu ft)

AREAS:

Wings, gross	7.66 m^2 (82.5 sq ft)

WEIGHTS AND LOADINGS (A: Legacy; B: Legacy FG):

Weight empty: A	680 kg (1,500 lb)
B	590 kg (1,300 lb)
Max baggage weight: A, B	41 kg (90 lb)
Max T-O weight:	
Normal category: A, B	997 kg (2,200 lb)
Utility category: A, B	861 kg (1,900 lb)
Max wing loading:	
Normal category: A, B	130.2 kg/m^2 (26.67 lb/sq ft)
Utility category: A, B	112.4 kg/m^2 (23.03 lb/sq ft)
Max power loading:	
Normal category: A	4.32 kg/kW (7.10 lb/hp)
B	6.70 kg/kW (11.00 lb/hp)
Utility category: A	3.73 kg/kW (6.13 lb/hp)
B	5.78 kg/kW (9.50 lb/hp)

PERFORMANCE (A: Legacy; B: Legacy FG):

Max cruising speed at FL180:	
A	261 kt (483 km/h; 300 mph)
Normal cruising speed: at FL80: A	240 kt (444 km/h; 276 mph)
B	182 kt (338 km/h; 210 mph)
at FL120: A	217 kt (402 km/h; 250 mph)
Stalling speed, flaps down: A	59 kt (108 km/h; 67 mph)
B	57 kt (105 km/h; 65 mph)
Max rate of climb at S/L: A	914 m (3,000 ft)/min
B	792 m (2,600 ft)/min
Service ceiling: A, B	5,485 m (18,000 ft)
T-O run: A	244 m (800 ft)
B	305 m (1,000 ft)
Landing run: A, B	275 m (900 ft)
Range with max fuel, no reserves:	
A	1,042 n miles (1,931 km; 1,200 miles)
B	1,173 n miles (2,172 km; 1,350 miles)
g limits: Normal: A, B	+3.8/−1.7
Utility: A, B	+4.4/−2.2

LEARJET

BOMBARDIER AEROSPACE LEARJET (SUBSIDIARY OF BOMBARDIER INC)

One Learjet Way, PO Box 7707, Wichita, Kansas 67277
Tel: (+1 316) 946 20 00
Fax: (+1 316) 946 22 20
VICE-PRESIDENT AND GENERAL MANAGER: Jim Ziegler
VICE-PRESIDENT, OPERATIONS: Ghislain Bourque
VICE-PRESIDENT, FINANCE: Chris Chrashaw
VICE-PRESIDENT, ENGINEERING: Keith Miller
DIRECTOR, PUBLIC RELATIONS: Dave Franson

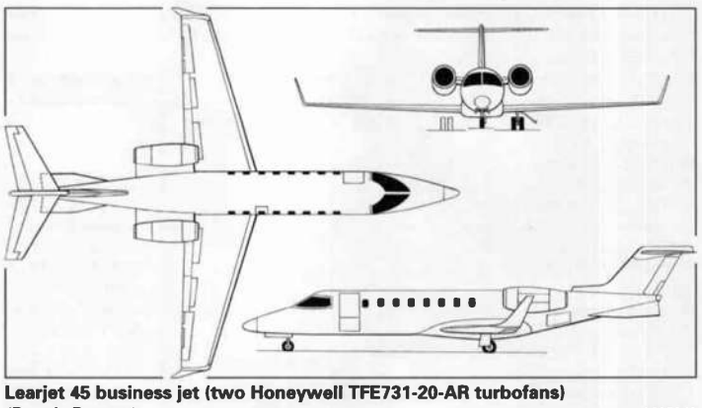
Company originally founded 1960 by Bill Lear Snr as Swiss American Aviation Corporation (SAAC); transferred to Kansas 1962 and renamed Lear Jet Corporation; prototype Lear Jet 23 (N801L) first flew 7 October 1963; Gates Rubber Company bought about 60 per cent share in 1967 and renamed it Gates Learjet Corporation, moving much of manufacturing to Tucson, Arizona; 64.8 per cent acquired by Integrated Acquisition Inc September 1987 and renamed Learjet Corporation; all manufacturing moved from Tucson to Wichita during 1988, leaving customer service completion and modification centre in Tucson.

Acquisition of Learjet by Canada's Bombardier announced April 1990 and concluded 22 June 1990 for US$75 million; name changed to Learjet Inc; Bombardier assumed responsibility for Learjet's line of credit; now part of Bombardier Inc. Learjet 40, 45 and 60 assembled in Wichita and flown to Tucson for completion and delivery.

More than 2,400 Learjets built, including 105 LJ23s, 259 LJ24s, 368 LJ25s, five LJ28s, four LJ29s, 225 LJ31s, 673 LJ35s, 62 LJ36s, 15 LJ40s, 256 LJ45s, 147 LJ55s and 281 LJ60s. 2,000th Learjet, Model 45 N158PH, delivered to Parker Hannifin Corporation in August 1999.

Learjet bought manufacturing and marketing rights and tooling of Aeronca thrust reversers, for application to Learjet and other aircraft, March 1989.

Total of 36 deliveries in 1994; 43 in 1995; 34 in 1996; 45 in 1997; 61 in 1998; 99 in 1999, 134 in 2000; 182 in 2001, 60 in 2002, 31 in 2003, 48 in 2004, 67 in 2005, and 55 in the first nine months of 2006.



Learjet 45 business jet (two Honeywell TFE731-20-AR turbofans) *(Dennis Punnett)* 0507269

LEARJET 45

TYPE: Business jet.

PROGRAMME: Design started September 1992; unveiled at NBAA Convention 20 September 1992. Other members of Bombardier group are involved; Learjet is responsible for project co-ordination, final assembly, testing and certification.

Engine testing began January 1995 with TFE731-20 installed in one nacelle of Learjet 31A testbed. Wing and fuselage of first production aircraft (N45XL) mated at Wichita 4 November 1994; first flight 7 October 1995; second prototype (N452LJ) first flown 6 April 1996, assigned to flutter testing; third aircraft (N453LJ), first flown 24 April 1996, assigned to avionics testing; fourth aircraft assigned to HIRF and lightning-strike testing, engine testing and fuel system operation; fifth aircraft fitted with production interior and assigned to function and reliability testing, including interior noise measurement.

Initial FAA certification granted 22 September 1997 followed by full approval in May 1998; JAA certification achieved 3 July 1998; FAA RVSM approval granted 25 July 2000. First customer delivery (N903HC) 28 July 1998, to Hytrol Conveyor of Jonesboro, Arkansas. First delivery to Europe (N459LJ) 8 September 1998 for Eifel Holdings Ltd of Jersey. More than 210 delivered by December 2002, including 2,000th Learjet, N158PH, to Parker Hannifin Corporation in August 1999. 100th Learjet 45 delivered in October 2000, initially as Bombardier company demonstrator, but destined for a Philippine operator; 200th delivered in April 2002. EASA approval to operate into London City Airport announced 11 October 2004. Civil Aviation Administration of China certification achieved 5 January 2005.

CURRENT VERSIONS: **Learjet 45:** Current version, *as described.*

Learjet 45^{XR}: Improved version offering enhanced payload/range capability. Announced at Farnborough International Air Show, 21 July 2002 and formally launched at NBAA Convention, Orlando, Florida, 10 September 2002; prototype demonstrated at NBAA Convention, Orlando, 7 to 9 October 2003 (N45XR c/n 232; FAA certification achieved 17 June 2004). Features include a 454 kg (1,000 lb) increase in maximum T-O weight; 15.57 kN (3,500 lb st) Honeywell TFE731-20-BR turbofans flat rated at ISA +25°C (104°F) with 0.67 kN (150 lb st) automatic power reserve at T-O; and redesigned cabin interior with seats that are 5 cm (2 in) wider and increase legroom by 15 cm (6 in), increased galley storage, LED lighting system that reduces heat emissions, improved access to systems behind the aft lavatory, and quick (20 min) removal of interior components. Learjet 45^{XR} maximum T-O weight increase and engine upgrade will be retrofittable to existing Learjet 45s.

CUSTOMERS: Deliveries began with seven in 1998, followed by 43 in 1999, 71 in 2000, 63 in 2001, 17 in 2003, 22 in 2004, 28 in 2005, and 25 in the first nine months of 2006. Major orders include 40, with 10 options, by JetSolutions for its FlexJets fractional ownership scheme. Customers include Singapore Airlines, which ordered two in April 2001, supplementing four aircraft delivered in 1998, Cathay Pacific Airways, which ordered two for crew training, operated by BAE Systems Flight Training (Australia) Pty Ltd at Adelaide, South Australia, of which the first was delivered on 24 August 2001 with the second delivered in 2002, Gold Air International which ordered five 45^{XR}s on 5 February 2003, Ocean Air Aero Taxi Ltd of Brazil, which ordered one 45^{XR} on 12 March 2003, Hughes Air Corporation of Calgary, Canada, which took delivery of a 45 on 10 July 2003, and the Irish Government, which took delivery of one in December 2003. Recent customers include the government of Sindh, Pakistan, which ordered one on 19 July 2006 for delivery in late 2006. The 300th delivery, to a US operator, took place on 15 June 2006.

COSTS: Learjet 45 USD9.848 million, Learjet 45^{XR} USD10.423 million (both 2002).

DESIGN FEATURES: Generally as Model 31; Learjet 45 designed to combine docile handling characteristics of 31/31A and 60 with exceptional fuel efficiency and good overall performance, and offer increased maintainability and reliability; new larger fuselage, wing and tail unit; increased head and shoulder room; wing carry-through spar recessed beneath floor; latest technology systems. Wing designed with NASA; winglets; sweepback 13° 25' at 25 per cent chord.

Performance enhancement package announced at the Paris Air Show in June 1999 includes maximum T-O weight increased by 136 kg (300 lb); reductions in T-O speeds; improved nosewheel steering and removal of 40 kt (74 km/h; 46 mph) steering system limitation; improved brake-by-wire effectiveness; reconfiguration of flap selector module to permit use of 8° flap setting, instead of 20°, for approach climb in the event of a go-around; improved climb performance with bleed air anti-icing systems operating; and updated Honeywell avionics software.

FLYING CONTROLS: Conventional and manual. Two spoiler/lift dumper panels in each wing; deflections 0°, 14° 30', 28° 30' and 60°. Horn-balanced elevators. Trim tab in rudder; two in each aileron. Flaps; deflections 0, 8, 20 and 40°.

Further improvements introduced in late 2000 include restyled seats providing greater freedom of movement in the cabin, a 10 to 12 dB reduction in cabin noise levels and improvements in the cabin air distribution system.

STRUCTURE: Unigraphics, CATIA and Computervision digital design systems adopted by Learjet, de Havilland of Canada and Shorts for engineering design. Short Brothers of UK manufactures the fuselage and de Havilland Canada the wings.

LANDING GEAR: Retractable tricycle type; semi-articulated trailing-link main legs retract inward, nose leg forward; twin-wheel main units, size 22×5.75-12 (10 ply) with brake-by-wire anti-skid carbon multidisc brakes; nosewheel has dual-chine tyre, size 18×4.4 (10 ply), with steer-by-wire.

POWER PLANT: Two Honeywell TFE731-20-1B turbofans (progressively 20R, 20AR and 20BR), each flat rated at 15.57 kN (3,500 lb st) at ISA +16°C (61° F), or 16.24 kN (3,650 lb st) with APR. Dee Howard target-type thrust reversers; digital electronic engine control. Fuel capacity 3,426 litres (905 US gallons; 754 Imp gallons) usable, plus 61 litres (16.0 US gallons; 13.4 Imp gallons) unusable. Oil capacity 7 litres (1.9 US gallons; 1.6 Imp gallons) per engine.

ACCOMMODATION: Two crew and up to nine passengers; eight-passenger cabin typically with PMP fully adjustable swivelling and reclining seats in double club arrangement, galley/refreshment centre and storage cabinet at front of cabin; lavatory, doubling as optional ninth seat, at rear; cabin pressurised, maximum differential 0.65 bar (9.43 lb/sq in); clamshell door with integral steps on port side at front of cabin, upper part serves as emergency exit; eight cabin windows per side, one forward of starboard wing leading-edge serving as emergency exit; externally accessible heated and lined baggage compartment, capacity 227 kg (500 lb), in aft fuselage accessed via door on port side beneath engine nacelle.

SYSTEMS: Honeywell air conditioning and pressurisation system, maximum differential 0.65 bar (9.4 lb/sq in), with dual independent digital control system and pneumatic redundancy; dual-zone automatic temperature control. Gaseous oxygen system, pressure 127.6 bar (1,850 lb/sq in). Main and auxiliary back-up hydraulic systems, pressure 207 bar (3,000 lb/sq in). Dual independent anti-icing and de-icing systems comprising bleed air anti-icing on wing and tailplane leading-edges and engine inlets, electric de-icing on pitot-static probes and electric anti-icing and de-fogging on windscreen. Honeywell RE 100 APU optional.

AVIONICS: Honeywell Primus 1000 integrated avionics system.

Comms: Dual Primus II nav/ident radios.

Radar: Primus 660 weather radar standard.

Learjet 45^{XR} twin-turbofan business jet *(Paul Jackson)* 1159778

Flight: Dual Primus II nav radios. Primus 1000 digital autopilot/flight director standard; Honeywell traffic-alert and collision-avoidance (TCAS II) optional.

Instrumentation: Primus 1000 with EICAS; dual PFDs and MFDs; flight and navigation information displayed on four 203 × 178 mm (8 × 7 in) EFIS screeens; heart of system is IC-600 integrated avionics computer, which combines EFIS and EICAS processor.

DIMENSIONS, EXTERNAL:

Wing span	14.56 m (47 ft 9¼ in)
Wing aspect ratio	7.3
Length overall	17.56 m (57 ft 7¼ in)
Max diameter of fuselage	1.75 m (5 ft 9 in)
Height overall	4.31 m (14 ft 1½ in)
Wheel track	2.84 m (9 ft 4 in)
Wheelbase	7.87 m (25 ft 9¾ in)

DIMENSIONS, INTERNAL:

Cabin:	
Length: incl flight deck	7.52 m (24 ft 8¼ in)
excl flight deck	6.02 m (19 ft 9 in)
Max width	1.55 m (5 ft 1 in)
Max height	1.50 m (4 ft 11 in)
Floor area, excl flight deck	5.76 m² (62.0 sq ft)
Volume, excl flight deck	11.6 m³ (410 cu ft)
Baggage compartment volume	1.4 m³ (50 cu ft)

AREAS:

Wings, basic	28.95 m² (311.6 sq ft)

WEIGHTS AND LOADINGS (A: Learjet 45, B: Learjet 45^{XR}):

Weight empty: A	5,797 kg (12,780 lb)
B	5,869 kg (12,939 lb)
Basic operating weight, typical: A, B	6,227 kg (13,729 lb)
Max baggage weight: cabin	77 kg (170 lb)
aft fuselage	227 kg (500 lb)
Max payload: A, B	1,030 kg (2,271 lb)
Payload with max fuel: A	435 kg (959 lb)
B	889 kg (1,959 lb)
Max fuel weight: A, B	2,750 kg (6,062 lb)
Fuel with max payload: A	2,154 kg (4,750 lb)
B	2,608 kg (5,750 lb)
Max T-O weight: A	9,298 kg (20,500 lb)
B	9,752 kg (21,500 lb)
Max landing weight: A, B	8,709 kg (19,200 lb)
Max ramp weight: A	9,412 kg (20,750 lb)
B	9,866 kg (21,750 lb)
Max zero-fuel weight: A, B	7,257 kg (16,000 lb)
Max wing loading: A	321.2 kg/m² (65.79 lb/sq ft)
B	336.9 kg/m² (69.00 lb/sq ft)
Max power loading: A	286 kg/kN (2.81 lb/lb st)
B	300 kg/kN (2.95 lb/lb st)

PERFORMANCE:

Max operating speed (VMO) to FL267	330 kt (611 km/h; 379 mph)
Max operating Mach No. (MMO) above FL267	0.81
High cruising speed: A, B	464 kt (859 km/h; 534 mph)
Normal cruising speed: A, B	457 kt (846 km/h; 526 mph)
Long-range cruising speed:	
A, B	430 kt (796 km/h; 495 mph)
Minimum control speed, landing, flaps 40°	97 kt (180 km/h; 112 mph) IAS
Time to FL430 after MTOW departure:	
A	23 min 6 s
B	24 min 54 s
Max certified altitude: A, B	15,545 m (51,000 ft)
T-O field length: A	1,326 m (4,350 ft)
B	1,542 m (5,060 ft)
FAR Pt 91 landing distance: A, B	811 m (2,660 ft)
Range with two crew and four passengers, NBAA IFR reserves:	
A, B	2,098 n miles (3,885 km; 2,414 miles)
Range with two crew and eight passengers, IFR reserves:	
B	2,007 n miles (3,717 km; 2,309 miles)

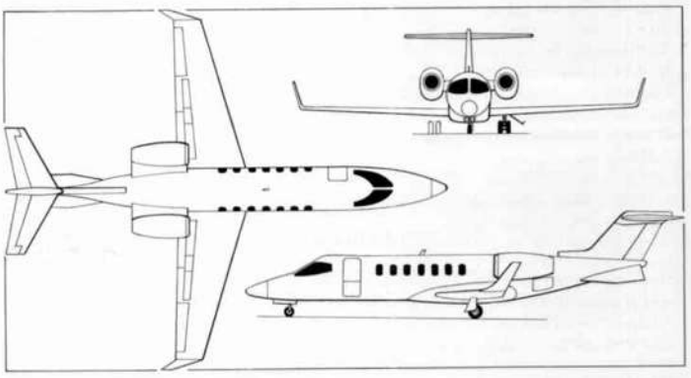
OPERATIONAL NOISE LEVELS:

T-O: A, B	74.5 EPNdB
Sideline: A	85.2 EPNdB
B	85.1 EPNdB
Approach: A, B	93.4 EPNdB

LEARJET 40

TYPE: Business jet.

PROGRAMME: Announced at Farnborough International Air Show 21 July 2002 as replacement for Learjet 31A. Prototype (N40LX, converted from Learjet 45 prototype) first flight 31 August 2002, immediately followed by first production aircraft (45-2001/N40LJ) 5 September. Public debut (N40LJ) and formal launch at NBAA Convention, Orlando, Florida, 10 September 2002; prototype and first production aircraft undertook flight test programme, leading to FAA certification (as variant of Learjet 45) on 11 July 2003, (and award of first airworthiness certificate to N40LJ on 18 September 2003), followed by EASA certification on 9 January 2004. Later that month, the first five aircraft were delivered, two to Bombardier's Flexjet fractional ownership programme, two to US operators, and one to a German customer.



Learjet 40 business jet *(James Goulding)* 0526908

CURRENT VERSIONS: **Learjet 40:** *As described.*

Learjet 40^{XR}: Improved version offering enhanced hot-and-high performance and faster climb. Announced 11 October 2004 at the NBAA Convention in Las Vegas. Features TFE731-20-BR turbofans flat-rated to ISA+25°C, increased maximum take-off weight of 9,525 kg (21,000 lb) and range with six passengers and max fuel of 1,781 n miles (3,298 km; 2,409 miles). FAA certification scheduled for fourth quarter 2005, with service entry shortly thereafter. Cost approximately USD400,000 more than a comparably equipped Learjet 40. Learjet 40s will be upgradable to Learjet40^{XR} standard through engine and airframe service bulletins. Service entry (no specific recertification required) January 2006.

CUSTOMERS: Total of 17 delivered in 2004, 21 in 2005, and 18 in the first nine months of 2006. Recent customers include Cirrus Aviation of Germany, which ordered two, of which the first entered service in February 2004.

COSTS: Approximately US$6.915 (2004).

DESIGN FEATURES: Generally as for Learjet 45, but fuselage shortened by 0.62 m (2 ft 0½ in) forward of wing, three cabin windows removed and capacity of fuselage fuel tank reduced.

POWER PLANT: As Learjet 45; TFE731-20AR-1B engines at outset, progressing to -20BR-1B. Fuel 3,036 litres (802 US gallons; 668 Imp gallons) usable, plus 61 litres (16.0 US gallons; 13.4 Imp gallons) unusable.

ACCOMMODATION: Two crew and up to seven passengers in forward club arrangement with galley on starboard side at front of cabin and full-width lavatory at rear. Compared with Learjet 45, cabin features redesigned seats that are 5 cm (2 in) wider and increase legroom by 15 cm (6 in), and an LED lighting system. The first 40 aircraft will feature an optional racing car-inspired red and black custom interior reflecting a sponsorship agreement between Bombardier and Indianapolis Motor Speedway Corporation.

DIMENSIONS, EXTERNAL:

Length overall	16.92 m (55 ft 6¼ in)
Wheelbase	7.86 m (25 ft 9½ in)

DIMENSIONS, INTERNAL:

Cabin: Length: incl flight deck	6.92 m (22 ft 8¼ in)
excl flight deck	5.40 m (17 ft 8½ in)
Floor area, excl flight deck	5.17 m² (55.7 sq ft)
Volume, excl flight deck	10.28 m³ (363 cu ft)

WEIGHTS AND LOADINGS:

Weight empty	5,779 kg (12,740 lb)
Basic operating weight	6,091 kg (13,428 lb)
Payload: max	1,167 kg (2,572 lb)
with max fuel	815 kg (1,797 lb)
Fuel weight: max	2,438 kg (5,375 lb)
with max payload	2,087 kg (4,600 lb)
Max ramp weight: initial	9,344 kg (20,600 lb)
SB 40-11-1	9,639 kg (21,250 lb)[1]
Max T-O weight: initial	9,230 kg (20,350 lb)
SB 40-11-1	9,525 kg (21,000 lb)[1]
Max landing weight	as Learjet 45
Max zero-fuel weight	as Learjet 45
Max wing loading	329.0 kg/m² (67.39 lb/sq ft)
Max power loading	293 kg/kN (2.88 lb/lb st)

[1] *Certified September 2004 (Service Bulletin)*

PERFORMANCE:

Max operating Mach No. (MMO)	as Learjet 45
Cruising speed: high	M0.81 (464 kt; 839 km/h; 534 mph)
normal	M0.79 (457 kt; 846 km/h; 526 mph)
long-range	M0.75 (480 kt; 796 km/h; 494 mph)
Minimum control speed	as Learjet 45

Learjet 40^{XR} company demonstrator *(Paul Jackson)* 1159781

Time to FL430 at MTOW ..... 22 min 42 s
Max certified altitude ..... as Learjet 45
T-O balanced field length ..... 1,306 m (4,285 ft)
FAR Pt 91 landing distance ..... as Learjet 45
Range with two crew and four passengers, IFR reserves ..... 1,857 n miles (3,439 km; 2,136 miles)
OPERATIONAL NOISE LEVELS As Learjet 45 except:
T-O ..... 74.4 EPNdB

LEARJET 60

TYPE: Business jet.

PROGRAMME: **Announced 3 October 1990 as Learjet 55C successor; first flight of proof-of-concept aircraft with one PW305 turbofan 18 October 1990; flight testing resumed 13 June 1991 with two PW305s and stretched fuselage (more than 300 hours flown by May 1992); first production aircraft first flight (N601LJ) 15 June 1992; certification awarded 15 January 1993; deliveries started immediately. Certified in Argentina, Austria, Bermuda, Brazil, Canada, China, Denmark, Germany, Grand Cayman, Italy, Luxembourg, Malaysia, Mexico, the Philippines, South Africa, Switzerland, Turkey, the United Arab Emirates and USA.**

Total fleet time stood at 775,000 flight hours, with a despatch reliability of 99.52 per cent in December 2004.

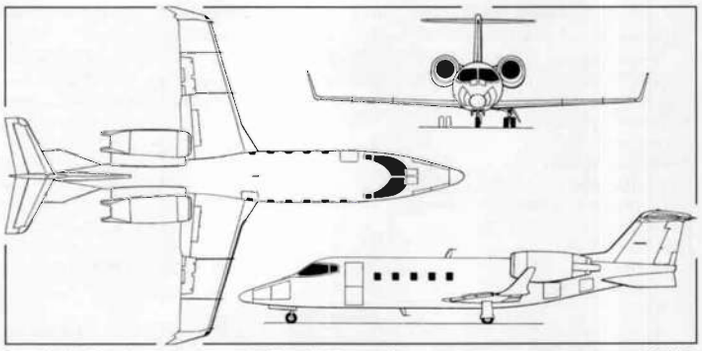
CURRENT VERSIONS: **Learjet 60**: Standard version, *as described*.

Learjet 60 Special Edition: Announced at the NBAA Convention in Las Vegas 11 October 2004, with deliveries commencing immediately from c/n 275, which was delivered to Unicorp National Development of Orlando, Florida. Former Learjet 60 optional items fitted as standard, including second ADF; second Honeywell KHF-950 long-range com; dual Rockwell Collins VHF-422C com; upgraded radio altimeter; EGPWS with windshear protection; TCAS II; Collins TWR-850 weather radar with turbulence detection; ice/lightning detection systems; ELT; upgraded CVR; digital FDR; APU; emergency lighting; tail illumination package; pulsating recognition and landing lights; lighted control wheel chart holders; plated and wood veneer cabin trim; slimline tables; left- and right-hand pyramid cabinets; premium carpets; lavatory with belted seat and extended baggage space; microwave oven; dual hot liquid containers; 110V/60HZ AC power outlets; dual channel Iridium satellite telephone with wireless handsets; forward and aft video monitors; CD player with 10-disk changer, DVD video system, and Airshow 400 in-flight entertainment system.

Learjet 60^{XR}: Announced at NBAA Convention, Orlando, Florida, 9 November 2005. First flight (N50163, c/n 60-294) 3 April 2006. Avionics fit certified by STC on 28 September 2006. FAA certification expected in fourth quarter 2006, with service entry in first quarter 2007. Launch customer Bombardier Flexjet has ordered 15.

New avionics suite features Rockwell Collins Pro Line 21 system, comprising four-screen LCD adaptive 203 x 254 mm (8 x 10 in) EFIS, dual AHRS, digitised EIS, IFIS with electronic charts, WXR-840 weather radar, dual nav/com, dual FMS-5000 FMS, TCAS II, EGPWS with windshear alert and ELT. Avionics options include XM graphic weather display, 3-D FMS maps, and second file server. Five standard cabin configurations include six-passenger executive configuration with two facing seats on starboard side of forward cabin with club four arrangement to rear, with additional belted lavatory seat in aft section; three seven-seat executive configurations with three-seat sideways-facing 9*g* divan on port or starboard side of the cabin and combinations of club-two or club-four seating, with additional belted lavatory seat in aft section; and high density arrangement seating eight in main cabin with two facing seats and sideways-facing two-seat 9*g* divan on starboard side of forward cabin with club-four arrangement to rear, and additional belted lavatory seat in aft section.

Other interior features include redesigned Audio International cabin electronic system with touch-screens for each passenger; audio-visual system with XM satellite radio and ports for DVD and MP3 players, iPods and laptop computers; advanced acoustic dampening and insulation; new LED lighting system; low profile galley with increased storage capacity and work surface area; and additional window in lavatory area. Cabin options include



Learjet 60 business transport *(Dennis Punnett)* 0507270

Airshow 410 or Airshow 4000 network in-flight entertainment system packages; Iridium satellite telephone; forward and aft video monitors with single or dual DVD players, XM radio, warming oven or microwave, dual hot liquid containers; and crystal, china and flatware galley cabinet inserts.

CUSTOMERS: Total of 281 built by October 2006, including 22 delivered in 1994, 24 in 1995, 23 in 1996, 24 in 1997, 32 in 1998, 32 in 1999, 35 in 2000, 29 in 2001, 18 in 2002, 12 in 2003, nine in 2004, 18 in 2005, and 12 in the first nine months of 2006. Recent customers include Government of Macedonia, which ordered one Special Edition in January 2005, and Nova Holding of Macedonia, which ordered two 60^{XRS} on 18 July 2006. The 300th Learjet 60 series aircraft was delivered 15 June 2006, to a Finnish operator.

COSTS: USD12.5 million (2004).

DESIGN FEATURES: Rear-engined business jet; low wing with leading-edge sweepback; T tail and two large strakes below rear fuselage.

Original Learjet 31 combined fuselage/cabin and power plant of Learjet 35A/36A with wing of Learjet 55; delta fins added to eliminate Dutch roll, stabilise aircraft at high airspeeds, induce docile stall and reduce approach speeds and field lengths; stick pusher/puller and dual yaw dampers no longer required; stick shaker and single yaw damper retained for comfort.

FLYING CONTROLS: Conventional and manual. Ailerons have brush seals and geared tabs; electrically actuated trim tab in port aileron. Electrically actuated tailplane incidence control has separate motors for pilot and co-pilot and single-fault survival protection; aircraft can be manually controlled following tailplane runaway and landed with reduced flap. Rudder has electric trim tab; automatic electric rudder assist servo operates automatically if rudder pedal loads exceed 22.6 kg (50 lb). Full-chord fences bracket the ailerons. Single spoiler panel in each wing used as airbrake and lift dumper. Hydraulically actuated flaps extend to 40°. Optional drag parachute mounted on inside of baggage hatch under tail.

LANDING GEAR: Retractable tricycle type, hydraulically actuated and electrically controlled; single wheel on nose unit and twin wheels on main units; nosewheel retracts forward, mainwheels inward; steerable nosewheel (±60°). Mainwheel tyre size 17.5×5.75–8, pressure 14.76 bar (214 lb/sq in); nosewheel tyre size 18×4.4 (10 ply), pressure 7.24 bar (105 lb/sq in).

POWER PLANT: Two Pratt & Whitney Canada PW305A turbofans with FADEC, each flat rated at 20.46 kN (4,600 lb st) at up to 27°C (80°F). Fuel details under Weights and Loadings below. Single-point pressure refuelling system standard; gravity-feed fuel filler ports in each wing.

ACCOMMODATION: Two crew and up to 10 passengers; gross pressure cabin volume 15.57 m^3 (550 cu ft); compared with 55C, main cabin is 0.71 m (2 ft 4 in) longer and rear baggage hold section 0.38 m (1 ft 3 in) longer; full-across aft lavatory has flat floor, large mirror, wardrobe and external servicing; total 1.67 m^3 (59 cu ft) baggage capacity divided between an externally accessible hold (larger than that of Learjet 55C) and internal pressurised,

Learjet 60 operated by the manufacturer *(Paul Jackson)* 1159782

Maiden flight of Learjet 60^{XR} on 3 April 2006 1159801

heated compartment that is accessible in flight; galley cabinet has warming oven, cold liquid dispensers, ice compartment and storage for dinnerware; entertainment centre; 10-way adjusting seating is standard. New interior introduced in 1998 (from c/n 115), featuring redesigned passenger service unit, wider headliner, revised beverage cabinet, optional television monitor and wider choice of upholstery fabrics and leather trim.

SYSTEMS: Environmental control system uses engine bleed air for air conditioning and pressurisation, maximum differential 0.65 bar (9.4 lb/sq in), maintaining sea level cabin altitude to 7,835 m (25,700 ft) and 2,440 m (8,000 ft) cabin altitude to 15,545 m (51,000 ft). Hydraulic system, pressure 103.4 bar (1,500 lb/sq in), provided by two engine-driven, variable volume pumps, with electrically driven auxiliary pump. Electrical system comprises two 30 V DC 400 A engine-driven starter-generators and two 24 V DC batteries. Oxygen system, capacity 2.18 m^3 (77.0 cu ft), with demand-type masks for crew and drop-down constant-flow masks for passengers. Bleed air anti-icing on wing leading-edges, engine inlets, engine spinners and inlet guide vanes, electric anti-icing on windscreen. Hamilton Sundstrand T-20G-10C3A APU.

AVIONICS: Standard fully integrated all-digital Rockwell Collins Pro Line 4.

Radar: Rockwell Collins WXR840 colour weather radar.

Flight: Four-tube (152 × 178 mm; 6 × 7 in) EFIS, dual digital air data computers, dual navigation and communications radios, UNS-1C FMS, dual automatic AHRS, Rockwell Collins AMS-850 avionics management system, advanced autopilot and long-range navaid as standard; circuit breaker and control panels redistributed, as in Learjet 31A.

DIMENSIONS, EXTERNAL:

Wing span	13.34 m (43 ft 9 in)
Wing chord: at root	2.74 m (9 ft 0 in)
at tip	1.12 m (3 ft 8 in)
Wing aspect ratio	7.2
Length: overall	17.89 m (58 ft 8¼ in)
fuselage	17.02 m (55 ft 10 in)
Fuselage max diameter	1.96 m (6 ft 5 in)
Height overall	4.44 m (14 ft 6¾ in)
Tailplane span	4.48 m (14 ft 8½ in)
Wheel track	2.51 m (8 ft 3 in)
Wheelbase	7.73 m (25 ft 4½ in)
Cabin door: Width	0.64 m (2 ft 1 in)
Height to sill	0.69 m (2 ft 3 in)

DIMENSIONS, INTERNAL:

Cabin: Length: incl flight deck	7.07 m (23 ft 2½ in)
excl flight deck	5.38 m (17 ft 8 in)
Max width	1.80 m (5 ft 11 in)
Max height	1.73 m (5 ft 8 in)
Floor area, excl flight deck	6.40 m^2 (68.9 sq ft)
Volume, excl flight deck	12.8 m^3 (453 cu ft)

AREAS:

Wings, gross	24.57 m^2 (264.5 sq ft)
Horizontal tail surfaces (total)	5.02 m^2 (54.00 sq ft)
Vertical tail surfaces (total)	4.79 m^2 (51.53 sq ft)

WEIGHTS AND LOADINGS (A: Learjet 60, B: Learjet 60^{XR}):

Weight empty: A	6,364 kg (14,030 lb)
Basic operating weight empty: A	6,700 kg (14,772 lb)
B	6,797 kg (14,985 lb)
Max payload: A	1,011 kg (2,228 lb)
B	914 kg (2,015 lb)
Payload with max fuel: A	484 kg (1,068 lb)
B	388 kg (855 lb)
Max usable fuel weight: A, B	3,588 kg (7,910 lb)
Fuel with max payload: A, B	3,062 kg (6,750 lb)
Max T-O weight: A, B	10,659 kg (23,500 lb)
Max ramp weight: A, B	10,773 kg (23,750 lb)
Max landing weight: A, B	8,845 kg (19,500 lb)
Max zero-fuel weight: A, B	7,711 kg (17,000 lb)
Max wing loading: A, B	433.8 kg/m^2 (88.85 lb/sq ft)
Max power loading	260 kg/kN (2.55 lb/lb st)

PERFORMANCE:

Max operating speed (VMO): A, B:	
S/L-FL80	300 kt (555 km/h; 345 mph) IAS
FL80-FL200	340 kt (629 km/h; 391 mph) IAS
FL200-FL230	340–330 kt (630–611 km/h; 391–378 mph) IAS
FL230-FL267-5	330 kt (611 km/h; 378 mph) IAS
Max operating Mach No. (MMO): A, B	
FL265-FL370	0.81
FL370-FL430	0.81-0.78
above FL430	0.78
Cruising speed: A, B: high	466 kt (863 km/h; 536 mph)
normal	453 kt (839 km/h; 521 mph)
long-range	422 kt (782 km/h; 486 mph)
Stalling speed, flaps and landing gear down: A, B	106 kt (197 km/h; 122 mph) CAS
Approach speed: A, B	139 kt (257 km/h; 160 mph) IAS
Max rate of climb at S/L: A, B	1,371 m (4,500 ft)/min
Rate of climb at S/L, OEI: A, B	378 m (1,240 ft)/min
Time to FL410 after MTOW departure: A, B	18 min 30 s
Max certified altitude: A, B	15,545 m (51,000 ft)
Service ceiling, OEI: A, B	7,195 m (23,600 ft)
T-O balanced field length: A, B	1,661 m (5,450 ft)
FAR Pt 91 landing distance: A, B	1,043 m (3,420 ft)
Range with two crew and four passengers:	
VFR: A	2,685 n miles (4,972 km; 3,089 miles)
NBAA IFR: A	2,493 n miles (4,617 km; 2,868 miles)
B	2,451 n miles (4,539 km; 2,820 miles)

OPERATIONAL NOISE LEVELS:

T-O: A	78.9 EPNdB
B	70.8 EPNdB
Sideline	83.2 EPNdB
Approach	87.7 EPNdB

LEGEND

LEGEND AIRCRAFT INC

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Web: www.turbinelegend.com
PRESIDENT: Lanny Rundell

Lanny Rundell of Southern Air (and formerly with Stoddard Hamilton) purchased the assets of Performance Aircraft in February 2002.

LEGEND LEGEND and LEGEND TURBINE LEGEND

TYPE: Tandem-seat sportplane kitbuilt; tandem-seat turboprop sportplane kitbuilt.

PROGRAMME: Prototype (N620L) first flown by Performance Aircraft Inc in 1996 with Chevrolet V-8 engine; subsequently converted to Turbine Legend with Walter M 601E turboprop; public debut in turboprop form at EAA Sun 'n' Fun at Lakeland, Florida, in April 1999.

CURRENT VERSIONS: **Legend:** Piston-engined version, powered by one 429 kW (575 hp) liquid-cooled Chevrolet V-8 driving a three-blade Hartzell propeller via a Geschwender 2:1 reduction gearbox. Wing span 8.22 m (27 ft 0 in). Ventral (P-51-type) air scoop.

Turbine Legend: Turboprop version, *as described.*

JC 100: Designation of Turbine Legend built in 2000 by Toys 4 Boys at Deland, Florida.

CUSTOMERS: By mid-2006, more than 39 kits had been sold and at least 24 aircraft were flying, including one in Canada.

COSTS: Fast-build kit, less engine USD119,700 (2005). Engine (new) USD104,000 (1999).

DESIGN FEATURES: Highly streamlined, low-wing monoplane with sweptback tail surfaces and steeply raked windscreen. Tapered wings and mid-mounted tailplane. Optional winglets. Quoted build time: 2,500 hours, standard; 1,900 hours fast-build. Roll rate 190°/s.

Legend Turbine Legend turboprop kitbuilt *(Paul Jackson)* 1040411

FLYING CONTROLS: Conventional and mechanical: horn-balanced elevators and rudder; three-axis electric trim; electrically actuated slotted flaps, maximum deflection 38°.

STRUCTURE: Mostly CFRP.

LANDING GEAR: Retractable tricycle type; mainwheel size 15×6.0-6, nosewheel size 5.00×5; mainwheels retract inwards, nosewheel rearwards; steering by differential braking; dual disc brakes standard.

POWER PLANT: One Walter M 601 turboprop, rated at 540 kW (724 shp) for take-off and 490 kW (657 shp) maximum continuous, driving an Avia V 508E/84 three-blade, constant-speed, reversible-pitch feathering propeller. Fuel contained in integral tanks in outer wings 379 litres (100 US gallons; 83.3 Imp gallons); optional tip tanks, combined capacity 95 litres (25.0 US gallons; 20.8 Imp gallons); three optional extra tanks in fuselage, total capacity 167 litres (44.0 US gallons; 36.7 Imp gallons).

ACCOMMODATION: Two persons in tandem under rear-hinged, upward-opening canopy with fixed single-piece windscreen. Dual controls standard.

DIMENSIONS, EXTERNAL:

Wing span	8.97 m (29 ft 5 in)
Wing aspect ratio	8.6
Length overall	7.84 m (25 ft 8½ in)
Height overall	2.93 m (9 ft 7¼ in)
Propeller diameter	2.13 m (7 ft 0 in)

DIMENSIONS, INTERNAL:

Cabin max width	0.75 m (2 ft 5½ in)

AREAS:

Wings, gross	9.38 m^2 (101.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	930 kg (2,050 lb)
Max baggage weight	54 kg (120 lb)
Max T-O weight	1,496 kg (3,300 lb)
Max wing loading	159.5 kg/m^2 (32.67 lb/sq ft)
Max power loading	3.06 kg/kW (5.02 lb/shp)

PERFORMANCE:

Never-exceed speed (VNE)	347 kt (643 km/h; 400 mph)
Max level speed at S/L	274 kt (507 km/h; 315 mph)
Max cruising speed at 7,620 m (25,000 ft)	290 kt (537 km/h; 334 mph)
Econ cruising speed at 7,620 m (25,000 ft)	245 kt (454 km/h; 282 mph)
Manoeuvring speed	261 kt (482 km/h; 300 mph)
Stalling speed: flaps up	66 kt (123 km/h; 76 mph)
landing configuration	58 kt (107 km/h; 66 mph)
Max rate of climb at S/L	1,981 m (6,500 ft)/min
Service ceiling	10,670 m (35,000 ft)
T-O and landing run	244 m (800 ft)
Range: with standard fuel and reserves:	
at max cruising speed	821 n miles (1,520 km; 944 miles)
at econ cruising speed	993 n miles (1,839 km; 1,142 miles)
with optional fuel	1,207 n miles (2,237 km; 1,390 miles)
g limits: normal	+6/–4
ultimate	+9/–6

LEZA

LEZA AIRCAM CORPORATION

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CEO AND PRESIDENT: Antonio Leza

Leza AirCam has a 4,090 m² (44,000 sq ft) factory at Sebring Airport and also produces the former Maxair Drifter and Super Drifter series of single- and two-seat ultralights.

In 2004, company announced that it was planning a 3,440 m² (37,000 sq ft) extension to its factory.

In June 2006, Leza sold the design rights, tooling and inventory for the two types to Lockwood Aviation.

LIBERTY

LIBERTY AEROSPACE INC

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PRESIDENT AND CEO: Anthony J P Tiarks
HEAD OF EUROPEAN OPERATIONS: Ivan Shaw
PUBLIC RELATIONS AND MARKETING: Russell Greenberg

Liberty was established specifically to produce the XL-2 lightplane. It received refinancing when KFH Bahrain acquired 75 per cent of the stock of Liberty's parent company in October 2004. The XL-2 was certified on 19 February 2004 and production deliveries began in 2005.

LIBERTY XL-2

TYPE: Two-seat lightplane.

PROGRAMME: Design, by the team that created the Europa kitbuilt (which see in UK section), began in 1997. Announced 26 May 2000; mockup displayed at NBAA Convention in New Orleans and AOPA-USA Convention in Long Beach during October 2000, when Scaled Technology Works (STW) announced as manufacturing partner; first three aircraft registered as built by STW Composites, but partnership ended in 2003 when STW closed.

'Official' first flight of prototype (N202XL) 2 April 2001, followed by public debut at EAA Sun 'n' Fun at Lakeland, Florida later that month; second prototype and sales demonstrator (N203XL) appeared at 2002 Sun 'n' Fun fitted with a redesigned engine cowling; production conforming prototype (N204XL) entered the flight test programme in September 2003; FAA FAR Pt 23 certification for day VFR achieved 19 February 2004; IFR certification 3 August 2005; Total of 16 aircraft manufactured by April 2006; initial delivery of an IFR-certified aircraft took place on 1 November 2005. Australian certification granted 1 December 2006.

CURRENT VERSIONS: **XL-2:** Standard version, adoption of Teledyne Continental IOF-240 engine announced 21 July 2001. *As described.*

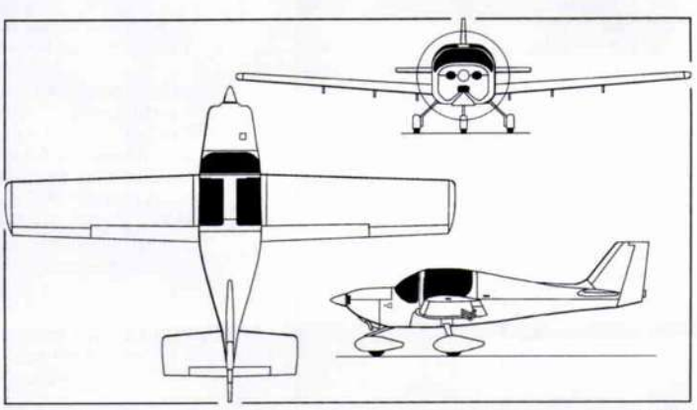
XL-2R: Proposed future version with Rotax 912 S flat-four.

XL-2 Surveillance Platform: Version under consideration in early 2004 would feature FLIR Systems Ultra 8500 FW long-range FLIR sensor; endurance 5 hours; estimated cost USD400,000.

CUSTOMERS: Launch customer Civil Flying School at Moorabbin Airport, Melbourne, Australia, ordered two in July 2000; Bill Crokaris of Melbourne has ordered one. First 50 aircraft (for Founders Club members, at special price of USD85,000); 60 sold by April 2004. Recent customers include Phases of Flight of Tamiami, Florida, and Ormond Beach Aviation Inc of Florida, which in February 2006 readed agreement with LAFT LLC of Helena, Montana for lease of up to 35 for its training fleet of which the first was delivered on 12 May 2006; LAFT LLC subsequently committed to options for a further 65 XL-2S. Del Sol Aviation of Albuquerque, New Mexico, which had ordered 13 for delivery over a three-year period, of which the first was delivered in July 2006. First delivery to a retail customer took place on 6 December 2005 to Thomas Sams of South Lake, Texas.

COSTS: Basic USD139,500 with Continental engine (2005). Estimated direct operating cost USD39.09 per hour.

Production Liberty XL-2 *(Paul Jackson)* 1159736



Liberty XL-2 two-seat lightplane *(Paul Jackson)* 1164882

DESIGN FEATURES: Based on Europa, but with modifications to optimise airframe for mass production; cabin is 10 cm (4 in) wider than that of Europa. Design goals included low price, efficient high-speed cruise with STOL performance, economy and ease of maintenance, advanced structural materials offering strength and durability, excellent handling with positive stability, and ability to store at home on a purpose-designed transporter.

FLYING CONTROLS: Conventional and manual, via pushrods. Dual controls and adjustable rudder pedals standard. All-moving mass-balanced tailplane with electrically actuated 1.3:1 geared anti-balance/trim tab maximum deflection +13/5°; mass-balanced ailerons with differential action, maximum deflection +25/−19°; electrically actuated slotted flaps occupying 70 per cent span and 30 per cent chord, maximum deflection 30°; rudder maximum deflection ±30°.

STRUCTURE: Welded 4130 steel tube forward fuselage and centre-section to carry engine, landing gear and wing attachment loads, with modular carbon fibre skin; flying surfaces comprise riveted subassembly with bonded aluminium skin; single-spar wings have optional folding facility, quick connect attachment to centre-section and self-connecting flap and aileron controls; de-riggable tailplane optional. Matrix Composites of Rockledge, Florida, manufactures composites fuselage components, and IAR SA of Romania supplies wing, tailplane and rudder; final assembly by Liberty at Melbourne, Florida.

LANDING GEAR: Non-retractable tricycle type; aluminium main legs; tubular steel nose leg; steering via castoring nosewheel and differential brakes. Cleveland wheels and hydraulic disc brakes. Tyre size 5.00×5.

POWER PLANT: One 93 kW (125 hp) Teledyne Continental IOF-240-B flat-four with Aerosance PowerLink FADEC driving a Sensenich W69EK7-63G two-blade, fixed-pitch, metal propeller, in standard version. Alternatively, for later certification, one 73.5 kW (98.6 hp) Rotax 912 S flat-four, driving a purpose-designed two-blade, fixed-pitch carbon fibre Dowty propeller via 2.43:1 reduction gearing. Fuel capacity 112 litres (29.5 US gallons; 24.6 Imp gallons) of which 106 litres (28 US gallons; 23.3 gallons) are usable.

ACCOMMODATION: Two persons, side by side with four-point safety harnesses; baggage compartment, with cargo net, behind seats, maximum capacity 45 kg (100 lb). Upward-hinged door on port side. Cabin heating.

SYSTEMS: Electrical system powered by 14 V 60 A engine-driven alternator. 14 V battery and 12 V auxiliary power outlet standard.

AVIONICS: Optional Garmin packages.

Basic IFR: Garmin GNC 430 GPS/com/nav/map/GS, GI 106A indicator, GMA 340 audio panel and GTX 327 transponder/altitude encoder.

Expanded IFR: As Basic IFR with addition of SL 30 com/nav/GS and second GI 106A indicator.

Deluxe IFR: As Expanded IFR but with addition of second GNS 430.

GNS 530 GPS/com/nav/map/GS and GTX 330 transponder can replace GNS 430 and GTX 327 in all packages.

Instrumentation: Vision Microsystems VM-1000 digital engine information display. Sensitive altimeter, magnetic compass, airspeed indicator, vertical speed indicator, electric tachometer, trim position indicator, flap position indicator, electric stall warning, annunciator panel, fuel contents gauge, fuel pressure gauge, manifold pressure gauge, percentage power gauge, OAT gauge, CHT gauge, EGT gauge, oil temperature and pressure gauges, voltmeter, ammeter and quartz clock.

EQUIPMENT: Standard equipment includes tinted windows, windscreen defrost, cloth upholstery, map/storage pockets, map shelf, baggage restraint net, static port and alternate static port, wingtip navigation lights, anti-collision beacon, tiedown points, fuel quick-drain and white paint finish. Optional equipment includes electric gyro package comprising artificial horizon, direction indicator and turn co-ordinator; pitot heat; speed kit comprising nose- and mainwheel fairings and flap hinge fairings; landing/taxi/instrument/ cabin flights; deluxe leather interior; pearlescent exterior paint; choice of two exterior decal designs; and towbar.

DIMENSIONS, EXTERNAL:

Wing span	8.53 m (28 ft 0 in)
Wing aspect ratio	7.0
Length overall	6.25 m (20 ft 6 in)
Height overall	2.24 m (7 ft 4 in)
Propeller diameter	1.75m (5 ft 9in)

DIMENSIONS, INTERNAL:

Cabin max width	1.22 m (4 ft 0 in)
Baggage volume	0.68 m³ (24.0 cu ft)

AREAS:

Wings, gross	11.33 m² (122.0 sq ft)

WEIGHTS AND LOADINGS (Continental engine):

Weight empty, VFR	500 kg (1,103 lb)
Baggage capacity	45 kg (100 lb)
Max T-O weight	750 kg (1,653 lb)
Max wing loading	72.1 kg/m² (14.76 lb/sq ft)
Max power loading	8.05 kg/kW (13.22 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	162 kt (300 km/h; 186 mph)
Max cruising speed	132 kt (244 km/h; 152 mph)
Econ cruising speed at 55% power	105 kt (194 km/h; 121 mph)
Max level speed	125 kt (232 km/h; 144 mph)
Manoeuvring speed	102 kt (189 km/h; 117 mph)
Stalling speed: flaps up	52 kt (96 km/h; 60 mph)
flaps down	45 kt (83 km/h; 52 mph)
Max rate of climb at S/L	268 m (879 ft)/min
T-O run	229 m (750 ft)
T-O to 15 m (50 ft)	381 m (1,250 ft)
Landing run	229 m (750 ft)
Range with max fuel and 55% power with reserves	500 n miles (926 km; 575 miles)
g limits	+3.8/−1.9

LITTLE WING

LITTLE WING AUTOGYROS INC

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PRESIDENT: Ronald Herron

Founded in 1995, company is developing a series of autogyros; the original Roto-Pup was to be joined by a new design, the tricycle landing gear, open cockpit **Skylark;** this is in abeyance while company works on other projects, including a radial-engined aircraft. Workforce one; manufacturing area 55 m^2 (600 sq ft).

By April 2005, the Little Wing LW-5 held 19 world records in various classes, including the following in Class E-3a: East to West Coast USA; West to East Coast USA; Round trip US transcontinental; distance without landing (573 n miles; 1,061 km; 659 miles); time to 6,000 m (19,685 ft) (24 min 28 s); and altitude (8,049 m; 26,408 ft).

LITTLE WING ROTO-PUP

TYPE: Single-seat autogyro ultralight kitbuilt; two-seat autogyro ultralight kitbuilt.

PROGRAMME: Initial design work began in 1980 and construction of LW-1 prototype (N45LW), using a Piper PA-11 fuselage and Continental O-200 engine, started December 1990; this made its first flight 21 October 1994. LW-2 (N46LW), scaled-down version of LW-1, first flew April 1995 as legal ultralight at 115 kg (254 lb) using McCulloch O-100 engine; both LW-1 and LW-2 controlled in pitch by standard elevator control and laterally by tilting of rotor head; LW-3 (N45LW), controlled by full universal tilting of rotor head, first flew 22 September 1996 using TEC 2180 UW motorcar engine. Certified by FAA in Experimental category. In 2003, LW-3 was fitted with a seven-cylinder radial engine which has increased empty weight by 45 kg (100 lb); testing continues; **LW-4** and **LW-5** added to range in 2001.

CURRENT VERSIONS: **LW-2:** Controlled by elevator, rudder and laterally tilting rotor head; no longer available.

LW-3: Single seat, controlled by rudder and universally tilting rotor head, pushrod actuated.

LW-4: Two-seat version of LW-3 with modified fuselage to accommodate extra seat in same fuselage length as LW-3. Prototype (N49LW) first flown 2001 with Hirth F-130 engine. Controlled by rudder and universally tilting rotor head. Flown solo from rear seat.

LW-5: Tandem-seat, shorter version (N100MK) with 84.6 kW (113.4 hp) Rotax 914. Landing gear moved 24 cm (9½ in) forward to compensate for 61 cm (2 ft 0 in) reduction in length. Flown solo from rear seat.

Roto-Pup Ultralight: First flew April 1995. McCulloch O-100 engine; fuselage uncovered to remain within 115 kg (254 lb) ultralight limit. Controlled by elevator, lateral tilting rotor head and rudder. Offered as plans only.

CUSTOMERS: Total of 300 sets of plans sold. Five customer kit-built examples have also flown, including Andrew Keech's LW-5 (N100MK) with Rotax 914F engine which currently (2007) holds 19 world records and three US national records for altitude, distance and time to 6,000 m (19,685 ft). Also flew 1,000 mile cross-country in June 2002, and set world speed record around 500 km circuit on 20 March 2005. Others nearing completion in Australia, Belgium, Finland, France, Italy, Japan and UK as well as four simultaneously in Michigan by group of builders.

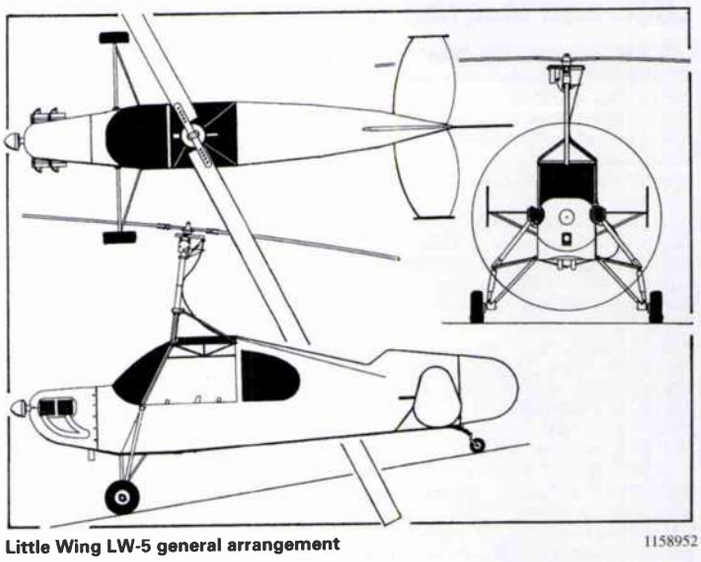
COSTS: LW-3 kit approximately USD10,000; LW-3+2 USD15,000, both without engines. Plans USD175 (all 2006).

DESIGN FEATURES: Tractor configured; fuselage design based on Piper PA-11 Cub Special but scaled-down to approximately 75 per cent size and using Pratt trusses in place of Cub's Warren trusses. Two-blade Rotor Flight Dynamics rotor; each blade is aluminium bonded and has positive twist of 6°. Rotor speed averages 390 rpm, blade tip speed 140 m (459 ft)/s. Rotor mast dampened by large rubber bushes at rear mast brace juncture and lateral pivot is spring-loaded. Rotor brake optional, but recommended on all versions. Automatic teetering limiters are standard.

FLYING CONTROLS: Floor-mounted control stick; pushrods (LW-3) and universally tilting rotor head for pitch and roll, plus cable-actuated rudder. Ground-adjustable horizontal stabiliser for airframe pitch and torque control; tip shields at ends of horizontal stabilisers. Heavy duty push-pull cables for rotor head tilting, arranged in matched pairs, used in LW-4 and LW-5.

STRUCTURE: Full chromoly 4130 steel tube welded fuselage. Rotor mast and pylon of extruded 6061-T6 aluminium covering 4130 internal structure, faired with 016 aluminium sheet and braced with 4130 struts; fuselage covered with Dacron fabric and polyurethane finish. Hub structure of 2024-T3 aluminium bar with multibolt attachments. Pitch is fixed. All aluminium 6061-T6 rotorhead with matched, double-row, angular contract bearings for radial and thrust loads. Pivots are all needle-bearings on hardened steel races.

Record-breaking Little Wing Roto-Pup LW-5 N100MK 1195969



Little Wing LW-5 general arrangement 1158952

LANDING GEAR: Tailwheel type; fixed. Two faired-in side Vs hinged to lower longerons and braced to fuselage sides at centreline by oleo struts. Matco 15 cm (6 in) aluminium mainwheels; tyre pressure 1.03 bar (15 lb/sq in). Matco solid rubber 3.00-2 steerable tailwheel on leaf spring suspension.

POWER PLANT: *LW-3:* One 52.2 kW (70 hp) TEC converted Volkswagen four-stroke engine with dual ignition; 59.6 kW (79.9 hp) Rotax 912; 73.5 kW (98.6 hp) Rotax 912S; 84.6 kW (113.4 hp) Rotax 914; 82.0 kW (110 hp) Rotec 2800 seven-cylinder radial four-stroke can all be fitted. Fuel capacity 38 litres (10.0 US gallons; 8.3 Imp gallons) in seat tank. Refuelling position on port side of cabin. Oil capacity 2.4 litres (5.0 US pints; 4.2 Imp pints).

LW-4 and LW-5: Rotax 912 912S and 914 driving three-blade carbon fibre WarpDrive propeller; and Rotec 2800 as LW-3 driving two-blade wooden Sterba propeller. Standard fuel capacity 49 litres (13.0 US gallons; 10.8 Imp gallons); optional belly tank of 57 litres (15.0 US gallons; 12.5 Imp gallons). Oil capacity 5.7 litres (1.5 US gallons; 1.25 Imp gallons) for Rotec engines, 3 litres (0.8 US gallons; 0.67 Imp gallons) in Rotax engines.

ACCOMMODATION: One or two occupants, according to version, in enclosed cockpit; forward-opening door on starboard side. Baggage compartment behind single seat. Polycarbonate windscreen and side windows.

SYSTEMS: Electric rotor pre-spin standard 1,000 A 12 V battery for ignition back-up and rotor pre-spin. Hydraulic pre-spin optional.

AVIONICS: Micronair 760 nav/com and EIS engine electronic monitoring system.

DIMENSIONS, EXTERNAL:

Rotor diameter: LW-2/3	7.62 m (25 ft 0 in)
Rotor blade chord	0.18 m (7 in)
Fuselage length: standard	5.49 m (18 ft 0 in)
LW-5	4.88 m (16 ft 0 in)
Height to top of rotor head	2.59 m (8 ft 6 in)
Tail unit span	2.13 m (7 ft 0 in)
Wheel track	2.13 m (7 ft 0 in)
Wheelbase: standard	3.96 m (13 ft 0 in)
LW-5	3.51 m (11 ft 6 in)
Propeller diameter: VW engine	1.57 m (5 ft 2 in)
Rotax 912, 912S, 914	1.83 m (6 ft 0 in)
Rotec engine	1.88 m (6 ft 2 in)

DIMENSIONS, INTERNAL:

Cabin: Length: standard	1.24 m (4 ft 1 in)
LW-5	1.90 m (6 ft 3 in)
Max width: standard	0.63 m (2 ft 1 in)
LW-5	0.66 m (2 ft 2 in)
Max height	1.07 m (3 ft 6 in)

AREAS:

Rotor blades (each)	0.54 m^2 (5.83 sq ft)
Rotor disc: LW-2/3	45.62 m^2 (491.1 sq ft)
Dorsal fin	0.42 m^2 (4.52 sq ft)
Auxiliary tip plates (each)	0.15 m^2 (1.60 sq ft)
Rudder	0.28 m^2 (3.03 sq ft)
Tailplane	0.81 m^2 (8.80 sq ft)
Elevators (total)	0.84 m^2 (9.00 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: LW-2	160 kg (352 lb)
LW-3	204 kg (450 lb)
Max baggage weight	11 kg (25 lb)
Max fuel weight	24 kg (54 lb)
Max T-O weight: LW-2	340 kg (750 lb)

PERFORMANCE:

Never-exceed speed (VNE)	104 kt (193 km/h; 120 mph)
Max operating speed at S/L: LW-3	87 kt (161 km/h; 100 mph)
Econ cruising speed at FL10: LW-3	52 kt (97 km/h; 60 mph)
Touchdown speed for power-off landing	9–13 kt (16–24 km/h; 10–15 mph)
Max rate of climb at S/L: LW-3	518 m (1,700 ft)/min
Service ceiling: standard	3,050 m (10,000 ft)
with Rotax 914	7,925 m (26,000 ft)
T-O run: LW-3	61 m (200 ft)
Landing run: LW-3	3–6 m (10–20 ft)
Range: LW-3	100 n miles (185 km; 115 miles)
LW-4, LW-5 with belly tank	347 n miles (643 km; 400 miles)

LOCKHEED MARTIN

LOCKHEED MARTIN CORPORATION

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EXECUTIVE VICE-PRESIDENT, INTEGRATED SYSTEMS AND SOLUTIONS: Dr Stanton D Sloane
SENIOR VICE-PRESIDENT, CORPORATE COMMUNICATIONS: Dennis Boxx

Former Lockheed Aircraft Corporation renamed Lockheed Corporation in September 1977. Merger with Martin Marietta announced 30 August 1994 and completed 15 March 1995. Further expansion resulted from the acquisition of Loral Corporation's defence electronics and systems integration businesses in April 1996 for approximately USD9.1 billion and completed purchase of Comsat in August 2000 for USD2.6 billion. Work force total of about 135,000 in June 2006. Net sales in 2005 reported as USD37.2 billion. Activities include design and production of aircraft, electronics, satellites, space systems, missiles, ocean systems, information systems, and systems for strategic defence and for command, control, communications and intelligence.

Major business groups of Lockheed Martin are:

AERONAUTICS COMPANY: **Electronic Systems,** comprising:
- Lockheed Martin Systems Integration — Owego
- Lockheed Martin Canada
- Lockheed Martin Simulation, Training and Support
- Lockheed Martin Transportation and Security Solutions
- Lockheed Martin Maritime Systems & Sensors
- Lockheed Martin Missiles and Fire Control
- Lockheed Martin Advanced Technology Laboratories

Information and Technology Services, comprising:
- Knolls Atomic Power Laboratory Inc
- Lockheed Martin Aircraft & Logistics Centers
- Lockheed Martin Information Technology
- Lockheed Martin Space Operations
- Lockheed Martin Systems Management
- Lockheed Martin Technical Operations
- Sandia National Laboratories
- Lockheed Martin Technology Ventures Corporation

Integrated Systems and Solutions

Space Systems Company

LOCKHEED MARTIN AERONAUTICS COMPANY

(LM Aero)

1 Lockheed Boulevard, Fort Worth, Texas 76108
Tel: (+1 817) 777 20 00
Fax: (+1 817) 763 47 97

PRESIDENT: Ralph D Heath
VICE-PRESIDENT, COMMUNICATIONS: Mary Jo Polidore

LM Aero includes the following operating units:

Lockheed Martin Aeronautics Company - Marietta

Lockheed Martin Aeronautics Company - Palmdale

Lockheed Martin Aeronautics Company - Fort Worth

Lockheed Martin Aeronautics Company established in January 2000 through consolidation of aeronautics businesses, with headquarters at Fort Worth, Texas. Sales were valued at USD10.2 billion in 2003, increasing to USD11.8 billion in 2004 and falling slightly to USD11.7 billion in 2005, throughout sustaining its position as biggest earning element of Lockheed Martin Corporation. Work force numbered about 20,000 in early 2005. Apart from main operating units detailed above, LM Aero has facilities in Florida, Mississippi, Pennsylvania and West Virginia.

Teaming arrangement agreed with Northrop Grumman to collaborate in development and marketing of AEW aircraft; also with KAI of South Korea to develop and market the T-50 Golden Eagle advanced trainer/lead-in fighter trainer.

LOCKHEED MARTIN AERONAUTICS - MARIETTA

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DIRECTOR, LOCAL MEDIA RELATIONS: Alyce M Samo

In April 1991, Lockheed won competition to produce F-22 (now F/A-22) with General Dynamics (now Lockheed Martin Tactical Aircraft Systems) and (then) Boeing Military Airplanes. Lockheed Martin Aeronautics Company-Marietta also involved in studies into advanced mobility aircraft for 21st century strategic transport; was subcontractor to Boeing on NASA High-Speed Civil Transport (HSCT) programme; working with NASA on advanced subsonic technology transport programme; and engaged in other, classified projects.

Long-term activities at Marietta include production of C-130J Hercules and F-22 Raptor aircraft. LMAS signed joint venture agreement with Alenia of Italy in September 1996 concerning development and marketing of the C-27J tactical transport that incorporates systems developed for the C-130J Hercules. However, lack of sales resulted in Lockheed Martin scaling down involvement in closing months of 2002, including withdrawal from marketing of C-27J as joint effort with Alenia in US military competitions.

Lockheed Martin Aeronautics Company-Marietta working to develop standard avionics suite for future versions (upgrades) of P-3 Orion and AEW aircraft; open architecture design for maximum flexibility and system growth; elements include AN/APS-145 radar, GPS and communications/navigation system. Also interest from several countries on possible new-build aircraft.

Aeronautical Systems Support, with headquarters in Smyrna, Georgia, is subordinate element, with responsibility for after sales support, including provision of spare parts and technical back-up, for variety of aircraft types.

LOCKHEED MARTIN (645) F-22 RAPTOR

TYPE: Multirole fighter.
PROGRAMME:

DEVELOPMENT MILESTONES

Requirement issued	1981
Request for proposals	Sep 85
Design submitted	Jul 86
Programme launched	31 Oct 86
First flight	29 Sep 90
First flight, pre-production	7 Sep 97
Production go-ahead	15 Aug 01
First flight, production	Sep 03
First delivery	26 Sep 03

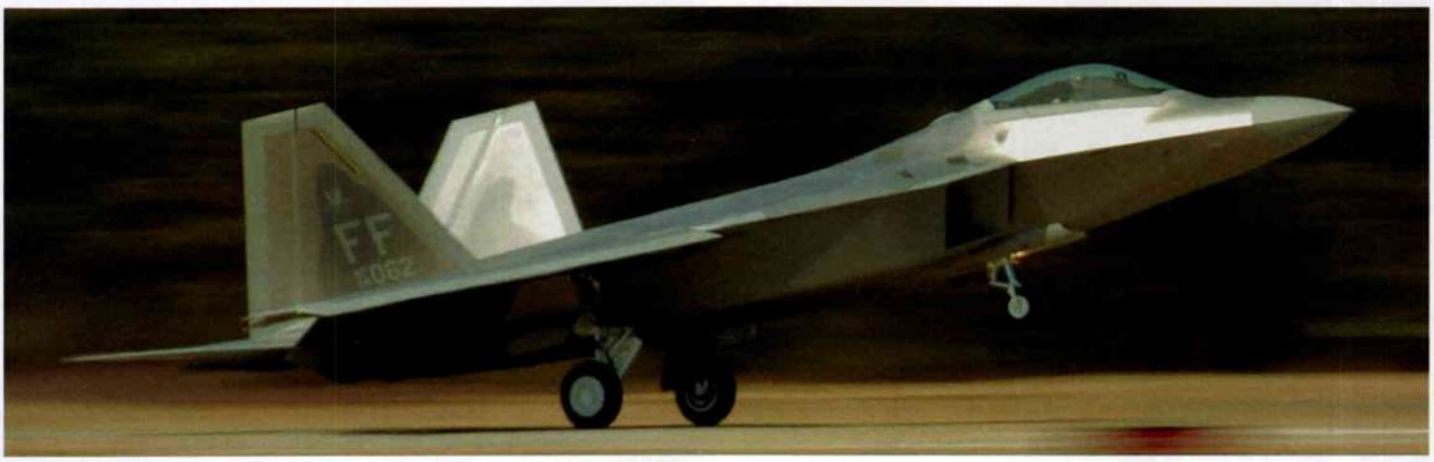
US Air Force Advanced Tactical Fighter (ATF) requirement called for 750 McDonnell Douglas F-15 Eagle replacements incorporating low observables technology and supercruise (supersonic cruise without afterburning); parallel assessment of two new power plants; request for information issued 1981; concept definition studies awarded September 1983 to Boeing, General Dynamics, Grumman, McDonnell Douglas, Northrop and Rockwell; requests for proposals issued September 1985; submissions received by 28 July 1986; USAF selection announced 31 October 1986 of demonstration/validation phase contractors: Lockheed YF-22 and Northrop YF-23; each produced two prototypes and ground-based avionics testbed. Competing engine demonstration/validation programmes launched September 1983; ground testing began 1986–87; flight-capable Pratt & Whitney YF119s and General Electric YF120s ordered early 1988; all four aircraft/engine combinations flown.

Decision of 11 October 1989 extended evaluation phase by six months; draft request for engineering and manufacturing development (EMD) proposals issued April 1990; first artists' impressions released May 1990; Lockheed teamed with General Dynamics (Fort Worth) and Boeing Military Airplanes to produce two YF-22 prototypes, which first flew on 29 September and 30 October 1990.

Acquisition of former General Dynamics gave Lockheed Martin control of 67.5 per cent of programme. Final engineering and manufacturing development (EMD) requests issued for both weapon system and engine 1 November 1990; proposals submitted 2 January 1991; F-22 and F119 power plant announced by USAF as winning combination, 23 April 1991; EMD contract given 2 August 1991 for 11 (later reduced to nine) flying prototypes, plus one static test article and one fatigue test airframe; design underwent several detail refinements through early 1990s.

Combat roles reassessment of May 1993 added air-to-ground attack with precision-guided munitions (PGMs) to F-22's roles. Under USD6.5 million contract addition on 25 May 1993, main weapon bay and avionics adapted for delivery of AIM-9X missile and 454 kg (1,000 lb) GBU-32 Joint Direct Attack Munition (JDAM). Addition of ground attack capability resulted in redesignation as the **F/A-22**, which announced by USAF Chief of Staff General John Jumper on 17 September 2002. This lasted only until 13 December 2005 when F-22A designation was re-adopted, with no change to planned capabilities, by General T Michael Moseley.

Preliminary design review, covering all aspects of the design, completed 30 April 1993; critical design review completed February 1995; preproduction verification (PPV) batch of four aircraft was scheduled to be ordered 1997 but these deleted from overall programme at start of that year; long lead items for first production batch (two aircraft), subsequently reclassified as Production Representative Test Vehicles (PRTV), ordered in 1998, with full funding in FY99. Minor design changes for production aircraft announced July 1991. Suggested name of SuperStar rejected in 1991 and it remained unnamed until occasion of roll-out in April 1997 when it was announced that the name Raptor had been chosen.



Lockheed Martin F-22A Raptor 04-4062 departs Marietta on delivery as the first aircraft for 94th FS 1040475

1040491

Lockheed Martin F-22A Raptor *(Paul Jackson)*

Fabrication of first component for first EMD aircraft (91-4001, c/n 4001) began 8 December 1993 at Boeing's facility in Kent, Washington; assembly of forward fuselage launched at Marietta on 2 November 1995 with start of work on nose landing gear well; assembly begun at Fort Worth in mid-1995 with mating of three assemblies that comprised the mid-fuselage of first EMD aircraft taking place in early 1996, followed by road transfer of entire section to Marietta in September 1996 for start of final assembly. Delivery by Boeing to Lockheed Martin at Marietta of subassemblies, including wing and aft fuselage, for first EMD aircraft took place on schedule in third quarter of 1996. Pratt & Whitney also delivered first F119 flight test power plant in September. Prototype rolled out 9 April 1997; planned May 1997 first flight delayed by fuel leaks and hardware-related anomalies. First flight accomplished 7 September 1997, with aircraft airborne for 58 minutes during which initial handling evaluation undertaken before landing gear was retracted and further handling assessment performed at speeds of up to 250 kt (463 km/h; 288 mph); maiden flight also included simulated powered approach at medium altitude before landing at Marietta. Second sortie of 35 minutes took place on 14 September 1997, after which aircraft underwent minor structural modifications and was then placed in structural test fixture for load ground tests and strain gauge calibration.

Low-rate initial production (LRIP) decision originally dependent upon accumulating 183 hours of flight testing; this milestone passed on 23 November 1998 and cleared way for release of USD195.5 million in late December 1998 for advance procurement (long lead items) for six Lot 1 LRIP aircraft, which subsequently reclassified as PRTV 2 aircraft after wrangle over funding in mid-1999. Earlier, in December 1998, Lockheed Martin received contract worth USD503 million for two PRTVs and associated programme support.

Wind tunnel testing occupied 19,195 hours up to YF-22 stage and a further 16,930 hours up to mid-1995, when Configuration 645 was finalised; six major categories were investigated (aerodynamic loads and weapons bay acoustics, inlet and engine compatibility, mission/manoeuvre performance, inlet icing, stability and control flying qualities, weapons and stores separation), with last-named comprising majority of 900 hours that remained to be done in 1995–97.

Avionics trials from November 1997 in a Boeing 757 (N757A) Flying Test Bed (FTB) with AN/APG-77 radar in F-22-type nosecone; block 1 software, permitting basic radar operation including simultaneous search-and-track modes, delivered to Boeing, April 1998 and subsequently tested on 757; block 2 software delivered on 7 December 1998, with block 3S beginning flight testing on 24 April 2000; this is early version of block 3.0 software, which delivered to Seattle on 11 August 2000 in readiness for airborne trials programme that began in mid-September. Communications/navigation/identification (CNI) system and EW suite tower-tested on full-scale model of forward fuselage at Fort Worth, Texas, during 1998–99; subsequently tested on Boeing 757 FTB, which is fitted with three common integrated processors (CIPs) for 1,400 hour software flight test programme. Further modification of Boeing 757 to mount representative wing section above forward fuselage completed in late 1998, and flight testing of conformal antennas began on 11 March 1999; by December 2000, 757 FTB had accumulated 641.9 flight test hours in 126 sorties. Radar testing accomplished using T-39 Sabreliner as target and involved a Lockheed T-33 for calibrated airborne trials from December 1998.

Milestones in 1999 included delivery of first AN/ALR-94 EW system on 15 February by Sanders to the Avionics Integration Laboratory in Seattle; 100th sortie in May; successful completion of design load limit testing of article 3999 on 25 September; and compliance with all five major 1999 flight test objectives (including flight at altitude of 50,000 ft; opening of side and main weapon bay doors in flight; supercruise demonstration; and flutter envelope expansion) by 24 September.

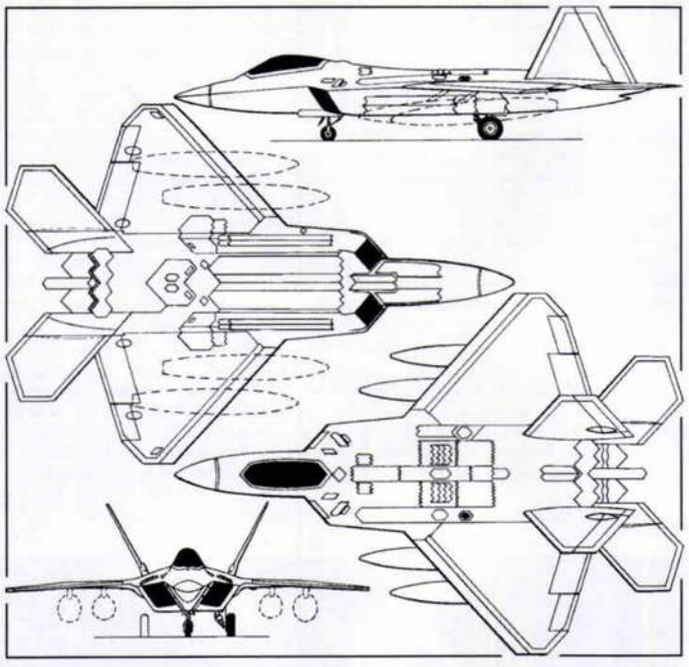
Flight test programme interrupted at least twice during 2000, with most serious occurrence arising in May after discovery of hairline cracks in canopies of first two aircraft; grounding order lifted on 5 June, when second EMD F-22 resumed testing with some restrictions while awaiting replacement unit. Major event of year was expected to be Pentagon Defense Acquisition Board review to culminate in award of contract for initial batch of LRIP aircraft; this was scheduled for 21 December, but slipped to 3 January 2001 and was further delayed by poor weather that prevented three of 11 critical test objectives being achieved; funding release dependent upon compliance with several 'exit criteria', including first flight of F-22 with block 3.0 software, first AMRAAM launch and first flights of aircraft 4004, 4005 and 4006. First AIM-120C AMRAAM launch (of 60 planned) achieved 24 October 2000; static tests completed 28 December 2000. Remaining three objectives satisfied by 6 February 2001, with first flight of aircraft 4006. However, decision to proceed with LRIP phase not taken until 15 August 2001, when initial batch of 10 aircraft approved with FY01 funds.

Objectives for 2002 comprised first flight of first Production Representative Test Vehicle (PRTV), which achieved on 12 October; first supercruise launch of AIM-120, including successful interception of aerial target, which accomplished on 5 November; expansion of flight envelope to permit start of USAF pilot training in anticipation of initial operational test and evaluation (IOT&E); and supercruise launch of, and interception by, heat-seeking AIM-9M, which undertaken on 22 November. Block 3.1 software package delivered 5 February 2002 and flown for first time (on 91-4006) on 25 April at Edwards AFB.

1040490

High AoA climb by 1st FW Lockheed Martin F-22A Raptor *(Paul Jackson)*

US Air Force 'Heritage Formation' of Lockheed Martin F-22A Raptor, North American P-51D Mustang and Boeing F-15C Eagle *(Paul Jackson)* 1040492



Lockheed Martin F-22A Raptor *(James Goulding)* 1158976

In February 2003, the fifth and sixth EMD aircraft successfully demonstrated the Intraflight Datalink (IFDL) facility for the first time. Subsequently, flight operations were briefly interrupted when nose gear of one aircraft retracted as engines were being shut down; this incident occurred on 18 March 2003 and resulted in the F-22 being grounded until 22 March.

Notable milestone passed on 18 April 2001, when 1,000th flight test hour recorded; 2,000th hour completed on 7 June 2002; 3,000th hour on 26 February 2003; 4,000th on 2 September 2003 and 5,000th on 9 February 2004. Nevertheless, delays in production and delivery of test aircraft meant programme was behind schedule, with knock-on effect on start of IOT&E; this was scheduled to start in August 2002, but was delayed and did not begin until 29 April 2004. At that time, 24 aircraft were flying and IOT&E was due for completion in September 2004. One year earlier, the first delivery to an operational unit was effected 26 September 2003, when Raptor 01-4018 was flown from Marietta to Tyndall AFB, Florida, for 43rd FS of 325th FW. Overall development programme was expected to be completed in March 2004, but continued until at least November 2005; this extension largely attributed to problems experienced with avionics software, such as tendency for elements of the avionics suite to shut down every 3 to 4 hours. By late April 2004, avionics package had demonstrated increased stability by completing five hours of continuous operation between malfunctions.

Total of 13 aircraft delivered to 325th FW by end of 2004, by which time first F-22 loss had occurred, this involving 422nd TES aircraft (00-4014) destroyed in take-off accident at Nellis on 20 December 2004. Deliveries to training unit at Tyndall continued into 2005, with entire fleet of 23 F-22As on strength by second quarter of 2005, although two aircraft loaned to 1st FW at Langley in early part of year. First Lot 3 aircraft (03-4041) was rolled out at Marietta on 27 October 2004. Initial delivery to 27th FS, 1st FW, Langley, on 12 May 2005 was 03-4042. Next two aircraft followed on 8 June, with subsequent deliveries to 27th FS being made at rate of two per month. 27th FS received USAF's 50th Raptor (03-4051) on 28 September 2005, at which time 63 of 83 F-22s on order had completed final assembly.

Final stage of trials programme was follow-on test and evaluation (FOT&E), which began on 29 August 2005 and concluded shortly before the end of that year; seven aircraft, modified to combat-coded configuration of 47th F-22A, took part in series of operational battlespace scenarios involving launch of AIM-120 AMRAAMs and delivery of JDAM weapons. Opposition forces were provided by Nellis-based 'aggressor' aircraft and completion of this programme resulted in the F-22A being given a mission capable rating and paved the way for declaration of IOC on 15 December 2005.

Re-equipment of 27th FS completed in early 2006, with second squadron at Langley (94th FS) accepting its first two aircraft (04-4062 and 04-4063) on 3 March 2006; remainder of Block 20 production expected to be assigned to 94th FS. First deployment to base outside continental US occurred in May-July 2006, when 12 F-22As of 27th FS participated in exercise 'Northern Edge'; during 12-day exercise period, these aircraft operated from Elmendorf AFB, Alaska and successfully accomplished 102 of 105 tasked sorties; dropped 26 JDAMs, scoring 26 direct hits; and demonstrated an 80:1 kill ratio in simulated air combat.

Shortly before this exercise, it emerged that a structural problem affecting the horizontal tail attachment points would require a retrofit programme; more than 70 aircraft (production numbers 4010 to 4083) are involved, with those up to 03-4061 to receive attention at the Ogden Air Logistics Center at Hill AFB, Utah, while the remaining 22 were to get strengthened fittings during the process of assembly at Marietta. Investigation of a separate problem resulting from inadequate heat treating of titanium structures in the forward fuselage section was also under way at this time; while this was not perceived to compromise flight safety, there was concern that fatigue could occur at a faster than predicted rate. Subsequently, in July 2006, the USAF decided to withhold funds to pay for inspection of the 48 affected aircraft.

Block 30 production aircraft to be assigned to 3rd Wing at Elmendorf AFB, Alaska; first F-22A for subordinate 90th FS will be 05-4087 which was rolled out on 16 October 2006. Initial training will be with 1st FW at Langley, deployment to Elmendorf following by mid-2007 and 90th FS anticipates being fully equipped by January 2008; second squadron at Elmendorf will be 525th FS, which due to reactivate in late 2007.

Next two squadrons to form, remain unidentified, but will probably be stationed at Holloman AFB, New Mexico, with seventh (and last of current planned force) to be established at Hickam AFB, Hawaii, in about 2010-11. Latter will be an Air National Guard (ANG) unit (199th FS), but will operate in association with regular 531st FS, sharing common resources at Hickam. Other second-line elements that will function in association with first-line units are to be located at Langley (149th FS/192nd FW from the ANG) and Elmendorf (302nd FS of Air Force Reserve Command).

By early August 2006, total of 76 F-22As had been delivered to USAF.

CURRENT VERSIONS: **F-22A**: Single-seat production version for USAF. Achieved IOC with 27th Fighter Squadron, 1st Fighter Wing on 15 December 2005. Current planning anticipates procurement of total of 183 F-22As (including final two EMD and eight PRTV aircraft for evaluation, service testing and development of tactics and operating procedures by USAF Air Warfare Center at Nellis AFB, Nevada).

F-22B: Projected two-seat version for USAF; development terminated 10 July 1996 to reduce costs.

FB-22: Proposed long-range strike-dedicated derivative under study by Lockheed Martin at USAF request in 2002; initial proposal larger than F-22, with combat radius of up to 1,565 n miles (2,897 km; 1,800 miles) and significantly bigger payload of 30 small diameter bombs. Most recent configuration, revealed at beginning of 2005, features larger, delta wing, increased capacity main weapons bays, plus 2,268 kg (5,000 lb) capacity wing weapons bays and external carriage of stealthy cruise missile. Total ordnance payload said to be 14,969 kg (33,000 lb), options including 1,000 kg (2,205 lb) JDAM, 250 kg (551 lb) Small Diameter Bombs, AAMs for self-defence and stand-off missiles, with wing stations plumbed for carriage of auxiliary fuel tanks if required.

If proceeded with, would have 85 per cent hardware and software commonality with F-22 and could enter production in 2012. Other probable changes might include insertion of fuselage plug to increase weapons bay size and carriage characteristics and compromised air-to-air combat capability. Secretary of the Air Force James Roche informed US Congress in late February 2003 that his optimum bomber force would include at least 150 FB-22s; however, USAF studies envisage deployment of about 50 new bombers starting in 2015.

NATF: Naval Advanced Tactical Fighter; projected US Navy variant to replace Grumman F-14 Tomcat; development abandoned.

CUSTOMERS: US Air Force; two YF-22 demonstrators; nine EMD aircraft plus one static and one fatigue test airframes; original 648 production aircraft programme of 1991 reduced to 442 in January 1994; latter originally to be funded from 1997 (long lead), beginning with four preproduction verification (PPV) aircraft in FY98, followed by series production of 438 (but PPV aircraft cancelled in early 1997). Quadrennial Defense Review (QDR) report in May 1997 resulted in planned procurement falling to 339 (including eight PRTV aircraft); further cuts followed, first to 333 in 1999 and then to 295 in 2001, although in early 2003, it appeared that as few as 276 could be acquired, with peak production rate of 32 per year during FY07 to FY10. By early 2004, imposition of a spending cap of USD36.8 billion by Congress resulted in yet another downward revision, to a total of about 224 F-22s.

Subsequently, in December 2004, US Department of Defense moved to cut total procurement to about 180 aircraft, although USAF vigorously defended F-22 programme and stated that it still required 381 aircraft. Ultimate total now looks likely to be 183, sufficient to allow equipment of seven combat-coded squadrons, plus training unit and small operational test and tactics unit; however, USAF leadership claims that minimum of 10 squadrons needed, which would require production of about another 60 aircraft and in December 2006 was calling for at least another 20, to be purchased with FY10 funds.

Contracts for two PRTV 1 aircraft and long lead items for batch of six PRTV 2 aircraft signed December 1998. Decision to authorise LRIP expected in December 2000 but delayed until 15 August 2001; clearance to begin full-rate production (FRP) due in December 2004, but not forthcoming until 18 April 2005. Pilot training at Tyndall AFB, Florida, by 43rd Fighter Squadron, 325th Fighter Wing from 2003, with IOC of first squadron achieved on 15 December 2005, this being 27th Fighter Squadron of 1st Fighter Wing at Langley AFB, Virginia. Following re-equipment of 1st Fighter Wing, next to convert will be two squadrons of 3rd Wing at Elmendorf AFB, Alaska; this expected to begin by end of 2006 with 90th FS.

In June 2006, US Congress appeared ready to lift ban imposed on export sales in 1997, with Japan and South Korea both viewed as potential customers for F-22.

PLANNED F-22 PROCUREMENT
(at December 2006)

FY	Lot	Quantity	First aircraft
99	PRTV 1	2	99-4010
00	PRTV 2	6	00-4012
01	LRIP 1	10	01-4018
02	LRIP 2	13	02-4028
03	LRIP 3	21	03-4041
04	LRIP 4	22	04-4062
05	LRIP 5	24	05-4084
06	FRP1	23	
07	FRP2	23	
Total		**141**	

Notes: Excludes two prototypes and nine EMD aircraft; further 40 aircraft expected to be procured in two lots during FY08 and FY09.

COSTS: USD818 million contracts to both ATF teams, October 1986, for 54-month studies; each airframe team investing own funds (Lockheed/Boeing/GD team investment totalled USD675 million in addition to DoD funding); each engine contractor, about USD50 million; total USD3,800 million spent by USAF on both ATFs up to April 1991; programme cost for 648 aircraft was USD13 billion for development (1991 base year) and USD52.5 billion for production (1994 then-year); flyaway cost USD61.2 million at 1991 prices.

EMD contract, 2 August 1991, comprised USD9,550 million for 11 (subsequently nine) airframes, plus USD1,375 million to P&W for 33 (later amended to 27) engines. FY94 US Congressional appropriation of USD2,100 million was USD163 million below expectations, resulting in slippage of critical design review and first flight. Similarly, FY95 appropriation of USD2,300 million was USD110 million below expected figure, leading to further delay in maiden flight; and on 9 December 1994, Defense Secretary William Perry announced 10 per cent cut (approximately USD210 million) in FY96 budget, necessitating a third restructuring of the programme.

On 30 December 1999, Lockheed Martin awarded contract for approximately USD1.3 billion, covering procurement of six PRTV 2 aircraft, augmenting earlier USD195.5 million contract for long-lead items; at same time, Pratt & Whitney received separate USD180 million award for 12 F119 engines. Additional appropriation of USD277.1 million allocated to Lockheed Martin for long-lead items for 10 Lot 1 LRIP aircraft; further USD862 million contract awarded 19 September 2001 towards remaining cost of producing these 10 aircraft. Total cost of LRIP 2 batch of 13 aircraft quoted as USD3.03 billion; subsequent appropriations for production aircraft have been USD4.46 billion in FY03 (21 aircraft); USD4.15 billion in FY04 (22); USD4,11 billion in FY05 (24) and USD3.82 billion in FY06 (23). By April 2004, total programme cost being reported as USD71.8 billion, of which development said to account for USD28.7 billion, although US General Accounting Office report of 15 March 2004 claimed that development costs are approaching USD40 billion. Flyaway unit cost for Lot 7 aircraft will be USD141.5 million according to FY07 budget documentation; same document stated total weapon system unit cost to be USD171.8 million.

DESIGN FEATURES: Low-observables configuration and construction; stealth/agility trade-off decided by design team. Antennas located in leading– or trailing-edges of wings and fins, or flush with surfaces, to minimise radar signature. Target thrust/weight ratio 1.4 (achieved ratio 1.2 at T-O weight); greatly improved reliability and maintainability for high sortie-generation rates, including under 20 minutes combat turnround time; enhanced survivability through 'first-look, first-shot, first-kill' capability; short T-O and landing distances; supersonic cruise and manoeuvring (supercruise) in region of M1.5 without afterburning; internal weapons storage and generous internal fuel; conformal sensors.

Highly integrated avionics for single-pilot operation and rapid reaction. Radar, RWR and comms/ident managed by single system presenting relevant data only, and with emissions controlled (passive to fully active) in stages, according to tactical situation. CIP handles all avionics functions, including self-protection and radio, and automatically reconfigures to compensate for faults and failures. Two CIPs, with space for third, linked by 400 Mbits/s fibre optic network (see Avionics). Computer architecture and avionics processes will need to be upgraded, in five to six years, following Intel decision to phase out 32-bit, 25 MHz i960MX chip which is obsolete; this chip has insufficient power to support intended air-to-ground applications after 2013, but is being installed on first 155 Raptors.

Lockheed Martin F-22A Raptor refuelling from a Boeing KC-135R
(SSgt Joshua Strang, USAF) 1040468

Wing and horizontal tail leading-edge sweep 42°; trailing-edge 17° forward, increased to 42° outboard of ailerons; all-moving five-edged horizontal tail. Vertical tail surfaces canted outwards at 28°; leading– and trailing-edge sweep 22.9°; biconvex aerofoil. Wing taper ratio 0.169; leading-edge anhedral 3.25°; root twist 0.5°; tip twist −3.1°; thickness/chord ratio 5.92 per cent at root, 4.29 per cent at tip; custom-designed aerofoil. Horizontal tails have no dihedral or twist.

Diamond-shaped cheek air intakes with highly contoured air ducts; single-axis thrust vectoring included on F119, but most specified performance achievable without.

Production aircraft coated with new, Boeing-developed, stealthy paint intended to enhance low-visibility attributes; this first applied to second EMD aircraft in March 2000.

FLYING CONTROLS: Triplex, digital, fly-by-wire system with GEC sidestick control, using line-replaceable electronic modules to enhance maintainability; thrust vectoring utilised to augment aerodynamic pitch control power and provide firm control even at low speeds and high angles of attack. Technology and control concepts demonstrated throughout the flight envelope during prototype air vehicle test programme, including flight at AoA greater than 60°; wind tunnel testing with models of production aircraft successfully attained AoAs greater than 85°.

Ailerons and flaperons occupy almost entire wing trailing-edge; full-span leading-edge flaps; conventional rudders in vertical tail surfaces; slab taileron surfaces; airbrake not included (differential rudder and wing trailing-edge surfaces for speed control). Control surface authorities: leading-edge flaps 0° up/35° down (2°/37° overtravel); trailing-edge flaperons 20° up/35° down; ailerons ±25°; horizontal tail leading-edges 30° up/25° down; rudders ±30°; speedbrake (rudder) 30° out.

STRUCTURE: Lockheed Martin at Marietta constructs forward fuselage, including cockpit (with avionics architecture, displays, controls, air data system), apertures, edges, tail assembly, landing gear and environmental control system and undertakes final assembly. Lockheed Martin's Fort Worth plant builds the centre-fuselage; Palmdale, the radome. Boeing responsible for wings, fuselage aft sections, power plant installation, auxiliary power generation system, radar, arresting gear system and avionics integration laboratory.

Total airframe weight comprises approximately 36 per cent titanium 64, three per cent titanium 62222, 24 per cent thermoset composites (both epoxy resin and bismaleimide), one per cent thermoplastic composites, 16 per cent aluminium, 6 per cent steel and 14 per cent

PLANNED F-22 DEPLOYMENT
(at at August 2006)

Wing	Squadron(s)	Associate Unit	Base	Equipped	Block
1st Fighter Wing (ACC)	27th and 94th FS	149th FS (ANG)	Langley AFB, Va	2005-06	20
3rd Wing (PACAF)	90th and 525th FS	302nd FS (AFRC)	Elmendorf AFB, Ak	2006-08	30
154th Wing (ANG)	199th FS (ANG)	531st FS	Hickam AFB, Hi	2010-11	40?
325th FW (AETC)	43rd FS	-	Tyndall AFB, Fl	2003-05	10

Notes: Holloman AFB, New Mexico has been identified as a probable future base for two squadrons equipped with the F-22A. Operating unit has not yet been identified, but may be the 49th FW; delivery of aircraft to this base appears likely to take place in 2009-10. In addition, a small number of aircraft are assigned to test duties.

other materials. Forward fuselage substructure is aluminium and composites; centre-fuselage includes titanium, aluminium and composites; both forward and centre-fuselage skins primarily graphite bismaleimide. Four main mid-fuselage section bulkheads are single-piece, closed-die, titanium forgings. Rear fuselage approximately 67 per cent titanium, 22 per cent aluminium and 11 per cent composites. Engine bay doors titanium honeycomb, produced by liquid-interface diffusion bonding. Tailbooms assembled by electron beam welding. Titanium vent screens (to reduce radar reflectivity) contain thousands of precisely shaped holes in special alignment, each cut by abrasive water-jet. Thermoplastics used in areas requiring high tolerance to damage, examples including doors for landing gear and weapon bay.

Wing skins are monolithic graphite bismaleimide. Main (front) wing spars are machined titanium forgings; intermediate spars are mix of resin transfer moulded (RTM) sine-wave composites and titanium for strength to meet vulnerability requirements in wing fuel tank; rear spars composites and titanium. Wingroot and control surface actuator attachment fittings are titanium HIP castings. Horizontal stabiliser incorporates 'tow placed' composites pivot shaft in addition to aluminium honeycomb core and graphite bismaleimide skins produced by GKN Aerospace Services; vertical stabilisers use solid graphite bismaleimide skins over graphite epoxy RTM spars. Wing control surfaces are combination of co-cured composites skins/substructure and non-metallic honeycomb core construction.

LANDING GEAR: Menasco retractable tricycle type, stressed for no-flare landings of up to 3.05 m (10 ft)/s. Honeywell wheels, brakes and anti-skid system. Nosewheel tyre Goodyear or Michelin 23.5×7.5-10 (22 ply) tubeless; mainwheel tyres Goodyear or Michelin 37×11.50-18 (30 ply) tubeless. Kaiser airfield arrester hook in enclosed fairing between engines.

POWER PLANT: Two 156 kN (35,000 lb st) class Pratt & Whitney F119-PW-100 advanced technology reheated turbofans, each fitted with a two-dimensional, convergent/divergent thrust vectoring (±20° in vertical plane) exhaust nozzle for enhanced performance and manoeuvrability.

Fuel in eight tanks in forward fuselage, mid-fuselage, wings and tailbooms; provision for later addition of fuel in saddle and fin tanks. Additionally, up to four external fuel tanks, each 2,271 litres (600 US gallons; 500 Imp gallons), on underwing hardpoints. Dorsal Xar Industries aerial refuelling receptacle covered by doors, except when required. Fuel grade JP-8.

ACCOMMODATION: Pilot only, on zero/zero modified Boeing ACES II ejection seat and wearing tactical life support system with improved *g*-suits, pressure breathing and arm restraint. Pilot's view over nose is −15°. Canopy manufactured by Sierracin Sylmar Corp as single-piece unit, hinged at rear.

SYSTEMS: Twin 276 bar (4,000 lb/sq in) hydraulic systems with four pumps (each 273 litres; 72.0 US gallons; 60.0 Imp gallons per minute), but single Parker Bertea actuator on each control surface to save weight and cost. Curtiss Wright actuators on leading-edge flaps. Two 65 kW engine-driven generators. Honeywell G250 335 kW (450 hp) APU driving a Hamilton Sundstrand 27 kW generator and 100 litre (26.5 US gallon; 22.0 Imp gallon)/min pump. Smiths 270 V DC electrical distribution system. Honeywell environmental control system for life support system and flight avionics (open loop air cycle), mission avionics (closed loop vapour cycle) and fuel cooling (thermal management). OBIGGS and Normalair-Garrett OBOGS.

AVIONICS: Final integration, as well as integration of entire suite with non-avionics systems, undertaken at Avionics Integration Laboratory, Seattle, Washington; airborne integration supported by Boeing 757 flying testbed and the Air Vehicle Integration Facility at Marietta.

Comms: TRW AN/ASQ-220 communication/navigation/identification (CNI) system includes Mk 12 IFF and UHF/VHF. CNI system uses modules contained in two integrated CNI racks, CIP assets and integrated display/control panels. Intra-Flight Data Link (IFDL) encrypted radio and wireless communications modem allows all Raptors in a flight to share target and system data without fear of being overheard. Supplier team, responsible for electronics and software, also includes Rockwell Collins, ITT and GEC.

Radar: Northrop Grumman/Raytheon AN/APG-77 multimode radar incorporates active electronically scanned array (AESA), capable of interleaving air-to-air search and multitarget track functions. Also has weather mapping mode and provisions for air-to-ground modes and side arrays. Radar reported to be capable of detecting 1 m^2 (10.76 sq ft) target at range of approximately 109 n miles (201 km; 125 miles). Fourth generation version of radar to be installed starting with Lot 5 production; this improved AN/APG-77(V)1 radar will incorporate advanced air-to-ground computer software.

Flight: Vehicle management system (VMS) combines flight and propulsion controls; integrated vehicle subsystem control (IVSC) operates utilities via digital databus. Total of 18 Raytheon 1750A common processor modules used for VMS, IVSC and stores management system. F-22 is first fighter with triplex digital flight control computers and no electrical or mechanical back-up; control reconfiguration modes provide safe flying after actuator or hydraulic failures. VMS controls 14 surfaces (horizontal tail, ailerons, flaperons, rudders, leading-edge flaps and inlet bleed and bypass doors). No AoA limitation, but overstressing made impossible by restrictions to roll rate and load factor, according to fuel state, stores carriage and flight condition. Lear Astronics VMS integrated with Rosemount low-observable air data system, including two AoA probes and four sideslip plates on nose. CNI system includes GPS, Tacan and ILS. Twin Litton LN-100F INS. Throttle and stick contain 20 controls with 63 functions.

Software Block 0 for initial flight tests. Block 1.1 installed on aircraft 4004 in 1999, was primarily for radar, but included more than half of the avionics suite's source lines of code. Block 2, installed in the 757 FTB in October 1999, began sensor fusion, including radio frequency co-ordination and some electronic warfare functions. Block 3S added CNI and ECCM; Block 3.0, tested in the 757 FTB in fourth quarter of 2000 and flown for first time in F-22 on 5 January 2001, provided full sensor fusion and weapon delivery function; Block 3.1.3 adds GBU-32 JDAM, JTIDS receive and GPS and will be available to IOC aircraft. Block 4 will incorporate helmet cueing and AIM-9X. Work is under way on a Block 5 upgrade that should provide JTIDS transmit as well as enhanced air-ground capability from around 2006, including compatibility with forthcoming Small Diameter Bomb (SDB).

Instrumentation: Fused situational awareness information is displayed to pilot via four Lockheed Martin colour liquid crystal multifunction displays (MFD); MFD bezel buttons provide pilot format control. Centre screen measures 203 × 203 mm (8 × 8 in) and typically will function as situation display; right and left screens measure 152 × 152 mm (6 × 6 in) and function as attack and defensive displays respectively; fourth screen (directly below situation display) can be used to provide global side-view depiction of tactical situation and may also present other data such as fuel status, engine parameters, stores data, BIT reports and electronic checklists. Additionally, 76 × 102 mm (3 × 4 in) upfront display screens on each side of the integrated control panel, immediately below the BAE Systems HUD. Illumination is NVG-compatible.

Mission: Two Hughes common integrated processors (CIP); CIP also contains mission software that uses tailorable mission planning data for sensor emitter management and multisensor fusion; mission-specific information delivered to system through Fairchild data transfer equipment/mass memory (DTE/MM) system that contains mass storage for default data and air vehicle operational flight programme; stores management system. General purpose processing capacity of CIP is rated at more than 700 million instructions per second (Mips) with growth to 2,000 Mips; signal processing capacity greater than 20 billion operations per second (Bops) with expansion capability to 50 Bops; CIP contains more than 300 Mbytes of memory with growth potential to 650 Mbytes. Of 132 slots available in CIPs 1 and 2, 41 are initially vacant and thus available for growth. Intra-flight datalink automatically shares tactical information between two or more F-22s. CNI system includes JTIDS (receive-only terminal). Lockheed Martin airborne video recorder. Lockheed Martin stores management system. Airframe contains provisions for IRST and side-mounted phased-array radar.

Self-defence: BAE Systems AN/ALR-94 electronic warfare (RF warning and countermeasures and missile launch detection functions) subsystem. AN/ALE-52 flare dispenser. Development flight testing of BAE Systems digital EW system undertaken at Edwards AFB in closing stages of 2005 as part of a product improvement programme that will replace older analogue receiver technology; inclusion of digital EW system began on Lot 5 production aircraft, with retrofit of older F-22s expected to follow.

ARMAMENT: Internal long-barrel General Dynamics M61A2 20 mm cannon with hinged muzzle cover and 480-round magazine capacity (production aircraft). Three internal bays for AIM-9M Sidewinder or next-generation AIM-9X (one in each side bay on Hughes LAU-141/A trapeze-type launcher) and six AIM-120C AMRAAM AAMs and/or 460 kg (1,015 lb) GBU-32 JDAM PGMs on Edo LAU-142/A vertical ejection launchers in main weapons bay. Four underwing stores stations at 3.17 m (125 in) and 4.42 m (174 in) from centreline of fuselage capable of carrying 2,268 kg (5,000 lb) each.

Typical weapon loads include six AIM-120s and two AIM-9s carried internally for air combat; two JDAMs, two AIM-120s and two AIM-9s carried internally for air-to-ground attack; and six AIM-120s and two AIM-9s internally, plus two external fuel tanks and further four AAMs (AIM-120 or AIM-9) underwing for long-range air combat.

Other weaponry envisaged for use by the F-22 includes the BLU-109 Penetrator, the wind-corrected munitions dispenser (WCMD), AGM-88 HARM, GBU-22 Paveway 3 guidance unit (with 500 lb bomb), new Small Diameter Bomb (SDB) and the low-cost autonomous attack system (LOCAAS) submunitions dispenser package.

DIMENSIONS, EXTERNAL:

Wing span	13.56 m (44 ft 6 in)
Wing chord: at root (theoretical)	9.85 m (32 ft 3½ in)
at tip (reference)	1.66 m (5 ft 5½ in)
at tip (actual)	1.14 m (3 ft 9 in)
Wing aspect ratio	2.4
Length overall	18.92 m (62 ft 1 in)
Height overall	5.08 m (16 ft 8 in)
Tail span: horizontal surfaces	8.84 m (29 ft 0 in)
vertical surfaces	5.97 m (19 ft 7 in)
Wheelbase	6.04 m (19 ft 9¾ in)
Weapon bay ground clearance	0.94 m (3 ft 1 in)

AREAS:

Wings, gross	78.0 m^2 (840.0 sq ft)
Leading-edge flaps (total)	4.76 m^2 (51.20 sq ft)
Flaperons (total)	5.10 m^2 (55.00 sq ft)
Ailerons (total)	1.98 m^2 (21.40 sq ft)
Vertical tails (total)	16.54 m^2 (178.00 sq ft)
Rudders/speedbrakes (total)	5.09 m^2 (54.80 sq ft)
Stabilators (total)	12.63 m^2 (136.00 sq ft)

WEIGHTS AND LOADINGS (estimated):

Weight empty (target)	14,365 kg (31,670 lb)
Max T-O weight	almost 27,216 kg (60,000 lb)
Max wing loading	348.7 kg/m^2 (71.43 lb/sq ft)
Max power loading	87 kg/kN (0.86 lb/lb st)

PERFORMANCE (YF-22, demonstrated):

Max level speed: supercruise	M1.58
with afterburning	M1.7 at 9,150 m (30,000 ft)
Ceiling	15,240 m (50,000 ft)
g limit	+7.9

PERFORMANCE (F-22A, design target, estimated):

Max level speed at S/L	800 kt (1,482 km/h; 921 mph)
g limit	+9

LOCKHEED MARTIN 382U/V SUPER HERCULES

US Air Force designations: C-, EC-, WC-130J
US Coast Guard designation: HC-130J
US Marine Corps designation: KC-130J
RAF designations: Super Hercules C. Mk 4 (C-130J-30); Super Hercules C. Mk 5 (C-130J)

TYPE: Medium transport/multirole.

PROGRAMME:

DEVELOPMENT MILESTONES

Programme launched	1991
First order (RAF)	Dec 94
Rolled out	18 Oct 95
First flight	5 Apr 96
First delivery (RAF)	24 Aug 98
Entered service (RAF)	14 Nov 00

US Air Force specification issued 1951, leading to first-generation Hercules (Allison T56 turboprops); first production contract for C-130A to Lockheed September 1952; first flight 23 August 1954; two YC-130 prototypes, 231 C-130As, 230 C-130Bs, 491 C-130Es, 1,089 C-130Hs and 113 L-100s manufactured before introduction of C-130J and commercial L-100J equivalent. Official total of 2,156 (including prototypes) delivered by January 1998, when final C-130H handed over.

Privately funded development and flight test programme for next-generation version began in 1991 as Hercules II, but subsequently known as C-130J Hercules, or L-100J in equivalent civilian form. Since late 2003, Lockheed Martin has adopted the name Super Hercules for the C-130J.

Initial British delivery accomplished on 24 August 1998; aircraft involved was ZH865, which arrived at Boscombe Down on 26 August for start of clearance trials by UK Defence Evaluation Research Agency (DERA). First aircraft ferried to RAF transport force at Lyneham was ZH878 on 21 November 1999. Final RAF aircraft flown from Marietta to Cambridge in late May 2000; final delivery to RAF on 21 June 2001.

First 'operational' mission accomplished by Lockheed Martin test crew in late November 1998, when C-130J completed three sorties from Marietta and airlifted 37,650 kg (83,000 lb) of hurricane relief supplies to Tegucigalpa, Honduras. Subsequently, 1999 witnessed start of deliveries to US Air Force Reserve Command and Air National Guard, as well as to operating units in Australia and the UK. Entire fleet had accumulated 30,000

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Royal Air Force Lockheed Martin Super Hercules C. Mk 5 *(Paul Jackson)*

US Coast Guard Lockheed Martin HC-130J marked as a 'C-130J' *(Paul Jackson)*

1158222

flight hours by February 2002; by 24 July 2002, this had risen to 50,000 hours. Roll-out of the 100th C-130J — an aircraft for the US Coast Guard — took place on 17 February 2003.

Block 5.3 software configuration available from third quarter 2001 is standard equipment for latest deliveries and was retrofitted to existing aircraft by end of 2002; Block 5.3 offers ability to fly integrated precision radar approaches, gives enhanced navigation capabilities and permits fully automatic formation flying using co-ordinated aircraft positioning system (CAPS). Next version is Block 5.4, introduced in FY05-06. Testing of this undertaken in fourth quarter of 2004 and focused on cargo handling system and upgrades to software associated with communications, navigation and identification systems; trials revealed need for further modification, with second series of tests from February 2005 until May 2005. Block 5.4 upgrade expected to have become operational at start of fourth quarter of 2005. In meantime, contract worth USD17.8 million signed in fourth quarter of 2004, covering purchase of total of 73 upgrade kits for installation from late 2005. A Block 6.0 configuration will follow in about 2007; this is expected to incorporate improvements originating with the Co-operative Systems and Software Upgrade Requirements Management (COSSURM); latter centres around a three-year, US$20 million contract awarded to Lockheed Martin in November 2003 by C-130J operators in Australia, Italy, the UK and the USA with the object of facilitating major avionics improvements. Upgrades that could feature in the Block 6.0 configuration include integration of the civil global air traffic management system as well as infrared countermeasures, inert gas generation system, Link 16 and improved logistic systems.

C-130J programme target of much criticism in 2004, with US DoD Inspector General audit report focusing on acquisition process, while the Pentagon's Operational Test and Evaluation director declared in January 2005 that the C-130J was "neither operationally effective nor operationally suitable"; a few weeks earlier, aircraft from the Air National Guard's 143rd AS and Air Force Reserve Command's 815th AS had begun the C-130J's first combat tour by deploying to an unidentified base in South-West Asia.

At the end of 2005, a total of 135 C-130Js had been delivered out of 182 aircraft then on order.

CURRENT VERSIONS: **C-130J:** Baseline version. Dimensionally similar to preceding C-130H, but incorporating new equipment and features as subsequently described. Subject of initial order for two from USAF in FY94, with subsequent contract for two in FY96; these initially earmarked for trials and eventually joined Air Force Reserve Command (AFRC), while further eight funded in FY97 and FY98 assigned to Air National Guard's 135th Airlift Squadron at Warfield ANGB, Martin State Airport, Baltimore, Maryland, which fully equipped by mid-July 2000. Initial aircraft delivered to AFRC 403rd Wing at Keesler AFB, Mississippi, on 31 March 1999 for training.

Description applies mainly to baseline C-130J except where indicated.

C-130J-30: Stretched version of current production C-130; fuselage lengthened by 4.57 m (15 ft 0 in), offering increases in capability of between 31 and 50 per cent, dependent upon mission and configuration (see accompanying diagram). Orders received from Australia, Denmark, Italy, UK and USA.

CC-130J: Designation allocated to C-130J-30 aircraft in USAF service during 2003 but subsequently dropped in 2004, when basic C-130J designation adopted by USAF. First three funded in FY99, with two more in FY00 and five in FY02. Initial deliveries to ANG units in Rhode Island and California; FY02 aircraft to be assigned to 146th AW (two aircraft), 143rd AW (one), 403rd Wing (one) and a new USAF C-130J training unit (48th Airlift Squadron) that was established within the 314th Airlift Wing at Little Rock AFB, Arkansas on 5 December 2003 (one); all five delivered in 2004. In March 2003, USAF concluded contract for multiyear procurement of 40 CC-130Js, at planned rate of eight per year from FY04 up to and including FY08, although only four funded in FY04, rising to 11 in FY05.

EC-130J: 'Commando Solo' psychological warfare version; first aircraft funded in FY97 budget, with first handed over on 17 October 1999; after flight testing, it moved to Palmdale, California, in July 2000 for fitting out before delivery to the 193rd Special Operations Squadron, Air National Guard, at Harrisburg IAP, Pennsylvania. IOC was expected by the end of 2003, but slipped into 2004 because of problems encountered in integrating a new switchable 60/90 kVA generator with the broadcast system; this in turn caused delay in delivery of fully equipped aircraft to the 193rd SOS. Following modification, first EC-130J joined 193rd SOS in September 2004. Additional procurement comprises third example in FY99 budget, fourth in FY00 and fifth in FY01; eventual total expected to be seven by FY09.

HC-130J: Replacement for earlier US Coast Guard HC-130s; funding for six aircraft contained in FY01 budget. First example accepted at Marietta in late 2002 and used for crew training before being formally delivered to Coast Guard at Elizabeth City, North Carolina, on 31 October 2003; these initially being used in logistics role but will eventually be fitted with full mission kit, including inverse synthetic aperture sea search radar. All six delivered by end of 2003; two subsequently deployed to 17th Coast Guard District and had begun flying operational missions from Kodiak, Alaska, by mid-2004.

KC-130J: Tanker/transport version for US Marine Corps, which has requirement for 51 to replace KC-130F, KC-130R and KC-130T variants. Originally to have two Flight Refuelling Mk32B-901E hose-and-drogue wing-mounted refuelling pods; three aircraft funded in FY97 budget, two in FY98, two in FY99, one in FY00, three in FY01 and two in FY02. Further aircraft for USMC covered by multiyear procurement contract concluded in March 2003; this comprises initial batch of four in FY03, with additional 17 aircraft at rate of four or five per year during FY05 to FY08. First contract for five USMC conversions (to be accomplished by end of 2000) announced 21 July 1998. Final assembly of first KC-130J (165735) began 22 March 1999, with first flight on 9 June 2000; total of three aircraft assigned to test programme at Patuxent River in latter half of 2000; first drogue engagement accomplished by Navy F/A-18 Hornet on 30 August 2000; initial trials revealed that aft fairing of pod was unsatisfactory, with cracks appearing in hose/drogue coupling; redesign of fairing in 2000–01 cleared way for further testing in second quarter of 2001, which confirmed much improved performance in areas of flying quality and durability. Further difficulties experienced with Mk 32B pods during flight testing (including 'sine wave' oscillation of hose) eventually culminated in Marine Corps deciding to abandon Flight Refuelling system and switch to proven Sargent Fletcher pods taken from existing KC-130F/R aircraft; new-build pods, with a higher fuel flow rate, are to be acquired by the Marines and Lockheed Martin will continue to work with Flight Refuelling on finding a solution that will allow the Mk 32B to be offered to export customers. On completion of trials, all three test aircraft assigned to USMC tanker/transport squadron VMGR-252 at MCAS Cherry Point, North Carolina, which took delivery at beginning of September 2001; total of seven handed over by end 2001. Two aircraft subsequently assigned to intensive 270-hour operational evaluation from October 2003, which paved way for operational introduction by USMC; analysis of results culminated in KC-130J being considered suitable for operational service with effect from September 2004. Initial deployment (to Al Asad, Iraq) begun 10 February 2005 by VMGR-252; previously, on 23 September 2004, VMGR-352 at Miramar, California, became second operational squadron when it accepted first of 11 KC-130Js. Provisions for installation of refuelling probe incorporated in basic aircraft. Additional fuel in underwing and cargo hold tanks; see Power Plant.

'KC-130J Sea Herk': Lockheed Martin proposal for transport/tanker version with minor changes to allow take-off and landing on future US Navy Rapid Strategic Lift Ship (RSLS), which expected to join fleet in about 2020; 'Sea Herk' could carry payload of 13,608 kg (30,000 lb) some 300 n miles (556 km; 345 miles) on internal fuel or 10,400 kg (22,928 lb) payload some 2,000 n miles (3,704 km; 2,301 miles) with use of external fuel pods.

MC-X Combat Talon 3: Potential new variant for USAF Special Operations Command, which has requirement for up to 54 aircraft, with procurement likely to begin in 2006. This will almost certainly be based on the C-130J. The same organisation is also contemplating acquisition of a new **AC-X** gunship that could utilise the C-130J airframe. In May 2004, Lockheed Martin presented **'Arsenal Ship'** concept to USAF, this envisaging suitably modified C-130 able to carry and launch up to eight large cruise missiles or greater number of smaller weapons comparable in size to AGM-158 JASSM in stand-off role.

WC-130J: Weather reconnaissance version with aerial reconnaissance weather officer console, dropsonde system operator console and dropsonde launch tube; initial four in FY96 budget, with three more in FY97, two in FY98 and one in FY99; for 53rd WRS, Air Force Reserve Command at Keesler AFB, Mississippi. USD46.9 million contract for modification of first six, with option for further four, signed 18 September 1998; deliveries began on

Lockheed Martin C-130J Super Hercules of USAF's 314th AW *(Paul Jackson)* 1158214

US Marine Corps Lockheed Martin KC-130J aerial tanker *(US Navy)* 1158221

30 September 1999; formal acceptance 12 October 1999. This version not declared fully operational until start of the hurricane season in June 2005.

CUSTOMERS: See tables. Total of 182 ordered by February 2006. First customer was RAF, which ordered 25 in December 1994; of these, 15 are stretched C-130J-30, designated C. Mk 4, with final 10 as standard C-130Js, designated Hercules C. Mk 5. Delivery of first example to the trials unit at Boscombe Down was due in November 1996, but was delayed until 26 August 1998. First service recipient was J Conversion Flight of No. 57 (Reserve) Squadron, followed by No. 24 and then No. 30 Squadrons at RAF Lyneham. Deliveries to Lyneham began on 21 November 1999, when C. Mk 4 ZH878 arrived for duty as temporary ground procedures trainer; two days later, on 23 November, C. Mk 4 ZH875 was formally handed over in official ceremony at Lyneham. Completion of deliveries occurred on 21 June 2001; operational service with RAF began 14 November 2000, when No.24 Squadron flew scheduled mission to Puerto Rico. No.30 Squadron attained operational status in June 2002.

Second order covered two C-130Js for evaluation by the USAF (these later transferred to Air Force Reserve Command) and was finalised on 13 October 1995, one week before the first was rolled out at Marietta. Further two funded in FY96, four in FY97 and four in FY98 for Air Force Reserve Command (AFRC) and Air National Guard (ANG) units; first ANG squadron was 135th AS at Martin State Airport, Baltimore. Orders for C-130J-30 began FY99 with contract for three ANG aircraft, with FY01 procurement including two more C-130J-30s for ANG and initial batch of six C-130Js for long-range SAR duties with US Coast Guard; five more C-130J-30s in FY02 budget, including first for USAF and AFRC. First C-130J-30 rolled out 25 January 2001; following testing, this delivered to 143rd AW, Rhode Island ANG, on 2 December 2001. Two more C-130J-30s to 143rd AW by end 2001, with next two for 146th AW, California ANG, which received its first example on 2 June 2002. USAF requirement exists for more than 150 C-130J-30s, of which initial tranche of about 40 covered by multiyear procurement contract signed in March 2003; first USAF aircraft delivered to 314th AW at Little Rock AFB, Arkansas, on 16 April 2004. Other special mission versions acquired by USA, including WC-130J for weather reconnaissance, KC-130J tanker and EC-130J for psychological warfare operations.

Second order received in 1995 was from Australia, for 12 C-130J-30s to replace C-130Es of No. 37 Squadron at Richmond, at total cost of US$660 million. Order placed on 21 December 1995 and included options for an additional 24 aircraft, plus eight options for New Zealand, which was guaranteed pricing based on Australia's larger order; options have not been converted to firm orders. First Australian C-130J (A97-440/N130JQ, c/n 5440) flew on 15 February 1997; delivery began 7 September 1999, when A97-464 arrived at Richmond; last aircraft handed over on 1 June 2000, with operational status achieved in December 2001.

Third overseas customer was Italy, which initially ordered 18 C-130Js, subsequently adding two more in January 2000 and another two in March 2000, with last four being stretched C-130J-30 version. At same time as placing final order, Italy revised overall procurement plan and eventually received 12 C-130Js and 10 C-130J-30s. First aircraft rolled out at Marietta on 11 July 2000. Italian military certification also awarded in July 2000, with first C-130J delivery (actually second aircraft, MM 62176, c/n 5497) to 2° Gruppo, 46° Aerobrigata at Pisa departing USA on 16 August; formal acceptance 21 September 2000. All are tanker-capable and configured to receive fuel, although only six likely to be operated as such at any one time. Two of the original aircraft to be adapted as sigint platforms by 2006, with antennae fitted to removable panels; reconfiguration from basic transport role to specialised sigint mission would require maximum of 24 hours; equipment is to include 12 workstations, a communications suite and secure datalinks. C-130J-30 version assigned to 50° Gruppo, 46° Aerobrigata, from third quarter of 2002, with final aircraft handed over to Italy at Marietta on 10 February 2005. Most recent export customer is Denmark, which ordered three C-130J-30s, with option on fourth, in December 2000; all three formally accepted at Marietta on 21 October 2003, with delivery to Denmark following in March and April of 2004. Danish option converted to firm order in July 2004, with delivery due in late 2007.

Other potential customers reported to be in discussion with Lockheed Martin include Bahrain, Egypt, Israel, Kuwait and Portugal. Saudi Arabia reported to have requirement for up to 24 aircraft, while C-130J demonstrated to Brunei and India in early 2005. In mid-2005, Canada also considering procurement of between 15 to 20 C-130J-30 aircraft and Australia has indicated that it may purchase six to eight tanker-configured examples.

MILITARY/GOVERNMENT C-130J SALES
(To March 2006, excluding US)

Country	J	J-30	Total
Australia		12	12
Denmark		4	4
Italy	12	10	22
UK	10	15	25
Total	**22**	**41**	**63**

COSTS: USD55 million programme unit cost (Australia) (1995). Italian order of November 1997 valued at USD1.2 billion. Baseline price of C-130J-30 quoted as USD67 million in early 2002. Multiyear procurement of 40 C-130J-30s for USAF and 20 KC-130Js for US Marine Corps valued at USD4.05 billion (unit price USD67.5 million). FY03 contract for one C-130J-30 for Air Force Reserve Command worth USD70.5 million.

DESIGN FEATURES: Archetypal tactical transport; upswept rear fuselage for ramp access; high wing for propeller ground clearance despite low floor height; latter provided by pannier-mounted landing gear, which obviates long mainwheel legs stowed in wings. Can deliver loads and parachutists over open ramp and parachutists through side doors; cargo hold pressurised.

Significant changes introduced with C-130J, which optimised for economical operation, justifying customers' substitution for earlier C-130s on 30 year lifetime savings alone. Entirely revised flight deck reduces LRUs by half and wire assemblies by 53 per cent, with

wire terminations cut by 81 per cent; has four MFDs, plus HUD for both pilots; lighting compatible with NVGs. Most systems have digital interfaces with the main mission computer to include unmodified mechanical systems like the hydraulics, which are largely unaltered from those of C-130H; provision for integrated self-defence suite (RWR, MAW, chaff/flare dispensers and IR jammers). Propulsion system provides 29 per cent more take-off thrust and is 15 per cent more efficient; fuel efficiencies obviate requirement for external tanks on most types of mission; propeller has 50 per cent fewer parts and weighs 15 per cent less. Manpower requirements of typical 16-aircraft squadron cut by 38 per cent compared with earlier versions of C-130, as result of reduced flight crew and 50 per cent better maintainability. Comprehensive computerised maintenance system employs a hand-held data module as interface between aircraft's BITE and operating base's central technical records.

Wing section NACA 64A318 at root and NACA 64A412 at tip; dihedral 2° 30'; incidence 3° at root, 0° at tip.

FLYING CONTROLS: All flying controls integrated with digital autopilot/flight director and comprise control surfaces boosted by dual hydraulic units; trim tabs on ailerons, both elevators and rudder; elevator tabs have AC main supply and DC standby; Lockheed-Fowler composites trailing-edge flaps.

STRUCTURE: All-metal two-spar wing with integrally stiffened taper-machined skin panels up to 14.63 m (48 ft 0 in) long. Incorporates carbon fibre composites materials for flaps and 32 graphite-epoxy trailing-edge panels.

LANDING GEAR: Hydraulically retractable tricycle type. Each main unit has two wheels in tandem, retracting into fairing built on to fuselage side. Nose unit has twin wheels and is steerable ±60°. Mainwheels 20.00-20 (26 ply) tubeless; nose 12.50–16 (12 ply) tubed or tubeless. Oleo shock-absorbers. Minimum ground turning radius: C-130J, 11.28 m (37 ft) about nosewheel and 25.91 m (85 ft) about wingtip; C-130J-30 14.33 m (47 ft) about nosewheel and 27.43 m (90 ft) about wingtip.

POWER PLANT: Four Rolls-Royce AE 2100D3 turboprops, flat rated to 3,424 kW (4,591 shp) (manufacturer's rating 3,458 kW; 4,637 shp at ISA +25°C), fitted with Dowty Aerospace R391 six-blade composites propellers and Lucas Aerospace FADEC. Automatic thrust control system (ATCs) and autofeather systems, plus engine monitoring system (EMS) which is incorporated into aircraft's integrated diagnostic system (IDS).

Total internal fuel capacity of 25,552 litres (6,750 US gallons; 5,621 Imp gallons) without foam and 24,363 litres (6,436 US gallons; 5,359 Imp gallons) with foam. Provisions only for two optional underwing pylon tanks, each with capacity of 5,220 litres (1,379 US gallons; 1,148 Imp gallons) without foam and 4,883 litres (1,290 US gallons; 1,074 Imp gallons) with foam. Total fuel capacity 35,992 litres (9,508 US gallons; 7,917 Imp gallons) without foam and 34,129 litres (9,016 US gallons; 7,507 Imp gallons) with foam. Tanker versions can carry cargo hold tank with additional 13,578 litres (3,587 US gallons; 2,987 Imp gallons). Single pressure refuelling point and overwing gravity fuelling. In-flight refuelling probe fitted as standard on port side of RAF aircraft; optional for all others, with Italian aircraft currently unique in being configured as receiver/tankers.

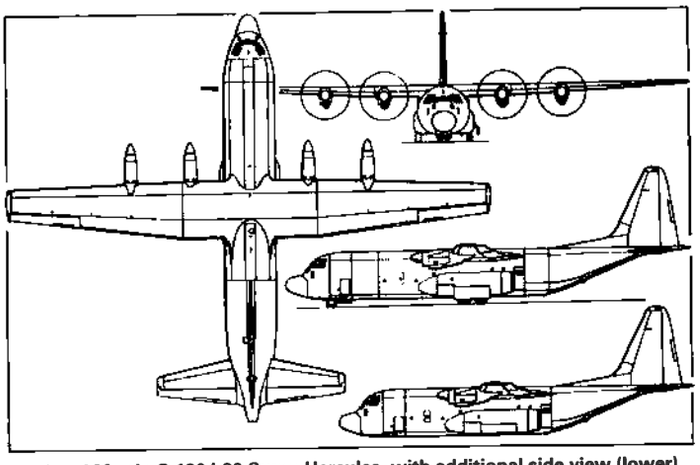
ACCOMMODATION: Crew of two on flight deck, comprising pilot and co-pilot, with provisions for optional third workstation. Ergonomic problems suffered by short pilots necessitated a number of alterations to cockpit, including redesign of seat and seat track. HUD and main control yoke, with throttle quadrant also modified. Two crew bunks, with lower incorporating three additional seats and harnesses for relief crew/flight deck passengers. Galley. Separate loadmaster's station in cargo hold, including folding desk, is standard equipment on RAF aircraft; optional for all others. Flight deck and main cabin pressurised and air conditioned.

Standard complements for C-130J as follows: 92 troops, 64 paratroopers, 74 litter patients plus two attendants, 54 passengers on palletised airline seating. Corresponding data for C-130J-30 are 128 troops, 92 paratroopers, 97 litter patients plus four attendants and 79 passengers on palletised airline seating. Airdrop loads comparable to C-130H/H-30 and include light armoured vehicles. Light and medium towed artillery pieces, wheeled and tracked vehicles and 463L palletised loads (five in C-130J and seven in C-130J-30, plus one on ramp in each model) are transportable. Hydraulically operated (with dual actuators) main loading door and ramp at rear of hold; can be opened in flight at up to 250 kt (463 km/h; 288 mph). Crew door on port forward fuselage side. Paratroop door on each side aft of landing gear fairing. Two emergency exit doors standard. Optional cargo handling system ordered by the USAF includes flush-mounted winch; in-ramp towplate for airdrop operations; low-profile rails and electric locks; flip-over rollers with covers; container delivery system centre vertical restraint rails. Capable of automatic preprogrammed cargo drops.

SYSTEMS: Lucas generator. Environmental control system in starboard undercarriage fairing is similar to that of the C-130H, incorporating dual air cycle machines, but with 30 per cent greater cooling capacity and a digital electronic control system. Honeywell GTCP85-185L(A) auxiliary power unit in port undercarriage fairing furnishes ground electrical power and bleed air for environmental control system. MIL-STD-1553B digital databus architecture. Integrated diagnostic system (IDS) incorporating fault detection/isolation subsystem with BIT (built-in test) facility. Goodrich pneumatic fin anti-icing system.

AVIONICS: *Comms:* Honeywell com/nav/ident management system, with Intel 80960 processor. AN/ARC-222 VHF, HF/UHF radio, intercom and IFF, with provisions for satcom system. All communication radios have secure features. AN/APX-119 IFF to be included on Block 5.4 and subsequent aircraft.

Radar: Northrop Grumman AN/APN-241 low-power colour radar incorporates Doppler beam-sharpening ground mapping mode, air-to-air skin paint mode and protective windshear mode as well as conventional colour weather radar.



Lockheed Martin C-130J-30 Super Hercules, with additional side view (lower) of C-130J *(Paul Jackson)* 1158213

Flight: HG-9550 radar altimeter, AN/ARN-153(V) Tacan, digital autopilot/flight director (DA/FD), dual Honeywell laser INS with embedded GPS receivers, Doppler velocity sensor, VOR, ILS, marker beacon receiver, UHF/VHF DF, ADF, E-TCAS, ground collision avoidance system (GCAS), global digital map display units and provision for microwave landing system.

Instrumentation: 'Dark cockpit' concept. Flight Dynamics HUD as certified primary flight instrument at pilot and co-pilot positions, four 152 × 203 mm (6 × 8 in) Avionics Display Corporation active matrix liquid-crystal display (AMLCD) colour multipurpose display systems (CMDSs) which are NVG-compatible for flight instrumentation, navigation and engine information and five Avionics Display Corporation 58 × 76 mm (2.3 × 3 in) monochrome AMLCDs for digital selector panels.

Mission: DRS Technologies AN/APN-243(V) station-keeping equipment. Provision for secure voice communication system.

Self-defence: Provisions for Lockheed Martin AN/AAR-47 missile warning system, Sanders AN/ALQ-157 IR countermeasures system, BAE Systems AN/ALE-47 chaff/flare dispensing systems and AN/ALR-56M radar warning receiver or AN/ALR-69 enhanced radar warning system. Testing of RWR, countermeasures dispensing system (CMDS) and missile warning system undertaken in September and October 2003; an aircraft from the 135th AS was used, spending a week in the Benefield Anechoic Facility at Edwards AFB to evaluate RWR and CMDS operation, before moving to the Naval Weapons Center at China Lake to test the missile warning system in flight; further trials followed in November 2004, these verifying correct operation of CMDS in fully automatic, semi-automatic and manual modes. Northrop Grumman Large Aircraft Infra-Red Countermeasures (LAIRCM) system to be installed on Air Mobility Command C-130J, following successful conclusion of EMD testing in 2002–04.

EQUIPMENT: USMC KC-130Js were intended to use Flight Refuelling Mk 32B-901E hose pods underwing, but problems encountered during flight testing have resulted in existing Sargent Fletcher refuelling pods being installed instead. Italy expected to fit the Mk 32B-901E pod to some aircraft and may also seek alternative solution. C-130J-30s for Air National Guard's 146th AW are equipped with Aero Union Systems Airborne Fire Fighting System (AFFS), which allows them to drop up to 15,142 litres (4,000 US gallons; 3,331 Imp gallons) of fire retardant in a single pass. Italian C-130J configured to operate with Special Avionics Mission Strap-on-Now (SAMSON) C-130 Open Skies System (COPS) in support of international arms control verification efforts.

DIMENSIONS, EXTERNAL:

Wing span	40.41 m (132 ft 7 in)
Wing aspect ratio	10.1
Length overall: C-130J	29.79 m (97 ft 9 in)
C-130J-30	34.37 m (112 ft 9 in)
Height overall: C-130J	11.84 m (38 ft 10 in)
C-130J-30	11.81 m (38 ft 9 in)
Tailplane span	16.05 m (52 ft 8 in)
Wheel track	4.34 m (14 ft 3 in)
Propeller diameter	4.11 m (13 ft 6 in)
Main cargo door (rear of cabin):	
Height	2.77 m (9 ft 1 in)
Width	3.12 m (10 ft 3 in)
Height to sill	1.03 m (3 ft 5 in)
Paratroop doors (each): Height	1.83 m (6 ft 0 in)
Width	0.91 m (3 ft 0 in)
Height to sill	1.03 m (3 ft 5 in)
Emergency exits (each): Height	1.22 m (4 ft 0 in)
Width	0.71 m (2 ft 4 in)

US C-130J PROCUREMENT
(By Fiscal Year to March 2006)

FY	C-130J	C-130J-30	EC-130J	HC-130J	KC-130J	WC-130J	Total
1994	2						2
1996	2					4	6
1997	4		1		3	3	11
1998	4		1		2	2	9
1999		3	1		2	1	7
2000			1		1		2
2001		2	1	6	3		12
2002		5			2		7
2003		1			4		5
2004		4					4
2005		11			4		15
2006		8			5		13
2007		9			4		13
2008		9			4		13
Total	**12**	**52**	**5**	**6**	**34**	**10**	**119**

DIMENSIONS, INTERNAL:
Cabin, excl flight deck:
Length excl ramp: C-130J ..... 12.19 m (40 ft 0 in)
C-130J-30 ..... 16.76 m (55 ft 0 in)
Length incl ramp: C-130J ..... 15.32 m (50 ft 3 in)
C-130J-30 ..... 19.89 m (65 ft 3 in)
Max width ..... 3.12 m (10 ft 3 in)
Max height ..... 2.74 m (9 ft 0 in)
Total usable volume: C-130J ..... 128.9 m^3 (4,551 cu ft)
C-130J-30 ..... 170.5 m^3 (6,022 cu ft)
AREAS:
Wings, gross ..... 162.12 m^2 (1,745.0 sq ft)
Ailerons (total) ..... 10.22 m^2 (110.00 sq ft)
Trailing-edge flaps (total) ..... 31.77 m^2 (342.00 sq ft)
Fin ..... 20.90 m^2 (225.00 sq ft)
Rudder, incl tab ..... 6.97 m^2 (75.00 sq ft)
Tailplane ..... 35.40 m^2 (381.00 sq ft)
Elevators, incl tabs ..... 14.40 m^2 (155.00 sq ft)
WEIGHTS AND LOADINGS(internal fuel only, except where specified):
Operating weight empty:
C-130J ..... 34,274 kg (75,562 lb)
C-130J-30 ..... 35,966 kg (79,291 lb)
Max fuel weight: internal ..... 20,819 kg (45,900 lb)
external (optional) ..... 8,506 kg (18,754 lb)
Max payload, 2.5 *g*: C-130J ..... 18,955 kg (41,790 lb)
C-130J-30 ..... 21,772 kg (48,000 lb)
Max T-O weight: C-130J-30 ..... 74,389 kg (164,000 lb)
Max overload T-O weight:
C-130J, C. Mk 4 ..... 79,380 kg (175,000 lb)
Max normal landing weight ..... 58,965 kg (130,000 lb)
Max overload landing weight ..... 70,305 kg (155,000 lb)
Max zero-fuel weight, 2.5 *g* ..... 53,230 kg (117,350 lb)
Max wing loading: C-130J-30 ..... 458.9 kg/m^2 (93.98 lb/sq ft)
Max power loading: C-130J-30 ..... 5.44 kg/kW (8.93 lb/shp)
PERFORMANCE (C-130J except where indicated):
Never-exceed speed (VNE) at 3,050 m (10,000 ft):
C. Mk 4 ..... 378 kt (700 km/h; 435 mph)
Max cruising speed:
C-130J ..... 348 kt (645 km/h; 400 mph)
C. Mk 4 at 7,620 m (25,000 ft) ..... 355 kt (657 km/h; 409 mph)
Econ cruising speed ..... 339 kt (628 km/h; 390 mph)
Stalling speed ..... 100 kt (185 km/h; 115 mph)
Max rate of climb at S/L ..... 640 m (2,100 ft)/min
Time to 6,100 m (20,000 ft) ..... 14 min
Cruising altitude ..... 8,535 m (28,000 ft)
Service ceiling at 66,680 kg (147,000 lb) AUW ..... 9,315 m (30,560 ft)
Service ceiling, OEI, at 66,680 kg (147,000 lb) AUW ..... 6,955 m (22,820 ft)
T-O run ..... 930 m (3,050 ft)
T-O to 15 m (50 ft) ..... 1,433 m (4,700 ft)
T-O run using max effort procedures ..... 549 m (1,800 ft)
Landing from 15 m (50 ft) at 58,967 kg (130,000 lb) AUW ..... 777 m (2,550 ft)
Landing run at 58,967 kg (130,000 lb) AUW ..... 427 m (1,400 ft)
Runway LCN: asphalt 37
concrete 42
Range with 15,876 kg (35,000 lb) payload: C-130J-30 ..... 2,832 n miles (5,244 km; 3,259 miles)

LOCKHEED MARTIN AERONAUTICS - PALMDALE

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Palmdale performs upgrades and modifications to Lockheed U-2, F-117 and C-130 aircraft. Is headquarters for Advanced Development Programs (ADP) initiatives across the Lockheed Martin Aeronautics Company, this facility also being known as the legendary Skunk Works. Responsibilities include derivatives or upgrades of current aircraft systems, new development systems, critical technology development and integration, and operational effectiveness and system analysis. Palmdale performs rapid prototyping, exemplified most recently by the X-35 Joint Strike Fighter concept demonstrators. Next-generation platforms such as new strategic and tactical airlift aircraft and advanced Unmanned Air Vehicle concepts are currently undergoing research and test at Palmdale.

LOCKHEED MARTIN P-791

TYPE: Hybrid buoyant aircraft.
PROGRAMME: Company-funded subscale POC prototype, possibly of a design intended for DARPA Walrus programme, but no details released. Eye-witness reports of five-minute maiden flight on 31 January 2006 suggest overall length of around 61 m (200 ft) and cruising speed of about 20 kt (37 km/h; 23 mph). Skunk Works understood to be continuing to develop hybrid lift technology, despite cancellation of Walrus programme.
DESIGN FEATURES: TCOM three-lobe envelope; air cushion landing gear (four units, one fore and aft on each outer lobe). Two side-mounted and two rear-mounted engines, possibly with vectored thrust.

Lockheed Martin P-791 prototype, registered N791LM 1190411

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DIRECTOR, FORT WORTH LOCAL MEDIA RELATIONS: Joseph W Stout
General Dynamics' Fort Worth Division sold to Lockheed; became Lockheed Fort Worth Company on 1 March 1993; renamed Lockheed Martin Tactical Aircraft Systems following merger between Lockheed and Martin Marietta in 1995. Adopted current title in January 2000 with consolidation of all Lockheed Martin aeronautical operations into single company with headquarters in Fort Worth, Texas.

Activities include production, development and support of F-16 Fighting Falcon; one-third share of F-22 Raptor development and initial production; and leadership of F-35 Lightning II (Joint Strike Fighter) development team (with Northrop Grumman and BAE Systems). Is principal subcontractor to Mitsubishi for production of F-2 in Japan and to KAI for development of T-50 Golden Eagle advanced trainer in South Korea.

Fort Worth work force numbered 16,200 in August 2003; factory and associated office facilities occupied 687,500 m^2 (7.4 million sq ft).

LOCKHEED MARTIN F-16 FIGHTING FALCON

Israel Defence Force names: F-16C Barak (Lightning), F-16D Brakeet (Thunderbolt) and F-16I Suefa (Storm)
Turkish Air Force name: Savaşan Şahin (Fighting Falcon)
United Arab Emirates Air Force name: Desert Falcon
TYPE: Multirole fighter.
PROGRAMME:

DEVELOPMENT MILESTONES

Request for proposals	6 Jan 1972
Design submitted	Feb 1972
Programme launched	Apr 1972
Rolled out	13 Dec 1973
First flight (YF-16)	20 Jan 1974
Official first flight (YF-16)	2 Feb 1974
First flight, pre-production	8 Dec 1976
First flight, production	7 Aug 1978
First delivery (USAF)	Aug 1978
Entered service (USAF)	6 Jan 1979

Emerged from General Dynamics YF-16 of US Air Force Lightweight Fighter prototype programme in 1972; first flight of prototype YF-16 (72-01567) 2 February 1974; first flight of second prototype (72-01568) 9 May 1974; selected for full-scale development (FSD) 13 January 1975; day fighter requirement extended to add air-to-ground capability with multimode radar and all-weather navigation; production of FSD aircraft began July 1975; first flight of FSD aircraft 8 December 1976. F-16 achieved 5 millionth flying hour late in 1993; 10 millionth flying hour passed in March 2002; total had risen to 12 million flight hours by June 2005. 4,000th aircraft delivered (to Egyptian Air Force) on 28 April 2000; total of 4,152 delivered as at 1 May 2004. 4,300th aircraft delivered (to Royal Air Force of Oman) on 20 April 2006.

Total sales 4,347 at end of 2001. Further orders from Chile (10 aircraft), Greece (30), Oman (12) and Poland (48), increased sales to 4,447 at start of 2006. US has indicated willingness to supply latest versions to Pakistan, which originally intended to obtain as many as 75 new-build aircraft. However, following devastating earthquake, Pakistan now contemplating acquisition of initial batch of 18 new-build F-16C and F-16D versions, as well as some refurbished F-16As and F-16Bs; it is likely that any new-build purchase will include option for follow-on batch of 18 aircraft. In addition, both Egypt and Thailand are understood to be considering acquisition of more new-build aircraft. In October 2005, Romania reported to be considering acquisition of substantial quantity of F-16s from surplus Israeli stocks.

CURRENT VERSIONS: **F-16A:** First version for air-to-air and air-to-ground missions; not currently in production.

F-16B: Standard tandem two-seat version of F-16A; fully operational both cockpits; fuselage length unaltered; reduced fuel.

F-16C/D: Single-seat and two-seat USAF Multinational Staged Improvement Program (**MSIP**) aircraft respectively, implemented February 1980. MSIP utilised growth capability to allow for precision ground attack and BVR missiles, and perfomance of all-weather, night and day missions; **Stage I** applied to Block 15 F-16A/Bs delivered from November 1981; **Stage II,** applied to Block 25 F-16C/Ds from July 1984, included core avionics, cockpit and airframe changes. Block 25 aircraft originally delivered with F100-PW-200 engine, but all surviving examples have F100-PW-220E following retrofit, as well as other improvements as detailed under Stage III of MSIP. **Stage III** involved installation of systems as they became available, beginning 1988 and extending to Block 50/52, including selected retrofits back to Block 25. Changes included adoption of Northrop Grumman AN/APG-68 multimode radar, with improved range, resolution, more operating modes and better ECCM than AN/APG-66; advanced cockpit with multifunction displays and upfront controls, BAE Systems wide-angle HUD, Fairchild mission data transfer equipment and radar altimeter; expanded base of fin giving space for proposed later fitment of AN/ALQ-165 Airborne Self-Protection Jamming system (since cancelled, though now installed in Korean aircraft); increased electrical power and cooling capacity; structural provision for increased take-off weight and manoeuvring limits; and new weapons such as AIM-120A AMRAAM and AGM-65D Maverick.

Common engine bay introduced at **Block 30/32** (FMS deliveries from December 1985 and USAF deliveries from July 1986) to allow fitting of either P&W F100-PW-220 (Block 32) or GE F110-GE-100 (Block 30) Alternate Fighter Engine. Other changes include computer memory expansion and seal-bonded fuselage fuel tanks. Additions in 1987 included voice message unit, doubled chaff/flare capacity, repositioning of RWR antennas to provide better coverage in forward hemisphere, AGM-45 Shrike anti-radiation missiles, crash survivable flight data recorder and modular common inlet duct ('large-mouth') allowing full thrust from F110 at low airspeeds.

Software upgraded for full Level IV multitarget compatibility with AMRAAM early 1988. Industry-sponsored development of radar missile capability for several air forces resulted in firing of AIM-7F and AIM-7M missiles from F-16C in May 1988; capability introduced mid-1991; missiles guided using pulse Doppler illumination while tracking targets in a high PRF mode of the AN/APG-68 radar.

First Polish Air Force Lockheed Martin F-16C Fighting Falcon 1158220

Lockheed Martin F-16C Fighting Falcons flown by 181st FW, Indiana Air National Guard *(MS John S Chapman, USAF)* 1158212

Block 40/42 (deliveries from December 1988) upgrades include AN/APG-68(V)1 radar allowing 100 hour operation before maintenance, full compatibility with Lockheed Martin low-altitude navigation and targeting infra-red for night (LANTIRN) pods, four-channel digital flight control system, expanded capacity core computers, diffractive optics HUD, enhanced envelope gunsight, GPS, improved leading-edge flap drive system, improved cockpit ergonomics, high gross weight landing gear, structural strengthening, increased performance battery and provision for improved EW equipment, including advanced interference blanker. LANTIRN targeting pod gives day/night standoff target identification, automatic target handoff for multiple launch of AGM-65 Maverick, autonomous laser-guided bomb delivery and precision air-to-ground laser ranging. LANTIRN navigation pod provides real-world IR view through HUD for night flight plus automatic/manual terrain following with dedicated radar sensor. Combat Edge pressure breathing system installed 1991 for higher pilot *g* tolerance.

A total of 39 Block 40 F-16C/Ds of the 31st FW was involved in a quick response capability (QRC) modification effort, known as 'Sure Strike', to install Improved Data Modem (IDM) equipment. Work was undertaken by a joint USAF/LMTAS team at Aviano AB, Italy, and was completed in December 1995, these being the first Block 40 aircraft to receive the IDM which was standard equipment on production Block 50 F-16s. In mid-1998, a demonstration programme was conducted to adapt existing IDM with Lockheed Martin kit to provide 'Gold Strike' system capable of two-way transmission of digitised video imagery of targets to enhance pilot's situational awareness.

First Block 40 F-16C/Ds issued in late 1990 to 363rd FW (Shaw AFB, South Carolina); first LANTIRN pods to 36th FS/51st FW at Osan, South Korea, in 1992. USAF Block 40/42 F-16Cs unofficially designated **F-16CG**. Following retirement of F-111F, Block 40/42 F-16Cs and F-16Ds with LANTIRN comprise more than 50 per cent of USAF night/precision strike force. All USAF F-16Cs and F-16Ds to receive FLIR targeting pod capability.

Block 50/52 (deliveries began with F-16C 90-0801 in October 1991 for operational testing) upgrades included F110-GE-129 and F100-PW-229 increased performance engines (IPE), AN/APG-68(V)5 radar with advanced programmable signal processor employing VHSIC technology, Have Quick IIA UHF radio and AN/ALR-56M advanced RWR. Changes initiated at **Block 50D/52D** in 1993 included full integration of AGM-88 HARM (high-speed anti-radiation missile) via HARM aircraft launcher interface computer (ALIC), improved data modem (IDM), upgraded programmable display generator with growth potential for colour and map, expanded data transfer cartridge, ring laser INS (Honeywell and Litton units both used) and improved VHF/FM antenna. AN/ALE-47 advanced chaff/flare dispenser fitted to all FMS Block 50 aircraft delivered after mid-1996 and incorporated as standard on USAF aircraft with effect from FY97 purchase; also retrofitted to earlier USAF Block 40/50 aircraft.

First Block 50D/52D (91-0360) delivered to USAF on 7 May 1993; optimised for defence suppression missions, having software for horizontal situation display on existing two MFDs and provision for AN/ASQ-213 HARM targeting system (HTS); sensor in pod on starboard side of engine inlet; HTS has capability similar to F-4G 'Wild Weasel' which it replaced in SEAD role. USAF has increased HTS inventory and incorporated software and hardware improvements enabling more targets to be tracked with enhanced ambiguity resolution and speedier reaction time.

Deliveries of Block 50/52 began to 4th FS of 388th FW at Hill AFB, Utah, from October 1992. Block 50D/52D aircraft initially to 309th FS (now 79th FS) of 363rd (now 20th) FW at Shaw AFB, South Carolina in 1993. Production for USAF was due to terminate with FY94 batch, but six additional F-16Cs funded in each of FY96 and FY97, plus three in FY98, one in FY99, 10 in FY00 and four in FY01; FY96 and subsequent aircraft to Block 50D standard. F-16s delivered from mid-2000 (FY97 and later) to improved configuration, incorporating modular mission computer by Raytheon (replacing three core avionics processors) that was developed for F-16A/B MLU programme, Honeywell colour liquid crystal multifunction displays (replacing monochrome CRT MFDs), Honeywell colour programmable display generator, Teac colour airborne videotape recorder, colour cockpit TV sensor and Litton onboard oxygen generating system (OBOGS). FY00 and subsequent aircraft have AN/APX-113 and associated avionics improvements. Majority of FY00 and FY01 aircraft delivered to USAF between April and December 2002, with final example (01-7053) receiving full CCIP upgrade before being handed over 18 March 2005. USAF Block 50/52 F-16Cs unofficially designated **F-16CJ**.

First Samsung-assembled F-16C Block 52D rolled out in South Korea on 7 November 1995; 140th and last delivered to Republic of Korea Air Force 20 August 2004. First flight of initial TAI-built F-16C Block 50D in late May 1996, with delivery to Turkish Air Force following on 29 July; last TAI-produced F-16 delivered October 1999. First Block 50D delivered to Greece 29 January 1997. First Block 52D delivered to Singapore 30 January 1998. First production lease (PL) Block 52D aircraft for Singapore was delivered 28 May 1998; this was under terms of commercial contract, with delivery achieved in less than 24 months from placing of order.

Advanced Block 50/52: Latest production versions, originally referred to as Block **50+/52+**. Basic configuration includes upgraded AN/APG-68(V)9 radar with 30 per cent

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greater air-to-air detection range and synthetic aperture radar (SAR) mode for high-resolution mapping and target detection/recognition. Is also compatible with latest FLIR navigation and targeting pod systems and has upgraded core avionics, including an improved modular mission computer, two 102 × 102 mm (4 × 4 in) colour cockpit displays, cockpit and exterior lighting compatible with night vision goggles, helmet-mounted cueing system, a digital terrain system, IFF interrogator/transponder, high off-boresight missile compatibility. Link 16 datalink and OBOGS. Available with a choice of internal electronic countermeasures equipment and able to take various customer-unique systems. Maximum take-off gross weight increased to 21,772 kg (48,000 lb). Can be fitted with low-drag conformal fuel tanks, with combined capacity of 1,705 litres (450 US gallons; 375 Imp gallons). Additional fuel in optional 2,271 litre (600 US gallon; 500 Imp gallon) auxiliary wing tanks. Two-seat aircraft have a rear cockpit configured for either a weapon system operator or instructor pilot (converted with a single switch), plus a dorsal avionics compartment that accommodates all of the systems of the single-seat aircraft, plus additional chaff/flare dispensers and specialised mission equipment.

First customer for Advanced Block 52 version was Greece, which revealed intention on 30 April 1999 to buy as many as 70 although subsequent contract covered only 50 aircraft, with fixed price option for up to 10 more that was converted to firm order on 14 September 2001. Deliveries began 31 October 2002, with formal inauguration ceremony at Forth Worth on 2 April 2003, when first five aircraft handed over. Initial aircraft ferried to Greece in May 2003, with deliveries completed in 2004, but further order covering another 30 aircraft announced in July 2005, with delivery to be effected in 2008-09. Other customers for Advanced Block 50/52 aircraft are Chile (Block 50), Oman (Block 50), Poland (Block 52) and Singapore (Block 52). First aircraft for Chile rolled out 14 April 2005 and made maiden flight 23 June; first two aircraft delivered to Chile on 24 January 2006, with balance to follow by year-end. First aircraft for Singapore made initial flight 26 February 2004, deliveries to Tengah beginning in July 2004. First flight of initial Omani aircraft accomplished 8 July 2005, with formal acceptance on 4 August, although first two aircraft did not arrive in Oman until October 2005. Maiden flight of first Polish aircraft (an F-16C) took place on 14 March 2006; initial delivery to Poland scheduled for 8 November 2006, with total of eight (five F-16C and three F-16D) due to have reached Poland by end of 2006.

USAF F-16C/D Retrofit Programmes: F-16 originally designed to fly 8,000 hours based on specified usage spectrum, but actual usage has in most cases been more severe, with aircraft regularly flying at higher operational weights than predicted. USAF F-16C/D aircraft now undergoing 'Falcon STAR' (structural augmentation roadmap). Modifications accomplished under this programme will ensure that aircraft achieve 8,000 hour service life, without depot inspection. USAF 'Falcon STAR' retrofit kit proofing conducted in 2003, with pilot production and installation beginning in 2004; first Falcon STAR aircraft delivered to 148th FW, Minnesota ANG, in February 2004. At least 10 other countries are involved in this programme.

ANG/AFRC Block 25/30/32 F-16C/Ds subject to combat upgrade plan integration details (CUPID) which completed by mid-2003. CUPID brought approximately 620 older F-16s to a standard close to that of the early Block 50/52 aircraft. Among the improvements are situation awareness datalink (SADL), improved airborne videotape recorder, colour camera, initial NVG-compatible cockpit lighting, LANTIRN and Rafael Litening II FLIR targeting pod capability, AN/ALQ-213 countermeasures control system and provisions for GPS/laser gyro INS. Subsequent enhancements include expanded central computer, joint helmet-mounted cueing system, AIM-9X missile, follow-on NVIS capability, PIDS-3 pylon upgrade for smart weapon compatibility, ACES II ejection seat improvements, enhanced main battery and software upgrades.

Block 40/42 F-16C/Ds are currently being upgraded to include NVG compatibility, MD-1295/A improved data modem, digital terrain system, AN/ALE-47 chaff dispenser, AN/ALE-50 towed decoy and smart weapons compatibility (including the GBU-27, JDAM, JSOW and WCMD). Block 50/52 F-16C/Ds already have these capabilities. Three squadrons of ANG Block 42 aircraft received F100-PW-229 engine as replacement for original F100-PW-220; first engines installed in mid-2002.

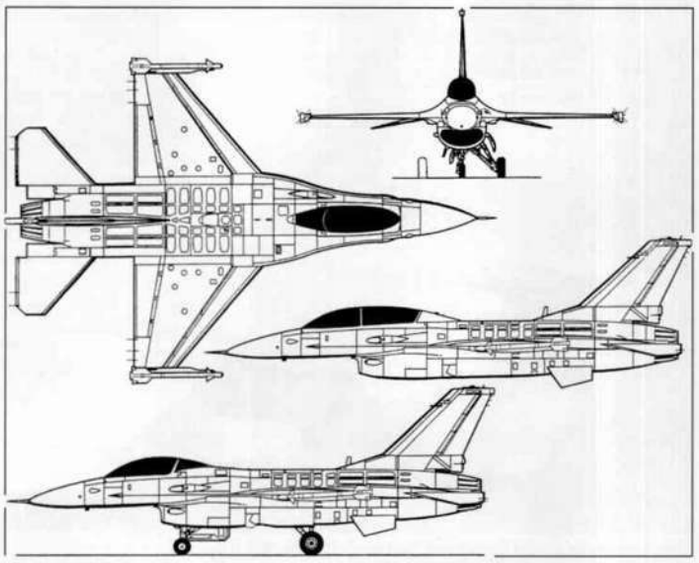
In June 1998, USAF launched an upgrade effort known as common configuration implementation program (CCIP), which is intended to provide common hardware and software capability to about 650 Block 40/42/50/52 aircraft. CCIP is a multiphase effort and is being implemented in stages, based on availability of subsystems. Work is being undertaken at the Ogden Air Logistics Center, Hill AFB, Utah, to where the first eight modification kits were shipped on 29 June 2001; these Phase 1 kits included the modular mission computer and colour MFDs applicable to 107 older aircraft of the Block 50/52 versions. The first aircraft to undergo CCIP was completed ahead of schedule and delivered to the 20th FW on 11 January 2002.

Phase 1A Block 50/52 kits include the AN/APX-113 combined electronic interrogator/transponder which gives autonomous BVR intercept capability. These aircraft also capable of alternative carriage of an advanced Lockheed Martin Sniper XR FLIR targeting pod in addition to the HARM targeting system pod. The first of about 250 aircraft to receive this capability was delivered in October 2002; first operational unit with Phase 1A aircraft was 389th Fighter Squadron at Mountain Home AFB, Idaho.

Phase 2, fielded in July 2003, adds Link 16 multifunctional information distribution system (MIDS) datalink, the Vision Systems International joint helmet-mounted cueing system (JHMCS) and an electronic horizontal situation indicator to 252 Block 50/52 aircraft. CCIP upgrade of USAF Block 50/52 aircraft completed in May 2006. By that time, work had begun on approximately 400 Block 40/42 Fighting Falcons that are to receive the full package of modifications detailed above, in Phase 3 of CCIP upgrade, which is expected to be completed in 2010. Delivery of the first upgraded Block 40/42 aircraft was made to Nellis AFB, Nevada, in February 2006. Several other F-16 operators are considering CCIP upgrade of their Block 40/50 aircraft.

F-16E/F: Originally known as Block 60 and redesignated as F-16E (single-seat) and F-16F (two-seat) in late 2003, this is the most advanced version yet and has Northrop Grumman AN/APG-80 multimode agile beam radar with active electronically scanned array (AESA) antenna, offering numerous advantages, including mode interleaving; also has internal Northrop Grumman AN/AAQ-32 internal FLIR navigation and targeting system, plus advanced cockpit layout, with three 127 × 178 mm (5 × 7 in) colour liquid crystal displays having picture-in-picture and moving map capability. New core avionics suite based on advanced mission computer utilising commercial hardware and software and a high-speed fibre optic databus. Other improvements include digital fuel management system, higher-capacity environmental control system, new air data system (eliminating probe on tip of nose) and expanded digital flight control system with additional automatic modes, such as terrain following. Specialised equipment includes Northrop Grumman Falcon Edge advanced internal ECM system and Thales secure radio and datalink. Power plant is General Electric F110-GE-132 engine in the 144.65 kN (32,500 lb st) class. High-capacity tyres and brakes, allowing maximum take-off gross weight to rise to 22,679 kg (50,000 lb). Many of the features introduced by Advanced Block 50/52 aircraft also adopted as standard on the F-16E/F, including conformal fuel tanks, dorsal avionics compartment and rear cockpit configured for weapon system operator.

United Arab Emirates announced selection of the F-16E/F **Desert Falcon** on 12 May 1998, although signature of contract for 80 aircraft delayed until first quarter of 2000. First flight (by F-16F 3001/N161LM) made 6 December 2003, with first three two-seaters used for flight testing. F-16E first flight accomplished on 6 August 2004 by 3026/N60019. Delivery to UAE began July 2004; at least 18 aircraft (seven F-16E; 11 F-16F) initially retained in US for pilot training with Arizona ANG 162nd FW at Tucson, Arizona. Training began 2 September 2004, with first delivery of aircraft to UAE occurring on 3 May 2005 when total of 10 arrived at Al Dhafra; final delivery set for 2007.



F-16C (GE F110 turbofan) with extra side view (top) of two-seat F-16D (P&W F100 turbofan) *(Paul Jackson)* 1158226

Initial deliveries to so-called Standard 0 configuration for pilot training in USA. First operational aircraft in Standard 1 configuration which marries Block 50 capability to new EW suite, advanced cockpit and new radar. Standard 2 available in early 2006 features advanced EW modes as well as terrain-following radar capability and additional weaponry; definitive Standard 3 version in 2007 will include BAE Systems TERPROM digital terrain avoidance and navigation system and, possibly, a helmet-mounted cueing system.

NF-16D: Variable stability in-flight simulator test aircraft (**VISTA**) modified from Block 30 F-16D (86-0048) ordered December 1988 to replace NT-33A testbed. Features include Calspan variable stability flight control system, fully programmable cockpit controls and displays, additional computer suite, permanent flight test data recording system, variable feel centrestick and sidestick in front cockpit, with latter also available for use in F-16 mode; safety pilot in rear cockpit. Internal gun, RWR and chaff/flare equipment removed, providing space for Phase II and III growth including additional computer, reprogrammable display generator and customer hardware allowance. Dorsal avionics compartment in bulged spine. NF-16D transferred to USAF Test Pilot School at Edwards AFB in 2001 to support TPS missions and various research and development activities. Aircraft participated in USAF Auto Air Collision Avoidance System (Auto ACAS) demonstration in mid-2003; USAF subsequently stated that Auto ACAS is technically feasible and could significantly reduce number of mid-air collisions as well as facilitate mixed-force operations of manned and unmanned aircraft.

F-16I: Two-seat version, basically similar to Advanced Block 52, for Israel, featuring Pratt & Whitney F100-PW-229 engine, conformal fuel tanks and SAR. Incorporates Northrop Grumman AN/APG-68(V)9 radar and significant amount of Israeli avionics, including EW suite, cockpit displays, helmet-mounted sight and advanced self-protection system (ASPS). EW suite, by Elisra, will include radar and missile approach warning systems plus jammers, while Elbit Systems to provide head-up display system, central mission computer, advanced display processor, DASH IV display and sight helmet system and stores management systems. RADA teamed with Smiths Aerospace to supply data acquisition system; Elop to provide HUD unit. Aircraft also to utilise Rafael Litening II targeting pod. Total of 50 initially purchased in USD2.5 billion deal; further 60 aircraft then on option, of which 52 converted to firm order on 19 December 2001. First aircraft completed in June 2003, thereafter being modified to accommodate flight test instrumentation. Roll-out and formal acceptance of first F-16I (401, marked as '253' to indicate the operating squadron) at Fort Worth 14 November 2003, with first flight (by fourth aircraft, also marked as 253) on 23 December 2003. First two aircraft delivered to Israel (for 253 Squadron) on 19 February 2004; balance to follow at rate of about two per month. In early 2004, however, it emerged that Israel was 'highly dissatisfied' with synthetic aperture mode of AN/APG-68 radar and that additional trials would be undertaken in Israel.

F-16N: US Navy supersonic adversary aircraft (SAA) modified from F-16C/D Block 30. Four of 26 were two-seat **TF-16N**. Entire fleet retired during 1994–95.

FS-X and TFS-X: F-16 design selected by Japan Defence Agency as basis for its FS-X (now F-2) requirement 19 October 1987; details under Mitsubishi in Japanese section.

F-16 Recce: Following trials with a prototype system in mid-1995, an LMTAS-designed reconnaissance pod for the US Air National Guard was flown for the first time on 29 September 1995 and subsequently tested on an F-16C (86-227) of the 149th Fighter Squadron, Virginia ANG. Four pods were built and then deployed with the 149th FS to Aviano AB, Italy, in May 1996 for operational validation in support of NATO missions over Bosnia. This successful trial culminated in decision to procure 20 podded systems for service with F-16C Block 30 aircraft of two ANG squadrons. The core of the programme, known as the BAE Systems Theater Airborne Reconnaissance System (TARS), is the Per Udsen MRP with USAF-supplied KS-87 cameras incorporating E-O video back instead of wet film; the Lockheed Martin Fairchild Systems medium-altitude E-O (MAEO) camera; an Ampex DCRsi-240 digital data recorder and a TERMA Elektronik cockpit control device. The TARS pods were delivered in 1999 and certified for operational use by the F-16 in first half of 2000; following operational deployment of 10 aircraft to Iraq in early 2004, USAF revealed that it was considering acquisition of additional TARS pods and also intending to integrate a datalink for relay of imagery in real time as well as adding synthetic aperture radar. Egypt ordered six TARS pods and two ground stations at beginning of 2003.

Elta EL/M-2060P pod also cleared for use by F-16 in 1999. System is contained in standard 300 US gallon drop tank and comprises autonomous, all-weather, day and night high-resolution reconnaissance synthetic aperture radar sensor with ability to transmit imagery to ground station via bidirectional datalink.

Most F-16s delivered since the early 1990s have provisions for a reconnaissance pod. Final 20 aircraft for South Korea (15 F-16C and 5 F-16D) configured for reconnaissance

mission, although decision on system delayed until 2005, when Elop LOROP pod selected. Omani F-16s to use BAE Systems F-9120 Advanced Airborne Reconnaissance System (AARS) and will receive two sensor pods and a ground exploitation station at a cost of about USD27.5 million. Poland has selected the Goodrich DB-110 EO reconnaissance pod and is understood to require seven pod systems and two ground exploitation stations (one of which will be mobile) as well as associated data recording, datalink and mission control systems.

F-16ES: Enhanced Strategic two-seat, long-range interdictor F-16 proposal; now defunct but provided basis for Advanced Block 50/52 and Israeli F-16I.

F-16U: Proposed two-seat version unsuccessfully offered to United Arab Emirates.

F-16 'Falcon 2000': Private venture design of early 1990s, similar to F-16U, which Lockheed Martin aimed at USAF as a follow-on to the F-16 before introduction of JSF. Also known as the **F-16X;** now defunct.

CUSTOMERS: See tables. Total 4,447 production aircraft ordered or requested to date, including planned USAF procurement of 2,230 and 28 embargoed Pakistan Air Force examples that were distributed equally between the USAF and US Navy, although two USAF aircraft were refurbished and delivered to Pakistan shortly before the end of 2005.

COSTS: Approximately USD40 million, flyaway, depending on configuration. Sale of 48 aircraft to Poland valued at USD3.5 billion. F-16E/F unit cost reported to be in region of USD50–55 million.

DESIGN FEATURES: Conceived as 'lo' complement to Boeing F-15 Eagle in hi-lo fighter mix; optimised for high agility in air combat. Cropped delta wings blended with fuselage, with highly swept vortex control strakes along fuselage forebody and joining wings to increase lift and improve directional stability at high angles of attack; wing section NACA 64A-204; leading-edge sweepback 40°; relaxed stability (rearward CG) to increase manoeuvrability; deep wingroots increase rigidity, save 113 kg (250 lb) structure weight and increase fuel volume; fixed geometry engine intake; pilot's ejection seat inclined 30° rearwards; single-piece birdproof forward canopy section; two ventral fins below wing trailing-edge.

Baseline F-16 airframe life planned as 8,000 hours with average usage of 55.5 per cent in air combat training, 20 per cent ground attack and 24.5 per cent general flying; structural strengthening programme for pre-Block 50 aircraft required during 1990s.

FLYING CONTROLS: Four-channel digital fly-by-wire (analogue in earlier variants); pitch/lateral control by pivoting monobloc tailerons and wing-mounted flaperons; maximum rate of flaperon movement 52°/s; automatic wing leading-edge manoeuvring flaps programmed for Mach number and angle of attack; flaperons and tailerons interchangeable left and right; sidestick control column with force feel replacing almost all stick movement.

STRUCTURE: Wing, mainly of light alloy, has 11 spars, five ribs and single-piece upper and lower skins; attached to fuse-lage by machined aluminium fittings; leading-edge flaps are one-piece bonded aluminium honeycomb and driven by rotary actuators; fin is multispar, multirib with graphite epoxy skins; brake parachute or ECM housed in fairing aft of fin root; tailerons have graphite epoxy laminate skins, attached to corrugated aluminium pivot shaft and removable full-depth aluminium honeycomb leading-edge; ventral fins have aluminium honeycomb and skins; split speedbrakes in fuselage extensions inboard of tailerons open to 60°. Nose radome by Brunswick Corporation.

LANDING GEAR: Goodrich (formerly Menasco) hydraulically retractable type, nose unit retracting rearward and main units forward into fuselage. Nosewheel is located aft of intake to reduce the risk of foreign objects being thrown into the engine during ground operation, and rotates 90° during retraction to lie horizontally under engine air intake duct. Oleo-pneumatic struts in all units. Aircraft Braking Systems mainwheels and brakes; Goodyear or Goodrich tubeless mainwheel tyres, size 27.75×8.75–14.5 (or 27.75×8.75R14.5) (24 ply), pressure 14.48 to 15.17 bar (210 to 220 lb/sq in) at T-O weights less than 13,608 kg (30,000 lb). Steerable nosewheel with Goodyear, Goodrich or Dunlop tubeless tyre, size 18×5.7–8 (18 ply), pressure 20.68 to 21.37 bar (300 to 310 lb/sq in) at T-O weights less than 13,608 kg (30,000 lb). All but two main unit components interchangeable. Brake-by-wire system on main gear, with Aircraft Braking Systems anti-skid units. Runway arresting hook under rear fuselage; Irvin 7.01 m (23 ft 0 in) diameter braking parachute fitted in Greek and Turkish (Block 30/40 only) F-16s. Israeli (F-16C/D models only) and Singaporean (F-16Ds) aircraft have braking parachute compartment configured for electronic equipment. Landing/taxying lights on nose landing gear door.

F-16 TABLES: Table 1 provides a rapid reference to customers and quantities; more detailed information on F-16C/D production block numbers appears in Table 2; F-16E/F/I production in Table 3.

Royal Air Force of Oman Lockheed Martin F-16C, the 4,300th F-16, handed over on 20 April 2006 1158219

Reheat take-off by a USAF Lockheed Martin F-16C ***(Paul Jackson)*** 1158218

TABLE 1: F-16 CUSTOMERS

Operator	Total	Single-seat	Qty	Two-seat	Qty	Power plant	First aircraft		First delivery	Squadrons (or base)
							A/C/E	B/D/F/I		
Bahrain	22	F-16C-40	18	F-16D-40	4	F110-GE-100	101	150	March 1990	1, 2
Belgium	160[1]	F-16A-10	55	F-16B-10	12	F100-PW-200	FA01	FB01	January 1979	
		F-16A-15	41	F-16B-15	8	F100-PW-200	FA56	FB13	October 1982	1, 2, 23, 31, 349, 350
		F-16A-15OCU	40	F-16B-15OCU	4	F100-PW-220	FA97	FB21	January 1988	
Chile	10	F-16C-50 (Adv)	6	F-16D-50 (Adv)	4	F100-GE-129	851	857	January 2006	Grupo Aéreo 3
Denmark	70	F-16A-10	30[1]	F-16B-10	8[1]	F100-PW-200	E-174	ET-204	January 1980	723, 727, 730
		F-16A-15	16[1]	F-16B-15	4[1]	F100-PW-200	E-596	ET-613	May 1982	723, 727, 730
		F-16A-15OCU	8[3]	F-16B-15OCU	4[3]	F100-PW-220	E-004	ET-197	December 1987	726
Egypt	220	F-16A-15	34	F-16B-15	8[2]	F100-PW-200	9301	9201	March 1982	72, 74
		F-16C-32	34	F-16D-32	6	F100-PW-220	9501	9401	August 1986	68, 70
		F-16C-40	34	F-16D-40	7	F110-GE-100	9901	9801	October 1991	60, 64
		F-16C-40	1	F-16D-40	5	F110-GE-100	9935	9808	1994	
		F-16C-40	34[7]	F-16D-40	12[7]	F110-GE-100	9951	9851	March 1994	75, 77
		F-16C-40	21			F110-GE-100B	9711	—	May 1999	71, 73
		F-16C-40	12	F-16D-40	12	F110-GE-100B	9732	9863	June 2001	
Greece	170	F-16C-30	34	F-16D-30	6	F110-GE-100	110	144	November 1988	330, 346
		F-16C-50	32	F-16D-50	8	F110-GE-129	045	077	January 1997	341, 347
		F-16C-52 (Adv)	40	F-16D-52 (Adv)	20	F110-PW-229	500	600	Late 2002	334, 340, 343
		F-16C-52 (Adv)	20	F-16D-52 (Adv)	10	F100-PW-229			2008	
Indonesia	12	F-16A-15OCU	8	F-16B-15OCU	4	F100-PW-220	S-1605	S-1601	December 1989	3
Israel	312	F-16A-10	67	F-16B-10	8	F100-PW-200	100	001	January 1980	140, 147, 253
		F-16C-30	51	F-16D-30	24	F110-GE-100A	301	020	December 1986	101, 105, 109, 110, 117
		F-16C-40	30	F-16D-40	30	F110-GE-100A	502	601	July 1991	101, 105, 109, 110, 117
				F-16I	102	F100-PW-229		401	February 2004	253
Korea, South	180	F-16C-32	30	F-16D-32	10	F100-PW-220	85-574	84-370	March 1986	161, 162, 155
		F-16C-52	95[8]	F-16D-52	45[8]	F100-PW-229	92-001	92-029	December 1994	
Lockheed Martin	12[11]	F-16C-52	4	F-16D-52	8	F100-PW-229	96-5033	96-5025	June 1998	Singapore (lease in USA)
Netherlands	213[3]	F-16A-10	46	F-16B-10	13	F100-PW-200	J-212	J-259	June 1979	306, 311, 312, 313,
		F-16A-15	84	F-16B-15	18	F100-PW-200	J-258	J-649	May 1982	315, 322, 323
		F-16A-15OCU	47	F-16B-15OCU	5	F100-PW-220	J-141	J-065	1988	
Norway	74	F-16A-10	28[3]	F-16B-10	7[3]	F100-PW-200	272	301	January 1980	332, 338
		F-16A-15	32[3]	F-16B-15	5[3]	F100-PW-200	300	690	June 1982	331, 334
				F-16B-15OCU	2	F100-PW-220	—	711	July 1989	331
Oman	12	F-16C-50 (Adv)	8	F-16D-50 (Adv)	4	F110-GE-129	810	801	August 2005	18
Pakistan	68	F-16A-15	28	F-16B-15	12	F100-PW-200	82-701	82-601	January 1983	9, 11, 14
		F-16A-15OCU	13	F-16B-15OCU	15	F100-PW-220	91-729	91-613	—	See note 10
Poland	48	F-16C-52 (Adv)	36	F-16D-52 (Adv)	12	F100-PW-229	4040	4076	November 2006	3
Portugal	20	F-16A-15OCU	17	F-16B-15OCU	3	F100-PW-220E	15101	15118	February 1994	201
Singapore	58	F-16A-15OCU	4	F-16B-15OCU	4	F100-PW-220	880	884	February 1988	140
		F-16C-52	18	F-16D-52	12	F100-PW-229	608	624	January 1998	143
				F-16D-52 (Adv)	20	F100-PW-229	—	661	Early 2004	
Taiwan	150	F-16A-20	120	F-16B-20	30	F100-PW-220	6601	6801	July 1996	12, 14, 17, 21, 22, 23, 26, 27

Operator	Total	Single-seat	Qty	Two-seat	Qty	Power plant	First aircraft A/C/E	First aircraft B/D/F/I	First delivery	Squadrons (or base)
Thailand	36	F-16A-15OCU	14	F-16B-15OCU	4	F100-PW-220	10305	10301	June 1988	103
		F-16A-15OCU	12	F-16B-15OCU	6	F100-PW-220	07020	07032	September 1995	403
Turkey	240[4]	F-16C-30	34	F-16D-30	9	F110-GE-100	86-0066	86-0191	May 1987	142, Oncel Flight
		F-16C-40	102	F-16D-40	15	F110-GE-100	88-0033	88-0014	July 1990	141, 161, 162, 191, 192, 181, 182
		F-16C-50	60	F-16D-50	20	F110-GE-129	93-0657	93-0691	July 1996	141, 151, 152
UAE	80	F-16E	55	F-16F	25	F110-GE-132	3026	3001	2004	
USAF	2,230[9]	F-16A-10	255	F-16B-10	74	F100-PW-200	78-0001	78-0077	August 1978	See note A
		F-16A-15	409[5]	F-16B-15	46[6]	F100-PW-200	80-0541	80-0635	September 1981	See note A
		F-16C-25	209	F-16D-25	35	F100-PW-200	83-1118	83-1174	July 1984	See note B
		F-16C-30/32	360/56	F-16D-30/32	48/5	both (100/220)	85-1398	85-1509	July 1986	See note B
		F-16C-40/42	234/150	F-16D-40/42	31/47	both (100/220)	87-0350	87-0391	December 1988	See note B
		F-16C-50/52	189/42	F-16D-50/52	28/12	both (129/229)	90-0801	90-0834	October 1991	See note B
US Navy	26	F-16N-30	22	TF-16N-30	4	F110-GE-100	163268	163278	June 1987	withdrawn
Venezuela	24	F-16A-15	18	F-16B-15	6	F100-PW-200	1041	1715	September 1983	161, 162
Totals	**4,447**		**3,497**		**950**					

[1] Built by Sabca (Belgium); 222nd and last Sabca F-16 (BAF FA-136) delivered 22 October 1991
[2] One built by Fokker (Netherlands)
[3] Built by Fokker; 300th and last Fokker F-16 (RNethAF J-021) delivered 27 February 1992
[4] Two F-16Cs and six F-16Ds built by GD; remainder by TAI
[5] Two built by Fokker
[6] Four built by Sabca
[7] TAI production
[8] 12 built by GD, 36 CKD kits and 92 produced locally by Korea Aerospace Industries (formerly Samsung Aerospace)
[9] Deliveries completed 18 March 2005. Table excludes YF-16 prototypes (two) and full-scale development (FSD) aircraft (six F-16A and two F-16B)
[10] 28 aircraft embargoed, placed in storage at Davis-Monthan AFB, Arizona for several years until distributed between US Navy Strike and Air Warfare Center (10 F-16A and four F-16B) as adversary aircraft for tactics training and US Air Force (three F-16A and 11 F-16B) for test support duties. Two of these aircraft subsequently refurbished at Hill AFB, Utah, and delivered to Pakistan in December 2005, these being F-16As that had been in use with the USAF
[11] New production aircraft leased to Singapore for training in the USA

Notes: **Note A:** Currently operated by US Air Force Flight Test Center/412th Test Wing, Edwards AFB, California; US Air Force Air Armament Center/46th Test Wing, Eglin AFB, Florida; Air National Guard.

Note B: Currently operated by US Air Force Flight Test Center/412th Test Wing, Edwards AFB, California; US Air Force Air Armament Center/46th Test Wing, Eglin AFB, Florida; 8th FW, Kunsan AB, South Korea; 20th FW, Shaw AFB, South Carolina; 27th FW, Cannon AFB, New Mexico; 31st FW, Aviano AB, Italy; 35th FW, Misawa AB, Japan; 51st FW, Osan AB, South Korea; 52nd FW, Spangdahlem AB, Germany; 53rd W, Eglin AFB, Florida; 56th FW, Luke AFB, Arizona; 57th W, Nellis AFB, Nevada; 354th FW, Eielson AFB, Alaska; 366th W, Mountain Home AFB, Idaho; 388th FW, Hill AFB, Utah; and also five fighter squadrons of the Air Force Reserve Command and more than 25 Air National Guard fighter squadrons.Blocks 1 and 5 retrofitted to Block 10 standard 1982–84; Block 15 retrofitted to Block 15OCU (avionics standard only) from 1987. New-build F-16As are Block 15OCU from November 1987.Export programme codenames are: Bahrain — Peace Crown I-II; Chile — Peace Puma; Egypt — Peace Vector I, II, III, IIIA, IV, V and VI; Greece — Peace Xenia I-IV; Indonesia — Peace Bima-Sena; Israel— Peace Marble I-V; Italy — Peace Caesar; Jordan — Peace Falcon I-II; South Korea — Peace Bridge I-II and Korean Fighter Program I-II; Oman — Peace A'sama A'safiya (Blue Skies); Pakistan— Peace Gate I-IV; Poland — Peace Sky; Portugal — Peace Atlantis I-II; Singapore — Peace Carvin I-IV; Taiwan— Peace Fenghuang; Thailand — Peace Naresuan I-III; Turkey— Peace Onyx I-II (and CAE-Link simulator, Peace Onyx III); and Venezuela — Peace Delta.Recent orders Poland selected F-16 at beginning of 2003 and will receive 48 aircraft (36 F-16C and 12 F-16D) in 2006–08. Greece announced intention to acquire another 30 aircraft (20 F-16C and 10 F-16D) in July 2005, with option on further 10, although in early 2006 it announced it would not be converting option to firm order.Transfers: Israelreceived 36 F-16As and 14 F-16Bs from surplus USAF stocks August 1994 to March 1995 for 140, 144 and 253 Squadrons. **Denmark** received three ex-USAF F-16As in July 1994, plus three F-16As and one F-16B in 1997. **Jordan** accepted initial batch of ex-USAF ADF aircraft (12 F-16As and four F-16Bs) on lease basis (subsequently permanent transfer) in December 1997/April 1998 and took delivery of eight more ex-USAF aircraft (seven F-16As and one F-16B) in January and February 2003, with further nine F-16As following by end of 2003. In November 2005, Jordan concluded deal to obtain three F-16BM aircraft from the Netherlands, for delivery in October 2006, and followed this in April 2006 with further acquisition of 20 aircraft from Belgium (12, probably all to be F-16AM) and the Netherlands (eight, comprising five F-16AM and three F-16BM) for delivery in 2008. **Portugal** received 25 second-hand aircraft (21 F-16As and four F-16Bs, of which five F-16As to be broken-down for spares, with the rest receiving F-16 Mid-Life Update improvements); first upgraded aircraft rolled out at Alverca 26 June 2003; **Thailand** request for surplus USAF aircraft approved by US Congress at beginning of 2000, with delivery of 15 F-16As and one F-16B drawn from storage beginning in August 2002. In November 2004, it was announced that Thailand would receive seven surviving early model aircraft from Singapore (three F-16As and four F-16Bs) in return for providing training facilities; **Italy** received 30 F-16A and four F-16B ADF aircraft in 2003–04 on five-year lease arrangement, with five-year follow-on option; first aircraft rolled out at Hill AFB, Utah on 9 May 2003, with initial batch of five aircraft ferried to Trapani 17 July 2003 (deal includes extra four aircraft for use as spares source). Chile to obtain 18 surplus aircraft (11 F-16AM and 7 F-16BM) from Netherlands, with delivery to be completed in 2006-07. Romania has indicated intention to acquire unspecified number of surplus aircraft from Israel. Pakistan expected to take delivery of 26 refurbished F-16A and F-16B aircraft, in addition to new-build F-16C and F-16D models. Two F-16As from embargoed order delivered in December 2005, following service with USAF test organisations and subsequent refurbishment.

POWER PLANT: One 131.6 kN (29,588 lb st) General Electric F110-GE-129, or one 129.4 kN (29,100 lb st) Pratt & Whitney F100-PW-229 afterburning turbofan as alternative standard. These Increased Performance Engines (IPE) installed from late 1991 in Block 50 and Block 52 aircraft and retrofitted to about 50 Air National Guard Block 42 aircraft. Pratt & Whitney has proposed F100-PW-229A version, with new fan module among other radical improvements that will raise airflow by more than 10 per cent, lower turbine temperatures by almost 50°C (122°F) and permit inspection intervals to rise from 4,300 cycles to 6,000. New version offers potential to increase maximum augmented thrust rating to about 142 kN (31,860 lb st), although this would require larger inlet on F-16. General Electric also engaged in improvement efforts, using company funding to begin development of F110-GE-129 EFE (Enhanced Fighter Engine) in October 1997; EFE initially to be rated at up to 151.0 kN (33,945 lb st), with further growth potential to 160.0 kN (35,970 lb st); alternatively, improved thrust levels can be sacrificed for up to a 50 per cent increase in TBO and servicing intervals. Production derivative known as F110-GE-132 rated at 144.6 kN (32,500 lb st) installed in F-16E/F aircraft for UAE. Immediately prior standard was 128.9 kN (28,984 lb st) F110-GE-100 or 105.7 kN (23,770 lb st) F100-PW-220 in Blocks 40/42.

Of 1,446 F-16Cs and F-16Ds ordered by USAF, 556 with F100 and 890 with F110. Fixed geometry intake, with boundary layer splitter plate, beneath fuselage. Apart from first few, F110-powered aircraft have intake widened by 30 cm (1 ft 0 in) from 368th F-16C (86-0262); Israeli second-batch F-16D-30s have power plants locally modified by Bet-Shemesh Engines to F110-GE-110A with provision for up to 50 per cent emergency thrust at low level.

Standard fuel contained in wing and five seal-bonded fuselage cells which function as two tanks; 3,986 litres (1,053 US gallons; 876 Imp gallons) in single-seat aircraft; 3,297 litres (871 US gallons; 726 Imp gallons) in two-seat aircraft. Halon inerting system. In-flight refuelling receptacle in top of centre-fuselage, aft of cockpit. Auxiliary fuel can be carried in drop tanks: one 1,136 litre (300 US gallon; 250 Imp gallon) under fuselage; 1,402 litre (370 US gallon; 308 Imp gallon) under each wing. Optional Israel Military Industries 2,271 litre (600 US gallon; 500 Imp gallon) underwing tanks initially adopted only by Israel, but have since been selected by one or two other operators; also adopted for F-16E/F versions. Latter have conformal fuel tanks (CFTs) with a combined capacity of 1,703 litres (450 US gallons; 375 Imp gallons). CFTs available as optional equipment on Advanced Block 50/52.

ACCOMMODATION: Pilot only in F-16C, in pressurised and air conditioned cockpit. Boeing (formerly McDonnell Douglas) ACES II zero/zero ejection seat. Bubble canopy made of polycarbonate advanced plastics material. Inside of USAF F-16C/D canopy coated with gold film to dissipate radar energy. In conjunction with radar-absorbing materials in air intake, this reduces frontal radar signature by 40 per cent. Windscreen and forward canopy are an integral unit without a forward bow frame, and are separated from the aft canopy by a simple support structure which serves also as the breakpoint where the forward section pivots upward and aft to give access to the cockpit. A redundant safety lock feature prevents canopy loss. Windscreen/canopy design provides 360° all-round view, 195° fore and aft, 40° down over the side, and 15° down over the nose.

To enable the pilot to sustain high *g* forces, and for pilot comfort, the seat is inclined 30° aft and the heel line is raised. In normal operation the canopy is pivoted upward and aft by electrical power; the pilot is also able to unlatch the canopy manually and open it with a back-up handcrank. Emergency jettison is provided by explosive unlatching devices and two rockets. A limited displacement, force-sensing control stick is provided on the right-hand console, with a suitable armrest, to provide precise control inputs during combat manoeuvres.

The F-16D has two cockpits in tandem, equipped with all controls, displays, instruments, avionics and life support systems required to perform both training and combat missions. The layout of the F-16D second station is similar to the F-16C, and is fully systems-operational. A single-enclosure polycarbonate transparency, made in two pieces and spliced aft of the forward seat with a metal bow frame and lateral support member, provides outstanding view from both cockpits.

Advanced Block 50/52 F-16Ds, F-16Fs and F-16Is are configured with weapon system operator station in rear cockpit, plus a large dorsal equipment compartment extending from the rear of the canopy to the leading edge of the fin; compartment houses avionics unique to each operator, plus additional chaff/flare dispensers and an in-flight refuelling receptacle.

SYSTEMS: Regenerative 12 kW environmental control system, with digital electronic control, uses engine bleed air for pressurisation and cooling of crew station and avionics compartments. Two separate and independent hydraulic systems supply power for operation of the primary flight control surfaces and the utility functions. System pressure (each) 207 bar (3,000 lb/sq in), rated at 161 litres (42.5 US gallons; 35.4 Imp gallons)/min. Bootstrap-type reservoirs, rated at 5.79 bar (84 lb/sq in).

Electrical system powered by engine-driven 60 kVA main generator and 10 kVA standby generator (including ground annunciator panel for total electrical system fault reporting), with Hamilton Sundstrand constant speed drive and powered by a Hamilton Sundstrand accessory drive gearbox. 17 Ah battery. Four dedicated, sealed cell batteries provide transient electrical power protection for the fly-by-wire flight control system.

An onboard Hamilton Sundstrand/Solar jet fuel starter is provided for engine self-start capability. Simmonds fuel measuring system. AlliedSignal emergency power unit automatically drives a 5 kVA emergency generator and emergency pump to provide uninterrupted electrical and hydraulic power for control in the event of the engine or primary power systems becoming inoperative.

AVIONICS: *Comms:* Magnavox AN/ARC-164 UHF transceiver (AN/URC-126 Have Quick IIA in Block 50/52); provision for Magnavox KY-58 secure voice system; Rockwell Collins

TABLE 2: F-16C/D PRODUCTION

Block	USAF		USN		Bahrain		Egypt		Greece		Israel		Korea		Singapore		Turkey		Lockheed Martin		Chile		Oman		Poland	
	F-16C	F-16D	F-16N	TF-16N	C	D	C	D	C	D	C	D	C	D	C	D	C	D	C	D	C	D	C	D	C	D
25	7	4																								
25A	16	3																								
25B	25	5																								
25C	35	5																								
25D	40	4																								
25E	47	4																								
25F	39	10																								
Subtotal	**209**	**35**																								
30	16	2									4	—														
32							1	4					2	6												
30A	40	2									15	1														
32A							13	2					4	—												
30B	47	3	4	—							15	—					17	6								
32B							20	—					4	—												
30C	35	2	8	—							16	—														
32C	20	3											4	—												
30D	42	4	8	—							1	4														
32D	13	—											4	—												
30E	55	5	2	4							—	10					17	3								
32E													4	—												
30F	51	6									—	9														
32F	2	1											4	—												
30H	34	12							2	4																
32H	11	1											4	—												
30J	25	8							12	2																
32J	10	—																								
30K	15	3							16	—																
30L									4	—																
32Q													—	4												
30VISTA	—	1																								
Subtotal	**625**	**88**	**22**	**4**			**34**	**6**	**34**	**6**	**51**	**24**	**30**	**10**			**34**	**9**								
40	2	—																								
40A	6	3															17	3								
42A	5	3																								
40B	22	—																								
42B	7	13																								
40C	38	3																								
42C	17	2																								
40D	38	2			2	4											17	3								
42D	17	3																								
40E	37	—			6	--																				
42E	18	5																								
40F	33	4															17	3								
42F	15	8																								
40G	31	5					2	—																		
42G	21	3																								
40H	14	5					—	4			6	4														
42H	27	6																								
40J	7	5					9	2			8	8					16	3								
42J	21	4																								
40K	6	4					15	1			8	8														
42K	2	—																								
40L							8				8	10					17	3								
40M							1	1																		
40N							—	8																		
40P																	18	—								
40Q							3	3																		
40R							12	5																		
40S							19																			
40T							5																			
40U							8																			
40V							8																			
40W					10																					
40							12	12																		
Subtotal	**1,009**	**166**	**22**	**4**	**18**	**4**	**136**	**42**			**81**	**54**					**136**	**24**								
50	4	—																								
50A	7	7																								
52A	1	1																								
50B	24	8																								
50C	21	4																								
50D	133	9							32	8							60	20								
52D	41	11											95	45	18	12			4	8	6	4	8	4		
50 (Adv)																									36	12
52 (Adv)									60	30						20										
Totals	**1,240**	**206**	**22**	**4**	**18**	**4**	**136**	**42**	**126**	**44**	**81**	**54**	**125**	**55**	**18**	**32**	**196**	**44**	**4**	**8**	**6**	**4**	**8**	**4**	**36**	**12**
Grand total													**2,529**													

AN/ARC-186 VHF AM/FM transceiver, ARC-190 HF radio, government-furnished AN/AIC-18/25 intercom and SCI advanced interference blanker, Teledyne Electronics AN/APX-101 IFF transponder with government-furnished IFF control, government-furnished National Security Agency KIT-1A/TSEC cryptographic equipment. F-16C/D Block 52 aircraft of Singapore and South Korea have Litton AN/APX-109+ advanced interrogator/transponder. AN/APX-113 advanced interrogator/transponder installed in Greek Block 50, Taiwanese Block 20 and Turkish Block 50 aircraft and is standard equipment on USAF aircraft procured in FY00 and FY01; is being retrofitted to earlier USAF aircraft as part of CCIP upgrade. Link 16 tactical datalink added by USAF in mid-2004, in concert with new M3+ connectivity software, following operational evaluation in March 2004.

Radar: Northrop Grumman AN/APG-68(V) pulse Doppler range and angle track radar, with mechanically scanned planar array in nose. Provides air-to-air modes for range-while-search, uplook search, velocity search with ranging, air combat, track-while-scan (10 targets), raid cluster resolution, single target track and pulse Doppler track to provide target illumination for AIM-7 missiles, plus air-to-surface modes for ground-mapping, Doppler

TABLE 3: OTHER VERSIONS PRODUCTION

Model	Israel	UAE	Total
F-16E		55	55
F-16F		25	25
F-16I	102		102
Total	**102**	**80**	**182**

beam-sharpening, ground moving target, sea target, fixed target track, target freeze after pop-up, beacon, and air-to-ground ranging. Improved AN/APG-68(V)9 radar installed on Advanced Block 50/52 aircraft; in August 2004, Northrop Grumman awarded USD22 million contract to develop an upgrade kit for USAF that will enable existing radars to be brought to latest standard, which has synthetic aperture radar (SAR) mapping and terrain following (TF) modes, plus interleaving of all modes; USAF expects to upgrade at least 280 F-16C/D aircraft. If internal FLIR targeting system is selected, this could share processor with ABR. F-16E/F aircraft for UAE have Northrop Grumman AN/APG-80 agile beam radar with active electronically scanned array (AESA). In late 2004, Turkey announced plans for major upgrade programme involving total of 218 aircraft (38 Block 30, 104 Block 40 and 76 Block 50), with Block 40 and Block 50 both to adopt AN/APG-68(V)9 radar.

Flight: Litton LN-39 standard inertial navigation system (ring laser Litton LN-93 or Honeywell H-423 in Block 50/52: LN-93 for Egypt, Indonesia, Israel, South Korea, Pakistan, Portugal and Taiwan, plus Netherlands retrofit and Greek second batch); Rockwell Collins AN/ARN-108 ILS, Rockwell Collins AN/ARN-118 Tacan, Rockwell Collins GPS, Honeywell central air data computer, Elbit Fort Worth enhanced stores management computer, Gould AN/APN-232 radar altimeter. Fairchild digital terrain system (incorporating BAE Systems Terprom algorithms) to be installed in all new USAF F-16s and USAF Reserve F-16C/Ds. Optional equipment includes Rockwell Collins VIR-130 VOR/ILS.

Instrumentation: Marconi wide-angle holographic electronic HUD with raster video capability (for LANTIRN) and integrated keyboard; data entry/cockpit interface and dedicated fault display by Litton Canada and Elbit Fort Worth; Astronautics cockpit/TV set. Cockpit lighting and external strip lighting compatible with night imaging systems.

Mission: Honeywell multifunction displays. Lockheed Martin LANTIRN package comprises AN/AAQ-13 (navigation) and AN/AAQ-14 (targeting) pods. Turkish aircraft (150+ modified by 1996) to share 60 LANTIRN pod systems; LANTIRN also purchased by Greece, South Korea and Singapore, although Singapore now seeking a replacement system. Sharpshooter pod (down-rated export version of AAQ-14 LANTIRN targeting system) acquired by Bahrain and Israel, but latter obtained indigenous Rafael Litening IR targeting and navigation pod as replacement. Total of 168 Litening II navigation/targeting pods ordered from Rafael and Northrop Grumman to equip Block 25/30/32/40/42 F-16C/Ds of the Air National Guard (136) and Air Force Reserve Command (32); programme called Precision Attack Targeting System, with first AFRC unit (457th FS at Fort Worth, Texas) receiving initial batch of four pods in February 2000; this and three more AFRC squadrons equipped by end of 2000. ANG accepted first pods during 2000; goal is to allocate eight pods to each 15-aircraft squadron. Litening ER (Extended Range) targeting and navigation pod system also being supplied to ANG, which received first eight (of 16) in fourth quarter of 2002; all delivered by end of year. Under CCIP modification programme, Block 40/42/50/52 aircraft of USAF adopting new Lockheed Martin AN/AAQ-33 Sniper XR advanced FLIR targeting pod system from late 2002 onwards; more than 500 pods could eventually be acquired, with total of 17 received by USAF by February 2004; deliveries of export equivalent to Norway have begun. Export version known as Pantera (Precision Attack Navigation and Targeting with Extended Range Acquisition) selected by Oman (seven pod systems) and Poland (22) by late 2003. Pantera one of several systems in contention to satisfy South Korea's requirement for new targeting pod system, which is expected to go to tender in about 2007.

Raytheon AN/ASQ-213 HARM Targeting System (HTS) pod introduced on Block 50D/52D aircraft and subsequently retrofitted to entire Block 50/52 fleet. Entered service 1994 and currently deployed by USAF units in USA, Japan and Germany.

Self-defence: Dalmo Victor AN/ALR-69 radar warning system replaced in USAF Block 50/52 by BAE Systems AN/ALR-56M advanced RWR, which also ordered for USAF Block 40/42 retrofit and (first export) Korean Block 52s. Korean aircraft retrofitted with the ITT Avionics/Northrop Grumman AN/ALQ-165 Airborne Self-Protection Jammer (ASPJ) from mid-2000. Provision for Northrop Grumman AN/ALQ-131 or Raytheon AN/ALQ-184 jamming pods. AN/ALQ-131 supplied to Bahrain and Egypt. Israeli Air Force F-16s extensively modified with locally designed and manufactured equipment, as well as optional US equipment to tailor them to the IAF defence role. This includes Elisra SPS 3000 self-protection jamming equipment in enlarged spines of F-16D-30s and Elta EL/L-8240 ECM in third batch of F-16C/Ds, replacing AN/ALQ-178(V)1 Rapport ECM in Israeli F-16As. Elisra Passive Airborne Warning System 2 (PAWS-2) IR-based missile defence system is being installed on F-16I following delivery to Israel. Chilean aircraft will have ITT Industries Advanced Integrated Defensive Electronic Warfare Suite (AIDEWS), incorporating radar warning and RF countermeasures. Northrop Grumman Falcon Edge integrated EW system installed on UAE F-16E/F.

BAE Systems AN/ALQ-178(V)3 Rapport III integral self-protection system in Turkish F-16C/Ds will almost certainly be replaced by improved AN/ALQ-178(V)5 system. In March 1993, Greece ordered Raytheon ASPIS (Advanced Self-Protection Integrated Suite) self-defence EW system, comprising Northrop Grumman AN/ALR-93 RWR, BAE Systems AN/ALE-47 chaff/flare dispensers and Raytheon AN/ALQ-187 I-DIAS jammer; enhanced version known as ASPIS II is being installed on Advanced Block 52 aircraft.

USAF Air National Guard procured Terma PIDS wing weapon pylon with additional chaff/flare dispensers.

BAE Systems AN/ALE-40(V)-4 chaff/flare dispensers (AN/ALE-47 in FY97 Block 50, FMS Block 20/50 since mid-1996 and for retrofit to Block 40/42 and 50/52 of USAF). Raytheon AN/ALE-50(V)2 towed decoy installed in AMRAAM missile pylons and adopted by USAF for all Block 40/42/50/52 aircraft was widely fielded in 1999; USAF to buy total of 961. USAF Air National Guard participated in wing weapon pylon upgrade programme that added MIL-STD-1760 interface to existing PIDS pylons.

ARMAMENT: General Dynamics M61A1 20 mm multibarrel cannon in the port side wing/body fairing, equipped with a General Dynamics ammunition handling system and an enhanced envelope gunsight (part of the head-up display system) and 511 rounds of ammunition. There is a mounting for an air-to-air missile at each wingtip, one underfuselage centreline hardpoint, and six underwing hardpoints for additional stores. For manoeuvring flight at 5.5 *g* the underfuselage station is stressed for a load of up to 1,000 kg (2,200 lb), the two inboard underwing stations for 2,041 kg (4,500 lb) each, the two centre underwing stations for 1,587 kg (3,500 lb) each, the two outboard underwing stations for 318 kg (700 lb) each, and the two wingtip stations for 193 kg (425 lb) each. For manoeuvring flight at 9 *g* the underfuselage station is stressed for a load of up to 544 kg (1,200 lb), the two inboard underwing stations for 1,134 kg (2,500 lb) each, the two centre underwing stations for 907 kg (2,000 lb) each, the two outboard underwing stations for 204 kg (450 lb) each, and the two wingtip stations for 193 kg (425 lb) each. There are mounting provisions on each side of the inlet shoulder dedicated to the carriage of sensor pods (electro-optical, FLIR and so on); each of these stations is stressed for 408 kg (900 lb) at 5.5 *g*, and 250 kg (550 lb) at 9 *g*.

Typical stores loads can include two wingtip-mounted AIM-9L/M/P Sidewinders, with up to four more on the outer underwing stations; Rafael Python 3 on Israeli F-16s from early 1991 and Python 4 from mid-1997; centreline GPU-5/A 30 mm cannon; drop tanks on the inboard underwing and underfuselage stations; HARM targeting system pod along the starboard side of the nacelle; and bombs, air-to-surface missiles or flare pods on the four inner underwing stations. Stores can be launched from Aircraft Hydro-Forming MAU-12C/A bomb ejector racks, Hughes LAU-88 launchers, Orgen triple or multiple ejector racks and Lucas Aerospace Flight Structures Twin Store Carrier (TSC). New BRU-57 dual-station 'smart' bomb racks fitted to Block 50/52 aircraft of USAF from fourth quarter of 2001; installed at mid-span hardpoint, each BRU-57 will be able to carry munitions such as JSOW, JDAM and WCMD; in April 2004, USAF certified Block 40/50 F-16s to carry AGM-158 Joint Air-to-Surface Standoff Missile (JASSM) and WCMD on BRU-57.

Weapons launched successfully from F-16s, in addition to AIM-9 Sidewinder and AIM-120A AMRAAM, include radar-guided AIM-7 Sparrow, Rafael Derby and Sky Flash BVR air-to-air missiles, AIM-132 ASRAAM and Magic 2 IR homing air-to-air missiles, AGM-65A/B/D/G Maverick air-to-surface missiles, AGM-88 HARM and AGM-45 Shrike anti-radiation missiles, AGM-84 Harpoon anti-ship missiles (clearance trials 1993–94) and, in Royal Norwegian Air Force service, the Penguin Mk 3 anti-ship missile. Israeli F-16s will soon have capability to operate with Rafael Spice PGM, which marries guidance kit (including control surfaces, EO sensor, GPS SatNav and datalink) to a 900 kg (2,000 lb) bomb; up to four weapons can be carried by F-16. LGBs include GBU-10, GBU-12, GBU-22, GBU-24 and GBU-27; F-16 can also deliver GBU-15 glide bomb, which used in conjunction with datalink pod. Israeli IMI STAR-1 anti-radiation weapon has also begun carriage trials on F-16D, although full-scale development is dependent upon receipt of a firm order; IMI runway attack munition (RAM) introduced into IDF/AF service in about 2000. CMS Defense Systems Autonomous Free-flight Dispenser System (AFDS) was tested at Eglin AFB, Florida, during 1992–93 and can be loaded with a variety of submunitions, including cratering bombs, shaped charge bomblets, anti-tank mines, area denial submunitions and general purpose bomblets.

Newest capability, introduced on Block 50/52 aircraft of USAF, incorporates 50T5 software upgrade, allowing F-16 to carry and deliver latest family of precision munitions; release to service occurred in mid-2000. New weapons comprise GBU-31 Joint Direct Attack Munition (JDAM), AGM-154 Joint StandOff Weapon (JSOW) and CBU-103, CBU-104 and CBU-105 wind-corrected munitions dispensers (WCMDs). First operational unit with JSOW and WCMD was 20th FW at Shaw AFB, South Carolina. GBU-38 227 kg (500 lb) JDAM capability added in late 2004, initially on Block 30/32 aircraft, followed by Block 40/42 and finally Block 50/52, with software changes incorporated on more than 1,250 aircraft by end of January 2005. Raytheon AIM-9X Sidewinder incorporated in Block 30/32 during 2005 and due to be added to Block 40/42 and Block 50/52 in first half of 2007.

DIMENSIONS, EXTERNAL (F-16C, D):

Data applicable to Block 50/52 versions:

- Wing span: over missile launchers ..... 9.45 m (31 ft 0 in)
- over missiles ..... 10.00 m (32 ft 9¾ in)
- Wing aspect ratio 3.2
- Length overall ..... 15.03 m (49 ft 4 in)
- Height overall ..... 5.09 m (16 ft 8½ in)
- Tailplane span ..... 5.58 m (18 ft 3¾ in)
- Wheel track ..... 2.36 m (7 ft 9 in)
- Wheelbase ..... 4.00 m (13 ft 1½ in)

AREAS (F-16C, D):

- Wings, gross ..... 27.87 m² (300.0 sq ft)
- Flaperons (total) ..... 2.91 m² (31.32 sq ft)
- Leading-edge flaps (total) ..... 3.41 m² (36.72 sq ft)
- Fin, incl dorsal fin ..... 4.00 m² (43.10 sq ft)
- Rudder ..... 1.08 m² (11.65 sq ft)
- Horizontal tail surfaces (total) ..... 5.92 m² (63.70 sq ft)

WEIGHTS AND LOADINGS:

- Weight empty:
  - F-16C: F100-PW-229:
    - with CFTs ..... 9,358 kg (20,631 lb)
    - without CFTs ..... 8,910 kg (19,643 lb)
  - F110-GE-129:
    - with CFTs ..... 9,466 kg (20,868 lb)
    - without CFTs ..... 9,017 kg (19,880 lb)
  - F-16D: F100-PW-229
    - with CFTs ..... 9,760 kg (21,517 lb)
    - without CFTs ..... 9,312 kg (20,529 lb)
  - F110-GE-129:
    - with CFTs ..... 9,867 kg (21,754 lb)
    - without CFTs ..... 9,419 kg (20,766 lb)
- Max internal fuel (JP-8): F-16C ..... 3,228 kg (7,116 lb)
- Max external fuel (JP-8), F-16C/D (with 300 US gallon centreline tank):
  - normal: with CFTs ..... 4,569 kg (10,072 lb)
  - without CFTs ..... 3,208 kg (7,072 lb)
  - optional: with CFTs ..... 5,879 kg (12,962 lb)
  - without CFTs ..... 4,519 kg (9,962 lb)
- Max external load (full internal fuel):
  - F-16C: F100-PW-229:
    - with CFTs ..... 9,635 kg (21,241 lb)
    - without CFTs ..... 8,855 kg (19,522 lb)
  - F110-GE-129:
    - with CFTs ..... 9,190 kg (20,260 lb)
    - without CFTs ..... 8,742 kg (19,272 lb)
- Typical combat weight (two AAMs, 50% fuel):
  - F-16C: F100-PW-229:
    - with CFTs ..... 12,254 kg (27,015 lb)
    - without CFTs ..... 11,125 kg (24,527 lb)
  - F110-GE-129:
    - with CFTs ..... 12,367 kg (27,265 lb)
    - without CFTs ..... 11,239 kg (24,777 lb)
- Max T-O weight with two AAMs, no tanks:
  - F-16C: F100-PW-229:
    - with CFTs ..... 14,548 kg (32,073 lb)
    - without CFTs ..... 12,723 kg (28,050 lb)

F110-GE-129:
with CFTs ..... 14,661 kg (32,323 lb)
without CFTs ..... 12,852 kg (28,335 lb)
with full external load:
F-16C/D Block 50/52 ..... 21,772 kg (48,000 lb)
Wing loading: at 12,927 kg (28,500 lb) AUW ..... 463.8 kg/m² (95.00 lb/sq ft)
at 19,187 kg (42,300 lb) AUW ..... 688.4 kg/m² (141.00 lb/sq ft)
at 21,772 kg (48,000 lb) AUW ..... 781.2 kg/m² (160.00 lb/sq ft)
Thrust/weight ratio (clean, without CFTs) ..... 1.03 to 1

PERFORMANCE:
Max level speed at 12,200 m (40,000 ft) ..... above M2.0
Service ceiling ..... more than 15,240 m (50,000 ft)
Radius of action:
F-16C Block 50, with CFTs, two 907 kg (2,000 lb) bombs, two Sidewinders, 3,940 litres (1,040 US gallons; 867 Imp gallons) external fuel, tanks retained, hi-lo-lo-hi ..... 735 n miles (1,361 km; 845 miles)
F-16C Block 50, with CFTs, armament as above, 5,542 litres (1,464 US gallons; 1,219 Imp gallons) external fuel, tanks retained, hi-lo-lo-hi ..... 845 n miles (1,565 km; 972 miles)
F-16C Block 50, two BVR missiles, two Sidewinders, 3,940 litres (1,040 US gallons; 867 Imp gallons) external fuel, not including CFTs, tanks dropped when empty, combat air patrol mission ..... 950 n miles (1,759 km; 1,093 miles)
Ferry range:
F-16C Block 50, with CFTs and 3,940 litres (1,040 US gallons; 867 Imp gallons) external fuel ..... 2,150 n miles (3,981 km; 2,474 miles)
F-16C Block 50, with 5,542 litres (1,464 US gallons; 1,219 Imp gallons) external fuel, not including CFTs ..... 2,415 n miles (4,472 km; 2,779 miles)
Symmetrical *g* limit with full internal fuel ..... +9

LOCKHEED MARTIN F-35 LIGHTNING II

TYPE: Multirole fighter.

PROGRAMME:

DEVELOPMENT MILESTONES

Requirement issued	Nov 94
Request for proposals	Dec 95
Programme launched	16 Nov 96
First prototype material cut	Sep 97
First flight (prototype)	24 Oct 00
Development go-ahead	26 Oct 01
First production material cut	10 Nov 03
First flight (production)	15 Dec 06

Origins of Joint Strike Fighter (JSF) programme vested in separate USAF/USN Joint Advanced Strike Technology (JAST) and Defense Advanced Research Project Agency (DARPA) Common Affordable Lightweight Fighter (CALF) projects of early 1990s.

Projects merged in November 1994, as JAST, after Congressional directive in mid-1994; programme renamed JSF in latter half of 1995. Previously, formal request for proposals (RFP) for preliminary research contracts released on 2 September 1994, stipulating industry response by 4 November and issue of contract awards by 16 December.

Some elements of US industry joined forces to win JAST/JSF work, with international collaboration in evidence. McDonnell Douglas led one team after signing October 1994 Memorandum of Understanding (MoU) with Northrop Grumman and British Aerospace; each company submitted individual bids, but all three would participate in event of securing contract. Boeing allied with Dassault of France on aspects of subsystem design effort.

Subsequent research contracts worth USD99.8 million distributed between four companies: Boeing (USD27.6 million), Lockheed Martin (USD19.9 million), McDonnell Douglas (USD28.2 million) and Northrop Grumman (USD24.1 million). Further USD28 million allocated for associated avionics, propulsion systems, structures and materials, and modelling and simulation.

Merger of JAST and CALF resulted in expanded flight test programme, involving two finalists; each to build two demonstrators, one with ASTOVL capability and the other to use conventional take-off and landing (CTOL).

Draft RFP issued December 1995, with USA and UK signing MoU on 20 December 1995, which committed UK to participate in four year weapons system concept demonstration (WSCD) phase. MoU also stipulated that UK must contribute some 10 per cent (approximately USD200 million) of demonstration phase costs as full collaborative partner.

Formal release of the final RFP for JSF was expected on 7 March 1996, but was delayed to June 1996, with contract award in November 1996.

All WSCD contenders chose Pratt & Whitney's F119 (later modified and redesignated F135) engine, although a General Electric/Allison/Rolls-Royce team secured a USD7 million contract in March 1996 to examine alternative power plants. These were based on the General Electric F110 and YF120 engines, with the latter chosen in May 1996 following Congressional directive aimed at fostering competition and also overcoming possible impact of developmental or operational problems with the F135. Further USD96 million multiyear contract awarded in February 1997 to cover technology maturation and core engine development of alternate engine over four-year period. Original intent was to begin full-scale EMD of F136 (as it was known) in about 2004, but budget cut in 2003 resulted in delay. F136 SDD eventually began with contract award in August 2005, with first flight of CTOL version targeted for October 2009, followed by STOVL version in April 2010. Production engines then expected to be available in early 2012, assuming that development continues in face of apparent US DoD intent to cancel that emerged in 2006 when FY07 budget request omitted funding for F136; subsequent Congressional review reinstated funds for FY07 and ensured survival of General Electric/Rolls-Royce engine in short term at least.

Lockheed Martin F-35A Lightning II at the moment of take-off 1185921

On 16 November 1996, US Secretary of Defense, William J Perry announced that Boeing and Lockheed Martin had been chosen to participate in WSCD. Simultaneously, Boeing was awarded a USD661.8 million contract for the X-32, while Lockheed Martin received USD718.8 million for the X-35; in addition, Pratt & Whitney secured a contract worth USD804 million for the associated Engine Ground and Flight Demonstration Program. Subsequently, Northrop Grumman and British Aerospace joined Lockheed Martin team.

Australia, Canada, France, Germany, Greece, Israel, Singapore, Spain and Sweden briefed on JSF programme. For System Development and Demonstration (SDD) phase, four partnership options were available. Most costly was Level 1, with responsibility for 10 per cent of cost; UK is only partner at this level. Italy and the Netherlands are Level 2 partners, each contributing about 5 per cent of cost. Level 3 involves payment of 1 to 2 per cent, with Denmark and Norway having teamed up to share burden, while Australia, Canada and Turkey meet the cost alone. Finally, Security Co-operation Participant (SCP) Level involves smaller contribution of about USD50 million; Israel and Singapore were first two SCP subscribers, signing letters of intent in February 2003 and letters of agreement thereafter. Greece, Poland and South Korea are potential future additions, while Spain and Taiwan may also acquire STOVL version in due course. Levels 1 and 2 entitled to receive contracts; Level 3 may receive subcontracts from Levels 1/2 participants; and SCP receive data only.

Lockheed Martin development included production of 91 per cent scale powered model of JAST demonstrator for wind-tunnel tests. Model JAST, with F100 engine, began trials at Pratt & Whitney's West Palm Beach, Florida, facility in February 1995; subsequently to outdoor hover test rig at NASA Ames and then installed in 24 × 36 m wind tunnel at Mountain View, California, for series of powered hover and transition tests which ran from December 1995 to 5 March 1996; total of 196 hours accumulated, representative of approximately 2,400 take-offs and landings with the vertical lift system. Midway through outdoor hover tests, design was reconfigured to eliminate canards.

Lockheed Martin design, development, construction and flight testing of full-scale demonstrator aircraft, required one initially to be flown as CTOL version (X-35A) to demonstrate land-based USAF model, before being reconfigured to serve as STOVL version (X-35B) for US Marine Corps, Royal Air Force and Royal Navy; other aircraft representative of carrier-capable US Navy model (X-35C). Although Fort Worth had leadership of team, both X-35 aircraft built at Palmdale, California.

Design of X-35 frozen as **Configuration 220** 13 June 1997 after Initial Design Review, at which time 11,000 hours of model testing accumulated. Development team joined by Northrop Grumman on 8 May 1997 and BAe (now BAE Systems) on 18 June 1997.

Release of engineering drawings in early September 1997 heralded start of parts production at Palmdale for demonstrator aircraft; by end of 1997, Lockheed Martin had completed about 70 per cent of required tooling and conducted second interim programme review. X-35 final design review completed in September 1998 and coincided with roll-out of full-scale mockup at Fort Worth. Assembly of first aircraft began in April 1998, with

First system development and demonstration (SDD) F-35A during its maiden flight on 15 December 2006 1185920

F-35A Lightning II flying near Fort Worth 1185922

main wing carry-through bulkhead installed in early August 1998, by which time manufacturing of large composites skins for upper and lower wing surfaces also complete; aircraft moved from assembly testing to factory floor on 18 September 1999, in readiness for installation of flight control surfaces and landing gear as well as systems checks.

Flight control system software tested on NF-16D VISTA in 1998 as part of integrated subsystem technology demonstration. Further trials using AFTI/F-16 in 1999–2000 involved all-electric flight control system and modular electric power system planned for JSF. JSF avionics also tested on Northrop Grumman's BAe One-Eleven Co-operative Avionics Test Bed (CATB), which was fitted with sensors, processors and software in 1999; trials begun of Northrop Grumman radar and distributed infra-red sensor system, Kaiser helmet-mounted display and Lockheed Martin core processor in first quarter 2000.

More than 100 hours of flight time accumulated by early September 2000 using CATB, when avionics development and integration process completed; successful demonstrations included automatic target cueing (ATC), whereby sensors acquire targets rapidly and automatically; electro-optical targeting system (EOTS); electronic warfare suite and electronically scanned radar. Subsequent testing included co-operative engagement between CATB and E-8C Joint STARS, demonstrating all-weather precision targeting and combat identification techniques for fixed and moving targets.

Design of JSF continued to be refined after selection of Configuration 230-1. By 1998, third version of **Configuration 230 (230-3)** had reduced area of USAF/USMC JSF wings by seven per cent, but increased USN variant's wing area by 11 per cent. Further redesign occurred in 1999, culminating in September with Configuration 230-5, with enlarged wing to satisfy sustained turn performance requirement and strengthened to meet 9 *g* stress requirement for the CTOL variant; further main change involved redesign of lift-fan nozzle from D-shape extendible box to venetian blind-type box, offering dual benefits of simpler design and reduced weight for the STOVL configuration.

Redesign process continued into 2000, with Configuration 230-5 benefiting from further refinements aimed at reducing weight and increasing payload bringback capability; resultant structural modification entailed weight reduction in several areas such as weapon bay and landing gear door assemblies. Configuration 230-5 finally submitted as Preferred Weapons System Concept design in mid-2000.

Significant events in latter part of 1998 and 1999 included first test run of basic Pratt & Whitney JSF119 engine (designated FX661) at West Palm Beach, Florida, facility on 11 June 1998; over 330 hours of developmental testing performed by end August 1999, validating complete X-35 flight envelope. Final altitude flight qualification testing undertaken with another engine (designated FX663) in fourth quarter of 1999. National Aerospace Laboratory low-speed wind tunnel in the Netherlands used to test scale models of JSF starting in June 1998; initial trials of lift fan system's clutch, fan and gearbox rigs at Indianapolis, Indiana, in May and June 1998; and installation of engine inlet duct in assembly tool at Palmdale at beginning of July 1998. Subsequently, also in July, over 50 hours of preliminary engine testing were completed at West Palm Beach, including vibration surveys, fan and core running-in, operating performance calibration and engine control stability assessment.

Testing of first STOVL engine (designated FX662) undertaken initially at West Palm Beach; first run with lift fan engaged accomplished on 10 November 1998, with operation to 100 per cent speed following on 22 November; first series of tests included stress surveys and performance calibration. Validation of STOVL propulsion system achieved in late August 1999, with high-power clutch engagement of shaft-driven lift fan, simulating seamless conversion from conventional wing-borne flight configuration to jet-borne flight configuration for STOVL approach ending with vertical landing.

Following this, on 9 December 1999, flight engine YF001 successfully installed on the X-35A demonstrator at Palmdale, with integration tests, including plumbing connections, data communications and electrical checks, beginning immediately thereafter.

In UK, DERA vectored-thrust advanced aircraft control (VAAC) Harrier T. Mk 4 completed 20 hour, 36 sortie, flight test programme in November 1998, during which a sidestick control column was evaluated by civilian and military pilots. Two-phase programme began with initial calibration to validate STOVL control laws and stick characteristics; subsequent evaluation included pattern work, approach and transition to hover and precision and aggressive hover tasks, resulting in confirmation that side-stick provided satisfactory control of STOVL aircraft at low speeds.

Lockheed Martin also reached preliminary agreement with partners over work-sharing arrangements to be implemented for large-scale production. Lockheed Martin has responsibility for forward fuselage, cockpit, wing edges and final assembly; Northrop Grumman to fabricate mid-fuselage and wing box, with BAE Systems producing tails and aft fuselage section.

Radar signature testing of full-scale pole model began in late 1999 at Helendale, California; this included measurement of radar cross-section, assessment of antenna performance and demonstration of the robustness of supportable low-observable materials.

Significant events in 2000 included X-35A flight readiness review in March. Subsequently, in April, testing associated with development and flight qualification of the JSF119-PW-611 engine for the X-35A and X-35C was completed after 193 hours of operating time. Final assembly and painting of X-35A in late May was followed by ground tests, including systems checkout, engine running at full military power and with full afterburner augmentation, and low- and medium-speed taxi tests. These extended into October and culminated in a successful first flight by X-35A Article 301 from Palmdale to Edwards on 24 October; by 6 November, further four flights had been made, including first by USAF pilot, and envelope had been expanded to 390 kt (722 km/h; 449 mph); first aerial refuelling (from KC-135) on 7 November; maiden supersonic flight 21 November, when 25 hours had been flown in 25 sorties. X-35A test programme completed on 22 November, whereupon Article 301 returned to Palmdale for conversion to X-35B. X-35C (Article 300) first flight took place on 16 December 2000 from Palmdale to Edwards AFB. Initial X-35C testing at Edwards completed in early February 2001, with aircraft making transcontinental ferry flight to Patuxent River, Maryland on 9–10 February for specialised trials.

Following installation of shaft-driven lift fan in late December 2000, X-35B STOVL version began hover-pit trials on 22 February 2001; these concluded 16 March and included 26 lift-fan clutch engagements from CTOL to STOVL mode at high rpm settings. Accelerated mission testing followed and was concluded on 6 April, with X-35B then being readied for flight trials; this process included installation of flight-ready lift fan. Taxi tests began 12 June 2001, followed by first brief vertical take-off and landing on 23 June, with sustained hover accomplished on next day. Initial testing at Palmdale completed successfully by 3 July, when X-35B flown to Edwards AFB for remainder of trials programme; notable events included first airborne transition from STOVL to conventional mode on 9 July; first vertical landing from wingborne flight on 16 July and 'Mission X' demonstrations involving short take-off, level supersonic dash and vertical landing on 20 and 26 July, before STOVL testing concluded on 30 July.

Both X-35 aircraft subsequently allocated to museums, with Article 300 going to the naval air museum at Patuxent River and Article 301 joining the Smithsonian collection in Washington, DC.

After study of test results and company proposals, the US Department of Defense announced on 26 October 2001 that Lockheed Martin would be awarded a USD19 billion contract to cover SDD of F-35. Originally scheduled to occupy 126 months (but since extended by at least two years), SDD began immediately. Simultaneously, it was revealed that Pratt & Whitney would receive a contract worth USD4 billion for development and production of the associated F135 engine. As a major partner, the UK is providing USD2 billion towards total SDD expenditures of approximately USD30 billion. Majority of preliminary design review successfully concluded on 27 March 2003, with a few items concerning aircraft weight and weapons integration not finally resolved until end of June. F-35A critical design review originally scheduled for 2005 postponed to February 2006; this and that of F-35B both successfully completed on 17 February.

A total of 15 fully instrumented flying aircraft will be built at Fort Worth and assigned to SDD. Six will emerge as **F-35As** (USAF CTOL version); four will be **F-35Cs** (US Navy CV version); and the remaining five will be **F-35Bs** (US Marine Corps/UK STOVL version). Further eight non-flying airframes: two of each version as static test articles, plus another F-35C for drop testing and one pole-test airframe for radar signature evaluation. Production of SDD aircraft began in 2004, with fabrication of the first composites upper wing starting on 6 February; assembly of first centre fuselage section by Northrop Grumman began in May, followed by start of assembly of first forward fuselage by Lockheed Martin on 14 July (completed 13 October) and first aft fuselage by BAE Systems on 24 August. Final assembly of this F-35A began May 2005, when centre fuselage supplied by Northrop Grumman mated with Lockheed Martin-produced wing assembly at Fort Worth; electrical power to aircraft switched on for first time on 7 September. Fins added on 28 November, followed by horizontal tail surfaces on 8 December to complete assembly of major structural components; engine delivered by Pratt & Whitney on 30 December 2005, allowing installation to take place on 13 February 2006. Work on first F-35B (Article BF-1) began with loading of initial jig on 6 September 2005.

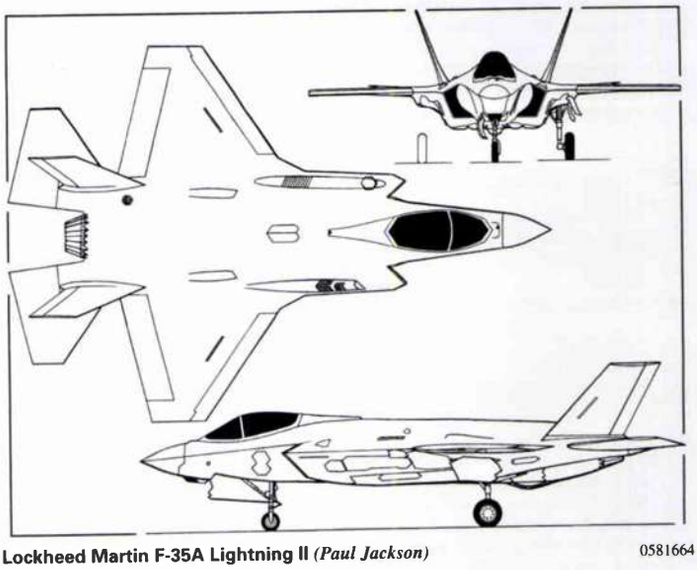
First F-35A (Article AA-1) rolled off production line at Fort Worth on 19 February 2006 and initially used for fuel system check-out; AA-1 still unpainted at this time, but had been by 7 July, when formally unveiled by Lockheed Martin. Selection of Lightning II name announced on same day by USAF Chief of Staff General Michael Moseley. Maiden flight then planned for October, but further delay encountered and first engine run not accomplished until 15 September 2006, with full afterburner test taking place three days later, on 18 September. AA-1 moved under own power for first time on 7 December 2006, when successfully completed initial (low speed) taxi run at Fort Worth. Two more taxi tests took place on 12 December, during which the F-35 reached a maximum speed of 110 kt (204 km/h; 127 mph). First flight 15 December 2007 at Fort Worth marked only as 'AA-1'.

Just over 40 per cent of total planned flight testing by all JSF variants to be undertaken by F-35A. F-35B to fly in third quarter of 2007, with second F-35A following in early 2008 and first F-35C in first quarter of 2009. Flight trials will be undertaken by Lockheed Martin at Fort Worth as well as joint industry/service teams at Edwards AFB, California (USAF) and NAS Patuxent River, Maryland (US Navy). In anticipation of start of flight testing at Edwards AFB, USAF reactivated 461st Flight Test Squadron on 27 October 2006. Programme originally expected to involve almost 15,000 flight hours, although this reduced to about 11,000 hours over period of six years.

Avionics testing to be accomplished initially by Boeing 737-300 Co-operative Avionics Testbed with modified nose housing an F-35 radar as well as aerodynamically neutral canard surfaces on both sides of forward fuselage; later will carry antennae and sensors for electro-optical targeting system (EOTS) and electro-optical distributed aperture system (EODAS). This aircraft expected to fly for first time in early 2007, following extensive modification programme undertaken by BAE Systems at Mojave, California. Northrop Grumman-owned BAC One-Eleven testbed also contributing to trials programme and made

First SDD Lockheed Martin F-35A Lightning II during taxying trials 1185923

Lockheed Martin F-35A before painting 1185924



Lockheed Martin F-35A Lightning II *(Paul Jackson)* 0581664

first flight with AN/APG-81 AESA radar on 23 August 2005. Full funding for Low-Rate Initial Production (LRIP) was scheduled to begin in FY06 but has been delayed by about a year, with consequent effect on delivery of production aircraft. Projected IOC dates have also slipped, with the F-35B still expected to be first, in 2012, followed by F-35A and F-35C in 2013. Initial aircraft will be to Block 1 standard, with basic warfighting capability (including compatibility with JDAM and AIM-120 AMRAAM); additional weaponry for enhanced air-to-air, SEAD, close air support and interdiction will be added on Block 2 standard aircraft, while Block 3 will introduce more missiles and bombs and add deep strike capability. Lockheed Martin anticipates production rate of 17 aircraft per month at Fort Worth from 2011, but would like to achieve rate of 22 per month. With peak demand likely to be for about 30 a month, this could only be accomplished with second production centre. In early 2003, UK government commissioned Rand to perform feasibility study into creating second assembly line with BAE Systems in UK; one key finding was that creating second assembly line in UK would increase direct assembly bill for British aircraft by almost GBP47 million and indirectly raise US government costs by a further GBP30 million, principally arising from reduced efficiencies.

Italy also keen on establishing own assembly centre at Cameri; Lockheed Martin would probably sub-contract assembly process to Alenia Aeronautica if questions over handling of sensitive technology such as low-observables can satisfactorily be answered, but US government approval required if this to produce aircraft for other air arms; government-to-government discussions between Italy and USA in 2006 appear encouraging, although concerns over technology transfer still to be addressed, with US reluctant to divulge sensitive technological secrets. This at heart of dialogue between US and UK in late 2005 and early 2006, prompting UK threat to withdraw if not guaranteed access to technology needed to operate, sustain and upgrade aircraft, especially computer software codes; this eventually resolved in May 2006, but other customers (including Australia) share similar concerns. Current planning anticipates first low-rate initial production (LRIP) batch to comprise five F-35A for USAF, with LRIP 2 consisting of 18 aircraft (8 F-35A and 10 F-35B) for USAF and USMC; however, only two USAF F-35A included in FY07 budget request.

Formal signature of MoU covering plans for production, sustainment and follow-on development (PSFD) phase due by all eight partners in December 2006; this document will stipulate quantities to be acquired by each partner and give details of production centres. It may also contain information about the creation of regional maintenance facilities.

CURRENT VERSIONS (SPECIFIC): Details of version, projected first flight date and tasks assigned to SDD aircraft are as follows:

AA-1 F-35A: First SDD aircraft. Maiden flight originally expected in August 2006 but rescheduled to October 2006 and further delayed. To be used for initial airworthiness testing at speeds up to 350 kt (648 km/h; 403 mph) and 4*g* loads. On completion of these, will be employed for ground-based proof-load testing, allowing updating of software and installation of helmet-mounted display.

AF-1 F-35A: First flight planned for August 2008. Flutter and flying qualities.

AF-2 F-35A: First flight planned for July 2008. Loads testing.

AF-3 F-35A: First flight planned for November 2008. Mission systems trials.

AF-4 F-35A: First flight planned for June 2009. Mission systems trials.

AF-5 F-35A: First flight planned for July 2009. Mission systems trials.

BF-1 F-35B: First flight planned for February 2008. Assessment of flying qualities.

BF-2 F-35B: First flight planned for April 2008. Flutter and flying qualities.

BF-3 F-35B: First flight planned for April 2008. Will be first aircraft with mission-system software. To be used for loads testing.

BF-4 F-35B: First flight planned for December 2008. Mission systems trials.

BF-5 F-35B: First flight planned for April 2009. Flying qualities, climatic assessments and live firing trials.

CF-1 F-35C: First flight planned for January 2009. Flutter and flying qualities.

CF-2 F-35C: First flight planned for December 2008. Loads testing.

CF-3 F-35C: First flight planned for March 2009. Carrier suitability trials.

CF-4 F-35C: First flight planned for April 2009. Mission systems trials.

F-35A testing will be accomplished by 461st Flight Test Squadron, Air Force Flight Test Center at Edwards AFB, California. F-35B and F-35C versions to go to Naval Air Test Center at Patuxent River, Maryland.

CURRENT VERSIONS (GENERAL): Three variants of basic design, optimised for the mission requirements of different armed services. As currently envisaged, basic company designation for operational JSF is Configuration 240-3, with following variants expected to enter service with US armed forces.

F-35A: Land-based **CTOL** derivative for USAF. Evaluated by X-35A between 24 October and 22 November 2000.

F-35B: **STOVL** version for US Marine Corps, Royal Air Force and Royal Navy, with USAF revealing intention in February 2004 to acquire some F-35Bs; as many as 300 aircraft could be involved, almost certainly to the same configuration as those for the Marine Corps, but probably also incorporating internal GAU-12 gun rather than pod-mounted weapon specified for Marines. Engine-driven lifting fan behind cockpit replaces some fuel. Wing folding originally specified on Royal Navy version only, but requirement since dropped. Broader and higher spine behind cockpit to accommodate lifting fan and air intake; shortened cockpit canopy replaces blister-type glazing of F-35A and B. Evaluated by X-35B between 23 June and 30 July 2001; final flight on 6 August 2001 was from Edwards AFB to Lockheed Martin facility at Palmdale.

In fourth quarter of 2003, concerns emerged over weight of the F-35B version. Reviews of structural design eliminated some of the excess, but in early 2004, (by which time design had progressed to **configuration 240-3**), it was evident that further weight reduction initiatives would be necessary. These concerns were sufficiently serious in nature to warrant postponing the critical design review (CDR), with that for the F-35B now set to occur in mid-2006; equivalent CDRs for the F-35A and F-35C versions are scheduled to take place in November 2005 and early 2007 respectively.

Another unwelcome consequence was that it became necessary to delay the start of SDD testing, in order to give Lockheed Martin additional time to solve the weight problem. In May 2004, the extent of this became known when it was revealed that the STOVL version was about 1,500 kg (3,300 lb) overweight. A special task force known as SWAT (STOVL Weight Attack Team) was created by Lockheed Martin to investigate and, by September 2004, this had succeeded in removing about 1,225 kg (2,700 lb) of the unwanted weight.

This was accomplished through a mixture of airframe and engine design improvements as well as some compromise of customer requirements. Most of the extra weight was eradicated by a redesign that involved moving a number of internal elements, but additional benefit stemmed from a change in methods used for mating of fuselage sections and by positioning wing spars more closely together so as to permit use of thinner wing skin. Revisions to the air inlet and engine nozzle designs provided further benefit in the form of extra effect from installed thrust of the F135 engine.

It also proved necessary to modify the weapons bays, which, on the F-35B, have reverted to the size originally specified. Thus, internal carriage of weaponry will be limited to a pair of weapons in the 454 kg (1,000 lb) class (plus two AIM-120 AMRAAMs), rather than the two 900 kg (2,000 lb) weapons that may be carried internally by both the F-35A and F-35C.

In November 2004, Lockheed Martin received go-ahead to alter design schedule and build **F-35B1** version, which is 2,087 kg (4,600 lb) lighter than original conception; this will have improved thrust performance and aerodynamic qualities.

F-35C: Carrier-based CTOL (CV). Wing, fin and elevator areas increased by chord extension; ailerons in addition to flaperons on wing; enlarged control surfaces and modified control system; strengthened landing gear with catapult launch bar on twin-wheel nose leg; concealed arrester hook; and folding wing. Evaluated by X-35C between 16 December 2000 and 10 March 2001 from test centres at Edwards AFB and Patuxent River, Maryland (from 10 February 2001).

EA-35B: Unofficial designation relating to Lockheed Martin studies into potential two-seat electronic attack version (based on F-35C) that could replace Marine Corps EA-6B from about 2015. Would retain internal weapons carriage capability, with sensors and jamming equipment embedded in fuselage and wings. In late 2006, the Marine Corps announced that it would not be proceeding with the EA-35B, but would seek to enhance electronic attack capabilities of the F-35B.

Pilotless F-35: Proposal revealed by Lockheed Martin in mid-2006 for unmanned derivative, as well as optionally-piloted version; studies by Skunk Works said to have begun in about 2003, but further progress not now expected until after all three manned variants have flown. One concept of operations under study involves four unmanned F-35s being controlled by two manned F-35s (or F-22s), with sensor information relayed via datalink; this envisages deletion of sensors from pilotless aircraft, allowing it to be used purely as weapons carrier, thus offering cost saving of close to 30 per cent. Removal of cockpit would permit installation of additional fuel tank, extending range and/or mission duration.

CUSTOMERS: Two X-35 demonstrators. Initial planning called for some 3,000 F-35s for USA and UK, but US Navy and Marine Corps requirement cut significantly in 2003 (see table) and significant reduction now expected in eventual quantity for USAF, which on 10 August 2006 announced intent to station first F-35 unit at Eglin AFB, Florida; this will be 33rd Fighter Wing, which to transfer from Air Combat Command to Air Education and Training Command by 2010, when first F-35s expected to arrive. All three variants are to be assigned to 33rd FW, which will train pilots for USAF, US Navy/Marine Corps and allied nations. UK confirmed on 30 September 2002 that F-35B (STOVL) version will be procured for both RAF and Royal Navy, with service introduction of so-called Joint Combat Aircraft (JCA) then anticipated during 2012; however, in September 2004, it became apparent that UK delivery has been delayed until 2011, with service introduction with first operational unit now unlikely before 2014. In November 2005, it was revealed that Lossiemouth is almost certain to be the main operating base in the UK. Orders also expected from Australia (planning to buy at least 50 and possibly as many as 100 F-35As and could also obtain about 20 F-35Bs for use from proposed future amphibious landing ships), Canada, Denmark, Italy (requirement for about 130 F-35Bs and could also purchase up to 70 F-35As to partly replace Tornado force), the Netherlands (requires about 85, but introduction delayed by two years until 2014, although intends to order initial quantity of three aircraft for participation

in multinational test and evaluation programme), Norway and Turkey (requires 120 for delivery from 2013. Israel and Singapore also prospective customers, with former having stated intent to obtain up to 100 F-35s. Taiwan has expressed provisional interest in obtaining about 60 F-35Bs (contract award anticipated in 2010), followed by up to 150 F-35As (contract award likely in 2012).

US AND UK F-35 REQUIREMENTS
(as at October 2003)

Service	Qty	Remarks
US Air Force	1,763	Replaces A-10 and F-16; complements F-22 Raptor. Primarily F-35A but expected to include some F-35Bs
US Navy/Marine Corps	680	To include F-35B and F-35C versions
Royal Navy (UK)	60	Replaces Sea Harrier
Royal Air Force (UK)	90	Replaces Harrier
Total	**2,593**	

COSTS: At time of downselect for SDD phase, unit cost of USAF F-35A quoted as USD37.3 million, with CV/STOVL versions costing under USD50 million each. USD3.27 billion SDD funding for FY03, following USD1.52 billion appropriation in FY02; USD4.1 billion authorised for FY04 with USD4.37 billion in FY05 and USD5.02 billion requested for FY06. FY06 budget finally approved as USD4.79 billion, of which USD4.67 billion allocated for research and development, with USD120 million set aside for advance procurement of USAF aircraft. FY07 request totalled USD5.29 billion, but final figure likely to be around USD4.49 billion, including USD60 million in advance procurement funds. Total SDD bill origianally estimated at USD18 billion, but subsequent delay and programme stretch appears likely to increase total outlay to around USD40 billion. Fly away costs mentioned in connection with Italian involvement quoted as USD36.6 million for CTOL version, USD47.4 million for CV version and USD45.3 million for STOVL version. UK purchase of 150 F-35Bs estimated to cost around GBP10 billion. In May 2006, average cost of F-35A estimated by Lockheed Martin to be around USD50 million in 2006 dollars.

DESIGN FEATURES: Trapezoidal mid-wing configuration, optimised for low observability. Twin tailfins; internal weapon bays. Wing and tailplane leading-edges swept back approximately 33°; trailing-edges swept forward approximately 14°; fins swept back approximately 42° and each canted outward at tips by approximately 19° (compared with same 25° on earlier version of design). Twin 'divertless' fibre-placed graphite/epoxy composites engine air intakes with no moving parts produced by ATK. All-electric flight control system.

STOVL version employs a lifting fan behind the cockpit, driven by a shaft from the single engine; inlet and outlet are covered by doors, except when in use; original side-hinged bi-fold hatch of X-35B replaced in early 2003 by single-piece cantilever inlet door hinged at rear. Other changes related to thermal management also incorporated at this time, to satisfy requirement to operate on 49°C (120°F) day. The resultant cold air barrier prevents hot air from being reingested when on or near the ground.

FLYING CONTROLS: All-electric flight control system for movement of primary flight control surfaces (flaps, tailerons and rudder) incorporating Parker Hannifin electrohydrostatic actuators. Moog leading-edge flap drive system. Composite/titanium flaperons by Stork Aerospace. Carbon-fibre composites conventional edges for horizontal tail by Terma A/S of Denmark. Flight control computer originally to be supplied by Honeywell, but replaced by advanced Lockheed Martin unit in third quarter of 1998 to eliminate anticipated throughput problems arising from growth in flight control software.

LANDING GEAR: Retractable tricycle type; mainwheels retract inwards; nosewheel(s) forward. Single wheels on each unit, except twin nosewheels and catapult towbar on F-35C, which also has reinforced gear for deck landings. Tyres will feature embedded transponder including integrated circuit and capacitive pressure sensor to facilitate monitoring of pressure and condition. Dunlop selected to provide 34 × 11.OR16 radial main tyres for SDD phase of STOVL F-35B version; Honeywell to develop wheels and brakes, with Crane Hydro-Aire supplying brake control and anti-skid system. Arresting gear for F-35A and F-35C designed, developed and produced by Stork Aerospace of Netherlands.

POWER PLANT: One 178 kN (40,000 lb) class (111 kN; 25,000 lb st dry rating) Pratt & Whitney F135 (formerly JSF119-PW-611; F119 derivative) turbofan; documentation in public domain quote figures of 128.1 kN (28,800 lb st) in non-augmented mode and 191.3 kN (43,000 lb st) with full afterburner augmentation. Rolls-Royce three-bearing swivel-duct nozzle on -611S version to deflect thrust downwards for STOVL, plus a Rolls-Royce engine-driven fan behind cockpit and a bleed air reaction control valve in each wingroot to provide stability at low speeds. For F-35B, total vertical lift of 177 kN (39,700 lb st) comprises some 40 per cent from main nozzle, 48 per cent from fan and 12 per cent from reaction control valves. Ground testing of first of seven F135 engines (including four STOVL power plants) began at West Palm Beach, Florida, on 11 October 2003; first run of STOVL engine followed on 14 April 2004, although testing of latter halted in June after discovery of erosion damage in second-stage vanes of low-pressure turbine. By early September 2005, test engines had accumulated just over 3,400 hours of operation. First production F135 engines due for delivery in 2007. F-35A has in-flight refuelling receptacle on spine; US Navy and Marine Corps require retractable probe on starboard side. JP-5 or JP-8 fuel. General Electric/Rolls-Royce F136 turbofan with same performance characteristics under development as alternative interchangeable power plant. Ground testing of F136 began at Evendale, Ohio, on 22 July 2004, with primary phase of testing completed late February 2005. First STOVL F136 entered test in February 2005, with first clutch engagement of lift fan accomplished in late March. USD2.4 billion SDD contract award for 14 test examples of this power plant made in August 2005, with first flight targeted for October 2009. At that time, production standard F136 engines expected to be available with effect from LRIP Lot 4 aircraft, with service release expected in 2012. Subsequently, USDoD moved to cancel alternative engine programme by omitting it from FY07 budget request; funding registered by Congress, giving F136 a reprieve, but future remains uncertain, especially in view of rising costs of F-35 programme.

ACCOMMODATION: Pilot only; canopy by Sierracin; canopy frame assembly by Smiths Aerospace. STOVL versions have canopy of reduced length. Martin-Baker Mk 16E lightweight ejection seat in X-35s; US16E version to be used by SDD aircraft. Zero-zero test of definitive Martin-Baker escape system successfully undertaken at Chalgrove, UK in August 2005, followed by airborne test from Meteor at 165 kt (306 km/h; 190 mph) in October 2005.

SYSTEMS: Hamilton Sundstrand electrical power generating system (EPGS), comprising 80 kW engine-driven switched-reluctance starter/generator providing two independent channels of 270 V DC electrical power. Electrical power management system (EPMS) by Smiths Aerospace includes distribution units, power panels, power distribution centres, batteries and battery charger equipment; electrical wiring on SDD aircraft by Stork Aerospace of the Netherlands; Honeywell thermal- and energy-management module (T/EMM) combining functions of auxiliary and emergency power units and environmental control system; 270 V DC lithium ion emergency battery by Saft America Inc. Weapons bay door drive system by TRW Aeronautical Systems. 276 bar (4,000 lb/sq in) high pressure hydraulic power generation and distribution system by Eaton Corporation. Programmable prognostics and health management system (PHMS) with downlink facility monitors aircraft systems while airborne and is able to predict failures before they occur.

AVIONICS: *Comms:* Northrop Grumman Radio Systems to provide next-generation CNI (communications, navigation and identification) avionics for F-35; package will include VHF/UHF radio, Have Quick I/II, SINCGARS/SIP, UHF SatCom, IFF/SIF transponder, ILS, MLS, ACLS, Tacan, intra-flight data link, Link 4A, Link 16/JTIDS and weapons data link.

Radar: Northrop Grumman MIRFS/MFA (multifunction integrated RF system/multifunction nose array) combines AN/APG-81 active electronically scanned array (AESA) radar, electronic warfare and communications functions planned for production F-35.

Flight: Lockheed Martin Tactical Defense Systems Integrated Core Processor (ICP) incorporating open system architecture. JPALS (Joint Precision Approach Landing System).

Instrumentation: Rockwell Collins 508 × 203 mm (20 × 8 in) panoramic projection, touch-sensitive screen (two half-size screens functioning as single unit); display management subsystem and computer by L-3 Display Systems. Meggitt secondary flight display system. Vision Systems International (Rockwell Collins and Elbit Systems) selected in third quarter of 1999 to provide advanced integrated helmet-mounted display (HMD) system; alternative HMD being developed by BAE Systems, which delivered first helmet to Lockheed Martin at end of September 2004. UK design based on binocular helmet developed for Typhoon.

Mission: Electro-optical sensor system (EOSS) being developed jointly by Lockheed Martin and Northrop Grumman; latter responsible for electro-optical distributed aperture system (EODAS) with functions that include air-to-air search-and-track, target cueing and missile warning, and air-to-ground surface-target tracking; EODAS uses six CMC Electronics conformal compact lightweight imaging IR sensors around airframe and seventh in targeting system pod, with combined data providing all-aspect multifunction imaging to pilot via wide-angle helmet-mounted display, overlaid with target and threat data information. Second key element of EOSS is Lockheed Martin internal Electro-Optical Targeting System (EOTS); incorporating BAE Systems Avionics laser precision ranger/designator, this can be used when engaging targets on the ground and in the air.

Self-defence: EW capability incorporated into MIRFS/MFA. BAE Systems is prime contractor for digital EW equipment and integration and delivered first complete EW system to Lockheed Martin on 28 April 2006; Litton Amecom to supply low-cost ESM equipment.

ARMAMENT: Internal cannon (in port engine air intake trunk upper surface) specified by USAF for F-35A. Boeing/Mauser BK 27 originally selected, but replaced by General Dynamics GAU-12 25 mm weapon in fourth quarter of 2002. US Navy F-35C and Marine Corps and UK STOVL variants to have 'missionised' GAU-12 25 mm cannon in externally-mounted, low-observables pod. Internal weapon bays, incorporating pneumatic weapon suspension and release equipment by EDO; F-35A and F-35C internal weapons fit is two AIM-120C AMRAAMs and two GBU-31 JDAM bombs or two AIM-120s and up to eight small diameter bombs (SDBs). Other weapons expected to be used by the F-35 include CBU-105 WCMD Sensor Fuzed Weapon, GBU-12 Paveway II, AGM-154 JSOW, AIM-132 ASRAAM and GBU-32 JDAM, all for internal carriage; externally carried weapons are expected to include AGM-158 JASSM, Storm Shadow cruise missile, as many as 24 SDBs and the AIM-9X Sidewinder. Optional external stores on six hardpoints, which can accommodate fuel tanks or up to 6,800 kg (15,000 lb) additional ordnance. Station capacities, according to October 2003 briefing document, will be as follows; 1 and 11 (outer wing) 136 kg (250 lb); 2 and 10 (mid-wing) 1,134 KG (2,500 lb); 3 and 9 (inner wing) 2,268 kg (5,000 lb); 4 and 8 (internal) 1,134 kg (2,500 lb); 5 and 7 (internal) 159 kg (350 lb); and 6 (centreline) 454 kg (1,000 lb). By February 2004, company briefings were quoting 136 kg (300 lb); 907 kg (2,000 lb), 2,268 kg (5,000 lb), 907 kg (2,000 lb); 159 kg (350 lb); and 454 kg (1,000 lb), respectively. Internal capacity of F-35B will be lower, following reduction in size of weapons bays, with stations 4 and 8 limited to maximum of 454 kg (1,000 lb).

Data are provisional.

DIMENSIONS, EXTERNAL (estimated):

Wing span: F-35A, F-35B	10.67 m (35 ft 0 in)
F-35C (wings spread)	13.11 m (43 ft 0 in)
F-35C (wings folded)	9.47 m (31 ft 1 in)
Length overall: F-35A, F-35C	15.67 m (51 ft 5 in)
F-35B	15.59 m (51 ft 2 in)
Height overall: F-35A, F-35B	4.57 m (15 ft 0 in)
F-35C	4.72 m (15 ft 6 in)
Tailplane span: F-35A, F-35B	7.29 m (23 ft 11 in)
F-35C	8.64 m (28 ft 4 in)
Wheel track: F-35A, F-35B	4.34 m (14 ft 3 in)
F-35C	4.22 m (13 ft 10 in)
Wheelbase: F-35A, F-35B	6.02 m (19 ft 9 in)
F-35C	6.17 m (20 ft 3 in)

AREAS:

Wings, gross: F-35A, F-35B	42.73 m² (460.0 sq ft)
F-35C	58.34 m² (628.0 sq ft)

WEIGHTS AND LOADINGS (estimated):

Weight empty: F-35A	12,020 kg (26,500 lb)
F-35B, F-35C	13,608 kg (30,000 lb)
Max weapon load	more than 9,072 kg (20,000 lb)
Max internal fuel weight:	
F-35A	more than 8,165 kg (18,000 lb)
F-35B	more than 5,897 kg (13,000 lb)
F-35C	more than 8,618 kg (19,000 lb)
Max T-O weight class	27,215 kg (60,000 lb)
Max wing loading: F-35A, F-35B	636.8 kg/m² (130.43 lb/sq ft)
F-35C	466.5 kg/m² (95.54 lb/sq ft)

PERFORMANCE (estimated):

Max level speed: all	M1.6
Combat radius: F-35A	590 n miles (1,093 km; 679 miles)
F-35B	450 n miles (833 km; 517 miles)
F-35C	600 n miles (1,111 km; 690 miles)

LOCKWOOD

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PRESIDENT: Phillip Lockwood

Phillip Lockwood, designer of the Air Cam, produced both that and the Maxair Drifter in the early 1990s. Lockwood Aviation then entered into partnership with Antonio Leza as Leza-Lockwood Aircraft; later, Leza purchased the design rights.

In June 2006, Lockwood Aviation regained the design rights, tooling and inventory of the Air Cam and Drifter from Leza and began construction of a 650 m² (7,000 sq ft) production facility. The company also sells spare parts for a range of light aircraft, as well as operating a repair plant and flying school.

LOCKWOOD DRIFTER and SUPER DRIFTER

TYPE: Tandem-seat ultralight kitbuilt.

PROGRAMME: Originated in 15 kW (20 hp) Maxair Hummer V-tail ultralight of early 1980s; Maxair Drifter marketed from 1984 by Lockwood Aviation Supply; also supplied in quantity to Antipodes as Austflight Drifter; production resumed by Leza-Lockwood in mid-1990s; transferred to Lockwood in 2006. Previously sold with Rotax XP505, 618 or 447 engine.

CURRENT VERSIONS: **Drifter MU582**: Baseline version; *as described.*

Super Drifter SD912XL: Higher-powered model with 59.6 kW (79.9 hp) Rotax 912 engine, electric start, flaps and hydraulic brakes.

CUSTOMERS: More than 1,100 of both models flying by November 2006.

COSTS: **MU582 USD21,635; SD912XL USD32,575, both including engine and propeller (2006).**

DESIGN FEATURES: **Circular tube fuselage; wings supported by cabane and V struts; wire-braced empennage. Noise fairing/windscreen for partial protection of pilot. Single-piece wing is removable for storage and transportation. Quoted assembly time 150 hours for Drifter and 200 hours for Super Drifter.**

FLYING CONTROLS: **Conventional and manual. Full-span ailerons on Drifter; flaps on Super Drifter.**

STRUCTURE: **Metal airframe with fabric-covered wings and empennage; composites nose fairing.**

LANDING GEAR: Generally as AirCam; Drifter has drum brakes and Super Drifter has hydraulic brakes. Steerable tailwheel. Optional floats.

POWER PLANT: *Drifter:* One 48.0 kW (64.4 hp) Rotax 582 driving a 1.52 m (5 ft 0 in) Warp Drive three-blade propeller. Fuel capacity 37.9 litres (10.0 US gallons; 8.3 Imp gallons).

Super Drifter: One 59.6 kW (79.9 hp) Rotax 912 driving a 1.73 m (5 ft 8 in) Warp Drive three-blade propeller. Fuel capacity as Drifter.

ACCOMMODATION: Pilot and passenger in tandem open cockpit.

SYSTEMS: **Super Drifter has electric starter.**

DIMENSIONS, EXTERNAL:

Wing span	**9.14 m (30 ft 0 in)**
Length overall	**6.55 m (21 ft 6 in)**
Height overall: Drifter	**2.82 m (9 ft 3 in)**
Super Drifter	**2.87 m (9 ft 5 in)**

AREAS:

Wings, gross	**13.94 m² (150.0 sq ft)**

WEIGHTS AND LOADINGS:

Weight empty: Drifter	193 kg (425 lb)
Super Drifter	225 kg (495 lb)
Max T-O weight: Drifter	408 kg (900 lb)
Super Drifter	453 kg (1,000 lb)

PERFORMANCE:

Never-exceed speed (V_{NE})	69 kt (128 km/h; 80 mph)
Normal cruising speed	61 kt (113 km/h; 70 mph)
Stalling speed: Drifter	34 kt (63 km/h; 39 mph)
Super Drifter	35 kt (65 km/h; 40 mph)
Max rate of climb at S/L	305 m (1,000 ft)/min
T-O run	61 m (200 ft)
Landing run	91 m (300 ft)
Range	200 n miles (370 km; 230 miles)

LOCKWOOD AIRCAM

TYPE: Two-seat kitbuilt twin.

PROGRAMME: Initially designed as camera platform for *National Geographic* magazine by Phillip Lockwood and first flew (N5084T) 1994. Redesigned as a kit and made public debut at Sun 'n' Fun 1996. First float-equipped version made initial flight 9 June 1999.

CUSTOMERS: More than 135 kits sold by November 2006; 73 on US register by November 2006. Export destinations include Australia, Costa Rica, Namibia and Zimbabwe.

COSTS: USD58,648 without engines; USD82,560 with Rotax 912 S engines (2005).

1040415

Lockwood Drifter tandem-seat ultralight *(Paul Jackson)*

1040412

Lockwood AirCam light twin *(Paul Jackson)*

DESIGN FEATURES: Configured for slow flight. Strut- and wire-braced wings and mid-mounted tailplane wire-braced to tall, narrow-chord fin. Quoted build time 800 hours.

FLYING CONTROLS: Conventional and manual. Full-width in-flight-adjustable trim tab on elevator. Pushrod-actuated ailerons taper at tips. Electric flaps.

STRUCTURE: All-metal monocoque fuselage with glass fibre cockpit enclosure. Constant chord, swept-tip wings of 6061-T6 aluminium tubing with aluminium spars and ribs, and fabric covering. Low-drag wing struts. Tailfin has glass fibre fillet and fabric-covered rudder and elevator with metal trim tab.

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted spring steel cantilever mainwheel legs; Hegar wheels; differential hydraulic disc brakes and 6.00-6 in tyres. Maule steerable tailwheel. Full Lotus floats optional.

POWER PLANT: Two 47.8 kW (64.1 hp) Rotax 582s or two 73.5 kW (98.6 hp) Rotax 912 ULSs or mounted above wings, driving three-blade ground-adjustable Warp Drive pusher propellers. Optionally two 85.8 kW (115 hp) turbocharged Rotax 914s can be fitted. Fuel in two wing-mounted aluminium tanks, total capacity 106 litres (28.0 US gallons; 23.3 Imp gallons).

ACCOMMODATION: Pilot and passenger/observer in tandem seats within open cockpit. Lexan windshield. Dual controls. Open baggage compartment behind second seat.

AVIONICS: To customer's specification. Options include Terra T X 760D COM, TRT 250D transponder.

EQUIPMENT: Fire extinguisher standard.

DIMENSIONS, EXTERNAL:

Wing span	11.07 m (36 ft 4 in)
Wing aspect ratio	6.5
Length overall	8.23 m (27 ft 0 in)
Height overall	2.54 m (8 ft 4 in)
Tailplane span	3.96 m (13 ft 0 in)
Wheel track	2.59 m (8 ft 6 in)
Min distance between propeller blade tips	0.15 m (6 in)

DIMENSIONS, INTERNAL:

Baggage compartment: Length	1.07 m (3 ft 6 in)
Max width	0.63 m (2 ft 0¾ in)

AREAS:

Wings, gross	18.95 m² (204.0 sq ft)

WEIGHTS AND LOADINGS (Rotax 912):

Weight empty	472 kg (1,040 lb)
Max T-O weight	762 kg (1,680 lb)
Max wing loading	40.21 kg/m² (8.24 lb/sq ft)
Max power loading	5.19 kg/kW (8.52 lb/hp)

PERFORMANCE (Rotax 912):

Never-exceed speed (VNE)	95 kt (177 km/h; 110 mph)
Max operating speed	87 kt (161 km/h; 100 mph)
Normal cruising speed	43–87 kt (80–161 km/h; 50–100 mph)
Stalling speed, power off, flaps down	34 kt (63 km/h; 39 mph)
Max rate of climb at S/L	610 m (2,000 ft)/min
Rate of climb at S/L, OEI	91 m (300 ft)/min
Service ceiling	5,485 m (18,000 ft)
T-O run	less than 61 m (200 ft)
Landing run	91 m (300 ft)
Range at 57 kt (106 km/h; 70 mph)	295 n miles (547 km; 340 miles)
Endurance	6 h
g limits	±6

LOEHLE

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In addition to its business of supplying materials to aircraft constructors, Loehle (pronounced 'low-lee') markets a range of lightplane and ultralight kits. These include the Sport Parasol and several scale warplanes, comprising SPAD XIII/Fokker D. VII/S.E. 5a (all based on common airframe), (Curtiss) Jenny, (Curtiss) P-40 'Flying Tiger', (North American) 5151 Mustang and KW-909 (Messerschmitt Bf 109/Focke-Wulf Fw 190). Most recent addition is a scale Supermarine Spitfire.

Partly-complete Loehle Spitfire Elite prototype *(Paul Jackson)* 1158592

LOEHLE SPITFIRE ELITE

TYPE: Single-seat sportplane kitbuilt.

PROGRAMME: Incomplete prototype exhibited at Sun 'n' Fun, Lakeland, April 2006.

COSTS: Kit USD34,995, less engine and tax, but including IFR instruments (2006).

DESIGN FEATURES: Three-quarters-scale Vickers Supermarine Spitfire; low-mounted elliptical wing; mid-mounted tailplane and rounded fin.

Quoted build time 750 hours. Wing and tailplane removable for storage.

FLYING CONTROLS: Conventional and manual. Horn-balanced rudder and elevators.

STRUCTURE: Wood. Monocoque forward fuselage; with glass fibre skin; lattice rear fuselage and fin, fabric-covered.

LANDING GEAR: Tailwheel type; retractable main legs; castoring, non-retractable tailwheel. Mainwheel brakes. Mainwheels retract outward into wings.

POWER PLANT: One 47.8 kW (64.1 hp) Rotax 582 piston engine standard; 58.8 kW (78.9 hp) Rotax 912 flat-four optional. Three-blade, ground-adjustable pitch propeller. Fuel capacity 57 litres (15.0 US gallons; 12.5 Imp gallons).

DIMENSIONS, EXTERNAL:

Wing span	8.31 m (27 ft 3 in)
Length overall	6.96 m (22 ft 10 in)

AREAS:

Wings, gross	12.26 m² (132.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	318 kg (700 lb)
Max T-O weight	544 kg (1,200 lb)

PERFORMANCE (estimated):

Normal cruising speed	91 kt (169 km/h; 105 mph)
Stalling speed	33 kt (62 km/h; 38 mph)
Max rate of climb at S/L (Rotax 582)	244 m (800 ft)/min
T-O run	61 m (200 ft)
Landing run	91 m (300 ft)
g limits	+4/–2

LOPRESTI

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PRESIDENT: Curt LoPresti

Original LoPresti Piper Aircraft Engineering Co formed as Piper subsidiary, but operations suspended December 1990 when Piper abandoned programme because of financial problems; design team retained in LoPresti Speed Merchants (performance improvement kits for Piper small singles and twins and other aircraft) and LoPresti Flight Concepts, which formed in October 1991 to acquire rights to SwiftFury following Piper's bankruptcy and carry through to certification and production; LFC to have been floated as public company mid-1992, but programme suspended by lawsuit over SwiftFury intellectual property. Judgement given in favour of LoPresti but no further progress before death of founder, LeRoy LoPresti on 7 August 2002.

SwiftFury programme re-established in July 2006, under current name of Fury, when Greater Belen Ecomomic Development Corporation at Belen, New Mexico, announced it would build 9,290 m² (100,000 sq ft) assembly plant for LoPresti at Alexander Municipal Airport, beginning January 2007; first aircraft to be completed 21 months thereafter; planned workforce 300.

Prototype LoPresti LP-1 Fury 1158821

LOPRESTI LP-1 FURY

TYPE: Aerobatic two-seat lightplane.

PROGRAMME: Modernised, high-performance development of 1940s Globe/Temco GC-1B Swift, with airframe improvements and 149 kW (200 hp) Textron Lycoming IO-360 instead of 93 kW (125 hp) Teledyne Continental; originally developed in partnership with Piper; first flight (N315LP; later N207LP; later N217LP) of converted Swift (c/n 246) 23 March 1989. First production aircraft to be completed in late 2008.

Original Globe GC-1 Swift constructed of Duraloid (Bakelite-bonded plywood); two prototypes only before US involvement in Second World War; redesigned in metal as GC-1A and flown January 1945; certified 7 May 1946. Total 408 GC-1As (63.4 kW; 85 hp Continental) built under subcontract by Temco, which then obtained type certificate and produced 1,090 GC-1Bs (93 kW; 125 hp Continental) up to 1951. Type certificate then passed to Univair, then Swift Museum Foundation.

CUSTOMERS: Total 569 SwiftFuries ordered before Piper abandonment.

COSTS: USD335,000 (2007); but USD295,000 to original (LoPresti-Piper) customers reconfirming orders within first year.

DESIGN FEATURES: Low wing, 10.2 cm (4 in) farther forward than on original Globe design, with large root fillets; dihedral wings and tailplane. Wing sections NACA 23015 (root) and 23009 (tip); dihedral 6°; incidence 2°. Tailplane dihedral 8°.

FLYING CONTROLS: Conventional and manual. Ailerons, elevators and rudder mechanically actuated by pushrods in roller bearings; electrically operated trim tab in port elevator, anti-servo tab in starboard elevator; ground adjustable tab on rudder; aileron travel +12/-25°; electrically operated single-slotted flaps deflect up to 40°; optional electrically operated speedbrake in upper surface of each wing. Stall strip on each inboard wing leading-edge; fence at inboard end of each aileron. Small auxiliary fixed horizontal surface on each side of rear fuselage forward of tailplane leading-edge.

STRUCTURE: Conventional aluminium alloy stressed skin construction, butt-jointed and flush-riveted.

LANDING GEAR: Tailwheel type, retractable. Main units fully enclosed by sequenced doors when retracted, tailwheel remaining partially exposed. Prototype's tailwheel non-steerable, with solid tyre; production aircraft to have steerable tailwheel with pneumatic tyre. Dual redundant braking system.

POWER PLANT: One 149 kW (200 hp) Textron Lycoming IO-360-A1B6 flat-four engine, driving a McCauley two-blade constant-speed metal propeller. Integral fuel tank in each wing, combined usable capacity 227 litres (60.0 US gallons; 50.0 Imp gallons).

ACCOMMODATION: Two seats side by side, with dual control sticks embodying HOTAS technology. Wraparound windscreen; one-piece rearward sliding canopy. Space for baggage aft of seats.

AVIONICS: *Comms:* Garmin SL-30 interactive nav/com, Garmin 330 Mode S transponder.
Flight: Garmin 496 GPS.

DIMENSIONS, EXTERNAL:

Wing span	8.93 m (29 ft 3½ in)
Wing aspect ratio	6.2
Length overall	6.86 m (22 ft 6 in)
Height overall	1.80 m (5 ft 10¾ in)
Wheelbase	3.78 m (12 ft 5 in)

DIMENSIONS, INTERNAL:

Cockpit: Max width	1.12 m (3 ft 8 in)
Max height	1.14 m (3 ft 9 in)

AREAS:

Wings, gross	12.88 m² (138.6 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	658 kg (1450 lb)
Max baggage weight	45 kg (100 lb)
Max T-O weight	1043 kg (2300 lb)
Max wing loading	81.02 kg/m² (16.59 lb/sq ft)
Max power loading	7.00 kg/kW (11.50 lb/hp)

PERFORMANCE (estimated):

Never-exceed speed	235 knots (435 km/h; 270 mph)
Max level speed at S/L	192 knots (356 km/h; 221 mph)
Max cruising speed, 75% power	187 knots (346 km/h; 215 mph)
Max flying speed, wheels down	117 knots (217 km/h; 135 mph)
Stalling speed, flaps down	47 knots (87 km/h; 55 mph)
Max rate of climb at S/L	411 m (1350 ft)/min
Service ceiling	6,400 m (21,000 ft)
Max rate of roll	180°/s
Range with 45 min reserves	869 n miles (1,609 km; 1,000 miles)
g limits	+6/–3 (aerobatic)
	+9/–4 (ultimate)

LUSCOMBE

LUSCOMBE AIRCRAFT CORPORATION

Renamed Quartz Mountain Aerospace.

LUSCOMBE-SILVAIRE

LUSCOMBE-SILVAIRE AIRCRAFT COMPANY INC

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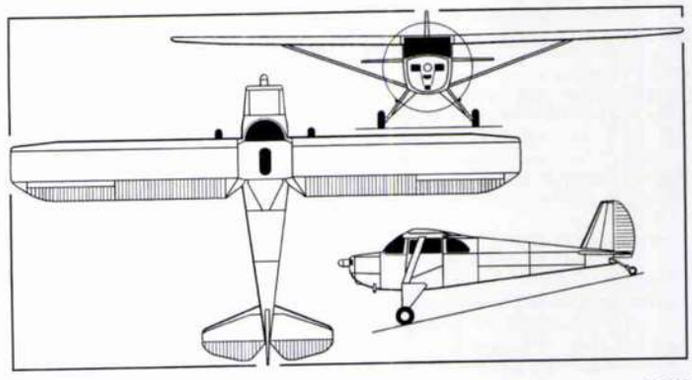
Web: www.luscombe-silvaire.com

Originally known as Renaissance Aircraft; formed to relaunch production of the classic Luscombe 8F light aircraft. This was seriously delayed by a dispute over ownership of the Luscombe 8 Type Certificate and manufacturing tools, all of which were acquired through a legal judgment of 14 May 2004. However, Renaissance then began search for investors to finance manufacture of new aircraft; this having failed, closure of previous Cape Girardeau plant announced 12 November 2004.

Project re-launched in 2005 when Team Luscombe Inc appointed sole agent for Renaissance products and mounted joint exhibit at AirVenture, Oshkosh, July 2005. Plans for production of Light Sport Aircraft version of Luscombe 8 at Flabob Airport, Riverside, California, announced 17 May 2006. This revealed at AOPA Expo, Palm Springs, California, November 2005 shortly after award of LSA approval coincident with change of company name to Luscombe-Silvaire and return of original Luscombe shape.



Luscombe-Silvaire LSA-8 Renai *(Paul Jackson)* 1164292

LUSCOMBE-SILVAIRE LSA-8 RENAI

TYPE: Two-seat lightplane.

PROGRAMME: Luscombe Airplane Corp Model 8 Silvaire first flew 18 December 1938; progressed through several subvariants, built by Luscombe, Temco Engineering and Silvaire Aircraft until 1960; total of some 5,867 produced. In 1999, Renaissance company refurbished an original Luscombe 8F (N999RA) as prototype for relaunched production. First deliveries were due late 2000, but not effected. Assembly of first aircraft (N722J) began late July 2001 and the aircraft registered in mid-2005, although airworthiness certificate had not then been issued.

Marketing of Luscombe LSA in Light Sport Aircraft certification category was launched at the EAA convention at Oshkosh in July 2005, with production based at Flabob Airport, Riverside, California. Tricycle landing gear version planned for future development. Initial production rate 50 per year, rising to 100-150 per year by the end of the second full year. LSA approval announced November 2006, coincident with name change to Luscombe-Silvaire LSA-8 Renai, demonstrator N104LS shown at AOPA Expo same month, configuration having reverted to original rounded rudder trailing edge from Renaissance straight-edged design.

CUSTOMERS: More than 10 deposits placed by July 2001.

COSTS: Base price USD90,000 (2006).

DESIGN FEATURES: High-wing, all-metal touring lightplane of late 1930s technology, but incorporating modifications and some modern features. Changes include considerable increase in power from original 67.1 kW (90 hp) Continental C-90; 60 per cent more baggage area or optional seating for two children; additional fuel; revised rudder shape; and new cockpit interior.

Luscombe-Silvaire LSA-8 Renai demonstrator 1159765

FLYING CONTROLS: Conventional and manual. Flight-adjustable tab in port elevator; ground-adjustable tabs on both ailerons. No horn balances. Plain flaps; deflections 0, 10, 20 and 30°.

STRUCTURE: Alclad aluminium monocoque fuselage; oval section duralumin bulkhead stampings and riveted Alclad skin. Wings constructed on two I-type spars of extruded aluminium and ribs of riveted T-section extrusions with Alclad skin. Ailerons covered with beaded Alclad sheet riveted to a single duralumin spar. Wings attached to upper sides of cabin and braced by single streamlined strut each side. Wing struts and landing gear attached to aluminium forgings riveted to forward section of metal seat bottom on each side. Duralumin/Alclad tailplane bolted to fuselage. Steel tube main landing gear legs hinged at fuselage sides and with single oleo-spring unit within fuselage.

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted, trousered, spring cantilever mainwheel legs with wheel fairings. Mainwheel tyres 6.00–6; toe-operated hydraulic brakes; optional speed fairings. Steerable tailwheel, size 2.30/2.50–4. Optional skis, floats or tundra tyres.

POWER PLANT: One 74.6 kW (100 hp) Teledyne Continental O-200 flat-four. Fuel tank in each wing, total 117 litres (30.0 US gallons; 25.0 Imp gallons).

ACCOMMODATION: Two, on individual leather seats, with dual controls. Forward-hinged door each side. Baggage compartment behind seats may be replaced by two child seats.

SYSTEMS: Electrical system with starter, ammeter and circuit breakers

AVIONICS: *Comms:* ELT standard. Optional Mode C VFR package includes Bendix/King Silver Crown KX 155 nav/com/glideslope with KI 209 VOR/LOC/GS head; KT 76C-10 transponder; KMA 12801 audio panel with intercom and push-to-talk switches on control columns, and Ameriking AK 350 encoder. Optional IFR package includes Mode C items as above and adds a second KX 155 with KI 1209 VOR/LOC/GS; KT 76C-10X transponder in place of KT 76C-10, and KA 33-00 cooling blower.

Flight: Optional Mode C VFR and IFR packages each include Bendix/King KMD 150-05 GPS with colour moving map display.

Instrumentation: Optional full gyro package includes engine-driven vacuum system and gauge; vacuum-driven directional gyro and attitude indicator; electric turn-and-bank indicator; ASI, OAT gauge and precision electric clock.

EQUIPMENT: Navigation, landing and wingtip strobe lights; vinyl and fabric cabin upholstery, and carved wood control column grips and fuel escutcheons, all standard. Combination EGT/CHT gauge, custom exterior paint; leather interior; thermal acoustic cabin insulation; custom wood instrument panel overlays with integral lighting, and interior and panel lights, all optional. Heated pitot tube included in optional IFR avionics package.

DIMENSIONS, EXTERNAL:

Wing span	6.71 m (35 ft 0 in)
Wing aspect ratio	8.8
Length overall	6.70 m (22 ft 0 in)
Height overall	2.13 m (7 ft 0 in)
Propeller diameter	1.88 m (6 ft 2 in)

DIMENSIONS, INTERNAL:
Cabin max width ..... 0.99 m (3 ft 3 in)
AREAS:
Wings, gross ..... 13.01 m² (140.0 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 449 kg (990 lb)
Max T-O weight: interim ..... 635 kg (1,400 lb)
planned ..... 793 kg (1,750 lb)
Max wing loading: interim ..... 48.8 kg/m² (10.00 lb/sq ft)
planned ..... 61.0 kg/m² (12.50 lb/sq ft)
Max power loading: interim ..... 5.68 kg/kW (9.33 lb/hp)
planned ..... 7.10 kg/kW (11.67 lb/hp)
PERFORMANCE:
Max level speed ..... 130 kt (241 km/h; 150 mph)
Max cruising speed at 75% power:
at S/L ..... 122 kg (225 km/h; 140 mph)
at FL80 ..... 126 kt (233 km/h; 145 mph)
Econ cruising speed at 65% power ..... 119 kt (220 km/h; 137 mph)
Stalling speed: flaps up ..... 41 kt (76 km/h; 47 mph)
flaps down ..... 38 kt (70 km/h; 43 mph)
Max rate of climb at S/L ..... 457 m (1,500 ft)/min
Service ceiling ..... 6,400 m (21,000 ft)
g limits ..... +4.6/–2.2

MAULE

MAULE AIR INC

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DIRECTOR: Ray Maule
VICE-PRESIDENT: David Maule
ENGINEER: David Wright
SALES MANAGER: Brent Maule

Original Maule Aircraft Corporation formed in Michigan by the late Belford D Maule to produce M-4, extending existing business of manufacturing aircraft accessories. Company transferred to Moultrie, Georgia, 1968; Maule Air Inc formed 1984 to produce uprated M-5 Lunar Rocket and M-7 Super Rocket; Lunar Rocket discontinued, but modified M-4 returned to production in 2005. Delivered 27 aircraft in 2005.

MAULE M-4

TYPE: Two-seat lightplane.
PROGRAMME: First post Second World War design by Belford D Maule. Four-seat M-4 Bee Dee first flew February 1957 and received FAA certification on 10 August 1961. Produced in –145, –180,–210 and –220 versions (indicating power of Continental or Franklin engines), being named Jetasen and Rocket in later versions; some 471 manufactured up to replacement by M-5 from 1975.

In preparation for Light Sport Airplane licensing category, prototype **M-4-100 Sport 100** (c/n 54001C/N5505C) first flew 18 July 2003 with 73.5 kW (98.6 hp) Rotax 912S flat-four and made public debut at AirVenture, Oshkosh, on 29 July. Changes from original included lower-powered engine and deletion of flaps. This version not marketed; replaced by M-4-180V.

CURRENT VERSIONS: **M-4-180V:** Announced August 2004, month following first flight of initial aircraft (c/n 53001, N799ZZ). Designation indicates 'Vintage'. Flaps reinstated; higher-powered engine. Generally as MX-7-180, except M-4 empennage and accommodation. FAA certification 6 September 2005.
CUSTOMERS: One delivered in 2004 and seven in the first nine months of 2006.
COSTS: : USD128,900 fixed-pitch propeller; USD138,900 variable-pitch propeller (2006).
DESIGN FEATURES: High wing attached to upper longerons and braced to lower longerons by streamline V struts. Vortex generators along entire wing leading-edge. Curved fin and tailplane tips. Wire-braced tailplane and fin.

Wing section USA 35B (modified); dihedral 1°; incidence 30'.

FLYING CONTROLS: Conventional and manual. Cable actuation. Mass-balanced rudder; horn-balanced elevators. Flight-adjustable, metal trim tab in port elevator. Control surface movements; ailerons ±20°; elevators +25/–21°; rudder ±21°. Flap settings 0, 20, 35 and –7° for high-speed cruise.
STRUCTURE: Welded steel tube fuselage and integral fin with fabric covering, except aluminium doors and composites engine cowling; all-metal wing (including ailerons and flaps) built on two spars, but with composites tips.
LANDING GEAR: Tailwheel type; fixed. Two faired side Vs with half-axles sprung under fuselage with compressed rubber shock-absorbers. Maule steerable tailwheel. Speed Mainwheels 7.00-6; tailwheel 3.80/2.50-4. Hydraulic mainwheel brakes. 'Half' speed fairings to rear of tyres only.
POWER PLANT: One 134 kW (180 hp) Textron Lycoming O-360-C4F flat-four driving a Sensenich 76EM8S5-0-56 or 76EM8S8-0-56 fixed-pitch propeller, or O-360-C1F driving a Hartzell HC-C2YR-1BF/F7666A constant-speed propeller. Fuel contained in tanks in wings; normal capacity 180 litres (47.6 US gallons; 39.7 Imp gallons), of which 163 litres (43.0 US gallons; 35.8 Imp gallons) usable; optional auxiliary wing tanks increase capacity to 276 litres (73.0 US gallons; 60.8 Imp gallons). Oil capacity 8 litres (2.0 US gallons; 1.7 Imp gallons).
ACCOMMODATION: Two seats, side by side. Baggage space to rear. Door each side. Dual controls standard.
AVIONICS: *Comms:* Garmin GTX 327 transponder; PS Engineering PM 1000II intercom; pilot and co-pilot PTT switches.

Flight: Garmin GNC 250XL GPS/comm.

DIMENSIONS, EXTERNAL:
Wing span ..... 9.40 m (30 ft 10 in)
Wing chord, constant ..... 1.60 m (5 ft 3 in)
Wing aspect ratio 6.2
Length overall ..... 6.88 m (22 ft 7 in)
Height overall ..... 1.89 m (6 ft 2 in)
Tailplane span ..... 2.97 m (9 ft 8¾ in)
Wheel track ..... 1.83 m (6 ft 0 in)
Wheelbase ..... 4.82 m (15 ft 10 in)
DIMENSIONS, INTERNAL:
Cabin max width ..... 1.08 m (3 ft 6½ in)
Baggage compartment volume ..... 0.51 m³ (18 cu ft)
AREAS:
Wings, gross ..... 14.67 m² (157.9 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 608 kg (1,340 lb)
Max baggage weight ..... 91 kg (200 lb)
Max T-O weight ..... 1,043 kg (2,300 lb)
Max wing loading ..... 71.1 kg/m² (14.57 lb/sq ft)
Max power loading ..... 7.78 kg/kW (12.78 lb/hp)
PERFORMANCE:
Cruising speed at 75% power ..... 109 kt (201 km/h; 125 mph)
Stalling speed, flaps down ..... 35 kt (65 km/h; 40 mph)
Service ceiling ..... 4,572 m (15,000 ft)
Max rate of climb at S/L ..... 280 m (920 ft)/min
T-O run ..... 168 m (550 ft)
T-O to 15 m (50 ft) ..... 366 m (1,200 ft)
Landing from 15 m (50 ft) ..... 183 m (600 ft)
Range ..... 821 n miles (1,520 km; 945 miles)

MAULE M-7 and M-9

TYPE: Light utility transport; light utility turboprop.
PROGRAMME: First certified 9 November 1983 as M-7-235 Super Rocket (prototype N5656A: based on M-6-235 but with extended cabin and additional windows). In May 2000, Maule received first of an initial batch of 10 SMA SR305 turbocharged diesel engines for installation in M-9s.
CURRENT VERSIONS: Produced with short (M-5), mid-length (M-6) or long (A Model) wing span and engine/landing gear options as detailed below; short option deleted on 1999 versions, while piston-engined and turboprop/nosewheel aircraft have only M-6 wing from that year, the turboprop/tailwheel variants employing A Model wings. Designation prefixes are T = tricycle and X = short span.

MX-7-180A Sportplane: Engineering designation 20. Certified 3 June 1993. As MX-7-160, but 134 kW (180 hp) Textron Lycoming O-360-C4F engine. Prototype N9225G. Two delivered in 2002 and one in 2003 and one in the first nine months of 2006.

MX-7-180AC Sportplane: Engineering designation 33. Certified 4 May 2000. As MX-7-180A, but spring aluminium landing gear. Three delivered in 2003, and three in 2004.

MXT-7-180A Comet: Engineering designation 21. Certified 3 June 1993. As MX-7-180, but tricycle landing gear and four seats standard. Introduced and first production aircraft (N1002N) flown 1996; optimised for flight training schools. Total of 18 delivered in 1999, six in 2000, one in 2001 and three in 2002, one in 2003, two in 2004, two in 2005, and one in the first nine months of 2006.

MX-7-180B Star Rocket: Engineering designation 22. Certified 12 July 1993. 134 kW (180 hp) Textron Lycoming O-360-C1F engine, Hartzell two-blade constant-speed metal propeller and five-position flaps. Two delivered in 2002, none in 2003, one in 2004, and one in the first nine months of 2006.

MX-7-180C: Engineering designation 28. Certified 27 August 1996. As MX-7-180B, but with spring aluminium main landing gear. Two delivered in 1999, two in 2000, one in 2001, two in 2002, three in 2003, one in 2004, and three in 2005.

MXT-7-180 Star Rocket: Engineering designation 14. Certified 9 November 1990. As MX-7-180B, but with tricycle landing gear. Previously known as Star Craft. One delivered in 1999, seven in 2000, and two in 2001; none delivered in 2002; one in 2003, six in 2004, two in 2005 and one in the first nine months of 2006.

MX-7-205C Rocket: Engineering designation 31. One 153 kW (205 hp) PZL-Franklin 6A-350-C1R engine, McCauley two-blade propeller. Prototype (N205MX) was being test flown by second quarter of 1999. Engine may be offered as an option on Textron Lycoming O-360-powered models. Not certified by 2004.

Maule M-4-180V prototype 1047436

Amphibian version of Maule M-7-260C *(Paul Jackson)* 1158617

1158593

Maule MX-7-180C *(Paul Jackson)*

1158597

Maule MXT-7-180A *(Paul Jackson)*

M-7-235B Super Rocket: Engineering designation 23. Certified 14 October 1993. Five-seater; choice of 175 kW (235 hp) carburetted Textron Lycoming O-540-J1A5, low-compression Mogas approved O-540-B4B5 or fuel-injected IO-540-W1A5 engines; McCauley constant-speed propeller, five-position flaps; fuselage raised 7.6 cm (3 in) at trailing-edge of wing and baggage area moved aft 12.7 cm (5 in) to accommodate fifth seat; recommended for high gross weight short-field operation, and for floatplane operation. Eight delivered in 1999, seven in 2000, five in 2001, six in 2002, three in 2003, two in 2004, seven in 2005, and five in the first nine months of 2006.

M-7-235C Orion: Engineering designation 25. Certified 10 October 1995. As for M-7-235B but with spring aluminium main landing gear. Sixteen delivered in 1999, 18 in 2000, 14 in 2001, 15 in 2002, nine in 2003, six in 2004, four in 2005, and two in the first nine months of 2006.

MT-7-235 Super Rocket: Engineering designation 18. Certified 20 March 1992. As M-7-235B, but tricycle landing gear, four-position flaps and IO-540-W1A5 engine only. Prototype N9226Y. Four delivered in 1999, five in 2000, 16 in 2001 and 12 in 2002, seven in 2003, one in 2004, two in 2005, and eight in the first nine months of 2006. Civil Air Patrol approved purchase of 15 in glider towing configuration mid-2000.

M-7-260 Super Rocket: Engineering designation 26. Certified 17 April 1998. As M-7-235B, but 194 kW (260 hp) Textron Lycoming IO-540-V4A5 engine; McCauley two-blade constant-speed propeller standard, Hartzell and MT propellers optional. Seven delivered in 1999, one in 2000, four in 2001, one in 2002, one in 2003, and two in 2005.

M-7-260C Orion: Engineering designation 30. Certified 19 October 1998. As M-7-235C, but 194 kW (260 hp) Textron Lycoming IO-540-V4A5 engine; McCauley two-blade constant-speed propeller standard, Hartzell and MT propellers optional. Eight delivered in 1999, seven each in 2000 and 2001, two in 2002, three in 2003, three in 2004, two in 2005, and one in the first nine months of 2006.

MT-7-260 Super Rocket: Engineering designation 27. Certified 17 April 1998. As MT-7-235, but 194 kW (260 hp) Textron Lycoming IO-540-V4A5 engine; McCauley two-blade constant-speed propeller standard, Hartzell and MT propellers optional. Three delivered in 1999, two in 2000, four in 2001, one in 2002, one in 2005, and four in the first nine months of 2006.

M-7-420AC: Engineering designation 29. Certified 17 December 1998. M-7 fuselage with long-span wings, 313 kW (420 shp) Rolls-Royce 250-B17C turboprop, spring aluminium tailwheel landing gear. One delivered in 1999, none in 2000, one each in 2001 and 2002, and one in 2003.

MT-7-420: Engineering designation 51. Certified 6 January 2003. As MT-7-260 but with 313 kW (420 shp) Rolls-Royce 250-B17C turboprop. First aircraft N683CE. Two delivered in 2004.

M-9-230: Engineering designation 44. M-7 with 169 kW (227 hp) SMA SR305-230 Diesel engine and LoPresti cowling; max take-off weight 1,270 kg (2,800 lb). Fuel capacity 322 litres (85.0 US gallons; 70.8 Imp gallons); estimated range more than 869 n miles (1,609 km; 1,000 miles). Prototype (c/n 44001/N305SR) first flown on 18 July 2003; public debut at EAA AirVenture Oshkosh 29 July 2003 at which time it had completed 18 hours' flying time. Estimated cost USD200,000 (2003).

Discontinued versions comprise MX-7-160 Sportplane, MXT-7-160 Comet, MX-7-160C Sportplane, MX-7-180, M-7-235, MX-7-235, M-7-420 and MX-7-420, all last described in 2005-06 *Jane's All the World's Aircraft*.

CUSTOMERS: Total of 990 produced by 31 March 2004, plus 908 of earlier M-5 and M-6 series. At 17 April 2001 Maule's order backlog stood at 100 aircraft, of which 10 were for SMA SR305-powered MX-9s.

COSTS: MXT-7-180A USD142,700; MX-7-180B USD145,900; MX-7-180C USD151,200; MXT-7-180 USD158,200; M-7-235B (O-540) USD162,200 (IO-540) USD170,200; M-7-

MAULE M-7 OPTIONS

Version	Power Plant							Gear		
	B2D	C4F	C1F	B4B5	W1A5	V4A5	B17	TW/S	TW/A	TR/A
MX-7-160	•							•		•
MXT-7-160	•								•	
MX-7-160C	•							•		
MX-7-180A		•							•	
MX-7-180AC		•						•		
MX-7-180B			•						•	
MX-7-180C			•							•
MXT-7-180			•							•
MXT-7-180A		•						•		
M-7-235B				•					•	
M-7-235C				•						•
MT-7-235					•			•		
M-7-260						•			•	
M-7-260C						•			•	
MT-7-260						•			•	
M-7-420AC							•			•
MT-7-420							•			

Notes: Power plants are Lycoming O-320-B2D, O-360-C4F, O-360-C1F, O-540-B4B5, IO-540-W1A5, IO-540-V4A5 (or earlier equivalents) and Rolls-Royce (Allison) 250-B17-C. Landing gears are tailwheel/oleo main gear, tailwheel/aluminium and tricycle/aluminium.

MAULE M-7 PRODUCTION

Version	Annual Deliveries																							Totals
	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	
MX-7-160											15	16	9	3										**43**
MXT-7-160											1	1	1			5								**8**
MX-7-180			20	12	8	17	6	7	12	9	4	1												**96**
MX-7-180A											9	17	22	5	7	1								**61**
MX-7-180B												1	4	8		4				2	2	1		**20**
MX-7-180C														1	2	6	2	2	1	2	3	1	3	**23**
MXT-7-180								3	21	7	16	4	4	18	3	4	1	7	2	2	1	6	2	**101**
MXT-7-180A											1	1	3	6	22	24	18	6	1	3	1	2	2	**90**
M-7-235	2	17	13	11	16	15	13	9	13	3	13	7												**132**
M-7-235B												5	17	11	7	6	8	7	5	6	3	2	7	**84**
M-7-235C														7	11	5	16	17	14	15	9	6	4	**105**
MT-7-235										2	6	9	6	4	2	6	4	5	16	12	7	1	2	**82**
MX-7-180AC																		1			3	3		**7**
MX-7-160C																	1							**1**
MX-7-235		2	23	25	18	14	5	3	16	9	2		1											**118**
M-7-260																1	7	1	4	1	1		2	**17**
M-7-260C																1	8	9	7	2	3	3	2	**33**
MT-7-260																	3	1	4	1			2	**11**
M-7-420A																			1					**1**
M-7-420AC																			2		1			**3**
MX-7-420								2	1			1												**4**
MT-7-420																						2		**2**
Yearly totals	**2**	**19**	**56**	**48**	**42**	**46**	**24**	**24**	**63**	**30**	**67**	**63**	**67**	**63**	**54**	**63**	**69**	**56**	**57**	**46**	**32**	**27**	**26**	**1,042**

Notes: Versions not achieving series production have included M-7-235A, MX-7-205C, M-7-420, MT-7-420 and MXT-7-420

235C (O-540) USD168,500 (IO-540) USD176,800; M-7-260 USD182,200; MT-7-235 USD183,100; M-7-260C USD189,200; MT-7-260 USD194,900. All 2006, standard equipment.

DESIGN FEATURES: Rugged, STOL utility aircraft. High, constant chord, wing braced by V-struts; mid-mounted tailplane; large sweptback fin.

USA 35B (modified) wing section; dihedral 1°; incidence 0° 30'; cambered wingtips standard.

FLYING CONTROLS: Conventional and manual. Ailerons linked to rudder servo tab to reduce adverse yaw; trim tab in port elevator; rudder trim by spring to starboard rudder pedal; flap deflection 40° down for slow flight (further setting of 48° down on all except-420), 24° down, 0 and 7° up for improved cruise performance; underfin on floatplane and amphibious versions.

STRUCTURE: All-metal two-spar wing with dual struts and glass fibre tips; fuselage frame of welded 4130 steel tube with Ceconite covering aft of cabin and metal doors and skin forward of cabin; glass fibre engine cowling.

LANDING GEAR: Fixed; tailwheel or nosewheel type, with spring cantilever or oleo shock-absorbtion. Refer to table for current version application. Narrow-track versions have two faired-in side Vs hinged to lower longerons plus half-axles incorporating. Maule oleo-pneumatic shock-absorbers joined under centreline. Wide-track versions have fuselage mounted spring aluminium cantilever mainwheel legs. Maule steerable tailwheel or cantilever, steerable nosewheel. Cleveland mainwheels with Goodyear or McCreary tyres size 7.00-6, pressure 1.79 bar (26 lb/sq in). Tailwheel tyre size 8×3.5-4, pressure 1.03 to 1.38 bar (15 to 20 lb/sq in). Cleveland hydraulic disc brakes. Parking brake. Oversize tyres, size 20×8.0-6 or 20×8.5-6 (pressure 1.24 bar; 18 lb/sq in) optional; dual caliper brakes optional.

Provisions for fitting optional Aqua 2200 and 2400, Baumann 2720 or Wipline 2350 and 3000 floats, or Baumann 2750A or Wipline 2350A and 3000A amphibious floats (also available on some tricycle models). Float option available for MX-7-160, MX-7-180A/B/C, M-7-235B/C, M-7-260 and M-7-420AC. Ski option available for M-7-235B.

POWER PLANT: One flat-four or flat-six engine as described under Current Versions, driving a Sensenich two-blade fixed-pitch or Hartzell two-blade constant-speed propeller (three-blade McCauley propeller optional on 175 kW; 235 hp and 194 kW; 260 hp models); or Rolls-Royce 250-B17C turboprop with three-blade, Hartzell HC-B3TF-7A/T10173F-21R constant-speed feathering and reversing propeller in -420 models. Piston versions have four fuel tanks in wings with total usable capacity of 276 litres (73.0 US gallons; 60.8 Imp gallons). Turboprop versions have total fuel capacity of 322 litres (85.0 US gallons; 70.8 Imp gallons). Refuelling points on wing upper surface. Auto fuel STC available as option on O-360-C1F, O-360-C4F and O-540-B4B5 engined versions.

ACCOMMODATION: Four or five seats according to model, as described under Current Versions; individual, adjustable front seats; non-adjustable, rear seats. Dual controls and three-point shoulder harnesses standard. Baggage compartment, capacity 113 kg (250 lb), aft of seats; cargo capacity with passenger seats removed 349 kg (770 lb). One front-hinged door on port side; three doors on starboard side, forward and centre doors hinged at front edge, rear baggage door hinged at rear edge to form double cargo door providing an opening 1.30 m (4 ft 3 in) wide to facilitate loading of bulky cargo; aircraft may be flown with doors removed. Accommodation heated and ventilated.

SYSTEMS: Hydraulic system for brakes only; electrical system powered by 60 A engine-driven alternator; 12 V battery (24 V battery on turboprops).

AVIONICS: Standard SP-3 VFR package comprises Garmin GNC 250XL GPS/com (GNC 420 upgrade optional), GTX 327 digital transponder, PS Engineering PM 1000II four-place intercom. IFR-4 package comprises GNS 430 GPS/nav/com, GNC 250XL GPS/com, GI-106A CDI with GS, GTX 327 digital transponder, PS Engineering PMA 7000B stereo audio panel. IFR-4KX package deletes GNC 250XL and adds Bendix/King KX-155-42 nav/com/GS and KI-209-01 VOR/GS indicator. IFR-5 package adds second GNS 430 to IFR-4 package. GNS 530 replacing one GNS 430 optional in IFR packages. Optional avionics upgrades include 28 V system for IFR packages, Century NSD 360A-15 or 360A-26 non-slaved/slaved HSIs replacing one GI-106A in IFR packages; S-TEC System 20, System 30 or System 50 autopilots and heading bug directional gyro; Garmin GTX 330 Mode S transponder upgrade from GTX 327; Bose Headset X; Light Speed Technologies Twenty 3G ANR headset; and fifth-seat microphone and headset jack. All avionics packages include Narco AR-850 remote altitude encoder, Bendix/King KA 33-00 cooling blower (KA 33-01 optional), ELT, pilot and co-pilot PTT switches, radio master switch, broadband antenna, and transponder antenna; IFR packages also include second broadband antenna, marker antenna and triplexer.

Instrumentation: Standard equipment includes full gyro panel/vacuum system comprising attitude and directional gyros, electric turn co-ordinator, VSI, OAT gauge and suction gauge; ASI; altimeter; compass; audio/visual stall warning indicator; CHT gauge; tachometer; electric fuel gauge, manifold pressure gauge (constant-speed propeller models only); fuel pressure gauge; oil pressure and temperature gauges; ammeter, and clock. Options include TAS indicator, carburettor air temperature gauge, hour meter, and KS Mix-Mizer EGT probe.

EQUIPMENT: Standard equipment Includes instrument and dome lights, auxiliary cabin heater, auxiliary fuel pump, auxiliary power plug, heated pitot tube, vinyl seats with velour inserts, vinyl cabin side panels, cloth velour cabin headliner, cabin soundproofing, cabin overhead speaker, window vents, cabin steps, cargo tiedowns, smoke-tinted windscreen, windscreen defroster, landing light in port wing, navigation lights, wingtip strobe lights, seven fuel drains, tiedown rings, airframe powder coating, wing corrosion proofing, and standard external paint scheme in Glacier White or Dune White base colour with single-colour trim. Options include dynamically balanced propeller, Tanis engine heater, leather seats and interior trim, four-point shoulder harnesses for pilot and co-pilot, Oregon Aero seat cushion system for pilot and co-pilot, two-position middle seat, colour co-ordinated instrument panel, landing light in starboard wing, Precise Flight pulselight, Micro Aerodynamics Inc vortex generators, dual tailplane struts (for glider towing), ground service plug, fuselage grab handles, Halon fire extinguisher, Schweizer or Tost glider tow/release kit, aircraft towbar, observation door, camera port, observation window, skylight, co-pilot's swing-out window, smoke-tinted cabin windows, and additional external trim colours.

DIMENSIONS, EXTERNAL:

Wing span: all except M-7-420AC ..... 10.03 m (32 ft 11 in)
M-7-420AC ..... 10.26 m (33 ft 8 in)
Wing chord, constant: all ..... 1.60 m (5 ft 3 in)
Wing aspect ratio: all versions except M-7-420AC 6.5
M-7-420AC 6.7
Length overall:
piston-engined versions ..... 7.21 m (23 ft 8 in)

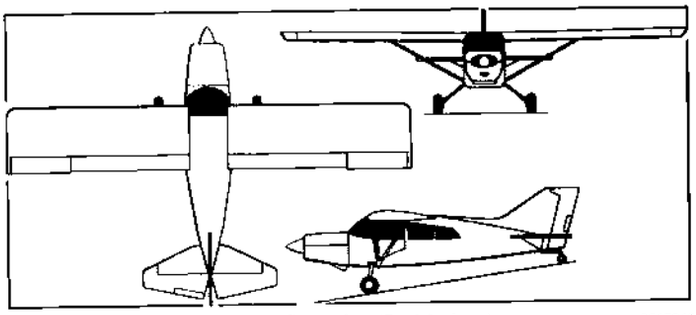
M-7-420AC ..... 7.32 m (24 ft 0 in)
MT-7-420 ..... 7.47 m (24 ft 6 in)
Height overall: tailwheel versions ..... 1.93 m (6 ft 4 in)
tricycle versions ..... 2.54 m (8 ft 4 in)
floatplane ..... 3.05 m (10 ft 0 in)
amphibian ..... 3.20 m (10 ft 6 in)
Wheel track:
MX-7-160, MX-7-180A, MX-7-180B, M-7-235B, M-7-260 ..... 1.83 m (6 ft 0 in)
MXT-7-160, MXT-7-180, MXT-7-180A, MT-7-235, MT-7-260, MT-7-420 ..... 2.34 m (7 ft 8 in)
MX-7-160, MX-7-180AC, MX-7-180C, M-7-235C, M-7-260C, M-7-420AC ..... 2.39 m (7 ft 10 in)
Propeller diameter:
MX-7-160, MX-7-160C, MXT-160 ..... 1.88 m (6 ft 2 in)
MX-7-180A, MX-7-180AC, MX-7-180C, MXT-7-180A, MX-7-180B, MXT-7-180 ..... 1.93 m (6 ft 4 in)
M-7-260, M-7-260C, MT-7-260 ..... 1.98 m (6 ft 6 in)
M-7-235B, M-7-235C, MT-7-235, M-7-260, M-7-260C, MT-7-260 three-blade:
option 1 ..... 1.98 m (6 ft 6 in)
option 2 ..... 2.03 m (6 ft 8 in)
M-7-235B, M-7-235C, MT-7-235 ..... 2.06 m (6 ft 9 in)
M-7-420, MT-7-420 ..... 2.03 m (6 ft 8 in)

DIMENSIONS, INTERNAL:
Cabin max width ..... 1.07 m (3 ft 6 in)

AREAS:
Wings, gross: all except M-7-420AC ..... 15.38 m² (165.6 sq ft)
M-7-420AC ..... 15.72 m² (169.2 sq ft)

WEIGHTS AND LOADINGS:
Weight empty: MX-7-160 ..... 621 kg (1,370 lb)
MX-7-160C ..... 670 kg (1,477 lb)
MXT-7-160 ..... 660 kg (1,456 lb)
MX-7-180A ..... 636 kg (1,402 lb)
MX-7-180AC ..... 654 kg (1,442 lb)
MXT-7-180A ..... 683 kg (1,505 lb)
MX-7-180B ..... 652 kg (1,438 lb)
MX-7-180C ..... 673 kg (1,483 lb)
MXT-7-180 ..... 693 kg (1,528 lb)
M-7-235B ..... 728 kg (1,605 lb)
M-7-235C ..... 750 kg (1,653 lb)
MT-7-235 ..... 751 kg (1,655 lb)
M-7-260 ..... 730 kg (1,610 lb)
M-7-260C ..... 758 kg (1,671 lb)
MT-7-260 ..... 769 kg (1,696 lb)
M-7-420AC ..... 712 kg (1,570 lb)
MT-7-420 (estimated) ..... 726 kg (1,600 lb)
Max T-O weight:
MX-7-160, MX-7-160C, MXT-7-160 ..... 997 kg (2,200 lb)
MX-7-180A, MX-7-180AC, MXT-7-180A ..... 1,088 kg (2,400 lb)
MX-7-180B, MX-7-180C, MXT-7-180, M-7-235B, M-7-235C, MT-7-235, M-7-260, M-7-260C, MT-7-260, M-7-420AC, MT-7-420 ..... 1,134 kg (2,500 lb)
Max wing loading:
MX-7-160, MX-7-160C, MXT-7-160 ..... 64.86 kg/m² (13.28 lb/sq ft)
MX-7-180A, MX-7-180AC, MXT-7-180A ..... 76.76 kg/m² (14.49 lb/sq ft)
MX-7-180B, MX-7-180C, MXT-7-180, M-7-235B, M-7-235C, MT-7-235, M-7-260, M-7-260C, MT-7-260, MT-7-420 ..... 73.71 kg/m² (15.10 lb/sq ft)
M-7-420AC ..... 72.14 kg/m² (14.78 lb/sq ft)
Max power loading:
MX-7-160, MX-7-160C, MXT-7-160 ..... 8.37 kg/kW (13.75 lb/hp)
MX-7-180A, MX-7-180AC, MXT-7-180A ..... 8.12 kg/kW (13.33 lb/hp)
MX-7-180B, MX-7-180C, MXT-7-180 ..... 8.45 kg/kW (13.89 lb/hp)
M-7-235B, M-7-235C, MX-7-235 ..... 6.47 kg/kW (10.64 lb/hp)
M-7-260, MJ-7-260 ..... 5.85 kg/kW (9.61 lb/hp)
MX-7-420AC, MJ-7-420 ..... 3.62 kg/kW (5.95 lb/shp)

PERFORMANCE:
Cruising speed at 75% power at optimum altitude:
MX-7-160, MX-7-160C, MXT-7-160 ..... 104 kt (193 km/h; 120 mph)
MX-7-180A, MX-7-180AC, MXT-7-180A ..... 117 kt (217 km/h; 135 mph)
MX-7-180B, MX-7-180C, MXT-7-180 ..... 126 kt (233 km/h; 145 mph)
M-7-235B, M-7-235C, MT-7-235 ..... 139 kt (257 km/h; 160 mph)



Typical Maule M-7 tailwheel configuration *(Paul Jackson)* 0567240

M-7-260, M-7-260C, MT-7-260 ..... 142 kt (264 km/h; 164 mph)
M-7-420AC, MT-7-420 ..... 165 kt (306 km/h; 190 mph)
Stalling speed, flaps down, power off:
MX-7-160, MX-7-160C, MX-7-180A, MX-7-180AC, MX-7-180C, MXT-7-180A, MX-7-180B, MXT-7-180, M-7-235B, M-7-235C, MT-7-235, M-7-260, M-7-260C, MT-7-260 ..... 35 kt (64 km/h; 40 mph)
MX-7-420AC, MT-7-420 ..... 44 kt (81 km/h; 50 mph)
Max rate of climb at S/L:
MX-7-160, MX-7-160C, MXT-7-160 ..... 251 m (825 ft)/min
MX-7-180A, MX-7-180AC, MXT-7-180A ..... 280 m (920 ft)/min
MX-7-180B, MX-7-180C, MXT-7-180 ..... 365 m (1,200 ft)/min
M-7-235B, M-7-235C, MT-7-235 ..... 457 m (1,500 ft)/min
M-7-260, M-7-260C, MT-7-260 ..... 503 m (1,650 ft)/min
MX-7-420AC, MT-7-420 ..... 853 m (2,800 ft)/min
Service ceiling:
MX-7-160, MX-7-160C, MXT-7-160 ..... 3,965 m (13,000 ft)
MX-7-180A, MX-7-180AC, MX-7-180C, MXT-7-180A, MX-7-180B, MX-7-180C, MXT-7-180 ..... 4,575 m (15,000 ft)
M-7-235B, MT-7-235, M-7-235C, M-7-260, M-7-260C, MT-7-260, M-7-420AC, MT-7-420 ..... 6,100 m (20,000 ft)
T-O run (solo, half fuel):
MX-7-160, MX-7-160C, MXT-7-160 ..... 183 m (600 ft)
MX-7-180C, MX-7-180B, MXT-7-180 ..... 92 m (300 ft)
MX-7-420AC, MT-7-420 ..... 61 m (200 ft)
MX-7-180A, MX-7-180AC, MXT-7-180A ..... 168 m (550 ft)
M-7-235B, M-7-235C, MT-7-235, M-7-260, M-7-260C, MT-7-260 ..... 76 m (250 ft)
M-7-420AC, MT-7-420 ..... 61 m (200 ft)
T-O to 15 m (50 ft):
MX-7-160, MX-7-160C, MXT-7-160 ..... 360 m (1,180 ft)
MX-7-180A, MX-7-180AC, MXT-7-180A ..... 350 m (1,150 ft)
MX-7-180B, MX-7-180C, MXT-7-180, M-7-235B, M-7-235C, MT-7-235, M-7-260, MT-7-260, M-7-420AC, MT-7-420 ..... 183 m (600 ft)
Landing from 15 m (50 ft):
all landplane models ..... 152 m (500 ft)
Range with main tank fuel only, optimum altitude, 30 min reserves:
MX-7-160, MXT-7-160 ..... 469 n miles (869 km; 540 miles)
MX-7-180A, MXT-7-180A ..... 434 n miles (804 km; 500 miles)
MXT-7-180, all tanks ..... 825 n miles (1,528 km; 950 miles)
Range with max fuel, no reserves:
MX-7-180C ..... 951 n miles (1,762 km; 1,095 miles)
M-7-235B:
O-540 engine ..... 792 n miles (1,467 km; 912 miles)
IO-540 engine ..... 829 n miles (1,537 km; 955 miles)
M-7-235C:
O-540 engine ..... 792 n miles (1,467 km; 912 miles)
IO-540 engine ..... 864 n miles (1,601 km; 995 miles)
M-7-235B floatplane:
O-540 engine ..... 708 n miles (1,311 km; 815 miles)
IO-540 engine ..... 772 n miles (1,430 km; 889 miles)
MX-7-420:
at 75% power ..... 551 n miles (1,022 km; 635 miles)
at 50% power ..... 782 n miles (1,448 km; 900 miles)

MAVERICK

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The Maverick Air company moved into new premises in May 1998 and immediately began manufacture of the first Twinjet. In early 2001, Colorado businessman Jim McCotter acquired a majority share in Maverick Air Inc, renaming it Maverick Jets, and announced plans to establish a new company, known as McCotter Aviation, to develop a six-seat, factory-built, FAA-certified version of the Leader, designated MC2400. Development has been delayed by loss of the prototype.

In 2006, Maverick launched a new version of Leader, known as SmartJet; and single-engine variant confusingly labelled Leader 2.

MAVERICK LEADER

TYPE: Private jet.
PROGRAMME: Launched at EAA Convention at Oshkosh, Wisconsin, July 1997; then known as Twinjet 1200; construction of proof-of-concept prototype, undertaken by Maverick Air of Pueblo, Colorado started September 1999; first flight (N750TJ) 4 August 1999; designated TJ-1500 Twinjet 1500; public debut at EAA AirVenture, Oshkosh, August 2000. Became Maverick Leader in 2002. Prototype destroyed in fatal crash 24 January 2003. FAA/JAA certification planned for 2004.

Planned production by Tbilaviamsheni in Georgia terminated by TAM in early 2004.
CUSTOMERS: In 2006, Maverick announced that a Leader currently under construction for an unidentified foreign VIP would be the last of "several flying" first-generation Leaders to be produced. *Jane's* has been unable to identify any of these aircraft, except the prototype.

MAVERICK LEADER 2

TYPE: Personal jet.
PROGRAMME: Announced 2006; also publicised as Solo Jet.
DESIGN FEATURES: Lightest of Maverick family. Single-engine derivative of Leader (retrospectively Leader 1), but with several major changes, including internal engine with 'pen nib' fairing above exhaust and low wing. Retains T tail and two ventral strakes below rear fuselage.
FLYING CONTROLS: Conventional and manual.
STRUCTURE: Generally of composites.
LANDING GEAR: Tricycle type; retractable.
POWER PLANT: One 14.19 kN (3,190 lb st) Pratt & Whitney JT-15-5 turbofan. Fuel capacity more than 1,137 litres (300 US gallons; 250 Imp gallons).
ACCOMMODATION: Five persons, comprising two pilots and three on bench seat to rear. Forward hinged door each side. Single-piece windscreen; door window and rear window each side.
SYSTEMS: Autopilot.
EQUIPMENT: Optional ballistic recovery parachute.

Artist's impression of Maverick Leader 2, or Solo Jet 1040548

DIMENSIONS, EXTERNAL:
- Wing span ... 10.97 m (36 ft 0 in)
- Wing aspect ratio ... 8.1
- Length overall ... 11.10 m (33 ft 5 in)

DIMENSIONS, INTERNAL:
- Cockpit: Length ... 2.74 m (9 ft 0 in)
- Max width ... 1.37 m (4 ft 6 in)
- Max height ... 1.17 m (3 ft 10 in)

AREAS:
- Wings, gross ... 14.86 m² (160.0 sq ft)

WEIGHTS AND LOADINGS (estimated):
- Weight empty ... 1,633 kg (3,600 lb)
- Max baggage weight ... 91 kg (200 lb)
- Max T-O weight ... 2,789 kg (6,150 lb)
- Max wing loading ... 187.7 kg/m² (38.44 lb/sq ft)
- Max power loading ... 197 kg/kN (1.93 lb/lb st)

PERFORMANCE (estimated):
- Never-exceed speed (VNE) ... 450 kt (833 km/h; 517 mph)
- Max operating Mach No. at FL310 ... 0.82
- Max level speed at S/L ... 350 kt (648 km/h; 402 mph)
- Stalling speed ... 71 kt (132 km/h; 82 mph)
- Max rate of climb at S/L ... 2,423 m (7,950 ft)/min
- T-O run: no flaps ... 480 m (1,575 ft)
- 10° flap ... 348 m (1,140 ft)
- Landing run ... 561 m (1,840 ft)
- Range ... 1,200 n miles (2,222 km; 1,380 miles)
- *g* limits ... +4.3/–1.75

MAVERICK SMARTJET

TYPE: Personal jet.

PROGRAMME: Announced 2006.

CURRENT VERSIONS: **SJ-1:** Baseline version.

SJ-2: Lighter, lower-powered version; reduced weight and fuel.

DESIGN FEATURES: Development of Maverick Leader; mid-size of Maverick family. Mid-mounted, unswept, constant-chord wings with upturned tips; sweptback fin with T-tail; two large ventral strakes. Pod-mounted engines on shoulders of rear fuselage.

FLYING CONTROLS: Conventional and manual.

STRUCTURE: Generally of composites.

LANDING GEAR: Tricycle type; retractable.

POWER PLANT: Two turbofans. Fuel capacity 796 litres (210 US gallons; 175 Imp gallons) in SJ-1; 606 litres (160 US gallons; 133 Imp gallons) in SJ-2.

ACCOMMODATION: Five persons, comprising two pilots and three on bench seat to rear. Forward hinged door each side. Single-piece windscreen; door window and rear window each side.

SYSTEMS: Autopilot.

EQUIPMENT: Optional ballistic recovery parachute.

DIMENSIONS, EXTERNAL:
- Wing span ... 10.26 m (33 ft 8 in)
- Wing aspect ratio ... 8.4
- Length overall ... 8.50 m (27 ft 10½ in)

DIMENSIONS, INTERNAL:
- Cockpit: Length ... 2.03 m (6 ft 8 in)
- Max width ... 1.37 m (4 ft 6 in)
- Max height ... 1.22 m (4 ft 0 in)

AREAS:
- Wings, gross ... 12.52 m² (134.75 sq ft)

WEIGHTS AND LOADINGS (estimated):
- Weight empty: SJ-1, SJ-2 ... 975 kg (2,150 lb)
- Max baggage weight: SJ-1, SJ-2 ... 45 kg (100 lb)
- Max T-O weight: SJ-1 ... 1,887 kg (4,160 lb)
- SJ-2 ... 1,719 kg (3,790 lb)
- Max wing loading: SJ-1 ... 150.7 kg/m² (30.87 lb/sq ft)
- SJ-2 ... 137.3 kg/m² (28.13 lb/sq ft)

PERFORMANCE (estimated):
- Never-exceed speed (VNE): SJ-1, SJ-2 ... 300 kt (555 km/h; 345 mph)
- Max level speed at S/L: SJ-1 ... 250 kt (463 km/h; 288 mph)
- SJ-2 ... 225 kt (417 km/h; 259 mph)
- Cruising speed at FL220: max: SJ-1 ... 290 kt (537 kmh; 334 mph)
- SJ-2 ... 244 kt (452 km/h; 280 mph)
- normal: SJ-1 ... 277 kt (513 km/h; 319 mph)
- SJ-2 ... 235 kt (435 km/h; 270 mph)
- Stalling speed: SJ-1 ... 67 kt (124 km/h; 78 mph)
- SJ-2 ... 65 kt (121 km/h; 75 mph)
- Max rate of climb at S/L: SJ-1 ... 853 m (2,800 ft)/min
- SJ-2 ... 716 m (2,350 ft)/min
- Max rate of climb at S/L, OEI: SJ-1 ... 351 m (1,150 ft)/min
- SJ-2 ... 267 m (876 ft)/min
- T-O run to 15 m (50 ft): SJ-1 ... 402 m (1,320 ft)
- SJ-2 ... 522 m (1,710 ft)
- Landing run: SJ-1 ... 442 m (1,450 ft)
- SJ-2 ... 401 m (1,315 ft)
- Range: SJ-1 ... 1,250 n miles (2,325 km; 1,438 miles)
- SJ-2 ... 1,050 n miles (1,944 km; 1,208 miles)
- *g* limits ... +3.8/–1.76

Artist's impression of Maverick SmartJet 1040545

MAVERICK CRUISER JET

TYPE: Personal jet.

PROGRAMME: Announced 2006. Artist's impressions show prototype registered N570TJ, which reserved in September 2006 by Cirrus Design (manufacturer of SR 20 and SR 22 and known to have light jet under development).

CURRENT VERSIONS: **Cruiser Jet:** *As described.*

Sea Jet: Flying boat hull; MTOW 2,721 kg (6,000 lb); max level speed 265 kt (491 km/h; 304 mph) at S/L; M0.6 at FL310; range 1,450 n miles (2,685 km; 1,668 miles).

Military: Basic trainer and light attack jet; hinged, wholly glazed canopy; engines 7.56 kN (1,700 lb st) each. Empty weight 1,383 kg (3,050 lb); MTOW 2,540 kg (5,600 lb); fuel more than 1,326 litres (350 US gallons; 292 Imp gallons).

DESIGN FEATURES: Development of Maverick Leader; heaviest of Maverick family. Mid-mounted, unswept, constant-chord wings with upturned tips; sweptback fin with T-tail; two large ventral strakes. Pod-mounted engines on shoulders of rear fuselage.

FLYING CONTROLS: Conventional and manual.

STRUCTURE: Generally of composites.

LANDING GEAR: Tricycle type; retractable.

POWER PLANT: Two 6.67 kN (1,500 lb st) turbofans. Fuel capacity more than 1,137 litres (300 US gallons; 250 Imp gallons).

ACCOMMODATION: Five persons, comprising two pilots and three on bench seat to rear. Forward hinged door each side. Single-piece windscreen; door window and rear window each side.

SYSTEMS: Autopilot.

EQUIPMENT: Optional ballistic recovery parachute.

DIMENSIONS, EXTERNAL:
- Wing span ... 10.97 m (36 ft 0 in)
- Wing aspect ratio ... 8.1
- Length overall ... 9.62 m (31 ft 7 in)

DIMENSIONS, INTERNAL:
- Cockpit: Length ... 2.43 m (8 ft 0 in)
- Max width ... 1.37 m (4 ft 6 in)
- Max height ... 1.17 m (3 ft 10 in)

AREAS:
- Wings, gross ... 14.86 m² (160.0 sq ft)

WEIGHTS AND LOADINGS (estimated):
- Weight empty ... 1,746 kg (3,850 lb)
- Max baggage weight ... 91 kg (200 lb)
- Max T-O weight ... 2,630 kg (5,800 lb)
- Max wing loading ... 177.0 kg/m² (36.25 lb/sq ft)
- Max power loading ... 197 kg/kN (1.93 lb/lb st)

PERFORMANCE (estimated):
- Never-exceed speed (VNE) ... 450 kt (833 km/h; 518 mph)
- Max operating Mach No. at FL310 ... 0.82
- Max level speed at S/L ... 325 kt (602 km/h; 374 mph)
- Stalling speed ... 69 kt (128 km/h; 80 mph)
- Max rate of climb at S/L ... 1,981 m (6,500 ft)/min

Artist's impression of Maverick Cruiser Jet 1040544

Projected Maverick Sea Jet 1040547

Max rate of climb at S/L, OEI ..... 533 m (1,750 ft)/min
T-O run: no flaps ..... 586 m (1,920 ft)
10° flap ..... 402 m (1,320 ft)
Landing run ..... 1,295 m (2,450 ft)
Range ..... 1,450 n miles (2,685 km; 1,668 miles)
g limits ..... +4.4/–1.76

MD

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McDonnell Douglas' line of light helicopters, derived from the Hughes company's products, was acquired by Boeing as part of its purchase of the former company in August 1997. Having no part in the Boeing business strategy, all except the AH-64 Apache were offered for sale and in January 1999 it was announced that Netherlands-based holding company MD Helicopters, owned by the Rotterdam Dockyard Company (RDC), had been successful in its bid.

MD now owns all production jigs and tooling for the MD 500, 530F, 520N, 600N and Explorer, as well as a licence to employ the NOTAR system in future helicopters (the technology remaining in Boeing ownership) and in August 2000 acquired the former Boeing facility at Falcon Field, Mesa, Arizona, and began a 6,975 m^2 (75,000 sq ft) expansion to include a spares warehouse, completion and delivery centre and customer training facility.

Production Certificate 714NM issued to MDHI on 18 February 1999, covering interim manufacture of two MD 500Es (c/n 0542 and 0543), four MD 530Fs (c/n 0134 to 0137), four MD 520Ns (c/n LN086 to LN089) and three MD 600Ns (c/n RN047, 052 and 054. PC 715NM issued 5 November 1999 for all subsequent production (including MD 600s c/n RN053 and 055 upwards).

In April 2000, Kaman was contracted to build fuselages for MD's single-engine product range at its Moosup and Jacksonville plants, deliveries beginning June 2000 and, in July 2000, was contracted also to supply rotor blades for the MD Explorer. Composite Solutions of Auburn, Washington, supplies tailbooms for the NOTAR range of helicopters. TAI of Turkey is building Explorer fuselages at Akinci.

Hongdu MD Helicopters established in early 2003 as 60:40 venture between Chinese manufacturer and MD's parent (RDM Holdings); RDM then said to be investing USD10 million for Chinese assembly line for MD 500 and MD 600 at Nanchang. However, no subsequent news of this venture had emerged by late 2005.

In July 2005, New York-based financial firm Patriarch Partners acquired a controlling interest in MD Helicopters, with RDC retaining a minority share; this expected to result in acceleration of previously slow production. In November 2005 MD Helicopters extended an earlier agreement by signing a long-term contract with Kaman Aerospace for the supply of fuselage structures for the MD500 and MD600 and composites rotor blades for the MD Explorer.

MD Helicopters delivered 33 aircraft in 1999 (five MD 500Es, six MD 530Fs, five MD 520Ns, six MD 600Ns and 11 Explorers), 41 in 2000 (11 MD 500Es, three MD 530Fs, four MD 520Ns, seven MD 600Ns and 16 Explorers), 28 in 2001 (four MD 500Es, two MD 520Ns, two MD 600Ns and 20 Explorers), 15 in 2002 (five MD 500Es, four MD 520Ns, two MD 600Ns and four Explorers), 15 in 2003 (three MD 500Es, three MD 530Fs, one MD 600N, and eight Explorers), 11 in 2004 (two MD500Es, one MD 530F, four MD 600N and four Explorers), and three in 2005 (two MD 520Ns and one MD 600).

Total fleet time of all MD *NOTAR* helicopters exceeded 500,000 hours by December 2003. High-time airframe was an MD 520N operated by the Phoenix Police Department in Arizona.

MD 500 and MD 530

TYPE: Light utility helicopter.

PROGRAMME: Derived from Hughes OH-6A/civil Model 500 first flown in 1963; US certification 30 June 1964; earlier versions produced for military and civil (engineering designations 369H, 369HM, 369HS, 369HE and 369D) use. First flight MD 500E (N5294A) 28 January 1982; first flight MD 530F, 22 October 1982.

CURRENT VERSIONS: **MD 500E:** Replaced MD 500D in production 1982; deliveries started following issue of Type Certificate on 15 December 1982; Rolls-Royce 250-C20R became optional replacement for standard 250-C20B in late 1988; window area of forward canopy increased in 1991 model. MD 500E introduced many cabin improvements including more space for front and rear seat occupants, lower bulkhead between front and rear seats, T tail and optional four-blade Quiet Knight tail rotor.

MD 530F Lifter: Powered by Rolls-Royce 250-C30; transmission rating increased from 280 kW (375 shp) to 317 kW (425 shp) from 11 July 1985; diameter of main rotor increased by 0.3 m (1 ft 0 in) and of tail rotor by 5 cm (2 in); cargo hook kit for 907 kg (2,000 lb) external load available; certified 29 July 1983; first delivery 20 January 1984. Upgraded drive system in **369FF** , certified 11 July 1985.

Detailed description applies to MD 500E and 530F, except where indicated.

MD 500/530 Defender: No longer in production.

MD 500N: Produced as MD 520N.

Mexican Navy MD Helicopters MD 500E 1159701

CUSTOMERS: Some 4,670 OH-6/MD 500/530 series (excluding licensed manufacture) produced by late 2004. Total of 568 MD 500Es, plus 145 MD 530Fs, delivered by end of 2006. The Police Departments of Mesa, Arizona, Columbus, Ohio, Wichita, Kansas, and Atlanta, Georgia; and the Xiongying Aero Club of Zhongshan, China, each took delivery of an MD500E during 2002; the Metropolitan Police Department of Las Vegas, Nevada, has three MD 530Fs. Mesa fleet rose to three in December 2002 while Oklahoma City's fleet simultaneously increased to two.

COSTS: Typical MD 500E USD860,000; MD 530F USD1.1 million (2002). Direct operating cost: MD 500E USD211, MD 530F USD237 per hour (both 2002).

DESIGN FEATURES: Fully articulated five-blade main rotor with blades retained by stack of laminated steel straps; blade aerofoil section NACA 015; blades can be folded after removing retention pins; two-blade tail rotor with optional X-pattern four-blade Quiet Knight tail rotor to reduce external noise; optional high-skid landing gear to protect tail rotor in rough country; protective skid on base of lower fin; narrow chord fin with high-set tailplane and endplate fins introduced with MD 500D. Main rotor rpm (500E/530F) 492/477 normal; main rotor tip speed 207 to 208 m (680 to 684 ft)/s; tail rotor rpm, 2,933/2,848.

FLYING CONTROLS: Plain mechanical without hydraulic boost.

STRUCTURE: Airframe based on two A frames from rotor head to landing gear legs, enclosing rear-seat occupants; front-seat occupants protected within straight line joining rotor hub and forward tips of landing skids; engine mounted inclined in rear of fuselage pod, with access through clamshell doors; main rotor blades have extruded aluminium spar hot-bonded to wraparound aluminium skin; tail rotor blades have swaged tubular spar and metal skin. Thicker fuselage skins, to reduce surface rippling, introduced during 2001.

LANDING GEAR: Tubular skids carried on oleo-pneumatic shock-absorbers. Utility floats, snow skis and emergency inflatable floats optional.

POWER PLANT: *MD 500E:* One 313 kW (420 shp) Rolls-Royce 250-C20B or 335.5 kW (450 shp) 250-C20R turboshaft, derated in both cases to 280 kW (375 shp) for T-O (5 minutes); maximum continuous rating 261 kW (350 shp).

MD 530F: One 485 kW (650 shp) Rolls-Royce 250-C30 turboshaft, derated to 317 kW (425 shp) up to 50 kt (92 km/h; 57 mph) and 280 kW (375 shp) above 50 kt (92 km/h; 57 mph) and for maximum continuous power (MCP).

MCP transmission rating 261 kW (350 shp); improved, heavy-duty transmission, rating 447 kW (600 shp), derated to 280 kW (375 shp) optional on production aircraft or for retrofit from June 1995.

Two interconnected bladder fuel tanks with combined usable capacity of 242 litres (64.0 US gallons; 53.3 Imp gallons). Self-sealing fuel tank optional. Refuelling point on starboard side of fuselage. Auxiliary fuel system, with 79.5 litre (21.0 US gallon; 17.5 Imp gallon) internal tank, available optionally. Oil capacity 5.7 litres (1.5 US gallons; 1.2 Imp gallons). Greater capacity internal fuel tanks also available.

ACCOMMODATION: Forward bench seat for pilot and two passengers, with two or four passengers, or two litter patients and one medical attendant, in rear portion of cabin. Pilot sits on left instead of normal right-hand seating. Low-back front seats and individual rear seats, with fabric or leather upholstery, optional. Baggage space, capacity 0.31 m^3 (11 cu ft), under and behind rear seat in five-seat form. Clear space for 1.2 m^3 (42 cu ft) of cargo or baggage with only three front seats in place. Two doors on each side. Interior soundproofing optional.

SYSTEMS: Aero Engineering Corporation air conditioning system or Fargo pod-mounted air conditioner optional.

AVIONICS (MD 500E): Optional avionics listed below.

Comms: Dual Bendix/King KY 195 or Rockwell Collins VHF-251 transceivers; Bendix/King KT 76 or Rockwell Collins TDR-950 transponder; intercom system, headsets, microphones; and optional public address system.

Radar: Optional installation.

Flight: Dual Bendix/King KX 175 or Rockwell Collins VHF-251/231 nav receivers, latter with IND-350 nav indicator; Bendix/King KR 85 or Rockwell Collins ADF-650 ADF.

Instrumentation: Basic VFR instruments and night flying lighting, attitude and directional gyros and rate of climb indicator.

Mission: Optional, FLIR and 30 Mcd Spectrolab SX-16 Nightsun searchlight.

EQUIPMENT: Optional equipment includes shatterproof glass, heating/demisting system, nylon mesh seats, dual controls, cargo hook, cargo racks, underfuselage cargo pod, heated pitot tube, extended landing gear, blade storage rack, litter kit, emergency inflatable floats and inflated utility floats.

DIMENSIONS, EXTERNAL:

Main rotor diameter: 500E ..... 8.05 m (26 ft 5 in)
530F ..... 8.33 m (27 ft 4 in)
Main rotor blade chord ..... 0.171 m (6¾ in)
Tail rotor diameter: 500E ..... 1.37 m (4 ft 6 in)
530F ..... 1.42 m (4 ft 8 in)
Distance between rotor centres: 500E ..... 4.67 m (15 ft 4 in)
530F ..... 4.88 m (16 ft 0 in)
Length overall, rotors turning: 500E ..... 8.61 m (28 ft 3 in)
530F ..... 9.94 m (32 ft 7¼ in)
Length of fuselage ..... 7.49 m (24 ft 7 in)
Height to top of rotor head: standard skids ..... 2.67 m (8 ft 9 in)
extended skids ..... 2.97 m (9 ft 8¾ in)
Tailplane span ..... 1.65 m (5 ft 5 in)
Skid track (standard) ..... 1.91 m (6 ft 3 in)
Cabin doors (each): Height ..... 1.13 m (3 ft 8½ in)
Max width ..... 0.76 m (2 ft 6 in)
Height to sill: 500E ..... 0.79 m (2 ft 7 in)
530F ..... 0.76 m (2 ft 6 in)
Cargo compartment doors (each): Height ..... 1.12 m (3 ft 8¼ in)
Width ..... 0.88 m (2 ft 10½ in)
Height to sill: 500E ..... 0.71 m (2 ft 4 in)
530F ..... 0.66 m (2 ft 2 in)

DIMENSIONS, INTERNAL:

Cabin: Length ..... 2.44 m (8 ft 0 in)
Max width ..... 1.31 m (4 ft 3½ in)
Max height ..... 1.52 m (5 ft 0 in)

AREAS:

Main rotor blades (each): 500E ..... 0.62 m^2 (6.67 sq ft)
530F ..... 0.65 m^2 (6.96 sq ft)

Tail rotor blades (each): 500E ..... 0.063 m² (0.675 sq ft)
530F ..... 0.066 m² (0.711 sq ft)
Main rotor disc: 500E ..... 50.89 m² (547.8 sq ft)
530F ..... 54.58 m² (587.5 sq ft)
Tail rotor disc: 500E ..... 1.53 m² (16.47 sq ft)
530F ..... 1.65 m² (17.72 sq ft)
Fin ..... 0.56 m² (6.05 sq ft)
Tailplane ..... 0.76 m² (8.18 sq ft)

WEIGHTS AND LOADINGS:
Weight empty: 500E ..... 672 kg (1,481 lb)
530F ..... 722 kg (1,591 lb)
Max normal T-O weight: 500E ..... 1,361 kg (3,000 lb)
530F ..... 1,406 kg (3,100 lb)
Max overload T-O weight: 500E, 530F ..... 1,610 kg (3,550 lb)
Max T-O weight, external load: 530F ..... 1,701 kg (3,750 lb)
Max hook capacity: 530F ..... 907 kg (2,000 lb)
Disc loading at max normal T-O weight: 500E ..... 26.8 kg/m² (5.48 lb/sq ft)
530F ..... 25.8 kg/m² (5.28 lb/sq ft)
Transmission loading at max T-O weight and power: 500E standard ..... 5.22 kg/kW (8.57 lb/shp)
500E optional ..... 4.87 kg/kW (8.00 lb/shp)
530F standard ..... 5.39 kg/kW (8.86 lb/shp)
530F optional ..... 5.03 kg/kW (8.27 lb/shp)

PERFORMANCE (at max normal T-O weight, except where indicated):
Never-exceed speed (VNE) at S/L:
500E, 530F ..... 152 kt (282 km/h; 175 mph)
Max cruising speed at S/L:
500E ..... 135 kt (250 km/h; 155 mph)
530F ..... 134 kt (248 km/h; 154 mph)
Max cruising speed at FL50:
500E ..... 132 kt (245 km/h; 152 mph)
530F ..... 135 kt (249 km/h; 155 mph)
Econ cruising speed at S/L:
500E ..... 129 kt (239 km/h; 149 mph)
530F ..... 131 kt (243 km/h; 151 mph)
Econ cruising speed at FL50:
500E, 530F ..... 123 kt (228 km/h; 142 mph)
Max rate of climb at S/L, ISA:
500E ..... 536 m (1,760 ft)/min
530F ..... 631 m (2,070 ft)/min
Max rate of climb at S/L, ISA+20°C:
530F ..... 628 m (2,061 ft)/min
Vertical rate of climb at S/L: 500E ..... 248 m (813 ft)/min
530F ..... 446 m (1,462 ft)/min
Service ceiling: 500E ..... 4,575 m (15,000 ft)
530F ..... 5,700 m (18,700 ft)
Hovering ceiling IGE: ISA: 500E ..... 2,621 m (8,600 ft)
530F ..... 4,875 m (16,000 ft)
ISA+20°C: 500E ..... 1,830 m (6,000 ft)
530F ..... 4,358 m (14,300 ft)
Hovering ceiling OGE: ISA: 500E ..... 2,073 m (6,800 ft)
530F ..... 4,389 m (14,400 ft)
ISA+20°C: 500E ..... 975 m (3,200 ft)
530F ..... 3,535 m (11,600 ft)
Range, 2 min warm-up, standard fuel, no reserves:
500E at S/L ..... 233 n miles (431 km; 268 miles)
530F at S/L ..... 200 n miles (371 km; 231 miles)
500E at FL50 ..... 290 n miles (334 km; 537 miles)
530F at FL50 ..... 232 n miles (429 km; 267 miles)
Endurance, 530F at S/L ..... 2 h 0 min

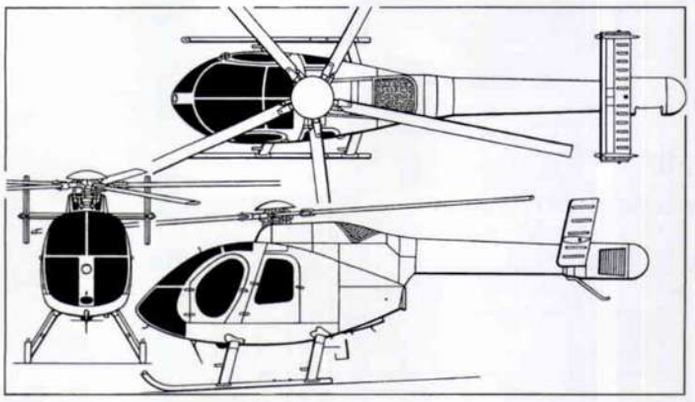
MD 520N

Engineering designation: MD 500N

TYPE: Light utility helicopter.

PROGRAMME: First flight OH-6A NOTAR (no tail rotor) testbed 17 December 1981; extensive modifications during 1985 with second blowing slot, new fan, 250-C20B engine and MD 500E nose; flight testing resumed 12 March 1986 and completed in June; retired to UcS Army Aviation Museum, Fort Rucker, Alabama, October 1990. Commercial MD 520N and uprated (485 kW; 650 shp Rolls Royce 250-C30) MD 530N NOTAR helicopters announced February 1988 and officially launched January 1989; first flight of MD 530N (N530NT) 29 December 1989, but this variant not pursued; first flight 520N (N520NT) 1 May 1990 and first production 520N 28 June 1991; 520N certified 12 September 1991 on MD500 type certificate; first production 520N (N521FB) delivered to Phoenix Police Department 31 October 1991. MD 520N set new Paris to London speed record in September 1992, at 1 hour 22 minutes 29 seconds. Now certified in 21 countries.

MD Helicopters MD 520N operated by Phoenix Police Department 1159702



MD 520N five-seat NOTAR helicopter *(Mike Keep)* 1159688

CURRENT VERSIONS: **MD 520N:** NOTAR version of MD 500, offering more power, higher operating altitude and greater maximum T-O weight than MD 500E. Engineering designation is **MD 500N**.

Description applies to 520N.

MD 600N: Stretched version, described separately.

MD 520N Defender: Military variant, being developed.

CUSTOMERS: Delivery of 100th MD 520N took place on 28 March 2005 to GALS Russian Helicopter Company; 104th registered late 2006. Law enforcement agencies flying MD 520Ns include Phoenix, Arizona (first operator; two more delivered in early 2002); Burbank, Glendale, Huntington Beach, Los Angeles, Ontario and San Jose, California; Hernando County, Florida; Orange County, Florida; Jefferson County, Kentucky, which took delivery of one in March 2002; Prince George County, Clinton, Maryland, which took delivery of two on 4 October 2000; Hamilton County, Ohio, which has seven 520Ns; El Salvador, whose Policia Nacional Civil took delivery of two in 1996; San Juan, Puerto Rico; Honolulu, Hawaii; and Calgary, Alberta, Canada. Other operators include the Tata Group of Mumbai, India, Weetabix Ltd, UK, and Belgian Gendarmerie (two).

COSTS: US$980,000 (2002). Direct operating cost US$224.71 per hour (2002).

DESIGN FEATURES: NOTAR system provides anti-torque and steering control without an external tail rotor, thus eliminating the danger of tail strikes; air emerging through Coanda slots and steering louvres is cool and at low velocity. Believed to be currently the quietest turbine helicopter, based on FAA certification test noise figures. Main rotor rpm 477; main rotor tip speed 208 m (684 ft)/s; NOTAR system fan rpm 5,388. Emergency floats among options. Redesigned diffuser in NOTAR tailboom and revised fan rigging introduced from early 2000 and available for retrofit; combined with uprated Rolls-Royce 250-C20R+ engine (see below); these improvements increase the aircraft's payload capability.

FLYING CONTROLS: Unboosted mechanical, as in earlier versions. Rotor downwash over tailboom deflected to port by two Coanda-type slots fed with low-pressure air from engine-driven variable-pitch fan in root of tailboom; this counters normal rotor torque; some fan air is also vented at tail through variable-aperture louvres controlled by pilot's foot pedals, giving steering control in hover and forward flight. Port moving fin on tailplane connected to foot pedals, primarily to increase directional control during autorotation and allow touchdown at under 20 kt (37 km/h; 23 mph); starboard fin operated independently by yaw damper.

STRUCTURE: Same as for MD 500E/530F, except graphite composites tailboom; metal tailplane and fins; new high-efficiency fan with composites blades fitted in production aircraft. NOTAR system components now have twice the lifespan of conventional tail rotor system assemblies. During 1993, NOTAR system components' warranty increased from two to three years. Thicker fuselage skins, to reduce surface rippling, will be introduced during 2001.

POWER PLANT: One Rolls-Royce 250-C20R turboshaft, derated to 317 kW (425 shp) for T-O (5 minutes) and 280 kW (375 shp) maximum continuous. Improved, heavy-duty transmission, rating 447 kW (600 shp), derated to 317 kW (425 shp) for T-O, 280 kW (375 hp) maximum continuous, on production aircraft from June 1995. Rolls-Royce 250-C20R+ engine, providing improved hot weather performance and 3 to 5 per cent more power, introduced from early 2000. Fuel capacity 235 litres (62.0 US gallons; 51.6 Imp gallons).

SYSTEMS: Electrical system includes 87 Ah starter-generator. Aero Aire air conditioning system optional.

EQUIPMENT: Phoenix Police Department pioneered use of MD 520Ns for firefighting, using 341 litre (90.0 US gallon; 75.0 Imp gallon) 'Bambi' buckets to drop 151,416 litres (40,000 US gallons; 33,307 Imp gallons) of water on fires in remote desert and mountain areas.

DIMENSIONS, EXTERNAL:
Rotor diameter ..... 8.33 m (27 ft 4 in)
Length: overall, rotor turning ..... 9.78 m (32 ft 1¼ in)
fuselage ..... 7.77 m (25 ft 6 in)
Height to top of rotor head:
standard skids ..... 2.74 m (9 ft 0 in)
extended skids ..... 3.01 m (9 ft 10¾ in)
Height to top of fins ..... 2.83 m (9 ft 3½ in)
Tailplane span ..... 2.01 m (6 ft 7¼ in)
Skid track ..... 1.92 m (6 ft 3½ in)

AREAS:
Rotor disc ..... 54.51 m² (586.8 sq ft)

WEIGHTS AND LOADINGS:
Weight empty: standard ..... 719 kg (1,586 lb)
Max fuel weight ..... 183 kg (404 lb)
Max hook capacity ..... 1,004 kg (2,214 lb)
Max T-O weight: normal ..... 1,519 kg (3,350 lb)
with external load ..... 1,746 kg (3,850 lb)
Max normal disc loading ..... 27.9 kg/m² (5.71 lb/sq ft)
Transmission loading at max T-O weight and power ..... 4.80 kg/kW (7.88 lb/shp)

PERFORMANCE (at normal max T-O weight, ISA, except where indicated):
Never-exceed speed (VNE) ..... 152 kt (281 km/h; 175 mph)
Max cruising speed at S/L ..... 123 kt (228 km/h; 141 mph)
Max rate of climb at S/L: ISA ..... 564 m (1,850 ft)/min
ISA + 20°C ..... 480 m (1,575 ft)/min
Service ceiling ..... 4,320 m (14,175 ft)
Hovering ceiling IGE ..... 2,835 m (9,300 ft)

Hovering ceiling OGE: ISA ..... 1,707 m (5,600 ft)
ISA +20°C ..... 1,292 m (4,240 ft)
Range at S/L ..... 253 n miles (469 km; 291 miles)
Endurance at S/L ..... 2 h 24 min
OPERATIONAL NOISE LEVELS:
T-O ..... 85.4 EPNdB
Approach ..... 87.9 EPNdB
Flyover ..... 80.2 EPNdB

MD 600N

TYPE: Light utility helicopter.

PROGRAMME: Stretched version of MD 520N. Announced as 'concept', 8 November 1994; prototype, then known as MD 630N (N630N, converted from MD 530F demonstrator), first flight 22 November 1994, 138 days after project approval; public debut at Heli-Expo in Las Vegas January 1995; production go-head 28 March 1995, at which time designation changed to MD 600N; prototype first flown with production standard engine and rotor system 6 November 1995; production prototype (N600RN) first flown 15 December 1995, and became certification test vehicle leading to FAR Pt 27 certification, but was destroyed in ground fire 28 May 1996, following emergency landing after rotor/tailboom strike during abrupt control reversal tests. This resulted in changes to tailboom/rotor clearance; third prototype (N605AS) flown 9 August 1996; further accidents to N630N on 4 and 21 November 1996 and on 18 January 1997, all during autorotational descents, culminated in total loss and delayed certification and first delivery, originally scheduled for 18 December 1996, to 15 May and 6 June 1997, respectively. MD 600N certified on MD500 certificate.

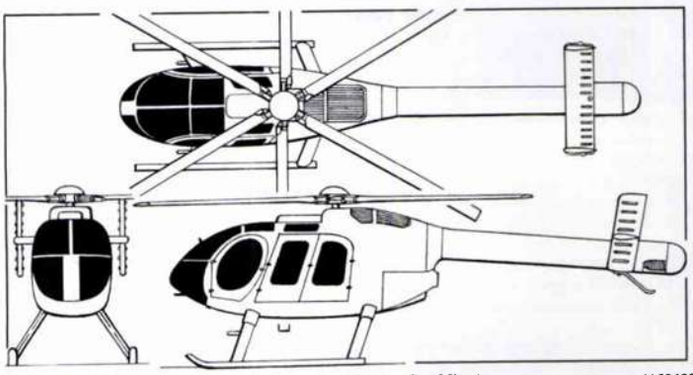
In July 1998, Boeing completed a year-long envelope expansion programme for the MD 600N leading to FAA approval for operation at a density altitude of 2,135 m (7,000 ft) at a T-O weight of 1,746 kg (3,850 lb) and at a density altitude of 1,220 m (4,000 ft) at a T-O weight of 1,860 kg (4,100 lb). Other performance enhancements approved by the FAA included provision for doors-off operation at speeds up to 115 kt (213 km/h; 132 mph), operation at temperatures -40°C/52°C (-40°F/126°F), lifting up to 968 kg (2,134 lb) on the external cargo hook, making slope landings up to 10° in any direction, operation with emergency floats and for installation of a movable landing light and additional wire strike protection on the fuselage. The MD 600N also completed HIRF trials at NAS Patuxent River, Maryland. Yaw-stability augmentation system (Y-SAS) under development during 2000, aimed at reducing pilot workload during extended flights and in turbulent conditions; Y-SAS was expected to be available from March 2001, following FAA certification, and will be field-installable.

CUSTOMERS: Total of 70 registered by mid-2006. Launch customer AirStar Helicopter of Arizona (two, of which first delivered 6 June 1997); Saab Helikopter AB of Sweden and Rotair Limited of Hong Kong ordered one each in June 1995; other customers include Guangdong General Aviation Company (GGAC) of the People's Republic of China, which took delivery of one MD 600N in November 2000, during Airshow China 2000 in Zhuhai, Los Angeles County Sheriff's Department Aero Bureau (three), Orange County, California, Sheriff's Department, Indianapolis, Indiana, Police Department (one), Presta Services of France (one), Turkish National Police, which ordered 10 in December 2000 for delivery during 2002 (subsequently postponed to 2003), UND (University of North Dakota) Aerospace (one), West Virginia State Police (one) and the US Border Patrol (45, of which 11 delivered by end of 1998, when procurement halted pending evaluation of UAVs for border patrol role).

COSTS: USD1.315 million (2002). Direct operating cost USD269 per hour (2002).

DESIGN FEATURES: Stretched MD 520N airframe (less than 1 per cent new parts) by means of 0.76 m (2 ft 6 in) plug aft of cockpit/cabin bulkhead and 0.71 m (2 ft 4 in) plug in tailboom, combined with more powerful engine, uprated transmission and six-blade main rotor. Cabin has flat floor to assist cargo handling, and will feature quick-change interior configurations

MD Helicopters MD 600N used for power line inspection 1159703



MD 600N eight-seat NOTAR helicopter *(James Goulding)* 1159689

to suit multiple-use operators. Intended for civil, utility, offshore, executive transport, medevac, aerial news gathering, touring, law enforcement and other noise-sensitive operations; also adaptable for armed scout, utility and other military missions.

Description generally as for MD 520N except as follows:

POWER PLANT: One 603 kW (808 shp) Rolls-Royce 250-C47M turboshaft, derated to 447 kW (600 shp) for T-O (5 minutes) and 395 kW (530 shp) maximum continuous, with FADEC. Transmission manufactured from WE43A magnesium alloy for lower weight, greater strength and enhanced corrosion resistance, rating 447 kW (600 shp). Fuel contained in two crashworthy bladder tanks in lower fuselage, total capacity 440 litres (116 US gallons; 96.8 Imp gallons), of which 434 litres (115 US gallons; 95.5 Imp gallons) are usable.

ACCOMMODATION: Standard seating for eight, including pilot, in 3+3+2 configuration with centre bench; alternative six-seat club and coach layouts; utility with main cabin seats removed; EMS with accommodation for pilot, one stretcher case and two medical attendants; or electronic news gathering, with accommodation for pilot and passenger in cockpit and operator with cabin and monitor in cabin. All facilitated by quick-release seat mechanisms. Two removable centre-opening doors on each side of cabin; door to cockpit on each side. Bubble 'comfort' windows and sliding windows for cabin, custom soundproofing and Integrated Flight Systems Inc air conditioning optional.

SYSTEMS: Electrical system comprises 28 V 200 Ah starter-generator and 28 V 17 Ah Ni/Cd battery. 24 V auxiliary power receptacle inside starboard cockpit door standard.

AVIONICS: To customer's choice, including VHF/UHF/FM/AM transceivers, GPS, transponder, ELT, intercom, stereo tape system and PA system.

EQUIPMENT: Optional equipment includes dual controls, particle separator, heated pitot tube, rotor brake, cargo hook, wire strike kit and emergency floats.

DIMENSIONS, EXTERNAL:
Rotor diameter ..... 8.38 m (27 ft 6 in)
Rotor ground clearance ..... 2.65 m (8 ft 8½ in)
Length: overall, rotor turning ..... 10.79 m (35 ft 4¾ in)
fuselage ..... 8.99 m (29 ft 6 in)
Fuselage width at cabin ..... 1.40 m (4 ft 7 in)
Height to top of rotor head:
standard skids ..... 2.65 m (8 ft 8½ in)
extended skids ..... 2.74 m (9 ft 0 in)
Height to top of fins:
standard skids ..... 2.68 m (8 ft 9½ in)
extended skids ..... 2.83 m (9 ft 3½ in)
Fuselage ground clearance, extended skids ..... 0.58 m (1 ft 10¾ in)
Skid track ..... 2.47 m (8 ft 1¼ in)
Tailplane span, over fins ..... 2.01 m (6 ft 7¼ in)
DIMENSIONS, INTERNAL:
Cabin, excl cockpit: Length ..... 1.83 m (6 ft 0 in)
Width ..... 1.22 m (4 ft 0 in)
Height ..... 1.22 m (4 ft 0 in)
AREAS:
Rotor disc ..... 55.18 m² (594.0 sq ft)
WEIGHTS AND LOADINGS:
Weight empty, standard ..... 952 kg (2,100 lb)
Useful load: internal ..... 907 kg (2,000 lb)
external ..... 1,179 kg (2,600 lb)
Max hook capacity ..... 1,361 kg (3,000 lb)
Max T-O weight: internal load ..... 1,859 kg (4,100 lb)
slung load ..... 2,131 kg (4,700 lb)
Max disc loading:
internal load ..... 33.7 kg/m² (6.90 lb/sq ft)
slung load ..... 38.6 kg/m² (7.91 lb/sq ft)
Transmission loading at max T-O weight and power:
internal load ..... 4.16 kg/kW (6.83 lb/shp)
slung load ..... 4.77 kg/kW (7.83 lb/shp)
PERFORMANCE:
Never-exceed speed (VNE) ..... 135 kt (250 km/h; 155 mph)
Max cruising speed, S/L to FL50, ISA ..... 134 kt (248 km/h; 154 mph)
Max rate of climb at S/L, ISA ..... 411 m (1,350 ft)/min
Max operating altitude ..... 6,100 m (20,000 ft)
Hovering ceiling, ISA: IGE ..... 3,383 m (11,100 ft)
OGE ..... 1,829 m (6,000 ft)
Max range:
at S/L ..... 342 n miles (633 km; 393 miles)
at FL50, ISA ..... 382 n miles (707 km; 439 miles)
Endurance: at S/L ..... 3 h 36 min
at FL50 ..... 3 h 54 min

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MD EXPLORER

US Coast Guard designation: MH-90 Enforcer

TYPE: Light utility helicopter.

PROGRAMME: Initially known as MDX, then MD 900 (proposed MD 901 with Turbomeca engines was not pursued); McDonnell Douglas design; announced February 1988; launched January 1989; Hawker de Havilland of Australia designed and manufactures airframe; Canadian Marconi tested initial version of integrated instrumentation display system (IIDS) early 1992; Kawasaki completed 50 hour test of transmission early 1992. Other partners include Aim Aviation (interior), IAI (cowling and seats) and Lucas Aerospace (actuators). Ten prototypes and trials aircraft, of which seven (Nos. 1, 3-7 and 9) for static tests; first flight (No.2/N900MD) 18 December 1992, followed by No.8/N900MH 17 September 1993 and No.10/N9208V 16 December 1993; first production/demonstrator Explorer (No.11/N92011) flown 3 August 1994. FAA certification 2 December 1994; first delivery 16 December 1994; JAA certification July 1996; FAA certification for single-pilot IFR operation achieved January 1997. Type certificate transferred to MDHI on 18 February 1999.

FAA certification of uprated PW207E engine achieved in July 2000, providing 11 per cent more power for take-off and 610 m (2,000 ft) increase in hovering capability OEI in hot-and-high conditions; first delivery of PW207E-engined Explorer to Police Aviation Services, UK, 27 September 2000. "100th production" Explorer (actually 89th overall, including prototypes) delivered 1 March 2002 to Tomen Aerospace Corporation of Japan for ENG operations by Aero Asahi of Hiroshima. Total fleet time stood at more than 120,000 hours by December 2002.

CURRENT VERSIONS: **MD Explorer:** Initial civilian utility version, as described.

Details apply to civilian version except where indicated.

MD Enhanced Explorer: Improved version, announced September 1996; originally MD 902, but now known as "902 Configuration". Main features include Pratt & Whitney Canada PW206E engines with increased OEI ratings; transmission approved for dry running for 30 minutes at 50 per cent power; improved engine air inlets, NOTAR inlet design and engine fire suppression system, and more powerful stabiliser control system, resulting in 7 per cent increase in range, 4 per cent increase in endurance and 113 kg (250 lb) increase in payload over Explorer. First flight (N9224U; c/n 900-0051, 41st Explorer) 5 September 1997. FAA certification to Category A performance standards (including continued take-off with one failed engine) and single-pilot IFR operation achieved 11 February 1998; JAA certification for Category A performance achieved July 1998. Retrofit kits to convert Explorers to Category A standard. First Enhanced Explorer delivery in May 1998 to Tomen Aerospace of Japan. PW206E replaced by PW207E from late 2000, beginning at c/n 900-0077, allowing further MTOW increase to 2,948 kg (6,500 lb).

MH-90 Enforcer: Beginning March 1999, under a programme code-named Operation New Frontier, the US Coast Guard used two leased MD 900 Explorers for shipboard anti-drug smuggling operations. Armed with a pintle-mounted M240 7.62 mm minigun at the door station. In September 1999 the MD900s were exchanged for two leased MD 902 Enhanced Explorers. These subsequently replaced by Agusta A 109s. Six delivered to Mexican Navy at Acapulco (two each respectively in May and December 1999 and April 2000) for anti-drug operations, equipped with 0.50 in General Dynamics GAU-19/A Gatling guns, and 70 mm rocket pods; further four in process of delivery. Weapons qualification trials were completed at Fort Bliss, Texas in November 2000.

CUSTOMERS: Market estimated at 800 to 1,000 in first decade; however, only 103 registered and built by end of 2003; followed by 104th in August 2006. First delivery 16 December 1994 to Petroleum Helicopters Inc (PHI) which ordered five; second delivery (N901CF) December 1994 to Rocky Mountain Helicopters for EMS duties with affiliate Care Flight unit of Regional Emergency Medical Services Authority (REMSA) in Reno, Nevada. Total of two delivered in 1994, 12 in 1995, 15 in 1996, one in 1997, four in 1998, 11 in 1999, 16 in 2000, 20 in 2001, four in 2002, eight in 2003, and four in 2004; initial (MD 900) series comprised 40 aircraft, including three flying prototypes; PW207E engine from 64th production (67th overall) aircraft.

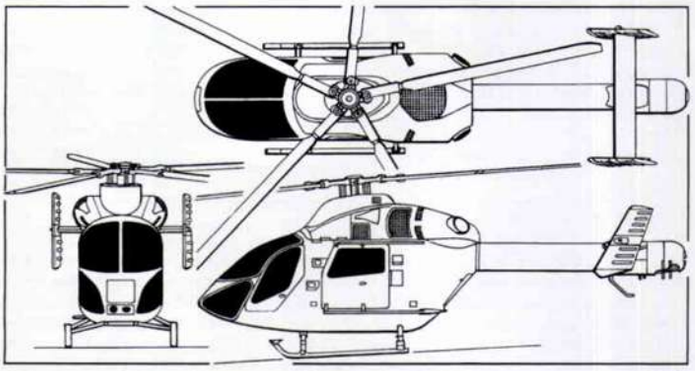
The US Drug Enforcement Administration took delivery of one on 21 January 2004.

COSTS: USD2.285 million (2002); direct operating cost USD408.11 (2002) per hour.

DESIGN FEATURES: NOTAR anti-torque system; all-composites five-blade rotor of tapered thickness with parabolic swept outer tip with bearingless flexbeam retention and pitch case; tuned fixed rotor mast and mounting truss for vibration reduction; replaceable rotor tips; maximum rotor speed 392 rpm; modified A-frame construction from rotor mounting to landing skids protects passenger cabin; energy-absorbing seats absorb 20 *g* vertically and 16 *g* fore and aft; onboard health monitoring, exceedance recording and blade track/balance.

FLYING CONTROLS: NOTAR tailboom (see details under MD 520N); mechanical engine control from collective pitch lever is back-up for electronic FADEC. Automatic stabilisation and autopilot available for IFR operation.

STRUCTURE: Cockpit, cabin and tail largely carbon fibre; top fairings Kevlar composites; no magnesium; lightning strike protection embedded in composites skin. Transmission overhaul life 5,000 hours; glass fibre blades have titanium leading-edge abrasion strip and are attached to bearingless hub by carbon fibre encased glass fibre flexbeams; rotor blades and hub on condition.



MD Explorer eight-seat commercial helicopter *(Mike Keep)* 1159690

LANDING GEAR: Fixed skids with replaceable abrasion pads; emergency floats optional.

POWER PLANT: Baseline MD 900 powered by two Pratt & Whitney Canada PW206E turboshafts with FADEC, each rated at 463 kW (621 shp) for 5 minutes for T-O, 489 kW (656 shp) for 2½ minutes OEI and 410 kW (550 shp) maximum continuous. Transmission rating 820 kW (1,100 shp) for T-O, 746 kW (1,000 shp) maximum continuous, 507 kW (680 shp) for 2½ minutes OEI and 462 kW (620 shp) maximum continuous OEI.

Fuel contained in single tank under passenger cabin, capacity 564 litres (149 US gallons; 124 Imp gallons), of which 553 litres (146 US gallons; 122 Imp gallons) are usable. single-point refuelling; self-sealing fuel lines.

ACCOMMODATION: Two pilots or pilot/passenger in front on energy-absorbing adjustable crew seats with five-point shoulder harnesses/seat belts; six passengers in club-type energy-absorbing seating with three-point restraints; rear baggage compartment accessible through rear door; cabin can accept long loads reaching from flight deck to rear door; hinged, jettisonable door to cockpit on each side; sliding door to cabin on each side.

SYSTEMS: Hydraulic system, operating pressure 34.475 bar (500 lb/sq in).

AVIONICS: Full IFR capability for single- or two-pilot operation.

Comms: Two headsets standard. Bendix/King Silver Crown VHF transceiver, audio control panel, ELT, cockpit voice recorder and Wulfsberg Flexcomm II optional.

Radar: Honeywell RDR 2000 vertical profile colour weather radar optional with IFR package.

Flight: Optional equipment includes Bendix/King Silver Crown VOR/ILS, HSI, ADF, DME, marker beacon receiver, radar altimeter, Loran C and KLN 90B GPS. Coupled three-axis autopilot optional.

Instrumentation: single- or two-pilot instrument panels incorporate Canadian Marconi integrated instrumentation display system (IIDS) with high-resolution sunlight-readable LCD screen displaying engine and system information including engine condition trend monitoring, exceedance recording, caution annunciators, onboard track and balance of rotor and fan, weight on cargo hook, outside air temperature, digital clock, running time meter and RS-232 download modem interface for personal computer. Other standard instrumentation includes airspeed indicator, encoding altimeter, vertical speed indicator, turn and slip indicator, wet compass and clock. EFIS 40 electronic flight information system and parallel IIDS monitor for long-line hook operations from left seat optional.

Mission: Law enforcement panel with space for FLIR screen available. Avionics and equipment options for law enforcement conversions are described in *Jane's Aircraft Upgrades*.

EQUIPMENT: Standard equipment includes magnetic chip detectors on engines, tiedown fittings, flush-mounted cargo tiedowns, rotor blade tiedowns, right side passenger step, utility beige colour carpet, trim, wall and ceiling panels, soundproofing, tinted windows, map case, recessed hover and approach light, wander and white dome lights in cockpit, white dome light in cabin, utility light in baggage compartment, single 28 V DC power outlet each in cockpit and cabin, single colour external paint with two-colour accent stripes, FOD covers, pitot tube cover and cockpit fire extinguisher.

Optional equipment includes dual controls, heated pitot head, rotor brake, pilot-activated engine fire extinguisher, engine air particle separator, maintenance hand pump for hydraulics, external cargo hook with 1,361 kg (3,000 lb) capacity 272 kg (600 lb) personnel

Belgian Police MD Explorer *(Paul Jackson)* 1159737

hoist, wire strike kit, emergency floats for skids, retractable landing light, port side cabin step, landing gear and rotor fairing canopy cover, heater/defogger, vapour-cycle air conditioner, upgraded soundproofing, passenger service unit with air gaspers and reading lights, window reveal panels, matching close-out panel for aft baggage area, upgraded passenger seats, smoke detector in baggage compartment, jack-point fittings and ground handling wheels.

DIMENSIONS, EXTERNAL:

Rotor diameter	10.31 m (33 ft 10 in)
Length: overall, rotor turning	11.83 m (38 ft 10 in)
fuselage	9.85 m (32 ft 4 in)
Fuselage width at cabin	1.63 m (5 ft 4 in)
Height: to top of rotor head	3.66 m (12 ft 0 in)
to top of fins	2.79 m (9 ft 2 in)
Min fuselage ground clearance	0.38 m (1 ft 3 in)
Tailplane span	2.84 m (9 ft 4 in)
Skid track	2.24 m (7 ft 4 in)
Cabin door width	1.27 m (4 ft 2 in)

DIMENSIONS, INTERNAL:

Cabin:	
Length: overall, incl baggage compartment	3.93 m (12 ft 10¾ in)
passenger compartment only	1.91 m (6 ft 3 in)
Max height	1.24 m (4 ft 1 in)
Max width	1.45 m (4 ft 9 in)
Volume	4.9 m^3 (173 cu ft)
Baggage (if closed off)	1.39 m^3 (49 cu ft)

AREAS:

Rotor disc	83.52 m^2 (899.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, standard configuration	1,531 kg (3,375 lb)
Standard fuel load	489 kg (1,078 lb)
Max internal payload	1,292 kg (2,848 lb)
Max slung load	1,361 kg (3,000 lb)
Max T-O weight: internal load	2,835 kg (6,250 lb)
external load	3,129 kg (6,900 lb)
Max disc loading: internal load	33.9 kg/m^2 (6.95 lb/sq ft)
external load	37.5 kg/m^2 (7.68 lb/sq ft)
Transmission loading at max T-O weight and power:	
internal load	3.80 kg/kW (6.25 lb/shp)
external load	3.82 kg/kW (6.27 lb/shp)

PERFORMANCE (at max internal load T-O weight, ISA, except where indicated):

Never-exceed speed (VNE) at S/L, ISA	140 kt (259 km/h; 161 mph)
Max cruising speed at S/L, 38°C (100°F)	134 kt (248 km/h; 154 mph)
Max rate of climb at S/L	579 m (1,900 ft)/min
Vertical rate of climb at S/L	411 m (1,350 ft)/min
Rate of climb at S/L, OEI	305 m (1,000 ft)/min
Service ceiling: both engines	5,335 m (17,500 ft)
OEI	3,200 m (10,500 ft)
Hovering ceiling: IGE, ISA	3,353 m (11,000 ft)
IGE, ISA + 20°C	2,042 m (6,700 ft)
OGE, ISA	2,743 m (9,000 ft)
OGE, ISA + 20°C	1,433 m (4,700 ft)
Hovering ceiling, OEI:	
IGE, ISA at 87% max T-O weight	1,220 m (4,000 ft)
Max range: at S/L	257 n miles (476 km; 295 miles)
at FL50, ISA	293 n miles (542 km; 337 miles)
Max endurance: at S/L	2 h 54 min
at FL50, ISA	3 h 12 min

OPERATIONAL NOISE LEVELS:

T-O	84.1 EPNdB
Approach	88.9 EPNdB
Flyover	83.1 EPNdB

ME 262 PROJECT

ME 262 PROJECT

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e-mail: me262project@juno.com
Web: www.stormbirds.com
PROJECT MANAGER: Bob Hammer
PRODUCTION CO-ORDINATOR: Jim Byron

Founded by the late Stephen L Snyder, Classic Fighter Industries Inc launched a programme in 1993 to build five exact flying replicas of a Second World War German jet fighter, the Messerschmitt Me 262. Work was originally contracted to the Texas Airplane Factory, but halted during 1997 because of a legal dispute. The production line was relocated to Paine Field (Snohomish County Airport) in early 1999; renamed Me 262 Project in 2001; first aircraft flew in late 2002 but was damaged soon after; it has since been repaired, second aircraft flown and a third rolled out in October 2006.

In May 2005, the company began restoration of two Bf 109F-4s for Air Assets International.

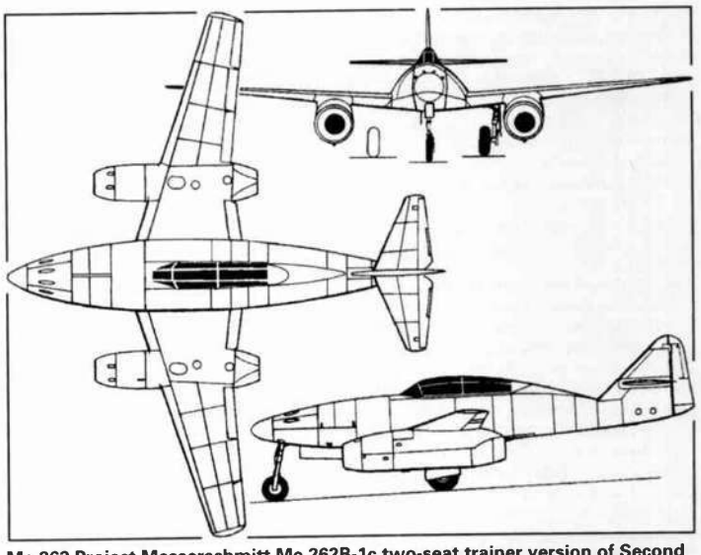
MESSERSCHMITT Me 262

TYPE: Two-seat jet sportplane.

PROGRAMME: Original prototype first flew 25 March 1942; entered operational service June 1944; flying terminated May 1945, except for limited number assigned to Allied technical evaluation or flown by Czechoslovak Air Force. Total of 1,443 built by Messerschmitt.

Classic programme based on reverse-engineering of WkNr 110639, former US Me 262B-1a evaluation aircraft, refurbished by Classic from 1993 onwards and redelivered to US Navy at Willow Grove, Pennsylvania, on 8 September 2000. Completion of first new-build aircraft rescheduled to 2002, due to company restructuring. First taxi testing undertaken 25 June 2002, following engine tests conducted from February 2002. Maiden flight (following earlier short 'hops') (N262AZ) 20 December 2002, but damaged in landing accident on 18 January 2003; repairs undertaken during 2003 and made its second 'first' flight (actually third individual flight) on 29 June 2004. Second aircraft was in final assembly in April 2004 and first flew 15 August 2005. Both aircraft delivered: 501244 'Tango Tango' on 19 January 2006 and 501241 'White 1' on 11 June 2006; third aircraft around 80 per cent complete by November 2006, having been rolled out on 10 October.

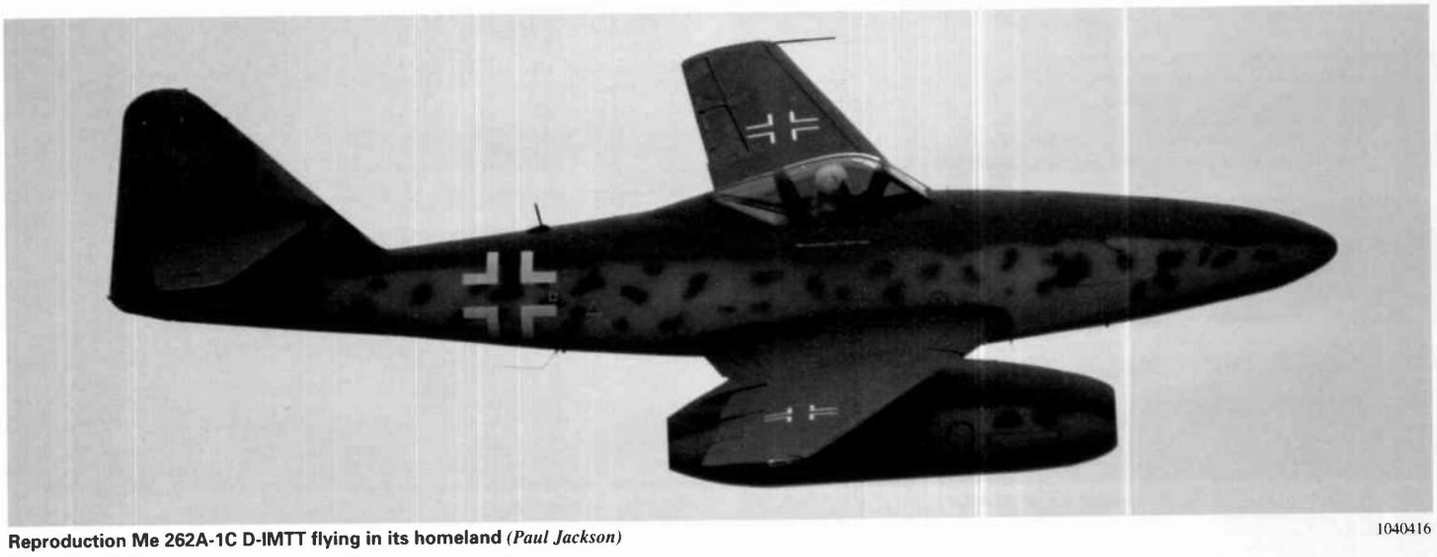
CURRENT VERSIONS: **Me 262A-1c**: Single-seat version; one (501245/'Red 13') under construction by Classic; 80 per cent complete in November 2006.



Me 262 Project Messerschmitt Me 262B-1c two-seat trainer version of Second World War jet fighter *(Paul Jackson)* 1158951

Me 262B-1c: Two-seat trainer; two (501241/N262AZ/'White 1' and 501242/'White ') under construction; first airframe for private owner in US; second 55 per cent complete, but suspended.

'Me 262A/B-1c': Further two aircraft (501243/'White 8' and 501244/N262MS 'Tango Tango'); can be converted to either of above variants. N262MS was second to fly on 15 August 2005, finished as A-1C; for Messerschmitt Foundation, Germany; following shipping to Germany it was reassembled and flown (as D-IMTT) on 25 April 2006; appeared at ILA (Berlin air show) in following month.



Reproduction Me 262A-1C D-IMTT flying in its homeland *(Paul Jackson)* 1040416

Current production aircraft assigned 'c' type suffix by Messerschmitt Foundation to indicate employment of J85 engine; maker's serial numbers follow on from German 1945 production.

Descriptions of Me 262 appear in 1945-46 Jane's All the World's Aircraft *and in various historical references. Differences from original are noted below.*

COSTS: Around USD2.5 million for flying example and USD1.5 million for static display example, excluding engines and avionics (2006).

DESIGN FEATURES: Modifications minimal, except where required to enhance safety. Replacement of Jumo 004 engine involves smaller, lighter and more powerful GE J85 being located in rear of original-sized nacelles; interior air duct and false Jumo engine exterior shape below access panels restore weight to original for aerodynamic and balance purposes. Landing gear mountings strengthened to obviate original weakness; modern disc brakes within mainwheel hubs; nosewheel brake deleted.

POWER PLANT: Two 12.7 kN (2,850 lb st) General Electric J85 turbojets; soft throttle stop at 8.0 kN (1,800 lb st) to emulate Jumo engine max output; full estimated installed thrust rating of up to 11.1 kN (2,500 lb st) employed for initiating (only) take-off roll and may be re-engaged above 226 kt (418 km/h; 260 mph) asymmetric safety speed.

PERFORMANCE:

Never-exceed speed (VNE)	434 kt (804 km/h; 500 mph)[1]
Max level speed (estimated)	539 kt (998 km/h; 620 mph)
Range with max fuel	more than 869 n miles (1,609 km; 1,000 miles)

[1] *Voluntary limitation*

MICCO

MICCO AIRCRAFT COMPANY

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Web: www.miccoaircraft.com
CEO: James E Billie
PRESIDENT: F DeWitt Beckett
MARKETING DIRECTOR: Decki J Beckett

Micco company originally formed by the Seminole tribe of native Americans and as descendant of the Meyers company, founded in 1936, which produced the OTW (102 built), MAC-125/145 (22 built), Meyers 200 (46 built) and Meyers 400 Interceptor turboprop; after purchase by Rockwell in July 1965, the Meyers 200 became the Aero Commander 200 (88 built), until production ceased in 1967. Type certificate transferred to Interceptor Corporation in 1969; to Prop-Jets Inc 1977; Nydia Myers Trust 1981; Ralph Haven 1987; New Myers 21 March 1991; and to Estumketda Ltd on 18 January 1995.

New Meyers renamed Micco (Seminole for chief) in 1997, remaining under Estumketda ownership. Had 3,720 m^2 (40,000 sq ft) of factory space and 465 m^2 (5,000 sq ft) of engineering and administrative offices at Fort Pierce, Florida, and employed 73 people in 2000. Production of the SP20 and its derivative, the SP26, ceased in November 2001 because of poor order book. Type certificate was sold to LanShe (at same address) on 22 February 2003, but this company closed in June 2004. Type certificate to Aero Acquisitions on 12 September 2005.

On 25 July 2005, Micco announced it had entered into an agreement for the acquisition of the type certificate, tooling, fixtures and inventory assets for the SP26. Production facilities established in Bartlesville, Oklahoma, where new aircraft deliveries planned from first quarter of 2007. Certificate was duly transferred to Micco Aircraft on 1 September 2006.

MICCO SP26

TYPE: Aerobatic two-seat lightplane.

PROGRAMME: Based on original 1947 Meyers MAC-145A, certified 2 November 1948, and 22 built (including two MAC-125s), but with increased power. Redesign started by Micco Aircraft March 1994, using converted MAC-145 (N520SP); construction started June 1995 and prototype (N720SP) first flown 17 December 1997. First production aircraft (N820SP) construction started January 1999. Certification to FAR Pt 23 issued 5 January 2000, with deliveries soon after. Second production aircraft shown at Sun 'n' Fun, Lakeland, Florida, April 2000, before delivery to TE Aero, Texas; third production aircraft to Clipper Aviation of Oneonta, New York, June 2000. Aircraft registered using MAC-145A (SP20) and MAC-145B (SP26) type certificates.

CURRENT VERSIONS: **SP20:** Baseline version. Not intended for manufacture by current company. One 149 kW (200 hp) Textron Lycoming IO-360-C1E6 flat-four driving a three-blade, constant-speed McCauley QZP (B3D36C424/74SA-0) propeller.

SP26: Updated and uprated aerobatic version. Six-cylinder engine in longer cowling, but firewall moved rearwards by identical distance (30 cm; 12 in), resulting in no overall change of fuselage length. Prominent strakes ahead of tailplane on prototype have now been removed. Prototype converted from N820SP; debut at Sun 'n' Fun, April 2000. Certification in Utility category granted on 19 October 2000 for 113 kg (250 lb) extension of MTOW over SP20. First production aircraft (N201MA) flew 15 November 2000 and delivered on 26 December 2000 to Andrew Spaulding of Cumberland, Maine. Aerobatic certification achieved 4 March 2002.

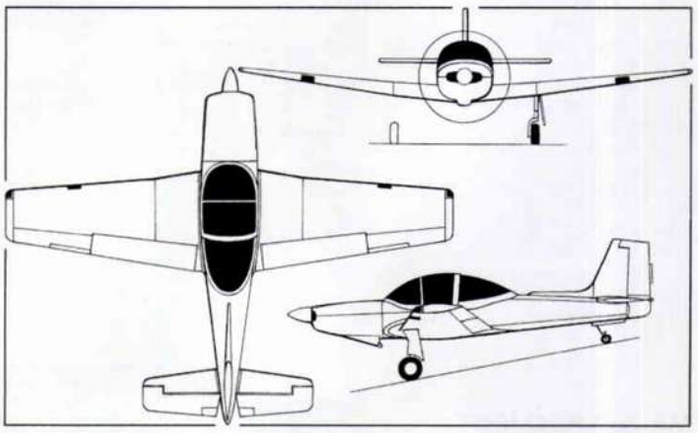
CUSTOMERS: Total 19 by late 2004. Seven SP-20s, including prototypes, built by Micro up to 2001; none by LanShe. Micro produced 10 SP-26s (excluding converted SP-26 acting as prototype); two built in 2003 under LanShe, comprising N179MA (apparently uncompleted) and N585SK. Last-mentioned offered for sale by new Micco in 2006.

DESIGN FEATURES: Low-wing, high-performance, metal sport aircraft; low development cost achieved by employment of existing design. Major changes from MAC-145A include replacement of the 108 kW (145 hp) Continental engine; substitution of a Meyers 200 fin and rudder; wings and flaps from the Meyers 400 Interceptor; and provision of a sliding canopy in place of the fixed canopy and side doors.

FLYING CONTROLS: Conventional and manual. Horn-balanced cable-operated rudder with ground-adjustable trim tab; horn-balanced push/pull tube-controlled elevators with flight-adjustable tabs in each. Control movements: elevator +28/-20°; ailerons +22/-12°; rudder ±22°. Electrically operated Fowler flaps, max deflection 30°.

STRUCTURE: 4130 steel tube centre section and all-aluminium wings.

Micco SP-26 built in 2001 by the original Micco company 1158996



Micco SP-26 aerobatic lightplane *(James Goulding)* 1158947

LANDING GEAR: Tailwheel type; main units retract inward into wings, tailwheel rearward; mainwheel doors cover legs only when retracted, wheel wells remaining exposed. Electrohydraulic Parker Hannifin hydraulic brakes and leaf spring shock-absorbers. 6.00-6 tyres on mainwheels; 10 cm (4 in) solid tailwheel. Ground turning radius about wingtip 6.07 m (19 ft 11 in).

POWER PLANT: One 149 kW (200 hp) Textron Lycoming IO-360-C1E6 flat-four driving a three-blade, constant-speed McCauley QZP (B3D36C424/74SA-0) propeller.

Fuel in integral wing tanks, combined capacity 273 litres (72.0 US gallons; 60.0 Imp gallons), of which 257 litres (68.0 US gallons; 56.6 Imp gallons) are usable. Three drain points. Oil capacity 9.5 litres (2.5 US gallons; 2.1 Imp gallons). Aerobatic versions have two additional 57 litre (15.0 US gallon; 12.5 Imp gallon) tanks located in the centre-section outboard of cabin area.

ACCOMMODATION: Two, side by side, under rearward-sliding canopy. Baggage area behind seats.

SYSTEMS: 28 V 70 A alternator and battery; landing lights.

AVIONICS: VFR or IFR standards available, recommended Trimble Terra suite; S-Tec 30 two-axis autopilot and Apollo MX20 multifunction display optional.

EQUIPMENT: Landing/taxying light in each wing leading-edge.

DIMENSIONS, EXTERNAL:

Wing span	9.25 m (30 ft 4 in)
Wing chord: at root	2.29 m (7 ft 6 in)
at tip	1.02 m (3 ft 4 in)
Wing aspect ratio	5.9
Length overall	7.34 m (24 ft 1 in)
Max diameter of fuselage	1.22 m (4 ft 0 in)
Height overall	1.98 m (6 ft 6 in)
Tailplane span	3.76 m (12 ft 4 in)
Wheel track	3.15 m (10 ft 4 in)
Wheelbase	4.02 m (13 ft 2¼ in)
Propeller diameter	1.98 m (6 ft 6 in)

DIMENSIONS, INTERNAL:

Cabin: Length	1.65 m (5 ft 5 in)
Max width	1.09 m (3 ft 7 in)
Max height	0.99 m (3 ft 3 in)
Baggage volume	0.40 m^3 (14.0 cu ft)

AREAS:

Wings, gross	14.55 m^2 (156.6 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	925 kg (2,040 lb)
Baggage capacity	45 kg (100 lb)
Max aerobatic weight	1,202 kg (2,650 lb)
Max T-O weight	1,292 kg (2,850 lb)
Max landing weight	1,243 kg (2,742 lb)
Max wing loading	88.9 kg/m^2 (18.20 lb/sq ft)
Max power loading: SP26	6.67 kg/kW (10.96 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE): SP26	195 kt (361 km/h; 224 mph)
Max level speed	165 kt (306 km/h; 190 mph)
Max cruising speed at 75% power: SP26	155 kt (287 km/h; 178 mph)
Normal cruising speed at 65% power	148 kt (274 km/h; 170 mph)
Econ cruising speed at 55% power	135 kt (250 km/h; 155 mph)
Stalling speed, power off: flaps and landing gear up	55 kt (102 km/h; 64 mph)
flaps and landing gear down	49 kt (91 km/h; 57 mph)
Max rate of climb at S/L	458 m (1,500 ft)/min
Service ceiling	5,486 m (18,000 ft)
T-O run	244 m (800 ft)
T-O to 15 m (50 ft)	335 m (1,100 ft)
Landing from 15 m (50 ft)	610 m (2,000 ft)
Landing run	213 m (700 ft)
Range with 30 min reserves: at max level speed	750 n miles (1,389 km; 863 miles)
at econ cruising speed	1,040 n miles (1,926 km; 1,196 miles)
g limits	+6/–3

MILLENNIUM

MILLENNIUM AEROSPACE CORPORATION

(subsidiary of Millennium International Group)

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e-mail: foxjet@dslextreme.com

PRODUCT DEVELOPMENT DIRECTOR: Barry Marshall

In May 2006, Millennium Aerospace of California purchased Foxjet International and its rights to the Foxjet light business jet which had been developed by Tony Fox during the late 1970s but which had not reached the prototype stage. Company is investigating locations for possible manufacturing plants, primarily in Gulf Coast region, and plans further aviation-related ventures.

MILLENNIUM FOXJET II

TYPE: Light business jet.

PROGRAMME: Original Foxjet F600 announced in 1977; retrospectively hailed as first of 'very light jets'; 73 orders by 1978; four full-size mockups produced for test and demonstration; production planned by Aeronca of Middletown, Ohio, at rate of 44 per month; optimum Williams WR44-800 high-bypass turbofan was also selected for use in cruise missiles and its civilian employment was then refused by US government; lack of alternative engine forced abandonment of the project after few parts for prototype had been manufactured and half of engineering work completed; Fox returned USD1 million of deposits, including that for order placed by Bill Lear of Lear Jet; associated DialJet on-demand air taxi operation was also abandoned; last entry in *Jane's All the World's Aircraft* was 1980-81 edition.

Millennium purchased Foxjet rights as means to acquire nearly complete design; proposed modifications restricted to some use of carbon fibre; modern avionics; and new power plant. Revised design exhibited at AOPA Expo, Palm Springs, California, November 2006. Exceptionally tight development schedule includes first flight in mid-2007, followed by certification in 2008.

CUSTOMERS: Millennium revealed 100 deposits from air taxi operators and private owners had been taken by November 2006.

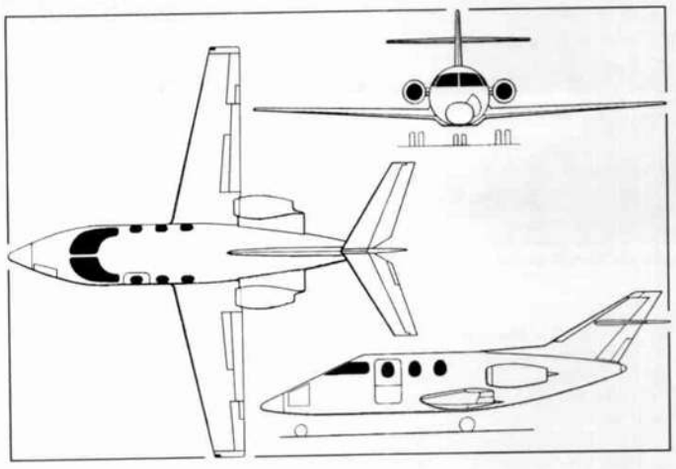
COSTS: Target price USD1.7 million (2006).

DESIGN FEATURES: Objectives of the 1970s project included lowering business jet fuel costs to some 9 cents/mile compared with 48 cents for similar aircraft (at cost of USD0.50 per US gallon); producing a business jet operable at nearly 9,000 US airfields (including grass) compared with only 900 available to larger aircraft; and unit cost of USD500,000 to 700,000, or about half the cost of then-competitors.

Cantilever low-wing monoplane with engines in pods, each side of rear fuselage; moderate leading-edge sweepback; straight trailing-edge; sweptback fin and cruciform, sweptback, variable incidence tailplane. Tab in rudder. Wing design by Branson Aircraft Corp; NACA 65 Series laminar flow section, commercial name 'Foxjet Super-Flow'; available for simple modification to supercritical form when required by future power increase.

FLYING CONTROLS: Conventional and manual. Trim tab in port aileron. Electrically operated, modified Fowler type single-slotted light alloy trailing-edge flaps. Hydraulically operated spoilers, forward of flaps, serve also as airbrakes.

Full-scale mockup of original Foxjet 1154694



Original Foxjet F600 *(Dennis Punnett)* 1158928

STRUCTURE: Generally fail-safe light alloy structure, but carbon fibre in selected areas. Semi-monocoque fuselage of circular cross-section; honeycomb pressure bulkheads and baggage deck.

LANDING GEAR: Tricycle type; retractable. Twin wheels on each unit. Hydraulic retraction; main units retract inward; nose unit aft. Manually operated emergency hydraulic system. Oleo-pneumatic shock absorbers. Main wheels have low-pressure tires size 5.00-5. Hydraulically steerable nosewheel unit, with water-chine, tire size 11x4.00-5. Hydraulic disc brakes on main wheels.

POWER PLANT: Two 6.01 kW (1,350 lb st) Pratt & Whitney Canada PW615 turbofan engines. Integral wing fuel tanks, total capacity 826 litres (218 US gallons; 182 Imp gallons); refuelling port above each wing.

ACCOMMODATION: Pilot and three to five passengers, in pairs. Dual controls optional. Current interior design by Porsche. Two-piece door (upward-hinged top, and downward-hinged lower portion with integral steps) on port side forward of wing. Emergency exit starboard side Accommodation air-conditioned and pressurised. Birdproof windscreen with pneumatic system for rain removal, defogging and defrosting. Equipment access door on port side of nose. Baggage hold aft of cabin.

SYSTEMS: Electrical anti-icing of each wing leading-edge at root and engine air intakes; optional pneumatic de-icing boots for remainder of leading-edges. Pressurisation system with max differential of 0.59 bar (8.5 lb/sq in), providing a cabin altitude of 2,440 m (8,000 ft) to FL410. Electrical system. Hydraulic system, with hydraulic backup. Pneumatic system. Oxygen system.

AVIONICS: Under revision.

DIMENSIONS, EXTERNAL:

Wing span	9.64 m (31 ft 7¾ in)
Wing aspect ratio	8.0
Length overall	6.265 m (20 ft 6½ in)
Max diameter of fuselage	1.40 m (4 ft 7 in)
Height overall	3.12 m (10 ft 2¾ in)
Tailplane span	4.06 m (13 ft 4 in)

DIMENSION, INTERNAL:

Cabin length	3.66 m (12 ft 0 in)

AREAS:

Wings, gross	11.61 m^2 (125.0 sq ft)

WEIGHTS AND LOADINGS:

Max fuel weight	652 kg (1,418 lb)
Max T-O weight	2,154 kg (4,750 lb)
Max wing loading	185.5 kg/m^2 (38.00 lb/sq ft)
Max power loading	179 kg/kN (1.76 lb/lb st)

PERFORMANCE:

Max level speed	356 kt (660 km/h; 410 mph)
Normal cruising speed	320 kt (593 km/h; 368 mph)
Stalling speed, flaps down	74 kt (137 km/h; 86 mph)
Range with max fuel	1,215 n miles (2,250 km; 1,400 miles)

MOONEY

MOONEY AIRPLANE COMPANY (MAC)

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David J Copeland (Sales and Marketing)
Kevin Herlehy (Production and Engineering)
Alan Nitchman (Customer Support)
PUBLIC RELATIONS:
Dave Franson
Cyndi Roth

Original Mooney Aircraft Corporation formed in Wichita, Kansas, 1948; produced single-seat M-18 Mite until 1952 (total 282); M20 family in production since then, briefly augmented in 1969-70 by 61 M10 Cadets (Alon A-2A Ercoupe with distinctive Mooney fin). Mooney and Aerospatiale (Socata) announced joint development of TBM 700 June 1987 (see under Socata in French section), but Mooney withdrew in 1991.

Mooney Aircraft Corporation filed for Chapter 11 bankruptcy protection on 27 July 2001, continuing production while restructuring the company; delivered 29 aircraft in 2001 against year's target of 70. Announced on 16 November 2001 that extended financing had been received to continue operations, including spares support, pending sale of the company. On 8 February 2002 AASI announced it had purchased Congress Financial Corporation's position as senior creditor and intended restarting production as well as moving its own production facility to Kerrville.

AASI subsequently reorganised as Mooney Aerospace Group, Ltd, with Mooney Airplane Company as wholly owned subsidiary. On 1 August 2003 Mooney signed an agreement with BAE Systems, Foxton Investments, the Kaskol Group of Russia, and Venture Industries, to form an international partnership for the development and marketing of a range of new-generation aircraft under the Mooney name. In late May 2004, Allen Holding Finance Ltd bought the stock of Mooney Airplane Company from its parent Mooney Aerospace Group Ltd for USD4 million. Under the terms of the agreement Allen Holding assumed more than USD21 million of MAC's debt owed to the secured debenture holders and also agreed to provide D4 million of new capital within 30 days. MAC received FAA production certificate on 26 June 2002 for Eagle 2, Ovation 2 and Bravo 2. Employment at Kerville totalled 186 in May 2004. Total of 10 aircraft delivered in 2002, all in final quarter, 36 in 2003, 36 in 2004, 85 in 2005, and 56 in the first nine months of 2006.

On 23 February 2006, Mooney marked its 60th anniversary with delivery of the 11,000th aircraft produced since the first M-18 Mite was delivered in 1948. The milestone aircraft was an Ovation2 GX delivered to a customer in New Jersey.

MOONEY M20M BRAVO

TYPE: Four-seat lightplane.

PROGRAMME: Wood-winged M20 prototype first flew 10 August 1953; some 700 of early series built before design translated into all-metal with M20B, introduced in 1961. Progressed through several further subvariants, of which M20M announced 2 February 1989 as TLS (Turbo Lycoming Sabre, with 201 kW; 270 hp TIO-540-AF1A); Bravo introduced in 1996, followed by Bravo DX on 2 April 2003 and Bravo GX in February 2004.

Mooney M20M Bravo DX *(Paul Jackson)* 1159738

CURRENT VERSIONS: **Bravo DX:** Introduced at EAA Sun 'n' Fun at Lakeland 2 April 2003. Features Garmin avionics suite including GNS 530/430, GDL 49 Nexrad weather uplink, GTX 330 Mode S transponder and Bendix/King KFC 225 autopilot/flight director, 3.28 m^3 (115.7 cu ft) oxygen system, Precise Flight speedbrakes, and six-way adjustable leather seats as standard; Honeywell K1825 electronic HSI, TKS anti-icing system and electric 17,000 BTU air conditioning system optional.

Bravo GX: Announced 10 February 2004. Features Garmin G1000 all-glass integrated avionics comprising dual 10.4 in XGA high-resolution colour LCD primary flight (PFD) and multifunction (MFD) displays; digital audio control panel with integrated marker beacon and clearance playback capability; dual integrated radio modules that provide IFR oceanic-approved GPS, VHF navigation with ILS and VHF communication, with 16-watt transceivers and 8.33 kHz channel spacing; Mode S transponder with Traffic Information Service; advanced solid-state Attitude and Heading Reference System (AHRS) with rapid alignment whether on the ground or in the air; digital air data computer; Mid-Continent 3400 backup attitude indicator; worldwide terrain database depicting topographic information and relative terrain; and (US specification aircraft only) XM satellite radio receiver featuring full-colour, graphical weather information via digital datalink and 101 channels of CD-quality audio. The G1000 installation adds 16 kg (36 lb) to the aircraft's empty weight. Deliveries from third quarter 2004.

Bravo GX 60th Anniversary Edition: Limited edition to mark company 60th anniversary, announced 3 November 2005. New interior features include redesigned door latches, handles and armrests, optional rear bench seat with seat belts for two adults or three children, redesigned console with new cup holders, redesigned seat cushions, bolsters and stitching, overhead lights and air outlets integrated into a new brushed metal assembly, relocated air outlets at pilot's feet, and new exterior colour schemes.

CUSTOMERS: Total of 315 TLS/Bravos delivered by June 2001 halt of production. Deliveries resumed in July 2002. Da Kine, Hawaii Inc of Hood River, Oregon, became the first customer for a Mooney Airplane Company-built aircraft (a Bravo), with an order announced on 25 July 2002. Five delivered in 2003, nine in 2004, including one to German customer, 20 in 2005, and five in the first nine months of 2006.

COSTS: Bravo DX USD439,950 (2004); Bravo GX USD475,000 (2006), both standard equipped.

DESIGN FEATURES: High-efficiency touring aircraft, originally designed by Mooney brothers. Low wing and mid-mounted tailplane; flying surfaces of characteristic Mooney 'reversed' configuration with unswept leading-edges and sharply forward-swept trailing-edges.

Wing section NACA $63_2$182-215 at root, $64_1$181-412 at tip; dihedral 5° 30'; incidence 2° 30' at root, 1° at tip; wing swept forward 2° 29' at quarter chord.

FLYING CONTROLS: Conventional and manual. Sealed gap, differential ailerons; fin and tailplane integral so that both tilt, varying tailplane incidence for trimming; no trim tabs; electrically actuated single-slotted flaps; electric rudder trim; Precise Flight speed brakes. Control surface movements: ailerons +14° 30'/-8°, elevator ±22°, rudder ±24°, flaps -10° T-O and -33° landing.

STRUCTURE: Single-spar wing with auxiliary spar out to mid-position of flaps; wing and tail surfaces covered with stretch-formed wraparound skins. Steel tube cabin section covered with light alloy skin; semi-monocoque rear fuse-lage with extruded stringers and sheet metal frames.

LANDING GEAR: Electrically retractable levered suspension tricycle type with airspeed safety switch bypass. Nosewheel retracts rearward, main units inward into wings. Rubber disc shock-absorbers in main units. Cleveland mainwheels, size 6.00-6 (6-ply), and steerable nosewheel, size 5.00-5 (6-ply). Tyre pressure, mainwheels 2.07 bar (30 lb/sq in), nosewheel 3.38 bar (49 lb/sq in). Cleveland hydraulic single-disc (double optional) brakes on mainwheels. Parking brake.

POWER PLANT: One 201 kW (270 hp) turbocharged Textron Lycoming TIO-540-AF1B flat-six engine, driving a McCauley B3D32C417/82NRD-7 three-blade, metal propeller. Two integral fuel tanks in inboard wing leading-edges, with a combined capacity of 386 litres (102 US gallons; 84.9 Imp gallons); optional additional tank increases capacity to 492 litres (130 US gallons; 108 Imp gallons). Two-piece nose cowling is of glass fibre/graphite composites construction.

ACCOMMODATION: Cabin accommodates four persons in pairs on individual vertically adjusting seats with reclining back, armrests, lumbar support and headrests; side armrests removable in rear seats. Front seats have inertia reel shoulder harnesses. Dual controls standard. Overhead ventilation system. Cabin heating and cooling system, with adjustable outlets and illuminated control. One-piece wraparound windscreen. Tinted Plexiglas windows. Rear seats removable for freight stowage. Rear seats fold forward for carrying cargo. Single door on starboard side. Compartment for 54 kg (120 lb) baggage behind cabin, with access from cabin or through door on starboard side. Amsafe inflatable restraint seatbelts optional from third quarter 2004.

SYSTEMS: Dual 70 Ah 28 V alternators, dual 24 V 10 Ah batteries, voltage regulator and warning lights, together with protective circuit breakers. Oxygen system, capacity 3,259 litres (115 cu ft), with masks and overhead outlets, standard. TKS known ice protection system and air conditioning optional.

AVIONICS: Standard equipment (Bravo) comprises Garmin GNS 530 nav/com/GPS, GNS 430 with GI 106A indicator, transponder/encoder, two-axis autopilot, and slaved HSI. Goodrich WX-500 Stormscope and SkyWatch optional. Bravo DX avionics as under Current Versions, above.

EQUIPMENT: Standard equipment includes attitude indicator, IFR directional gyro, two electric fuel quantity gauges, electric OAT gauge, CHT and EGT gauges, Precise Flight speed brakes, push-pull tube-actuated flight control system, annunciator panel; navigation lights, wing-mounted dual landing/taxying lights, internally lit instruments with rheostat; sound-damping composites interior, vertically adjusting front seats, wing jackpoints and external tiedowns, fuel tank quick drains, auxiliary power plug, heated pitot tube, polished propeller spinner, epoxy polyimide and conversion anti-corrosion treatment, external polyurethane paint finish, dual static ports with drains, and alternate static air source.

The following data refer to the Bravo GX:

DIMENSIONS, EXTERNAL:

Wing span	11.00 m (36 ft 1 in)
Wing chord, mean	1.50 m (4 ft 11¼ in)
Wing aspect ratio	7.4
Length overall	8.15 m (26 ft 9 in)
Height overall	2.54 m (8 ft 4 in)
Tailplane span	3.58 m (11 ft 9 in)
Wheel track	2.79 m (9 ft 2 in)
Wheelbase	2.02 m (6 ft 7½ in)
Propeller diameter	1.91 m (6 ft 3 in)
Baggage door: Width	0.53 m (1 ft 9 in)
Height	0.43 m (1 ft 5 in)

DIMENSIONS, INTERNAL:

Cabin: Length	3.20 m (10 ft 6 in)
Max width	1.10 m (3 ft 7½ in)
Max height	1.13 m (3 ft 8½ in)

MOONEY M20 PRODUCTION
(to late 2005)

Model	Name	Eng desig	Built	Certification
M20			200	24 Aug 55
M20A			501	13 Feb 58
M20B	Mk 21		224	14 Dec 60
M20C	Mk 21		2,222	20 Oct 61
	Ranger			
	Aerostar 200			
M20D	Master		160	15 Oct 62
M20E	Super 21	21	1,485	4 Sep 63
	Chapparal	21		
	Aerostar 201	21		
M20F	Executive	22	1,251	25 Jul 65
	Aerostar 220	22		
M20G	Statesman		190	13 Nov 67
M20J	201	24	2,135	27 Sep 76
	201LM			
	201SE			
	205			
	ATS			
	MSE			
	Allegro			
MT20	TX-1		2	nil
M20K	231	25	1,151	16 Nov 78
	231SE	25		
	252 TSE	25		
	Encore	25		
M20L	PFM	26	41	25 Feb 88
M20M	TLS	27	315	28 Jun 89
	Bravo/Bravo DX/GX	27	35	
M20R	Ovation	29	280	30 Jun 94
	Ovation2/2DX/2GX	29	120	
M20S	Eagle	30	65	7 Feb 99
M20T	EFS	28	1	nil
Total			**10,380**	

Notes: Individual models have had several marketing names. Engineering designation forms part of aircraft's serial number. Certification date is for FAA.

Floor area ..... 3.53 m² (38.0 sq ft)
Volume ..... 3.9 m³ (137 cu ft)
Baggage compartment volume ..... 0.64 m³ (22.6 cu ft)

AREAS:
Wings, gross ..... 16.26 m² (175.0 sq ft)
Ailerons (total) ..... 1.06 m² (11.40 sq ft)
Trailing-edge flaps (total) ..... 1.66 m² (17.90 sq ft)
Fin ..... 0.73 m² (7.92 sq ft)
Rudder ..... 0.58 m² (6.23 sq ft)
Tailplane ..... 1.99 m² (21.45 sq ft)
Elevators (total) ..... 1.11 m² (12.05 sq ft)

WEIGHTS AND LOADINGS:
Weight empty, typical ..... 1,068 kg (2,355 lb)
Max T-O weight ..... 1,528 kg (3,368 lb)
Max landing weight ..... 1,452 kg (3,200 lb)
Max wing loading ..... 94.0 kg/m² (19.25 lb/sq ft)
Max power loading ..... 7.59 kg/kW (12.47 lb/hp)

PERFORMANCE:
Max cruising speed: at FL130 ..... 195 kt (361 km/h; 224 mph)
at FL250 ..... 214 kt (396 km/h; 246 mph)
Stalling speed: flaps and wheels up ..... 66 kt (122 km/h; 76 mph)
flaps and wheels down ..... 59 kt (109 km/h; 68 mph)
T-O to 15 m (50 ft) ..... 671 m (2,200 ft)
Max rate of climb at S/L ..... 344 m (1,130 ft)/min
Max certified altitude ..... 7,620 m (25,000 ft)
Max range with standard fuel, with reserves ..... 1,150 n miles (2,130 km; 1,323 miles)
Endurance ..... 6 h 42 min
Max range with optional fuel, with reserves ..... 1,500 n miles (2,778 km; 1,726 miles)

MOONEY M20R OVATION

TYPE: Four-seat lightplane.

PROGRAMME: Prototype (N20XR) rolled out April 1994; first flight May 1994; FAA certification June 1994. Similar M20S Eagle certified February 1999, but discontinued in 2003.

CURRENT VERSIONS: **M20R Ovation2:** Baseline version, superseded Ovation; unveiled at the AOPA Convention on 22 October 1999. A limited edition Mooney Ovation2 Platinum Edition, with advanced avionics and instrumentation, plus airframe and cabin upgrades, has been introduced. An Ovation2 which made its first flight on 18 June 2002 was the first new production Mooney following the formation of Mooney Aerospace Group, Ltd.

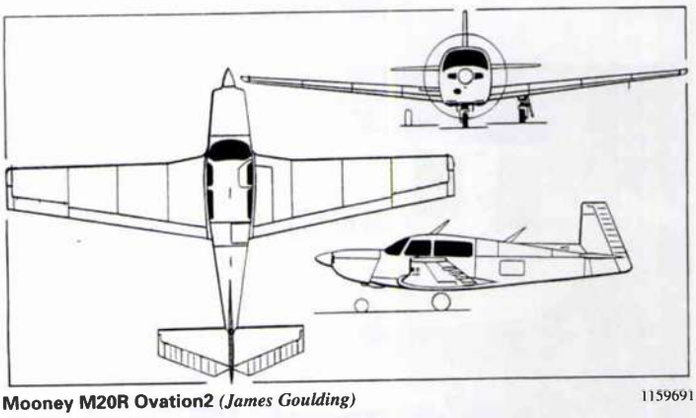
Ovation2 DX Freedom: Limited edition introduced at EAA Sun 'n' Fun at Lakeland 2 April 2003. Features thin-blade, McCauley two-blade propeller providing a 6 kt (11 km/h; 7 mph) increase in cruising speed at FL80; Garmin avionics suite including GNS 530/430, GDL 49 Nexrad weather uplink, GTX 330 Mode S transponder and Bendix/King KFC 225 autopilot flight director; six-way adjustable leather seats with adjustable lumbar support and Precise Flight speedbrakes as standard; 3.28 m³ (115.7 cu ft) oxygen system, TKS anti-icing system and 25,000 BTU air conditioning system optional.

Ovation2 GX: Announced 10 February 2004. Features Garmin G1000 all-glass integrated avionics comprising dual 264 mm (10.4 in) XGA high-resolution colour LCD primary flight (PFD) and multifunction (MFD) displays; digital audio control panel with integrated marker beacon and clearance playback capability; dual integrated radio modules that provide IFR oceanic-approved GPS, VHF navigation with ILS and VHF communication, with 16-watt transceivers and 8.33 kHz channel spacing; Mode S transponder with Traffic Information Service; advanced solid-state attitude and heading reference system (AHRS) with rapid alignment whether on the ground or in the air; digital air data computer; worldwide terrain database depicting topographic information and relative terrain; (US specification aircraft only) XM satellite radio receiver featuring full-colour, graphical weather information via digital datalink and 101 channels of CD-quality audio; and Mid-Continent 3400 backup electric attitude indicator. The G1000 installation adds 16 kg (36 lb). First Ovation2 GX is c/n 29-0333.

Ovation3: Announced 1 June 2006. Based on Ovation2 GX airframe and equipment, as described, but with 231 kW (310 hp) Teledyne Continental Platinum IO-550-G/AP normally aspirated engine affording up to 9 kt (17 km/h; 10 mph) increase in maximum cruising speed at optimal altitude and reduced take-off run. Max T-O weight 1,530 kg (3,374 lb); max wing loading 94.1 kg/m (19.28 lb/sq ft); max power loading 6.62 kg/kW (10.88 lb/hp); cruising speed at 2,438 m (8,000 ft) 196 kt (363 km/h; 226 mph); T-O run 274 m (900 ft); max rate of climb at S/L 396 m (1,300 ft)/min; max range with standard fuel and reserves 1,860 n miles (3,445 km; 2,140 miles); max range with optional fuel and reserves 2,400 nm (4,445 km; 2,762 miles). First delivery June 2006.

Ovation2 GX 60th Anniversary Edition: Limited edition to mark company's 60th anniversary, announced 3 November 2005. New interior features include redesigned door latches, handles and armrests, optional rear bench seat with seat belts for two adults or three children, redesigned console with new cup holders, redesigned seat cushions, bolsters and stitching, overhead lights and air outlets integrated into a new brushed metal assembly, relocated air outlets at pilot's feet, and new exterior colour schemes.

Mooney M20R Ovation2 DX Freedom *(Paul Jackson)* 1159743



Mooney M20R Ovation2 *(James Goulding)* 1159691

CUSTOMERS: Most sold in USA, but others exported to Brazil, France, Germany, Israel, Italy, Paraguay, South Africa, Switzerland, Thailand and UK; orders include three for Western Michigan University. Total of 280 Ovations and 62 Eagles had been registered before Mooney reconstituted in February 2002; 65th and final Eagle completed in 2003. Ten delivered in 2002, comprising eight Ovations and two Eagles, 19 Ovation2s, 11 Ovation2 DXs, and one Eagle 2 in 2003, 28 Ovation2 DXs in 2004, one Ovation2 DX and 64 Ovation2 GXs in 2005, and 51 Ovation2 GXs in the first nine months of 2006. An Ovation2 GX (N903DS, c/n 29-0421) delivered on 23 February 2006 to Dennis F Strigl of New Jersey was the 11,000th Mooney produced since the first M-18 Mite was delivered in 1948.

COSTS: Ovation USD319,950; Ovation2 DX USD389,950; (both 2004); Ovation2 GX USD425,000 (2006); Ovation3 USD453,000 (2007).

DESIGN FEATURES: Combines airframe of M20M Bravo (which see) with normally aspirated flat-six engine. Completely restyled instrument panel, seats and cabin interior with sandwich-core rigid trim/soundproofing panels and leather and wool fabric upholstery.

POWER PLANT: M20R Ovation2 has one 224 kW (300 hp) Teledyne Continental IO-550-G5B flat-six engine, derated to 209 kW (280 hp), driving a McCauley 3A32C418-G/82NRC-9 three-blade, constant-speed metal propeller; Ovation2 GX has Hartzell propeller giving slight performance improvement. Standard fuel capacity 386 litres (102 US gallons; 84.9 Imp gallons); optional 492 litres (130 US gallons; 108 Imp gallons).

AVIONICS: Generally as for Mooney M20M Bravo.

EQUIPMENT: Generally as for M20M Bravo, except as detailed under Current Versions.

The following data refer to the Ovation2 GX:

DIMENSIONS, EXTERNAL:
Propeller diameter ..... 1.85 m (6 ft 1 in)

WEIGHTS AND LOADINGS:
Weight empty ..... 1,025 kg (2,260 lb)
Baggage capacity ..... 54 kg (120 lb)
Max usable fuel ..... 242 kg (534 lb)
Max T-O weight ..... 1,528 kg (3,368 lb)
Max landing weight ..... 1,451 kg (3,200 lb)
Max wing loading ..... 94.0 kg/m² (19.25 lb/sq ft)
Max power loading ..... 7.32 kg/kW (12.03 lb/hp)

PERFORMANCE:
Max cruising speed ..... 190 kt (352 km/h; 219 mph)
Stalling speed:
flaps and wheels up ..... 66 kt (123 km/h; 76 mph)
flaps and wheels down ..... 59 kt (110 km/h; 68 mph)

Mooney M20R Ovation2 GX *(Paul Jackson)* 1159741

T-O to 15 m (50 ft) ..... 494 m (1,620 ft)
Max rate of climb at S/L ..... 378 m (1,240 ft)/min
Service ceiling ..... 6,100 m (20,000 ft)
Max range with standard fuel and reserves ..... 1,860 n miles (3,445 km; 2,140 miles)
Max range with optional fuel and reserves ..... 2,400 n miles (4,444 km; 2,761 miles)

MOONEY M20TN ACCLAIM

TYPE: Four-seat lightplane.

PROGRAMME: First flown (N311TN) 16 March 2006. Announced 4 April 2006 at EAA Sun 'n' Fun Fly-In at Lakeland, Florida, where second aircraft (N312TN/c/n 31-0002) displayed. FAA certification achieved 4 January 2007, with first deliveries scheduled to follow immediately. Acclaim (Mooney Type No 31) will replace the Bravo in the Mooney range.

The description of the Mooney Bravo GX applies also to the Acclaim except as follows.

COSTS: USD495,000 standard equipped (2006).

STRUCTURE: 'Mini-fin' winglets standard.

POWER PLANT: One 208.8 kW (280 hp) Teledyne Continental TSIO-550-G turbo-normalised engine equipped with twin turbochargers and dual intercoolers, driving a Hartzell three-blade constant-speed propeller.

AVIONICS: Garmin G1000 as core system.

DIMENSIONS, EXTERNAL:
Wing span ..... 11.10 m (36 ft 5 in)

WEIGHTS AND LOADINGS:
Weight empty ..... 1,067 kg (2,353 lb)
Max power loading ..... 5.11 kg/kW (8.40 lb/hp)

PERFORMANCE:
Max cruising speed at FL250 ..... 230 kt (426 km/h; 265 mph)
Cruising speed at FL100 ..... 200 kt (370 km/h; 230 mph)
Max rate of climb at S/L ..... 378 m (1,240 ft)/min
T-O to 15 m (50 ft) ..... 494 m (1,620 ft)
Range, with reserves: standard fuel ..... 1,200 n miles (2,222 km; 1,381 miles)
optional fuel ..... 1,615 n miles (2,991 km; 1,858 miles)

Third Mooney M20TN Acclaim displayed at NBAA Convention, Orlando, October 2006 *(Paul Jackson)* 1159739

MXR

MXR TECHNOLOGIES INC

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CEO & DESIGNER: Chris Meyer

Having previously built and flown a Giles G-202, Mr Meyer obtained the jigs and tools for production of that aircraft when the Giles company ceased operations in 2000. Following redesign, the resultant MX2 was marketed from 2005 onwards.

MXR MX2

TYPE: Aerobatic two-seat sportplane.

PROGRAMME: Akrotech Giles G-202 first flew 22 December 1995 as two-seat version of G-200; marketed as kit, while factory-built CAP 222 briefly offered in Europe by CAP Aviation of France.

MX2 design began 2000; prototype (N22120) first flew May 2002 as conversion of G-202 c/n 60; following further two years of development, first aircraft of initial production batch of five (N262MX, c/n 1) flew in April 2005 and made type's public debut at AirVenture, Oshkosh, July 2005. Fourth production airframe assembled by Gary Ward for McGyver Air Shows and awarded airworthiness certificate in March 2006. Third production (N263MX) completed August 2006; second then yet to fly.

CURRENT VERSIONS: **MX2:** *As described*

MXS: Single-seat; under development for 2007 Red Bull Air Races. Redesigned fuselage; increased agility.

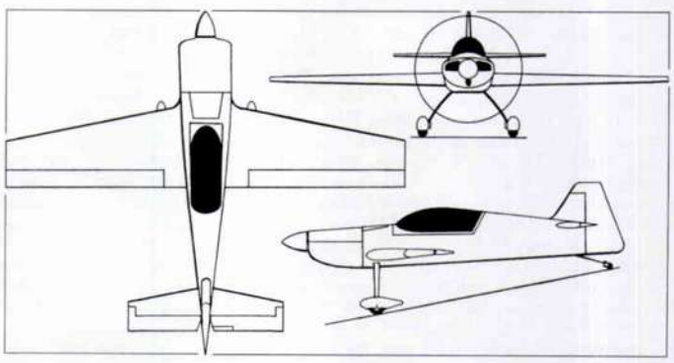
DESIGN FEATURES: Optimised for agility and speed. Robust airframe with low wing and mid-set tailplane, each with sweptback leading-edge.

Changes from G-202 include increased wing and tailplane span; lengthened nose; and redesigned interior. Roll rate more than 400°/s.

Initially marketed semi-complete, with fuselage having landing gear installed; quoted assembly time 1,000 hours; kit version may be introduced later.

FLYING CONTROLS: Full-span ailerons, each with underslung, spade-type balance; mass- and horn-balanced rudder; no flaps or aileron droop. Ailerons and elevators actuated by pushrods; rudder by cables. Trim tab on starboard elevator. Control deflections: ailerons ±25°; elevators ±33°; rudder ±30°.

First production MXR MX2 aerobatic sportplane *(Paul Jackson)* 1037974



MXR MX2 aerobatic two-seat sportplane *(Paul Jackson)* 1159829

STRUCTURE: Wholly of Toray carbon fibre, except engine mount, control hardware and landing gear.

LANDING GEAR: Fuselage-mounted spring aluminium cantilever mainwheel legs; mainwheels 5.00-5; steerable, solid tailwheel. Mainwheel speed fairings.

POWER PLANT: One 194 kW (260 hp) Textron Lycoming IO-540 flat-six as standard; uprated versions up to 283 kW (380 hp) optional. MT-Propeller MTV-9-B/C-203-20d constant-speed (hydraulic), three-blade, metal propeller. Two wing fuel tanks, each of 76 litres (20.0 US gallons; 16.7 Imp gallons) standard, 114 litres (30.0 US gallons; 25.0 Imp gallons) optional, plus fuselage tank of 68 litres (18.0 US gallons; 15.0 Imp gallons). Standard capacity 220 litres (58.0 US gallons; 48.3 Imp gallons).

ACCOMMODATION: Two pilots in tandem on 45° reclining seats under single-piece, starboard-hinged canopy/windscreen.

DIMENSIONS, EXTERNAL:
Wing span ..... 7.32 m (24 ft 0 in)
Wing aspect ratio 5.6
Length overall ..... 6.55 m (21 ft 6 in)
Height overall ..... 1.83 m (6 ft 0 in)

DIMENSIONS, INTERNAL:
Cockpit width: max ..... 0.71 m (2 ft 4 in)
min ..... 0.58 m (1 ft 11 in)

AREAS:
Wings, gross ..... 9.48 m² (102.0 sq ft)

WEIGHTS AND LOADINGS:
Weight empty ..... 584 kg (1,287 lb)
Max T-O weight: Aerobatic ..... 839 kg (1,850 lb)
Normal ..... 975 kg (2,150 lb)
Max wing loading: Aerobatic ..... 88.6 kg/m² (18.14 lb/sq ft)
Normal ..... 102.9 kg/m² (21.08 lb/sq ft)
Max power loading: Aerobatic ..... 4.33 kg/kW (7.11 lb/hp)
Normal ..... 5.03 kg/kW (8.26 lb/hp)

PERFORMANCE:
Never-exceed speed (VNE) ..... 220 kt (407 km/h; 253 mph)
Stalling speed ..... 58 kt (108 km/h; 67 mph)
g limits, Aerobatic weight ..... ±14

NAGY

IMRE NAGY

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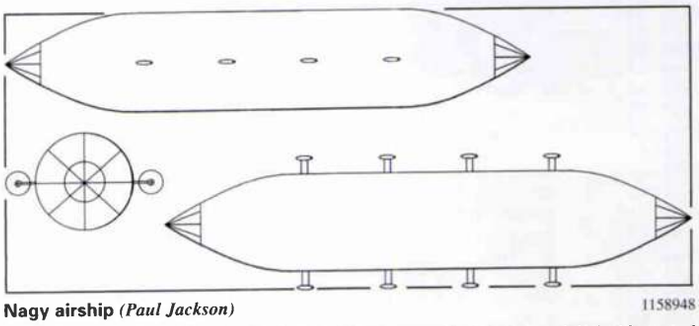
e-mail: nagyairship@aol.com
Web: www.nagyairship.com
DESIGNER: Imre Nagy

Mr Nagy has applied for an international patent for an airship of innovative design, a small prototype of which has begun construction.

NAGY HIGH-SPEED AIRSHIP

TYPE: Helium rigid airship.
PROGRAMME: First reported in mid-2003. Prototype of 2-ton version (c/n 001) registered as N241H on 1 June 2004 and said to be nearing completion in September 2004, but delayed by processing of patent application. As of September 2006, efforts were being made to complete prototype by year-end. All R & D completed; all versions said to be production-ready on receipt of order.
CURRENT VERSIONS: **2-ton version:** 20-passenger prototype/POC vehicle for projected larger versions. Potential as air patrol, rescue, ambulance or media vehicle, or as 'flying home'.
10-ton version: Projected 100-passenger version. Additional applications could include airborne hospital, coast guard, military or homeland security vehicle.
100-ton version: Projected 1,000-passenger version. Possible high-density cargo or military transport or luxury travel vehicle.
COSTS: Basic unit price USD6 million for 2-ton, USD10 million for 10-ton, USD30 million for 100-ton (2004).
DESIGN FEATURES: Mainly cylindrical hull, tapering to pointed cone at each end. Crew and passenger accommodation entirely internal. Vectored-thrust propulsion units (360° travel) mounted on external outriggers each side, fore and aft. Payload capability quoted as up to 85 per cent of total body volume. Requires no ground handling crew.
FLYING CONTROLS: Computer-controlled, with GPS-based navigation. Helium recovery system eliminates need for ballast.
STRUCTURE: Described only as 'space-age stronger-than-steel fabrics' and 'stronger than rigid' frame body. Helium contained in multiple independent cells ("can not crash, even if cut in half").
Following data all provisional.

Artist's impression of Nagy High-Speed Airship 1047198



Nagy airship *(Paul Jackson)* 1158948

POWER PLANT: Four 447 kW (600 hp) engines (type unspecified) in 2-ton, eight in 10-ton and 12 in 100-ton versions. Fuel capacity (all versions) adequate for non-stop global circumnavigation.
EQUIPMENT: Hoist to upload or download passengers or cargo where landings are not possible.
DIMENSIONS, EXTERNAL (A: 2-ton, B: 10-ton, C: 100-ton):
Length overall: A ..... 45.72 m (150 ft)
B ..... 82.30 m (270 ft)
C ..... 167.64 m (550 ft)
Diameter: A ..... 10.67 m (35 ft)
B ..... 16.76 m (55 ft)
C ..... 33.53 m (110 ft)
DIMENSIONS, INTERNAL:
Total volume: A ..... 2,720 m^3 (96,000 cu ft)
B ..... 11,600 m^3 (410,000 cu ft)
C ..... 116,100 m^3 (4,100,000 cu ft)
Passenger compartment:
Length: A ..... 42.67 m (140 ft)
B ..... 76.20 m (250 ft)
C ..... 152.40 m (500 ft)
Width: A ..... 3.05 m (10 ft)
B ..... 6.10 m (20 ft)
C ..... 9.14 m (30 ft)
Height: A ..... 3.05 m (10 ft)
B ..... 6.10 m (20 ft)
C ..... 9.14 m (30 ft)
Floor area: A ..... 130.1 m^2 (1,400 sq ft)
B (2 floors, total) ..... 929.0 m^2 (10,000 sq ft)
C (3 floors, total) ..... 4,180.6 m^2 (45,000 sq ft)
WEIGHTS AND LOADINGS:
Max T-O weight: A ..... 1,814 kg (4,000 lb)
B ..... 9,071 kg (20,000 lb)
C ..... 90,718 kg (200,000 lb)
PERFORMANCE (estimated):
Max level speed: A, B, C ..... more than 173 kt (321 km/h; 200 mph)
Absolute ceiling: A, B, C ..... 21,340 m (70,000 ft)

NASA

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NASA continues to undertake research and development allied to aerospace technology but space science and space flight activity continues to absorb the greater share of the annual budget. For FY07, total of USD16.8 billion requested, including USD724 million for aeronautics technology. Prime NASA concerns have traditionally been, and continue to be, R&D, rather than operationally driven. In addition to programmes described here in detail, NASA funds are also allocated to a variety of projects and concept studies, including research into 'quiet' sonic booms (with Northrop Grumman), air traffic management and UAVs.

NASA AIRCRAFT TRIALS PROGRAMMES

Of some 100 aircraft operated by NASA, most are standard types assigned to specific research programmes. The fleet comprises about 35 dedicated to research and 65 to programme support; most carry civilian registrations. Main operating bases of NASA's Aerospace Technology division are:
Ames Research Center, Moffett Federal Airfield, California
Dryden Flight Research Center, Edwards AFB, California
Glenn Research Center, Cleveland-Hopkins IAP, Ohio
Langley Research Center, Langley AFB, Hampton, Virginia
Other significant aircraft operations bases are:
Johnson Space Center, Ellington ANGB, Houston, Texas
Wallops Flight Facility, Wallops Island, Virginia

NASA FLEET 2005

Regn	Type	Base
N2NA	Gulfstream III	Houston, Texas
N7NA	Beech B200 King Air	Edwards AFB, California
N8NA	Beech B200 King Air	Wallops Island, Virginia
N417NA	Bell UH-1H Iroquois	Kennedy Space Center, Florida
N418NA	Bell UH-1H Iroquois	Kennedy Space Center, Florida
N419NA	Bell UH-1H Iroquois	Kennedy Space Center, Florida
N420NA	Bell UH-1H Iroquois	Kennedy Space Center, Florida
N426NA	Lockheed P-3B Orion	Wallops Island, Virginia
N436NA	Douglas DC-8-72	Wallops Island, Virginia
N501NA	Cirrus SR22	Langley, Virginia
N504NA	Cessna 206H	Langley, Virginia
N507NA	Lancair Columbia 300X	Langley, Virginia
N511NA	Northrop T-38A Talon	Houston, Texas
N515NA	Boeing 737-130	Langley, Virginia
N524NA	NA OV-10A Bronco	Langley, Virginia
N529NA	Beech 200 King Air	Langley, Virginia
N535NA	Bell UH-1H Iroquois	Langley, Virginia
N557NA	Boeing 757-225	Langley, Virginia
N601NA	Lockheed S-3B Viking	Cleveland, Ohio
N605NA	Learjet 23	Cleveland, Ohio
N607NA	DHC-6 Twin Otter	Cleveland, Ohio
N616NA	Learjet 25	Cleveland, Ohio
N747NA	Boeing 747SP-21	Moffett Field, California
N801NA	Beech 200 King Air	Edwards AFB, California
N803NA	Molino PIK-20E	Edwards AFB, California
N806NA	Lockheed ER-2S	Edwards AFB, California
N809NA	Lockheed ER-2S	Edwards AFB, California
N816NA	Lockheed Martin F-16A	Edwards AFB, California
N818NA	Lockheed YO-3A	Edwards AFB, California
N819NA	Beech T-34C Turbo-Mentor	Edwards AFB, California
N836NA	Boeing F-15B Eagle	Edwards AFB, California
N837NA	Boeing F-15B Eagle	Edwards AFB, California
N840NA	Boeing F/A-18A Hornet	Edwards AFB, California
N843NA	Boeing F/A-18A Hornet	Edwards AFB, California
N845NA	Boeing F/A-18B Hornet	Edwards AFB, California
N846NA	Boeing F/A-18B Hornet	Edwards AFB, California
N847NA	Boeing F/A-18A Hornet	Edwards AFB, California
N850NA	Boeing F/A-18A Hornet	Edwards AFB, California
N851NA	Boeing F/A-18A Hornet	Edwards AFB, California
N852NA	Boeing F/A-18B Hornet	Edwards AFB, California
N853NA	Boeing F/A-18A Hornet	Edwards AFB, California
N864NA	Northrop T-38B Talon	Edwards AFB, California
N865NA	Beech T-34C Turbo-Mentor	Edwards AFB, California
N901NA	Northrop T-38A Talon	Houston, Texas
N902NA	Northrop T-38A Talon	Houston, Texas
N903NA	Northrop T-38A Talon	Houston, Texas
N904NA	Northrop T-38A Talon	Houston, Texas
N905NA	Boeing 747-123	Houston, Texas
N906NA	Northrop T-38A Talon	Houston, Texas
N907NA	Northrop T-38A Talon	Houston, Texas
N908NA	Northrop T-38A Talon	Houston, Texas
N909NA	Northrop T-38A Talon	Houston, Texas

Regn	Type	Base
N910NA	Northrop T-38A Talon	Houston, Texas
N911NA	Boeing 747SR-46	Houston, Texas
N912NA	Northrop T-38A Talon	Houston, Texas
N913NA	Northrop T-38A Talon	Houston, Texas
N914NA	Northrop T-38A Talon	Houston, Texas
N915NA	Northrop T-38A Talon	Houston, Texas
N916NA	Northrop T-38A Talon	Houston, Texas
N917NA	Northrop T-38A Talon	Houston, Texas
N918NA	Northrop T-38A Talon	Houston, Texas
N919NA	Northrop T-38A Talon	Houston, Texas
N920NA	Northrop T-38A Talon	Houston, Texas
N921NA	Northrop T-38A Talon	Houston, Texas
N923NA	Northrop T-38A Talon	Houston, Texas
N924NA	Northrop T-38A Talon	Houston, Texas
N926NA	General Dynamics WB-57F	Houston, Texas
N928NA	General Dynamics WB-57F	Houston, Texas
N932NA	Douglas DC-9-33RC	Houston, Texas
N934NA	DC-9-33F	Houston, Texas
N941NA	Airbus 377SGT-F Super Guppy	Houston, Texas
N944NA	Gulfstream II	Houston, Texas
N945NA	Gulfstream II	Houston, Texas
N946NA	Gulfstream II	Houston, Texas
N947NA	Gulfstream II	Houston, Texas
N948NA	Gulfstream II	Houston, Texas
N949NA	Gulfstream II	Houston, Texas
N950NA	Gulfstream II	Houston, Texas
N955NA	Northrop T-38A Talon	Houston, Texas
N956NA	Northrop T-38A Talon	Houston, Texas
N959NA	Northrop T-38A Talon	Houston, Texas
N960NA	Northrop T-38A Talon	Houston, Texas
N961NA	Northrop T-38A Talon	Houston, Texas
N962NA	Northrop T-38A Talon	Houston, Texas
N963NA	Northrop T-38A Talon	Houston, Texas
N965NA	Northrop T-38A Talon	Houston, Texas
N966NA	Northrop T-38A Talon	Houston, Texas
N967NA	Northrop T-38A Talon	Edwards AFB, California

Notes: Aircraft registered to NASA are not necessarily all airworthy at any one time. Does not include some temporary military assignments or B-52H 61-0025 and C-20A 83-0502

Details follow of some significant research projects.

Boeing F-15B: Original F-15B prototype (NASA837/71-0290) modified for ACTIVE (Advanced Control Technology for Integrated Vehicles) project involving thrust vectoring nozzles developed by Pratt & Whitney. Series of trials, in non-reversionary mode, undertaken in 1999, included take-offs and landings using vectoring only as well as flight to unlimited angles of attack and speeds of M2. New nozzles can turn up to 20° in any direction, permitting thrust control in pitch and yaw. ACTIVE programme is a joint venture involving NASA, the USAF's Wright Laboratory, Boeing (formerly McDonnell Douglas) and Pratt & Whitney.

ACTIVE F-15B also used to evaluate 'neural network'-based controller as opening part of intelligent flight control system (IFCS) programme; total of 15 flights accomplished during March and April 1999. Additional flights conducted by third quarter of 2003, when evaluation completed; latter phase included revolutionary 'self-learning' FCS with potential to allow damaged aircraft to be safely recovered by automatic adjustment of FCS to take into account damaged or defective surfaces and systems.

A second F-15B (NASA836/74-0141), known as the Aerodynamic Flight Facility and equipped with a flight test fixture (airborne test-bench) on the centreline pylon, flew seven sorties between 26 February and 1 April 1996 to test materials for the X-33's thermal protection system; used during 1999 for investigation of supersonic natural laminar flow of advanced wing design, carrying 0.91 by 1.22 m (3 by 4 ft) test article on centreline pylon during four test flights at speeds approaching M2 and altitudes of up to 13,715 m (45,000 ft). This aircraft recently involved in experiments into gust monitoring and aeroelasticity, with 0.45 m (1 ft 6 in) long, flexible, test wing mounted on the flight test fixture. Future projects include trials of Pulse Detonation Engine; these will involve an experimental engine suspended from a new centreline Propulsion Flight Test Fixture (PFTF) that was flown for the first time in late 2001.

One of NASA's two vintage Martin WB-57Fs, used for earth surveillance

1158810

Boeing F/A-18: F/A-18A NASA853 refurbished to serve as testbed for Active Aeroelastic Wing (AAW) programme that examines use of 'flexible wings' to research airflow over the wing and assess how this affects controllability. Following modification, aircraft rolled out at Dryden on 27 March 2002 and made initial flight on 15 November 2002, this being one of 51 sorties performed in the first phase of testing which was accomplished in 2003. Second series of trials incorporating wing-warping was intended for early 2004, after development of new flight control laws allowing wing to be twisted; this phase planned to last for three to four months. However, flying did not resume until December 2004; total of 25 flights undertaken at subsonic and supersonic speeds, with results of these permitting further alterations to control laws before final few sorties intended to demonstrate improved roll control at M1.2 and 6,100 m (20,000 ft) as well as load alleviation in wind-up turns.

Two NASA F/A-18As (NASA843 and NASA847) used for demonstration of autonomous close formation flight in 2001. Achieved automatic 61 m (200 ft) horizontal and 15 m (50 ft) lateral separation on 21 February 2001 on seventh of planned 12 sorties. This test effort also included study of wingtip vortex effect, confirming that close formation flying could offer significant fuel economies; in one test, one F/A-18 flew in wingtip vortex of another F/A-18, with subsequent analysis revealing that trailing aircraft consumed 270 kg (600 lb) less fuel than a third F/A-18 which was not part of the formation. This equates to about a 14 per cent reduction in fuel burn.

Same pair of aircraft used in early 2003 for initial phase of test project intended to ultimately develop viable automated air-to-air refuelling system for use by unmanned air vehicles. Subsequently, on 30 August 2006, one F/A-18 successfully formatted with an Omega Air Boeing 707 tanker and made contact under automatic control; several contacts were made with trailing drogue during which fuel was transferred. This demonstration was accomplished with the aid of an Octec optical tracking system employing a camera mounted on the refuelling probe that identified and locked on to drogue basket before guiding the F/A-18 into position to make contact.

Boeing 747SP: Engineering work under way to build Stratospheric Observatory For Infra-red Astronomy (SOFIA) with 2.69 m (8 ft 10 in) telescope housed in unpressurised cavity in aft fuselage and looking to port; partner is German Ministry of Science (BMFT), which delivered telescope to USA on 4 September 2002; cruise altitude 12,500 to 13,700 m (41,000 to 45,000 ft); to fly up to 160 sorties (8 hours each) per year for 20 years. US$484 million, 10 year contract secured in December 1996 by a team led by Universities Space Research Association (USRA) to design, assemble, test and operate SOFIA. Former United Airlines Boeing 747SP (N145UA) chosen from several in storage at Las Vegas, Nevada, and ferried to San Francisco in February 1997 for attention by United before being handed over to NASA; following acceptance, 747SP delivered to Waco, Texas, in May 1997 for modification and fitting out by Raytheon E-Systems; suspension assembly for telescope successfully installed by end of first quarter 2003, with new upper rigid door fitted on 20 December 2004.Several months of testing of telescope and associated systems will

NASA F/A-18B N845NA conducting its first automatic refuelling from a Boeing 707 on 30 August 2006 ***(Jim Ross, NASA)***

1158809

presage delivery to NASA Ames, from where scientific observation missions were expected to begin in 2005, although aircraft placed in storage upon completion of modification work in April 2005.

Boeing NB-52B Stratofortress: Used for aerial launch of test vehicles, with most recent activity involving X-43A Hyper-X project. After more than 40 years of service as launch platform, NB-52B was formally retired on 17 December 2004 and replaced by a B-52H (61-0025) which was delivered on 30 July 2001 and then flown to Tinker AFB, Oklahoma for programmed depot maintenance, returning on 17 April 2002. B-52H has universal pylon able to accept different adaptors and initially accommodate loads of up to 11,340 kg (25,000 lb), although it is planned to increase payload capability to more than 31,750 kg (70,000 lb).

McDonnell Douglas DC-8-72: Assigned to Airborne Science Program at Dryden, following outfitting with Jet Propulsion Laboratory (Pasadena, California) advanced airborne synthetic aperture radar and other sensor systems including imaging spectroradiometer and thermal emission and reflection radiometer. Used for convection and moisture experiments, Earth science studies and also supporting NASA investigation into ozone depletion. In first quarter of 2002, used for ice and snow studies, employing synthetic aperture radar and other sensors to gather data on how the snow process works. Previously, the DC-8 (N817NA) had deployed to the Pacific Rim to conduct studies of volcanic activity. Most recent task, in January and February 2005, involved measurement of atmospheric quality in the Arctic. Aircraft was reassigned to Wallops Island facility in late 2005 as N436NA.

NEMESIS

NEMESIS AIR RACING

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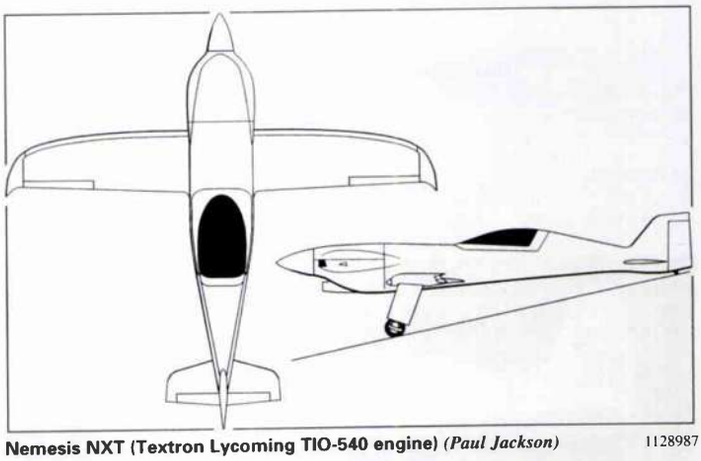
PRESIDENT AND DESIGNER: Jon Sharp
DESIGN ENGINEER: Kevin Luttge

Current NXT originated in Sharp DR 90 Nemesis air racer (N18JS), built in 1991 from pressure-moulded graphite/epoxy foam core sandwich and powered by a 74.6 kW (100 hp) Continental O-200 engine; other innovations in Formula 1 racing class included natural laminar flow wing, computer lofted drawings, sidestick control, onboard data system and single-piece centre section including wing and landing gear. Won 45 of 48 contests entered between 1991 and retirement to Smithsonian National Air and Space Museum in 1999; exceeded 16 class speed records.

NEMESIS NXT

TYPE: Side-by-side sportplane kitbuilt.
PROGRAMME: Announced June 2000 as successor to Sharp DR 90 Nemesis; designation indicates Neoteric eXperimental Technology. First flight (N333XT) 10 July 2004.
CUSTOMERS: Total six kits delivered by early 2006, of which three (including prototype) then flying.
COSTS: Kit USD129,550 (2006).
DESIGN FEATURES: Formula 1 air racer; robust structure and low drag among design objectives. Low wing with progressive sweepback and medium aspect ratio; sweptback fin and tailplane; broad, flattened forward fuselage accommodating engine; cockpit behind wings. Wing section modified NASA laminar flow.
FLYING CONTROLS: Conventional and manual. Balanced ailerons; inset elevators without tabs; rudder without tab. Split flaps with 'piano' hinges. Electric trimming of rudder and elevator.
STRUCTURE: Carbon fibre airframe of FiberCote E760 pre-preg material manufactured to high degree of accuracy in Perfect Fit Technology procedure to save assembly time. Wing top and bottom skins incorporate integral spar caps; fuselage right and left sides have integral longerons and incorporate low dielectric fin; tailplane assembled from top and bottom halves; integral rollover structure. Wing permanently attached at assembly.
LANDING GEAR: Tailwheel type; mainwheels retractable. Solid tailwheel mounted in lower surface of rudder, lower half only protruding; no provision for castoring. Mainwheel legs, incorporating oleo-damped, levered suspension wheels, retract inwards by electro-hydraulic, mechanically-timed mechanism including emergency hand-pump. Mainwheel tyres 5.00-5; Grove wheels with heavy-duty axles and hydraulic brakes.
POWER PLANT: One 261 kW (350 hp) Textron Lycoming TIO-540-NXT flat-six driving a Hartzell FC7291X three-blade, 'scimitar', constant-speed propeller. Alternatively 305 kW (409 hp) TSIO-540-NXT. Fuel capacity 341 litres (90.0 US gallons; 75.0 Imp gallons).



Nemesis NXT (Textron Lycoming TIO-540 engine) ***(Paul Jackson)*** 1128987

ACCOMMODATION: Two persons, side by side in staggered seats beneath single-piece, starboard-hinged canopy/windscreen. Central sidestick control.
DIMENSIONS, EXTERNAL:
Wing span ..... 7.32 m (24 ft 0 in)
Wing aspect ratio 8.2
Length overall ..... 7.01 m (23 ft 0 in)
DIMENSIONS, INTERNAL:
Cockpit height ..... 0.89 m (2 ft 11 in)
AREAS:
Wings, gross ..... 6.50 m² (70.0 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 726 kg (1,600 lb)
Max T-O weight ..... 1,179 kg (2,600 lb)
Max wing loading ..... 181.3 kg/m² (37.14 lb/sq ft)
Max power loading ..... 4.52 kg/kW (7.43 lb/hp)
PERFORMANCE:
Cruising speed ..... 282 kt (523 km/h; 325 mph) IAS
Stalling speed ..... 79 kt (145 km/h; 90 mph) IAS
Max rate of climb at S/L ..... 914 m (3,000 ft)/min
T-O run ..... 762 m (2,500 ft)
Landing run ..... 1,067 m (3,500 ft)
g limits ..... +6/–4

Nemesis NXT two-seat racer ***(Paul Jackson)*** 1159074

NEW CENTURY

NEW CENTURY AEROSPORT INC

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Web: www.radialrocket.com
DIRECTORS:
Jeff Ackland
Mark Burrow

New Century's Radial Rocket high-powered kitplane was first exhibited at the 2004 AirVenture at Oshkosh. Promotion was continuing in 2006, although no sales had been reported.

NEW CENTURY RADIAL ROCKET

TYPE: Tandem-seat sportplane kitbuilt.
PROGRAMME: Prototype (N364R) exhibited at AirVenture, Oshkosh, July 2004, shortly after its maiden flight.
COSTS: Kit USD49,950, excluding engine and instruments (2006). Fast-build option extra USD13,925.
DESIGN FEATURES: High-performance kitbuilt. Low, moderately tapered wing; rounded fin with low-set tailplane. Laminar flow wing designed by Jeff Viken.

New Century Radial Rocket prototype *(Paul Jackson)* 1037977

FLYING CONTROLS: Conventional and manual. Rudder and tailplane horn balances; inset aileron hinges. 'Semi-Fowler' flaps. Three-axis electric trim.
STRUCTURE: Generally of composites. Pre-moulded outer skins use pre-preg materials that are vacuum-bagged and oven-cured, thus optimised for light weight, high strength, and aerodynamic cleanliness. Carbon fibre materials in selected areas of the airframe, including wing spar caps and fuselage longerons. Fuselage consists of left and right halves, incorporating vertical stabilizer. Pre-moulded overlapping joggles for quick and accurate fuselage shell assembly. Flat pre-moulded, honeycomb core panels incorporated in fabrication of internal ribs and bulkheads for fuselage and flying surfaces. One-piece wing is supplied with forward and aft spars completed and installed; 'wet wing' fuel bays sealed with an epoxy. Ailerons and flaps are built in place on the wing fixture, for accurate alignment to the aerofoil. Optional carbon fibre skins for flight control surfaces.
LANDING GEAR: Tailwheel type; fixed or retractable. Wing-mounted, tall, streamlined cantilever main legs with integral shock-absorbers. Steerable tailwheel. Mainwheel 5.00-5 on prototype; 6.00-6 on production aircraft.
POWER PLANT: One 265 kW (355 hp) VOKBM M-14P nine-cylinder radial engine driving an MT-Propeller three-blade, constant-speed propeller. Fuel in integral wing tanks, combined capacity 318 litres (84.0 US gallons; 70.0 Imp gallons).
DIMENSIONS, EXTERNAL:

Wing span: prototype	6.71 m (22 ft 0 in)
production	7.65 m (25 ft 2½ in)
Wing aspect ratio	7.0
Length overall	6.77 m (22 ft 2½ in)
Wheel track	2.57 m (8 ft 5 in)
Tailplane span: prototype	2.44 m (8 ft 0 in)
production	3.20 m (10 ft 6 in)
Propeller diameter	2.49 m (8 ft 2 in)

DIMENSIONS, INTERNAL:

Cockpit max width: front	0.86 m (2 ft 10 in)
rear	0.76 m (2 ft 6 in)

AREAS:

Wings, gross: prototype	7.62 m² (82.0 sq ft)
production	8.36 m² (90.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	748 kg (1,650 lb)
Max T-O weight	1,111 kg (2,450 lb)

PERFORMANCE:

Never-exceed speed (VNE)	243 kt (450 km/h; 280 mph)
Max level speed	200 kt (370 km/h; 230 mph)
Econ cruising speed	174 kt (322 km/h; 200 mph)
Stalling speed: flaps up	73 kt (136 km/h; 84 mph)
flaps down	59 kt (110 km/h; 68 mph)
Max rate of climb at S/L	610 m (2,000 ft)/min
Range with 30 min reserves	1,042 n miles (1,931 km; 1,200 miles)
g limits	+6/–4

NEXAER

NEXAER

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PRESIDENT AND CEO: Paul M Klahn

Nexaer was established in August 2001 and showed a mockup of its first aircraft at AirVenture, Oshkosh, in July 2005. Prototype, built by Composicraft Inc, completed mid-2006. Workforce six in 2006.

NEXAER LS1

TYPE: Two-seat lightplane.
PROGRAMME: First flight planned October 2005, but not achieved by target date. Prototype (N103XR) completed May 2006; first 'flight' on 16 October 2006 was brief runway hop.
CURRENT VERSIONS: **SE:** Standard Edition. Optimised for US LSA category. Jabiru 2200 engine; single controls; mechanical flight instruments, including Garmin SL40 nav/com and GTX 327 transponder.
TE: Trainer Edition. Jabiru 2200 engine; dual controls; mechanical flight instruments, including SL30 and GTX 327; ballistic recovery parachute.
LE: Luxury Edition. Jabiru 3300 engine; single controls; dual EFIS; SL40, GTX 330 transponder; two-axis digital autopilot; dual GPS; ballistic parachute; luxury internal and external finish.
DESIGN FEATURES: Low-mounted, moderately sweptback wings and tailplane; sweptback fin.
FLYING CONTROLS: Conventional and manual. No flaps.
STRUCTURE: Composites, including carbon fibre cabin and Kevlar fuel tank. Ribless wing structure.
LANDING GEAR: Tricycle type; fixed.
POWER PLANT: One 59.7 kW (80 hp) Jabiru 2200 flat-four or 89 kW (120 hp) Jabiru 3300 flat-six piston engine and fixed-pitch propeller, according to version. Fuel tank in fuselage, capacity 102 litres (27.0 US gallons; 22.5 Imp gallons). Airframe also suitable for installation of Rotax 912, Teledyne Continental O-200 or Textron Lycoming O-235 engines.
ACCOMMODATION: Two persons, side by side with baggage area at rear. Upward-hinged canopy each side; fixed windscreen. Accommodation heated and ventilated.
EQUIPMENT: Exterior lighting standard.

Initial hop of Nexaer LS1 on 16 October 2006 1158849

DIMENSIONS, EXTERNAL:

Wing span	8.99 m (29 ft 6 in)
Wing aspect ratio	7.1
Length overall	7.09 m (23 ft 3 in)
Height overall	2.39 m (4 ft 6 in)

DIMENSIONS, INTERNAL:

Cockpit max width	1.37 m (4 ft 6 in)

AREAS:

Wings, gross	11.52 m² (124.0 sq ft)

WEIGHTS AND LOADINGS (Jabiru 3300 engine):

Weight empty	340 kg (750 lb)
Max T-O weight	598 kg (1,320 lb)
Max wing loading	52.0 kg/m² (10.65 lb/sq ft)
Max power loading	6.70 kg/kW (11.00 lb/hp)

PERFORMANCE (Jabiru 3300 engine):

Never-exceed speed (VNE)	160 kt (296 km/h; 184 mph)
Max level speed	120 kt (222 km/h; 138 mph)
Manoeuvring speed	105 kt (194 km/h; 121 mph)
Stalling speed	44 kt (82 km/h; 51 mph)
Max rate of climb at S/L	457 m (1,500 ft)/min
T-O run	107 m (350 ft)
Range	477 n miles (885 km; 550 miles)
g limits	+4.5/–2.0

NORTHROP GRUMMAN

NORTHROP GRUMMAN CORPORATION

1840 Century Park East, Los Angeles, California 90067-2199
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Web: www.northropgrumman.com
CHAIRMAN, CEO AND PRESIDENT: Dr Ronald D Sugar
CORPORATE VICE-PRESIDENT AND CHIEF FINANCIAL OFFICER: Wesley G Bush
CORPORATE VICE-PRESIDENT, COMMUNICATIONS: Rosanne P O'Brien

Northrop company formed 1939 to produce military aircraft; activities extended to missiles, target drones, electronics, space technology, communications, support services and commercial products. Grumman Aircraft Engineering Corporation incorporated 6 December 1929; became major supplier of carrierborne aircraft to US Navy.

Acquisition of Grumman by Northrop completed 1 May 1994 and new corporation formed 18 May. Northrop Grumman subsequently completed acquisition of Vought Aircraft Company, with USD130 million purchase of Carlyle Group's 51 per cent interest, in August 1994. Further expansion announced on 3 January 1996, when Northrop Grumman revealed agreement to acquire the defence and electronic systems businesses of the Westinghouse Electric Corporation for USD3 billion. Finalisation of this purchase in March 1996 resulted in significant increase in products and technologies offered by Northrop Grumman. A major addition, finalised in July 1999, was that of Teledyne Ryan Aeronautical at cost of approximately USD140 million. Subsequently, in early April 2001, Northrop Grumman completed acquisition of Litton Industries Inc; value of this acquisition estimated at USD5.1 billion (including USD1.3 billion net debt). Another acquisition, announced on 20 April 2001, involved purchase of Electronic and Information Systems Group of Aerojet-General Corporation for USD315 million. Further growth followed on 30 November 2001, with acquisition of Newport News Shipbuilding, manufacturer of nuclear-powered submarines and aircraft carriers. In first quarter of 2002, Northrop Grumman announced merger with TRW Inc; deal finalised by 1 July, when Northrop Grumman revealed details of USD7.8 billion purchase. TRW Systems renamed Northrop Grumman Mission Systems and TRW Space and Electronics renamed Northrop Grumman Space Technology. Agreement concluded in January 2006 with Hindustan Aeronautics Ltd of India, that could lead to HAL eventually producing aircraft assemblies and components for the E-2 Hawkeye. Workforce totalled 125,000 in early 2005. Revenue of USD29,853 million achieved in 2004, compared with USD26,396 million in 2003 and USD17,406 million in 2002.

Northrop Grumman now organised into seven operating sectors as follows:

ELECTRONIC SYSTEMS Responsibilities include the development and production of radar and electronic systems for installation in the F-16 Fighting Falcon, F-22 Raptor, B-1B Lancer, AH-64D Apache Longbow, C-130 Hercules, E-3 Sentry and Boeing 737 AWACS and E-8C Joint STARS. Teamed with Rafael of Israel for sale and production of Litening II target-designation and navigation pod. Revenues for 2004 were USD6,417 million, compared with USD6,039 million in 2003 and USD5,326 million in 2002. Headquartered at Linthicum, Maryland; workforce totalled 22,000 in December 2002. Development, integration and manufacturing expertise also embraces military airborne, space and undersea radar, surveillance and reconnaissance systems, air defence systems, tactical communications equipment, anti-submarine warfare sensors and systems, submersibles, mine countermeasures equipment, marine systems and shipboard instrumentation. Radar systems are produced for civil air traffic control agencies in the USA, Europe, Africa, the Middle and Far East, Asia and Latin America.

INFORMATION TECHNOLOGY Headquartered at McClean, Virginia. Wholly owned subsidiary, now including much of Litton, provides technical engineering, project management and support resource services for information technology systems, plus technical and professional services in operations and maintenance.

MISSION SYSTEMS At Reston, Virginia.

INTEGRATED SYSTEMS *As described.*

SHIP SYSTEMS At Pascagoula, Mississippi.

NEWPORT NEWS Production and assembly of nuclear-powered submarines, warships and aircraft carriers.

SPACE TECHNOLOGY At Redondo Beach, California.

INTEGRATED SYSTEMS

Tel: (+1 310) 332 10 00
Fax: (+1 310) 332 73 10
Web: www.is.northropgrumman.com
CORPORATE VICE-PRESIDENT AND PRESIDENT, INTEGRATED SYSTEMS: Scott J Seymour
DIRECTOR OF COMMUNICATIONS: Wendell D Bugg

Having divested itself of the aerostructures business, Integrated Systems now functions as prime contractor for the B-2A Spirit stealth bomber and the E-8C Joint STARS airborne targeting and battlefield management system, while continuing production of the E-2C Hawkeye for the US Navy. Serves as principal subcontractor for the F/A-18 (see Boeing) and is teamed with Lockheed Martin on the F-35 JSF programme. Other work includes modification and support of the EA-6B Prowler, F-5 Tiger II and Fairchild A-10 Thunderbolt II. Also engaged in production and support of UAVs for reconnaissance, surveillance and deception as well as aerial target systems.

Revenues for 2004 were USD4,747 million, compared with USD3,851 million in 2003; workforce totalled 13,400 in early 2004.

Operating elements of Integrated Systems are organised into business areas, with responsibilities as described.

Air Combat Systems

1 Northrop Grumman Avenue, El Segundo, California 90245-2804
Tel: (+1 310) 331 36 16
SECTOR VICE-PRESIDENT: Gary Ervin
MANAGER, COMMUNICATIONS: James F Hart

B-2 Spirit, F/A-18 Hornet/Super Hornet, F-35 Joint Strike Fighter and F-5 Tiger II/T-38 Talon. Has sites at Palmdale and San Diego, California; New Town, North Dakota; Whiteman AFB, Missouri; Tinker AFB, Oklahoma; and Hill AFB, Utah.

Airborne Early Warning And Electronic Warfare Systems

South Oyster Bay Road, Bethpage, New York 11714-3582
Tel: (+1 516) 575 51 19
SECTOR VICE-PRESIDENT: Philip A Teel
MANAGER, COMMUNICATIONS: John Vosilla

Production and continued development of E-2 Hawkeye, plus modification, repair and support of other types, including EA-6B Prowler, A-10 Thunderbolt II, C-2 Greyhound, F-5 Tiger II and S-2T Turbo-Tracker. Has sites at St Augustine and Cecil Field, Florida; Point Mugu, California, plus field support services at many other locations.

Airborne Ground Surveillance And Battle Management Systems

2000 NASA Boulevard, Melbourne, Florida 32904
Tel: (+1 321) 726 75 26
SECTOR VICE-PRESIDENT: Alan J Doshier
MANAGER, COMMUNICATIONS: James Stratford

Support and upgrading of E-8C Joint STARS, plus associated advanced surveillance and battle management systems; currently developing new surveillance systems as part of Multi-Platform Radar Technology Insertion Program (MP-RTIP) for USAF E-10A multisensor command and control aircraft. Has additional site at Lake Charles, Louisiana.

Unmanned Systems

340-2C Building 2, 17066 Goldentop Road, San Diego, California 92127
SECTOR VICE-PRESIDENT: Christopher M Hernandez
MANAGER, COMMUNICATIONS: Cynthia J Curiel

Responsible for development and production of unmanned air vehicles, including Global Hawk, Fire Scout and BQM-74E. Has sites at Edwards AFB and Palmdale, California.

NORTHROP GRUMMAN E-2 HAWKEYE

TYPE: Airborne early warning and control system.

PROGRAMME:

DEVELOPMENT MILESTONES

E-2A	
First flight	21 Oct 60
First delivery	19 Jan 64
Subsequent versions	
E-2C	
First flight	20 Jan 71
First flight, production	23 Sep 72
Entered service (US Navy)	Nov 73
E-2D	
Official go-ahead (SDD contract award)	Aug 04

First flight of first of three prototypes 21 October 1960; total 59 production E-2As, of which 51 updated to E-2B by end 1971 apart from two TE-2A trainers and two converted to E-2C prototypes; first flight of E-2C prototype 20 January 1971; production started mid-1971; first flight production aircraft 23 September 1972; 219 of all E-2C versions ordered, of which 211 had been delivered by the first quarter of 2006. Flying hours by that time exceeded one million.

Northrop Grumman E-2C Hawkeye retrofitted with Hamilton Sundstrand eight-blade propellers *(Paul Jackson)* 1158240

VAW-116 (squadron) Northrop Grumman E-2C Hawkeye
(PMA Ronald A Dallatorre, USN) 1158232

CURRENT VERSIONS: **E-2C:** Current service and production version (*as detailed*). Baseline aircraft (65 built) had AN/APS-120 or AN/APS-125 radar; replaced in production by 'Group 0' version (35 built) with AN/APS-138 radar. In closing stages of 2004, US Navy possessed only four active 'Group 0' aircraft; assigned to VAW-77 at Atlanta, Georgia, these have since been retired from service.

AN/APS-139 and Allison T56-A-427 engines formed **Group I** update; first operational aircraft (163538) delivered to VAW-112 on 8 August 1989; 18 built; AN/APS-139 could detect cruise missiles at ranges exceeding 100 n miles (185 km; 115 miles); also monitored maritime traffic; radar coverage extended by AN/ALR-73 passive detection system (PDS), detecting electronic emitters at twice radar detection range. All Group I aircraft subsequently modified to either TE-2C or Group II standard. AN/APS-145 in **Group II** aircraft from December 1991; other enhancements give Group II 96 per cent expansion in radar volume, 400 per cent extra target tracking capability, 40 per cent more radar and identification range and 960 per cent increase in numbers of targets displayed. Group II added JTIDS in 1993–94; also has GPS. Final Group II aircraft for US Navy delivered in mid-2001; one since modified to TE-2C configuration. Retrofit with eight-blade propellers was due to start in 2001, with first operational example expected in fourth quarter; however, vibration problems encountered in testing caused delay and new propeller did not enter service until mid-2004. On 15 August 2005, Northrop Grumman announced completion of Group II Mission Computer Replacement Program (MCRP), whereby approximately 48 aircraft were upgraded; this involved installation of new processor and open systems, Commercial Off-The-Shelf (COTS) hardware. Benefits include predicted MTBF in excess of 8,000 hours for mission computer; reduced hardware weight from 318 kg (700 lb) to 48 kg (105 lb); lowered heat dissipation from 1,700 W to 80 W; and reduced central processing unit load time to below 30 seconds (previously in excess of 2.5 minutes).

TE-2C: Training model, based on E-2C; two conversions (158639, 158648) originally undertaken, of which one (158639) was later assigned to JTIDS development with Northrop Grumman. At least four further conversions (159105, 163029, 163848, 164110) subsequently made for training purposes with VAW-120 at Norfolk, Virginia, of which only the last mentioned was in service in October 2005. Five new-build examples to be acquired in FY04–07, with these lacking radar, but including wiring and hardware systems to facilitate future conversion.

E-2T: Originally reported to be conversion of E-2B for Taiwan, but new-build aircraft equivalent to E-2C Group I actually supplied; AN/APS-138 radar and electronic warfare upgrades. Delivery began in 1995, with further two obtained following agreement in July 1999; these to Hawkeye 2000E standard, with AN/APS-145 radar, but lacking CEC and satcom equipment. Delivery of first accomplished in USA 10 August 2004, with second following by end of year; both subsequently shipped to Taiwan, arriving there 19 May 2005. Original four aircraft being upgraded to Hawkeye 2000E standard during 2006-07. Alternative, unofficial, designation of latest Taiwanese aircraft is **E-2K**, derived from Hawkeye 2000 (E-2C 2K).

Hawkeye 2000: In December 1994, company received US$155 million contract to redefine E-2C as the Hawkeye 2000. Key element is mission computer upgrade (MCU), with new equipment based on Raytheon's Model 940.

Initial trials of upgraded mission computer installed on second Group II aircraft (164109) began with first flight on 24 January 1997 and were completed in July 1997, at which time authorisation given for low-rate initial production of new mission computer. However, early flight trials revealed software problems that delayed production of new mission computer by about a year. More ambitious technical and operational evaluations undertaken with five modified aircraft in 1999–2001. All were Group II aircraft fitted with MCU and ACIS (see below) elements of proposed Hawkeye 2000; first two delivered to Patuxent River for initial evaluation by May 1999. At least four to Point Mugu from August 1999, joining VAW-117 for operational evaluation from October, with latter phase including deployed duty aboard a carrier for full battlegroup operations. In meantime, another E-2C (163849) used as testbed for satcom, vapour-cycle cooling upgrade and Navy's USG-3 co-operative engagement capability (CEC) package, following first flight in April 1998; latter results in addition of 1.37 m (4 ft 6 in) antenna dish under belly containing omnidirectional transceiver that connects with command centres on parent aircraft carrier and surface combatant warships; provision of satcom evident through addition of cone-shaped fairing on top of rotodome.

New mission computer is less than half the weight of L-304, one-third of volume, and offers 15 times the processing power; other improvements for Hawkeye 2000 include government-furnished advanced control indicator set (ACIS), satellite-based voice and data communications capability, a new Honeywell vapour-cycle cooling system, air-to-air refuelling capability (if required) and inclusion of equipment and systems that form part of Navy CEC package. MCU and ACIS make use of commercial off-the-shelf technology incorporating open architecture.

In April 1999, contract awarded for 24 aircraft for US Navy (21 Hawkeye 2000s) as five-year procurement package, Taiwan (two Hawkeye 2000Es) and France (one Group II Hawkeye); in early 2003, US Navy announced intention to award second multiyear procurement contract, for total of eight aircraft to be acquired at rate of two per year during FY04 to FY07, with first delivery programmed for January 2007. Five will be configured as TE-2C trainers, lacking mission system. First deployment of Hawkeye 2000 with US Navy by VAW-117 squadron in 2003. Export-configured Hawkeye 2000s lack CEC and satcom facilities.

E-2D: Originally known as **Advanced Hawkeye**, with E-2D designation formally assigned in July 2004, but not officially announced until March 2005. Full-scale development began in early August 2003, following award of system development and demonstration (SDD) contract to Northrop Grumman. Total of USD1.9 billion to be invested in new version by 2012, of which USD413.5 million will go towards developing new space-time adaptive UHF radar; Lockheed Martin Naval Electronics and Surveillance Systems is prime contractor for radar, with Northrop Grumman Electronic Systems furnishing multiple solid-state transmitters and Raytheon providing receivers. The new radar, designated AN/APY-9 by 2006, will feature an L-3 Communications Randtron Antenna Systems UHF electronically scanned ADS-18S array in the existing rotodome and is expected to have twice the range of the current AN/APS-145 radar, as well as superior performance in eliminating clutter and ability to track small targets like cruise missiles. BAE Systems responsible for IFF system. Critical design review (CDR) of new radar undertaken in early 2005 and was reported to be 'very successful'; overall aircraft CDR completed in November 2005.

Other features include surveillance infra-red search and track (SIRST) system, modular communications equipment, multisensor integration and tactical ('glass') cockpit featuring three flat-panel displays, with latter enabling co-pilot to augment mission system operators by performing some tactical functions. Airframe structure strengthened and lightened through application of improved manufacturing techniques, but without recourse to composites. US Navy is prime customer, but another potential buyer is UK Royal Navy, which has emerging requirement for new AEW platform to operate from future aircraft carrier. US planning calls for E-2D to augment traditional AEW roles with increasing emphasis on battle management, land-sea-air connectivity, surveillance, electronic support measures, SAR, emergency air traffic control and border and EEZ patrol.

Communication suite to be greatly expanded and include additional satellite communication systems, plus multiple AN/ARC-210 radios with MIDS tactical datalink and Block 2 CEC sensor datalink. E-2D also planned to be first US Navy aircraft to have Joint Tactical Radio System (replacing AN/ARC-210 units). Upgraded IFF to be produced by BAE Systems.

Power plant will be T56-A-427A version of existing Hawkeye engine, with digital electronic engine control and eight-blade Hamilton Sundstrand NP2000 propellers from outset. MTOW will exceed 25,850 kg (57,000 lb) with maximum landing weight increased to about 20,412 kg (45,000 lb). Hamilton Sundstrand also to provide new 255 kVA generator. Following tanker proximity trials, installation judged possible of refuelling probe above cockpit and funding requested in 2006.

Northrop Grumman received USD49 million pre-systems development and demonstration contract for E-2C RMP (Radar Modernization Program) in late 2001; work done under this 12-month contract concerned definition of physical architecture of future mission system. Northrop Grumman also conducted initial flight testing of new radar's transmitter, receiver, antenna and rotary coupler on an NC-130H Hercules.

Two E-2D prototypes will be utilised for SDD; keel of first aircraft laid May 2005. First flight of first development aircraft expected to take place in August 2007. Subsequent deployment planning anticipates starting procurement in FY09, with an initial batch of four aircraft for operational evaluation in 2011. Further batches of four aircraft are planned for FY10 and FY11, with additional 57 in later years, giving US Navy total fleet of 75, the minimum needed to sustain carrier battle group operations at projected levels. Peak production rate not expected to exceed eight aircraft per year. IOC expected in 2011, with full operational capability due between 2015 and 2017.

CUSTOMERS: US Navy orders for E-2C had totalled 139 by FY92, of which all delivered by March 1994. Further procurement authorised December 1994, when Northrop Grumman awarded USD122.5 million contract for start-up of new assembly line at St Augustine, Florida. Initial orders for seven Group II aircraft (four with FY95 funds, three with FY96 funds); first of these new aircraft (165293) was rolled out on 24 February 1997, flew on 22 March, and was delivered to VAW-120 at Norfolk, Virginia. Further contract in December 1996 to cover advance acquisition costs of four Group II aircraft with FY97 funds; four more ordered before April 1999 award of multiyear contract for 24 aircraft for US Navy (21), France (one) and Taiwan (two). Delivery of first new-build Hawkeye 2000 to US Navy accomplished in October 2001. Five Hawkeye 2000s delivered in 2002, then five in 2003 and three in 2004, with remainder following by second quarter of 2006; additional eight aircraft (three E-2C and five TE-2C) to follow, with delivery programmed to take place between January 2007 and September 2009. Current US Navy programme status in adjacent table:

Variant	Quantity	First aircraft
E-2C Baseline	65	158638
E-2C 'Group 0'	35	161341
E-2C Group I	18[1]	163029
E-2C Group II	36	164108
E-2C Hawkeye 2000	29[2]	165648
Total	**183**	

[1] Two aircraft later converted to TE-2C and 16 upgraded to Group II standard
[2] Includes eight aircraft for procurement in FY04-07 to sustain production until E-2D becomes available; five of these to be completed as TE-2C trainers

Major retrofit programme for USN aircraft to Group II standard was planned from FY95, but 1994 defence review established new E-2Cs more economical than retrofit; however, 16 Group I E-2Cs were upgraded to Group II at St Augustine, Florida; first returned to service on 21 December 1995. First operational squadron with upgraded Group II E-2C was VAW-123 which accepted its fourth and final aircraft on 29 April 1996.

E-2C entered service with VAW-123 at NAS Norfolk, Virginia, November 1973 and went to sea on board USS *Saratoga* late 1974; E-2C issued to 19 other squadrons, including three of Naval Reserve; current squadrons are VAW-112, 113, 116 and 117 at Point Mugu, California; VAW-115 at Atsugi, Japan; VAW-120, 121, 123 to 126 at Norfolk, Virginia, plus VAW-77 of Reserves at Atlanta, Georgia, for anti-drug smuggling surveillance duty. VAW-120 is training unit. Miramar was base of first Group II squadron, VAW-113, June 1992. VAW-113 first operational evaluation cruise in USS *Carl Vinson*, 1993. New Build Group II aircraft also issued to VAW-110 (disbanded September 1994), 112, 116 and 117. Hawkeye 2000 in process of delivery to US Navy; first operational squadron was VAW-117. VAW-116 and VAW-125 both also using Hawkeye 2000 by end of 2004, when about 15 aircraft had been accepted. VAW-113 subsequently transitioned to Hawkeye 2000 in 2005.

See table for exports. Singaporean aircraft with AN/APS-138 radar; Taiwan received E-2T with AN/APS-138 radar. Follow-on Taiwan order, for two Hawkeye 2000Es, placed in 1999, with first example handed over at St Augustine, Florida, on 10 August 2004. Israeli aircraft in storage by 1994, with three sold to Mexico in 2002; these refurbished by Israel Aircraft Industries, with first aircraft (AMP-100) handed over in Israel on 21 January 2004. Following training of Mexican personnel, this and second aircraft ferried to Mexico in June

2004; third example delivered via UK in November 2004. France signed Letter of Offer and Acceptance (LOA) in June 1995 for two aircraft; first flight of first Aéronavale aircraft on 12 March 1998, with formal roll-out ceremony at St Augustine, Florida, on 28 April 1998. Both aircraft initially retained in USA for crew training, with first E-2C (actually No 2/165456) delivered to Lann-Bihoué, France, on 14 December 1998; second in April 1999. Operating unit, 4 Flottille, formed at Lann-Bihoué January 1999. French Navy given authorisation in 1998 to purchase third Group II Hawkeye, which was delivered in late 2003 and ferried to Lann-Bihoué in February 2004.

Italy a potential customer in longer term, with requirement for at least two AEW aircraft by 2007. Egypt and Singapore said to be considering acquisition of surplus US Navy aircraft in mid-2000, with former subsequently signing contract for single example as attrition replacement; this delivered in February 2003, following upgrade to Hawkeye 2000 standard.

United Arab Emirates expected to obtain five refurbished Hawkeye 2000 aircraft from surplus US Navy stocks; possibility of sale at estimated cost of USD400 million notified to Congress on 4 September 2002. Contract was expected to be signed in first quarter of 2004, but concerns over technology transfer have caused delay and deal still not finalised by March 2006, although still then under discussion, with intention of mid-2007 purchase; aircraft will probably be fitted with in-flight refuelling probe above cockpit. India reported in early 2004 to be evaluating Hawkeye; Hawkeye 2000 demonstrated at Aero India 2005 show and apparently a candidate to satisfy Indian Navy requirement for up to six AEW aircraft, plus Coast Guard need for at least two; discussions continuing in mid-2006 but no formal request made up to that time. Malaysia also said to be contemplating purchase of E-2 in early 2005.

COSTS: Procurement of 21 new Hawkeye 2000s for US Navy cost USD1.47 billion; follow-on order for eight aircraft valued at USD706 million. Upgrading of 13 Japanese aircraft to Hawkeye 2000 standard expected to cost approximately USD400 million, with cost of Egyptian upgrade of six aircraft valued at USD174 million. System Development and Demonstration (SDD) of E-2D predicted to cost USD2.1 billion between 2009 and 2012.

DESIGN FEATURES: E-2C can cover naval task force in all weathers flying at 9,150 m (30,000 ft) and can detect and assess approaching aircraft at in excess of 300 n miles (556 km; 345 miles); AN/APS-145 has total radiation aperture control antenna (TRAC-A) to reduce sidelobes to offset jamming; radar sweeps 6 million cu mile envelope and simultaneously monitors surface ships; long-range, automatic target track initiation and high-speed processing enable each E-2C to track more than 2,000 targets simultaneously and automatically, and control more than 40 intercepts; Randtron Systems AN/APA-171 antenna housed in 7.32 m (24 ft) diameter radome, rotating at 5 to 6 rpm above rear fuselage; antenna arrays in rotodome provide radar sum and difference signals and IFF.

High-mounted tapered wing; moderately sweptback tailplane with pronounced dihedral; twin fins and twin auxiliary fins, all with sweptback leading-edges and at right angles to tailplane. Rotating, circular radar housing mounted on cabane above rear fuselage; Hawkeye 2000 has satcom antenna housing on top of radome. Nose-tow catapult attachment, arrester hook and tail bumper; wings fold hydraulically on skewed hinges to lie parallel to fuselage.

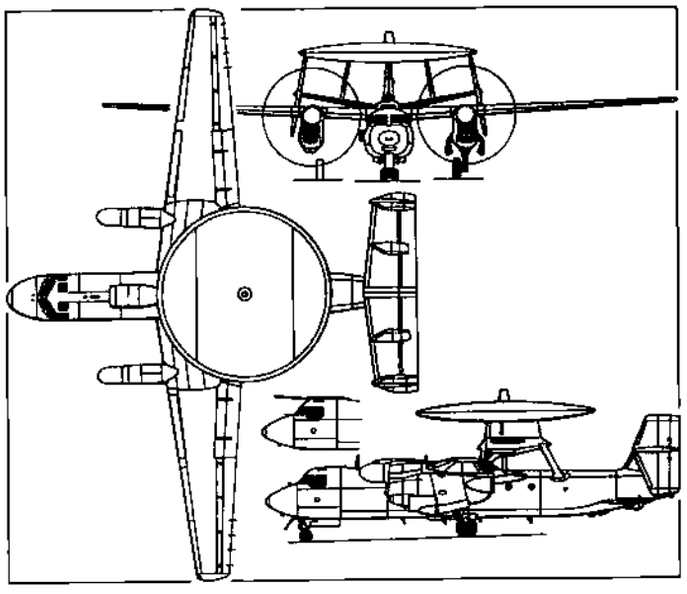
Wing incidence 4° at root, 1° at tip.

FLYING CONTROLS: Conventional and fully powered, with artificial feel; tailplane has 11° dihedral; four fins and three double-hinged rudders; long-span ailerons droop automatically when hydraulically operated Fowler flaps are extended; autopilot provides autostabilisation or full flight control. Empennage (including horizontal stabilisers, elevators, rudders, vertical fins and tabs) produced by Potez Aéronautique of France, following award of contract in mid-1997 for initial batch of five assemblies; first completed assembly delivered in second quarter of 1999.

STRUCTURE: Wing centre-section has three beams, ribs and machined skins; hinged leading-edge provides access to flying and engine controls. Fuselage conventional light metal. Composites used in parts of tail.

LANDING GEAR: Hydraulically retractable tricycle type. Pneumatic emergency extension. Steerable nosewheel unit retracts rearward. Mainwheels retract forward and rotate to lie flat in bottom of nacelles. Twin wheels on nose unit only. Oleo-pneumatic shock-absorbers. Mainwheel tyres size 36×11 (24 ply) tubeless, pressure 17.93 bar (260 lb/sq in) on ship, 14.48 bar (210 lb/sq in) ashore. Nosewheel tyres 20×5.5 (12/14 ply) tubeless. Hydraulic brakes. Hydraulically operated retractable tailskid. A-frame arrester hook under tail.

POWER PLANT: Two 3,803 kW (5,100 ehp) Allison T56-A-427 turboprops, driving Hamilton Sundstrand Type 54460-1 four-blade fully feathering reversible-pitch constant-speed propellers. These have foam-filled blades which have a steel spar and glass fibre shell. T56-A-427 engines provide 15 per cent improvement in efficiency, compared with -425 installed before 1989. US Navy and Northrop Grumman seeking to extend mission duration and undertook in-flight refuelling trials in late 2004, using F/A-18 Hornet as tanker; previously, only Israel had configured Hawkeye to be refuelled in flight; further trials accomplished by test squadron VX-20 in December 2005 and January 2006, using E-2C 165294, which fitted with test probe above cockpit. December 2005 trial involved total of 16 dry connections with drogue trailed by KC-130J Super Hercules tanker, while January 2006 programme involved F/A-18E Super Hornet deploying drogue from refuelling pod. Additional testing is expected to be performed by Naval Air Systems Command. Hamilton Sundstrand/Ratier Figeac NP2000 eight-blade, all-composites propeller flight tested on E-2C 163535 starting on 19 April 2001, following successful ground running on T56 and completion of critical design review in September 1998, with carrier suitability evaluation in USS *John F Kennedy* in November 2003. Fleet introduction began in 2004, with VAW-124 being one of first operational squadrons to receive new propeller; entire fleet to be retrofitted by end of 2006, with NP2000 also installed on French and Taiwanese Hawkeyes in 2005. In 2002, US Navy requested Northrop Grumman to undertake studies into possibility of adopting a new engine, although current plans do not include a change of engine. E-2D will have option to incorporate additional fuel cells in fixed outer wing section, extending mission duration by three hours.



Northrop Grumman E-2C Hawkeye (T56 turboprop engines) with additional scrap view of proposed refuelling probe *(James Goulding)* 1159220

ACCOMMODATION: Normal crew of five, consisting of pilot and co-pilot on flight deck, plus ATDS Combat Information Center (CIC) staff of combat information centre officer, air control officer and radar operator. Downward-hinged door, with built-in steps, on port side of centre-fuselage and three overhead escape hatches.

SYSTEMS: Pneumatic boot de-icing on wings, tailplane and fins. Spinners and blades incorporate electric anti-icing. Hamilton Sundstrand 255 kVA generator to be installed on E-2D.

AVIONICS: *Comms:* AN/AIC-14A intercom. AN/ARC-210 wideband/narrowband radio installed on Hawkeye 2000.

Radar: Lockheed Martin AN/APS-145 advanced radar processing system (ARPS) with fully automatic overland/overwater detection capability, Randtron AN/APA-171 rotodome (radar and IFF antennas). New Lockheed Martin AN/APY-9 radar being developed for installation on E-2D.

Flight: Lockheed Martin AN/ASN-92 CAINS carrier aircraft inertial navigation system, GPS, AN/ASN-50 heading and attitude reference system, Rockwell Collins AN/ARA-50 UHF ADF, AN/ASW-25B ACLS, BAE Systems standard central air data computer, ASM-400 in-flight performance monitor, Honeywell AN/APN-171(V) radar altimeter.

Instrumentation: Smiths Aerospace flight management and integrated standby instrument systems to be installed on E-2D.

Mission: BAE Systems/Hazeltine AN/APA-172 control indicator group with Lockheed Martin enhanced (colour) main display units (EMDU), which being replaced by L-3 Communications flat panel display screen during 2000–07; Litton OL-77/ASQ computer programmer (L-304) with Lockheed Martin enhanced high-speed processor, BAE Systems/Hazeltine OL-483/AP airborne interrogator system, Litton AN/ALR-73 passive detection system, AN/ARC-158 UHF datalink, AN/ARQ-34 HF datalink and JTIDS Class 2 HP terminal. Barco Display Systems graphics controllers with radar display capability and colour flat panel displays on Hawkeye 2000. Hawkeye 2000 also has AN/ALQ-217 ESM in place of AN/ALR-73 and Multi-Mission Advanced Tactical Terminal (MATT) for data communications.

DIMENSIONS, EXTERNAL:

Wing span	24.56 m (80 ft 7 in)
Wing chord: at root	3.96 m (13 ft 0 in)
at tip	1.32 m (4 ft 4 in)
Wing aspect ratio	9.3
Width, wings folded	8.94 m (29 ft 4 in)
Length overall	17.60 m (57 ft 8¾ in)
Height overall	5.58 m (18 ft 3¾ in)
Diameter of rotodome	7.32 m (24 ft 0 in)
Tailplane span	7.99 m (26 ft 2½ in)
Wheel track	5.93 m (19 ft 5¾ in)
Wheelbase	7.06 m (23 ft 2 in)
Propeller diameter	4.11 m (13 ft 6 in)

E-2C EXPORTS

Customer	Quantity	Group	First aircraft	Delivery	Unit
Egypt[4]	6	0	162791	1987–88(5)	87 Squadron
		0	164626	1993(1)	87 Squadron
France	3	II	1(165455)	1998(2)	4 Flottille
		II	3(166417)	2003(1)	4 Flottille
Israel[1]	4	0	160771	1978	192 Sqdn
Japan[2]	13	0	34-3451	1982(4)	601 Sqdn
		0	54-3455	1984(4)	601 Sqdn
		0	34-3459	1992–93(3)	601 Sqdn
		0	44-3462	1993(2)	601 Sqdn
Singapore	4	0	011(162793)	1987	111 Sqdn
Taiwan[3]	4		2501	1995	78 Sqdn
	2	2000E	2505(166418)	2004	78 Sqdn
Total	**36**				

[1] Israeli aircraft withdrawn from use in 1994; three sold to Mexico in 2002 and refurbished by IAI before delivery in 2004

[2] Japanese aircraft being upgraded to Hawkeye 2000 standard; first flight of first upgraded aircraft 14 July 2004

[3] Taiwanese aircraft known as E-2Ts; initial four aircraft to be upgraded to Hawkeye 2000E standard in 2006-07.

[4] Five of the original Egyptian aircraft being upgraded to Hawkeye 2000 standard; a sixth, former US Navy aircraft, was first to be upgraded and was delivered to Egypt in February 2003 (not included in table); second upgraded aircraft delivered August 2004, with remaining four to follow by April 2007

AREAS:
- Wings, gross ... 65.03 m² (700.0 sq ft)
- Ailerons (total) ... 5.76 m² (62.00 sq ft)
- Trailing-edge flaps (total) ... 11.03 m² (118.75 sq ft)
- Fins, incl rudders and tabs:
  - outboard (total) ... 10.25 m² (110.36 sq ft)
  - inboard (total) ... 4.76 m² (51.26 sq ft)
- Tailplane ... 11.62 m² (125.07 sq ft)
- Elevators (total) ... 3.72 m² (40.06 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty ... 18,363 kg (40,484 lb)
- Max fuel weight (internal, usable) ... 5,624 kg (12,400 lb)
- Max T-O weight ... 24,687 kg (54,426 lb)
- Max wing loading ... 379.6 kg/m² (77.75 lb/sq ft)
- Max power loading ... 3.25 kg/kW (5.34 lb/ehp)

PERFORMANCE:
- Max level speed ... 338 kt (626 km/h; 389 mph)
- Max cruising speed ... 325 kt (602 km/h; 374 mph)
- Cruising speed: normal ... 259 kt (480 km/h; 298 mph)
  - ferry ... 268 kt (496 km/h; 308 mph)
- Approach speed ... 103 kt (191 km/h; 119 mph)
- Stalling speed (landing configuration) ... 75 kt (138 km/h; 86 mph)
- Service ceiling ... 11,275 m (37,000 ft)
- Min T-O run ... 564 m (1,850 ft)
- T-O to 15 m (50 ft) ... 793 m (2,600 ft)
- Min landing run ... 439 m (1,440 ft)
- Ferry range ... 1,541 n miles (2,854 km; 1,773 miles)
- Time on station, 175 n miles (320 km; 200 miles) from base ... 4 h 24 min
- Endurance with max fuel ... 6 h 15 min

NORTHROP GRUMMAN E-10

TYPE: Airborne multisensor command and control system.

PROGRAMME: Now in doubt, following withdrawal of funding, programme launched when Boeing 767-400ER selected by USAF in second quarter of 2002 to serve as testbed for next-generation multisensor command and control aircraft (MC2A); may also have been chosen as platform for production system, for which decision originally expected in about July 2005 as part of Milestone B approval process, although now unlikely until after 2008 as consequence of continued uncertainty over future direction of programme and repeated substantial cuts in funding. On 14 May 2003, Northrop Grumman and Raytheon received a pre-system development and demonstration contract, worth USD215 million, for weapon system integration. E-10 will be equipped with Northrop Grumman Multi-Platform Radar Technology Insertion Program (MP-RTIP) J-band radar; this merges moving target indicator over synthetic aperture radar, resulting in enhanced ground moving target indicator capability.

Trials intended to validate this new concept of intelligence gathering undertaken with a Boeing 707 (N404PA) that flew for the first time in modified form on 18 April 2002; known as *Paul Revere*, this aircraft performed a series of operational test flights in mid-2002, including some as part of the Joint Expeditionary Forces experiment at Nellis AFB, Nevada. Key objectives to be addressed by *Paul Revere* comprise directing activities of manned and unmanned air and space sensor systems used for surveillance and reconnaissance; integration and monitoring of all-source sensor data; location, identification, designation and tracking of targets using multisensor integration software techniques; undertaking weapon-target matching; establishing tactical priorities and objectives when engaging time-sensitive targets; and accomplishment of rapid and timely bomb damage assessment following an attack.

Total procurement of E-10 was dependent upon whether USAF chose to add AMTI (airborne moving target indicator) capability or deploy another type of platform to replace the E-3 Sentry from 2035 onwards. At present, notional Increment 2 E-10 aircraft will not feature AMTI sensor (radar), but may have the potential for integrating AMTI data obtained from external source. However, recent changes in programme direction have seen mission focusing almost exclusively on detection of cruise missiles and moving ground targets.

The 767-400ER testbed was the subject of a USD126 million contract awarded to Boeing in August 2003. Delivery of the 'green' aircraft was then expected in December 2006, at which time to have been flown to Northrop Grumman's facility at Lake Charles, Louisiana, for modification to E-10 configuration. To have been fitted with prototype systems tasked with battle management, command, control, communications and intelligence. Development of this subsystem was expected to take five years and cost in excess of USD400 million.

The system development and demonstration (SDD) phase was originally due to begin in mid-2004, but was delayed by at least two years. In the interval, work continued on the key MP-RTIP sensor, with Northrop Grumman receiving a USD888 million contract in April 2004 for Phase 2 SDD work that was expected to result in application to the E-10 as well as the RQ-4 Global Hawk UAV.

Solicitation for the E-10 battle management command and control (BMC2) system began in June 2003. Three teams, headed by Boeing, Lockheed Martin and Northrop Grumman, were in competition, with all three invited in April 2004 to bid for the SDD contract. Formal submission of proposals followed in May 2004, with Northrop Grumman's system being selected in September 2004, at which time development cost was projected to be slightly over USD300 million.

In August 2006, E-10 was excluded from FY08 Program Objective Memorandum, a document outlining proposed Air Force spending plans for the period FY08 to FY13, implying its abandonment. Development continued, however, and between 7 and 9 October 2006, the contractor 'flew' a fully functional mock-up of its proposed battle management command and control (BMC2) subsystem as the central node in a network of simulated battlefield sensors, command and control elements and precision strike elements.

Critical platform design review completed mid-November 2006 to ensure all design requirements identified and that initial design by the customer/contractor team reflected those requirements; this leading to detail design; final design review; and start of modification of Boeing 767-400ER testbed airframe, which was due for delivery in unmodified state in December 2007. On 8 January 2007, Northrop Grumman announced receipt of USD256 million contract for design and analysis of E-10A Technology Development Program (TDP) through initial design review, then scheduled for May 2007. Thereafter, no further funds assigned, and programme expected to stagnate.

CURRENT VERSIONS: Three basic versions in prospect, although only the **E-10A** was funded; this will feature the primary MP-RTIP sensor and have cruise missile defence as a cornerstone capability. Under original schedule, system testbed, with MP-RTIP, expected to make maiden flight in 2009; followed by first two production aircraft in 2012 and remaining two in 2013. However, budget cut of USD115 million for FY05 appropriation imposed by Congress, with consequent impact on deployment operationally; in late 2004, in-service date expected to be 2015, while further reductions in funding being considered in early 2005 likely to delay IOC until 2018. Deployment now unlikely.

E-10B: perceived as a replacement for E-3 Sentry with enhanced air moving target indicator capability if it comes to fruition, while **E-10C** viewed as a replacement for RC-135 Rivet Joint, with enhanced sigint/comint gathering capability.

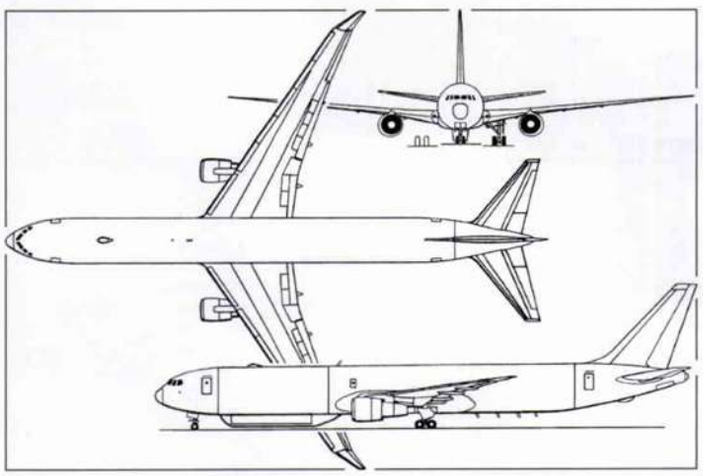
COSTS: Development and production of a system testbed and four operational E-10 aircraft as originally proposed estimated to be USD5.3 billion.

POWER PLANT: Two 282 kN (63,500 lb st) General Electric CF6-80C2B8F high-bypass turbofans.

ACCOMMODATION: BMC2 system of basic E-10A expected to require about 25 operators in addition to flight deck crew. Additional personnel will be required on E-10B and E-10C versions.

SYSTEMS: Supplemental electric power system by Hamilton Sundstrand. 1 MW auxiliary power unit located in aft cargo hold.

AVIONICS: Northrop Grumman MP-RTIP J-band radar sensor accommodated in 6.09 m (20 ft 0 in) ventral housing beneath forward fuselage section.



Northrop Grumman E-10A command and control system *(Paul Jackson)*

1164881

NORTHROP GRUMMAN OFW

TYPE: Technology demonstrator.

PROGRAMME: Oblique Flying Wing (OFW) project announced 23 March 2006 with award of USD10.3 million, 20-month DARPA Phase 1 contract to Northrop Grumman Integrated Systems. Purpose is to design an experimental, tail-less, supersonic, variable-sweep flying wing, nicknamed Switchblade, to demonstrate feasibility of such an aircraft for future military missions. Two such missions typified in 2005 programme document: (1) intelligence, surveillance and reconnaissance (ISR) with range of 5,000 n miles (9,260 km; 5,753 miles) at subsonic speed at 18,280 m (60,000 ft) with a 1,814 kg (4,000 lb) payload; and (2) bombing mission at same range with 6,804 kg (15,000 lb) payload, cruising at M1.6 and with dash speed of M2.0.

First phase ends in November 2007 and will include recommendations on whether OFW will be manned, unmanned or both; could be followed by second phase to finalise design, build and fly prototype in about 2010 or 2011. Wing span of this expected to be "at least 12 m" (39.4 ft), according to DARPA.

DESIGN FEATURES: Depending upon its speed, aircraft would vary angle of wing's leading-edge relative to the direction of flight: relatively low sweep at low speeds to highly swept at high speeds, reducing supersonic wave drag. Theoretically, an OFW could maximise its performance in every flight regime – take-off or landing, high or low altitude, supersonic or subsonic speed – offering potential benefits for missions requiring rapid deployment, long range and long endurance.

All previous oblique wing or oblique flying wing research aircraft have been subsonic. As well as being supersonic, the Switchblade demonstrator will be the first such aircraft with no tail surfaces.

Computerised impression of possible OFW configuration 1040429

OHIO

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VICE-PRESIDENT AND CHIEF FINANCIAL OFFICER: Scott Gindlesberg
ENGINEERING ADVISER: Don VanFossen

This company, founded in 1999, has the Dynalifter hybrid semi-rigid in the development stage. Design assistance is being given by Conceptual Research Corporation, Analytical Methods Inc and Composite Engineering Inc. Maiden flight was anticipated during 2006.

OHIO DYNALIFTER

TYPE: Hybrid rigid air vehicle.

PROGRAMME: Announced in 2000, following taxi tests of 14.16 m^3 (500 cu ft) subscale prototype which began in March of that year. US Patent No. 6, 311, 925 for internal structure awarded in 2001. Design concept (by Daniel Raymer) is scalable, with four different sized versions undergoing design development. CFD analysis completed in 2003. Pentagon interest reported in late 2002 as potential addition to US Civil Reserve Air Fleet; interest from Department of Homeland Security in 2004.

Barber Airport in Alliance, Ohio, selected in July 2003 as site for 30.5 m (100 ft) long, 4,645 m^2 (50,000 sq ft) shelter where, in December 2003, 36.58 m (120 ft) long Dynalifter 1 began construction; this then expected to fly late 2004 or early 2005, but not rolled out (N141DL) until 21 September 2005. Slow- and high-speed taxi tests during first half of 2006; FAA experimental airworthiness certificate awarded 10 July 2006, at which time described as "poised to begin flight testing", though maiden flight still awaited more than six months later.

CURRENT VERSIONS (PROJECTED): **PSC-1 Freighter:** Outsize, 500 US ton (446.4 UK ton) carrier, half of which is payload. Potential applications include time-definite shipping market; parcels shipping; sealed intermodal containers; discounted international shipping across oceans or undeveloped areas; light, high-volume goods; or long-loiter patrol and surveillance.

PSC-2 Sightseer/Transport: Smaller version (one-fifth size of Freighter) for advertising; coastal patrol; tundra transportation; tourist transport and passenger ferry; or other civil applications.

PSC-3: International-range version with detachable 1,699 m^3 (60,000 cu ft) cargo bay; MTOW 158,757 kg (350,000 lb); payload in 65 US ton (58 UK ton) range.

PSC-4 Dynalifter 1: Small (two-person) prototype/PoC aircraft; patroller with 454 kg (1,000 lb) payload; aimed at most tasks currently performed by helicopters.

DESIGN FEATURES: Flattened oval hull shape, of approximately aerofoil shape in side elevation, with detachable, container-loaded ventral cargo bay; option for ramp-loaded bay on PSC-1. Low/mid-mounted wings, with winglets, just aft of CG; low-mounted foreplanes at nose; engines (see Power Plant paragraph) mounted on wings and foreplanes. Conventional tail surfaces, with twin fins above and below tailplane halves.

Design allows concentrated wing lift, concentrated cargo lift, and high *g* loading from landing gear. Power/weight ratio said to be similar to that of powered sailplane and about one-fifth that of typical turboprop cargo aircraft. Ground handling weight is 75 per cent of maximum in-flight weight.

Company designates Dynalifter concept not as an airship but as a new category of helium-assisted cargo aircraft, combining static (helium) and dynamic (wings/foreplanes) lift in equal proportions, permitting it to be smaller than traditional airship for given weight of payload and to offer capability for higher speeds. It also has STOL capabilities, using medium-sized runways, and detachable nature of cargo bay can shorten turnaround times.

FLYING CONTROLS: Honeywell FBW actuators. Hull provides about one-third of total dynamic lift.

STRUCTURE: Ohio Airships (US patented) cable stay-bridge suspension. Helium cells (32 in PSC-4) of aluminium-coated nylon.

LANDING GEAR: *PSC-1:* Quadricycle type, comprising four six-wheel (46×16) bogies mounted equidistant from CG; complete steering rotation by 100° in each direction.

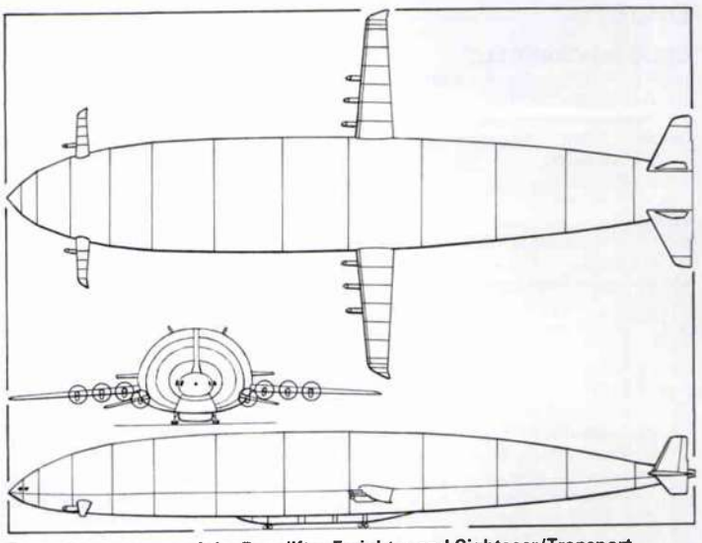
PSC-2: As PSC-1 except bogies are two-wheel (36×11).

PSC-4: Two 68.6 kW (92 hp) Rotax piston engines.

POWER PLANT: *PSC-1:* Eight 3,803 kW (5,100 shp) Rolls-Royce (Allison) T56-A-427 turboprops (three on each wing and one on each canard), each driving a four-blade propeller.

PSC-2: Four 1,864 kW (2,500 shp) Pratt & Whitney Canada PW127 turboprops (one on each wing and one on each canard).

Roll-out of prototype PSC-4 Dynalifter 1 1151474



General appearance of the Dynalifter Freighter and Sightseer/Transport *(James Goulding)* 0567103

PSC-4: Two 68.6 kW (92 hp) Rotax piston engines.

ACCOMMODATION: Minimum flight crew of four pilots in PSC-1 (two for take-off and landing, two for in-flight duties); two-person ground crew for container operation. Take-off and landing pilots only in PSC-2, and no ground crew.

SYSTEMS: Dual 207 bar (3,000 lb/sq in) engine-driven hydraulic systems, one in each wing; third (back-up) system driven by pair of redundant APUs in rear of hull. AC electrical power from four 90 kVA generators.

AVIONICS: Commercial off-the-shelf.

DIMENSIONS, EXTERNAL:

Hull:	
Length: PSC-1	302.6 m (992.8 ft)
PSC-2	176.8 m (580.0 ft)
Max width: PSC-1	51.2 m (168.0 ft)
PSC-2	29.9 m (98.0 ft)
Max depth: PSC-1	36.9 m (121.0 ft)
PSC-2	21.6 m (71.0 ft)
Fineness ratio: PSC-1, PSC-2	7
Wing span: PSC-1	163.2 m (535.5 ft)
PSC-2	73.2 m (240.0 ft)

DIMENSIONS, INTERNAL:

Hull volume: PSC-1	311,485 m^3 (11 million cu ft)
PSC-2	63,430 m^3 (2.24 million cu ft)
Cargo hold:	
Length: PSC-1	45.72 m (150.0 ft)
PSC-2	25.91 m (85.0 ft)
Width: PSC-1	12.19 m (40.0 ft)
PSC-2	6.10 m (20.0 ft)
Height: PSC-1	4.57 m (15.0 ft)
PSC-2	4.27 m (14.0 ft)
Volume: PSC-1	2,548.5 m^3 (90,000 cu ft)
PSC-2	673.9 m^3 (23,800 cu ft)

WEIGHTS AND LOADINGS:

Weight empty: PSC-1	188,618 kg (415,832 lb)
PSC-2	48,693 kg (107,350 lb)
Fuel weight: PSC-1	105,430 kg (232,432 lb)
PSC-2	21,144 kg (46,615 lb)
Payload weight:	
PSC-1: for 5,000 n mile range	102,058 kg (225,000 lb)
max	158,757 kg (350,000 lb)
PSC-2: for 3,200 n mile range	6,350 kg (14,000 lb)
max	20,412 kg (45,000 lb)
Static displacement lift: PSC-1	226,796 kg (500,000 lb)
PSC-2	45,359 kg (100,000 lb)
Dynamic lift at designed airspeed:	
PSC-1	226,796 kg (500,000 lb)
PSC-2	45,359 kg (100,000 lb)
Max T-O weight: PSC-1	453,592 kg (1,000,000 lb)
PSC-2	90,718 kg (200,000 lb)

PERFORMANCE (estimated):

Max level speed:	
PSC-1, PSC-2	120 kt (222 km/h; 138 mph)
Cruising speed: PSC-2	90 kt (167 km/h; 104 mph)
Stalling speed: PSC-1, PSC-2	40 kt (75 km/h; 47 mph)
Cruise altitude/pressure ceiling:	
PSC-2	3,050 m (10,000 ft)
Range with max payload:	
PSC-1	3,200 n miles (5,926 km; 3,682 miles)
PSC-2	1,800 n miles (3,333 km; 2,071 miles)
Range with reduced payload:	
PSC-1 with 102,058 kg (225,000 lb)	5,000 n miles (9,260 km; 5,754 miles)
PSC-2 with 6,350 kg (14,000 lb)	3,200 n miles (5,926 km; 3,682 miles)
Endurance:	
PSC-1 with 11,340 kg (25,000 lb) payload	more than 2.5 days
PSC-2 at 3,050 m (10,000 ft) with max payload	18 h

OPUS

OPUS AIRCRAFT LLC

Rockingham County/Shiloh Airport, Stoneville, North Carolina 27048
Tel: (+1 336) 882 18 31
Web: www.opusaircraft.com
OWNERS:
Frank Auman Jr
Tony Dawson

Opus purchased the rights to the Super2, originally produced by ARV, on 8 October 2004 and announced that it was to restart production at Shiloh Airport the following year. It intended to recruit a workforce of 20 and build up to 50 aircraft per year. Its aircraft have been re-engined with Rotax and Jabiru power plants.

OPUS ARV SUPER2

TYPE: Side-by-side ultralight/kitbuilt.

PROGRAMME: Initial production in UK from assembly of Scottish-built kits. Original prototype Island Aircraft ARV-1 Super2 (G-OARV) first flew 11 March 1985; see 2000–01 and earlier *Jane's All the World's Aircraft* for other non-US history.

Design rights acquired by Highlander in USA; company started construction of US prototype in September 1995 and this (N280KT) flew for first time in February 1996. By August 1996, Highlander had sold six kits, two of which were flying by year end. Programme transferred to SkyCraft in 1999. No known production by last-mentioned. Opus took over production rights in October 2004 and announced intention to resume production; two aircraft (both apparently from original UK production) registered by November 2006.

Description applies to US-built version, unless otherwise stated.

CUSTOMERS: Total of 32 (including kits) Super2s built by early 1994 (seven by Aviation Scotland). UK production then discontinued. Aircraft c/n 033 to Sweden in October 1994 as SE-KYP for demonstrations. Total of 37 aircraft believed built by early 2001. One aircraft registered in Canada in 2002 with serial number CAN-002.

COSTS: Quick-build kit USD18,950; factory-built version USD130,000 (2002).

DESIGN FEATURES: Design objective low initial cost and low maintenance cost; engine with aluminium radiator in recessed duct in rear fuselage; superplastically formed aluminium alloy pressings to save weight; shoulder location of wing with forward sweep, low panel line and close cowling of small engine combine to provide optimum view from cabin, particularly in turns. Designed to BCAR Section K and FAR Pt 21.91; intended to be suitable for home building in kit form; quoted build time 900 hours.

Wing section NACA 2415 (modified); 5° forward sweep, 2° dihedral and 3° incidence.

FLYING CONTROLS: Conventional and manual. Mass-balanced ailerons operated by torque tube through leading-edge of manually operated, three-position, plain flaps; mass-balanced rudder and elevator with trim tab.

STRUCTURE: Single-spar aluminium alloy wing, cold bonded and flush riveted. Single uncompromised main bulkhead carries wings, bracing struts, controls, seats, fuel tank and main landing gear; conventional double beam forward of main bulkhead carries firewall, nose landing gear and engine; front fuselage skinning in four panels; rear fuselage of aluminium alloy with single curvature skinning. Cowlings, fairings and wingtips of glass fibre. Tail unit conventional aluminium alloy structure with three-spar fixed surfaces; single-spar rudder and elevator. Airframe corrosion-treated.

LANDING GEAR: Non-retractable tricycle type. Cantilever main legs of tapered steel leaf spring. All three wheels size 3.50×6.0, with tyres size 13×4.00–6, pressure 1.72 bar (25 lb/sq in). Hydraulic single disc brakes. Steerable nose leg has rubber shock rings and gas-filled damper.

POWER PLANT: One 59.6 kW (79.9 hp) Rotax 912 UL flat-four engine driving two-blade propeller. Mid-West AE110 rotary engine reinstated as option in 1998, along with 2SI three-cylinder two-stroke and Jabiru 2200 four-cylinder four-stroke engines; Opus only marketing Rotax and Jabiru options. Fuel capacity 76 litres (20.0 US gallons; 16.7 Imp gallons) in single fuselage tank. Oil capacity 1.9 litres (0.5 US gallon; 0.4 Imp gallon).

ACCOMMODATION: Rearward-hinged one-piece Perspex canopy. Dual controls standard.

AVIONICS: To customers' requirements.

Comms: Optional Honeywell or Becker nav/com, Narco transponder.

Instrumentation: Three basic flight instruments plus engine instruments. Optional vacuum instruments driven by dual venturis mounted under front fuselage.

DIMENSIONS, EXTERNAL:

Wing span	8.99 m (29 ft 6 in)
Length overall	5.49 m (18 ft 0 in)
Height overall	2.29 m (7 ft 6 in)
Propeller diameter	1.07 m (3 ft 6 in)

DIMENSIONS, INTERNAL:

Cabin: Length	1.27 m (4 ft 2 in)
Max width	0.99 m (3 ft 3 in)
Max height	1.09 m (3 ft 7 in)

AREAS:

Wings, gross	8.59 m² (92.5 sq ft)

WEIGHTS AND LOADINGS:

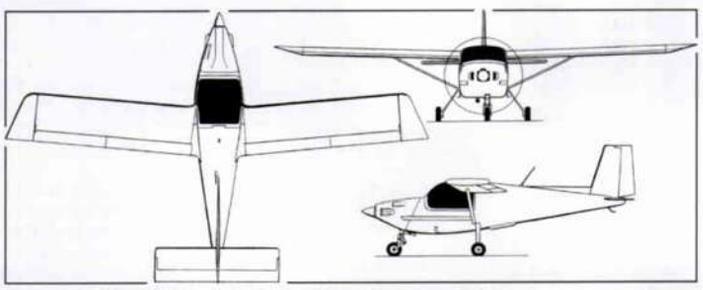
Weight empty, equipped	313 kg (690 lb)
Max T-O and landing weight	529 kg (1,168 lb)
Max wing loading	61.7 kg/m² (12.63 lb/sq ft)
Max power loading	8.89 kg/kW (14.60 lb/hp)

PERFORMANCE (at max T-O weight):

Never-exceed speed (VNE)	131 kt (243 km/h; 151 mph)
Max level speed	119 kt (220 km/h; 137 mph)
Cruising speed at 75% power	100 kt (185 km/h; 115 mph)
Stalling speed, power off, 40° flap	40 kt (73 km/h; 45 mph)
Max rate of climb at S/L	244 m (800 ft)/min
Service ceiling	3,050 m (10,000 ft)
T-O and landing run	138 m (450 ft)
T-O to 15 m (50 ft)	423 m (1,387 ft)
Landing from 15 m (50 ft)	442 m (1,450 ft)
Range	499 n miles (925 km; 575 miles)
g limits	+3.8/–2.0

ARV Super2 from the original production series *(Paul Jackson)* 0526991

ARV-1 Super2 built in UK *(Paul Jackson)* 1040501



Opus ARV Super2 two-seat monoplane *(Dennis Punnett)* 0507664

PAM

PERFORMANCE AVIATION MANUFACTURING GROUP

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Tel: (+1 757) 570 32 65
Fax: (+1 757) 229 73 80
e-mail: pamgroup@cox.net
Web: www.flying-platform.com
CEO: Clement Makowski
PRESIDENT: Robert J Pegg

PAM Group was founded in 1998 and is developing an individual lifting vehicle. There are no reports of sales or production.

'Hands off' demonstration of stability by prototype PAM 100B Individual Lifting Vehicle 1040433

PARABOUNCE

ONE GIANT LEAP LLC

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Fax: (+1 323) 882 61 72
e-mail: AGiantLeap@aol.com
Web: www.parabounce.com
PRESIDENT AND CEO: Stephen Meadows

Parabounce manufactures recreational balloons filled with sufficient helium to permit their users to leap up to 38 m (125 ft) into the air before floating back down to the ground. In late 2002, it introduced the Propbike, a small, human-powered airship. At least one example has been produced for use by the originating company, but commercial promotion does not appear to have taken place.

PAWNEE

PAWNEE AVIATION

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e-mail: rwillocks@swnebr.net
Web: www.pawneeaviation.com
PRESIDENT: Ron Willocks

Previously at Longmont, Colorado, Pawnee moved to its current location in January 2005. It is marketing the Chief two-seat helicopter, although its development has been delayed by an accident.

PAWNEE CHIEF

TYPE: Three-seat helicopter kitbuilt.

PROGRAMME: Prototype (N505PA) completed in 1998. Series manufacture to be undertaken at new premises in Nebraska. Single-seat Warrior used as proof of concept development. Prototype made first flight 12 December 2005 but was later destroyed in roll-over accident. Second aircraft reported almost complete in August 2006.

DESIGN FEATURES: Optimised for higher operating altitudes and weights than most other kit helicopters.

Two-blade main and tail rotors. Cog belt drive from engine to secondary drive shaft, which turns both rotors. Right-angle transmission to main rotor through pressure-lubricated gearbox; six-bearing drive shaft to tail rotor.

Quoted built time 150 to 200 hours.

STRUCTURE: Composites pod with firewall and floor of aluminium honeycomb. Welded 4130 steel tube fuselage of triangular section, unenclosed.

LANDING GEAR: Skid type; fixed.

POWER PLANT: One 224 kW (300 hp) Perfomance Parts Ram Jet V-8 converted motorcar engine, derated from 265 kW (355 hp). Welded metal fuel tanks each side of engine, combined capacity 121 litres (32.0 US gallons; 26.6 Imp gallons).

ACCOMMODATION: Two persons, side by side. Door each side.

DIMENSIONS, EXTERNAL:

Main rotor diameter	9.14 m (30 ft 0 in)
Length overall	9.83 m (32 ft 3 in)
Height overall	2.49 m (8 ft 2 in)

DIMENSIONS, INTERNAL:

Cockpit max width	1.47 m (4 ft 10 in)

Pawnee Chief three-seat helicopter *(Paul Jackson)* 1040413

AREAS:

Main rotor disc	65.68 m² (706.9 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	689 kg (1,520 lb)
Max T-O weight	1,088 kg (2,400 lb)
Max disc loading	16.6 kg/m² (3.40 lb/sq ft)
Max power loading	4.87 kg/kW (8.00 lb/hp)

PERFORMANCE:

Cruising speed	74 kt (137 km/h; 85 mph)
Max rate of climb at S/L	305 m (1,000 ft)/min
Service ceiling	3,050 m (10,000 ft)
Range	217 n miles (402 km; 250 miles)

PIASECKI

PIASECKI AIRCRAFT CORPORATION

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DIRECTOR, PROGRAM REQUIREMENTS: Joseph P Cosgrove

Frank Piasecki developed and flew the USA's second successful helicopter on 11 April 1943 and the world's first tandem rotor helicopter on 7 March 1945; created Piasecki Helicopter Corporation in 1946, this forming subsidiary Piasecki Aircraft Corporation in 1955, following which the original company was sold to Boeing.

Piasecki assisted PZL-Świdnik of Poland (which see) in FAA certification of the W-3A helicopter, which was awarded in May 1993. Piasecki has exclusive sales agreement for W-3A in the Americas and Pacific Rim countries. W-3A Sokół complies with FAR Pt 29, is certified for full IFR operations and has US instrumentation. Also designs and builds Air Guard and Air Scout UAV demonstrators for US Army FCS programme under contracts awarded in August 2005.

AirGuard demonstrator based on BRC 540C autogyro built by William Harris and powered by Subaru piston engine. First flight (N540CX) announced 12 July 2006; completed initial series of tests 11 September 2006; world's first autonomous autogyro, although flown with safety pilot.

Piasecki Air Guard demonstrator 1159704

PIASECKI VECTORED THRUST DUCTED PROPELLER (VTDP)

US military designation: X-49A

TYPE: New-concept rotorcraft.

PROGRAMME: Began with US Army contract to develop a compound helicopter incorporating the Piasecki VTDP concept for the AH-64 Apache and AH-1W SuperCobra. Programme

Computer-generated image of H-60/VTDP compound helicopter 0563225

objectives were met or exceeded by both the AH-64 VTCAD (Vectored Thrust Combat Agility Demonstrator) and AH-1W VTCAD configurations, resulting in increased maximum level flight speed; 50 per cent improvement in longitudinal acceleration and deceleration capability in level flight; 50 per cent decrease in turn and pull-up radii at speeds in excess of 95 kt (176 km/h; 109 mph); and handling qualities at least as good as those of the baseline AH-64A and AH-1W. In addition, tactical simulations confirmed superiority of the VTCADs over the standard Apache and AH-1W SuperCobra. Is currently a US Army programme directed towards Sikorsky UH-60 improvements.

A separate US Navy contract, awarded in 1995 and valued at USD16.1 million, involved investigation into application of VTDP technology to the AH-1W(4BW)/AH-1Z four-blade rotor configuration. The Navy contract included ground testing of the full-scale VTDP and additional flight controls simulation and testing of the 4BW/VTDP configuration.

Piasecki then proposed flight demonstration of this technology to the Navy on an AH-1W(4BW), but instead was awarded a four-year USD26.1 million Advanced Technology Demonstration (ATD) contract on 28 September 2000 for integration, testing and flight demonstration of VTDP on a modified Sikorsky YSH-60F (BuAer 163283). This flight test programme, to have begun in 2005, but not announced by late 2006, will be conducted by Piasecki under an FAA experimental flight certificate, US civil registration N40VT (owner registered as US Navy). The VTDP concept is being investigated by the DoD as an affordable means of upgrading the capabilities extending the service life of existing single main rotor helicopters such as the UH-1, UH/SH-60 and AH-64, until the follow-on Joint Replacement Aircraft is fielded some time after 2030. Most recently, the US Air Force selected the H-60/VTDP concept unofficially known as SpeedHawk, as one of a number of alternatives being considered as an upgrade or replacement, to be fielded by 2010, for its ageing HH-60G combat search and rescue helicopters.

By mid-2000, Piasecki had constructed and completed ground testing of a full-scale 2.44 m (8 ft 0 in) diameter duct and integrated five-blade propeller. In addition to installation of this unit, modifications to the YSH-60F will include addition of lifting wings (from a Piper Aerostar business aircraft) with flaperons and integration of VTDP controls into the helicopter's existing mechanical control system, all of which is expected to add some 726 kg (1,600 lb) to the demonstrator's empty weight. The increase in empty weight will be lower in production versions, which will employ a supplementary power unit (SPU) that will provide an increase in hover payload to offset the increased empty weight. By mid-2005, the drive system, including the SPU, has successfully completed endurance testing, all critical structural tests had been completed, and modification of the test aircraft was 80 per cent complete.

DESIGN FEATURES: The VTDP comprises a ducted propeller with integral vanes and spherical sectors to vector propeller thrust. It provides lateral thrust for anti-torque and lateral control, in lieu of a tail rotor, as well as forward thrust for auxiliary propulsion. Combined with the lifting wing, it provides for increasing speed to more than 200 kt (370 km/h; 230 mph); greater manoeuvrability; reduced vibration and fatigue loads; and consequent improvement in component lives and reduction in maintenance requirements and life cycle costs.

Piasecki estimated that a VTDP-based H-60 compound helicopter would have an unrefuelled combat radius of 762 n miles (1,411 km; 876 miles) following a rolling take-off, and 520 n miles (963 km; 598 miles) after a vertical take-off, representing a three-fold increase over the standard H-60.

PIPER

PIPER AIRCRAFT INC

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CORPORATE COMMUNICATIONS DIRECTOR: Mark S Miller

In July 1995, after Piper had stabilised its financial position during four years of Chapter 11 protection, the US Bankruptcy Court approved a new reorganisation plan under which Piper's assets were bought for US$95 million by Newco Pac Inc, a new company jointly owned by Philadelphia-based investment firm Dimeling, Schreiber and Park, Teledyne Continental Motors (which was Piper's largest creditor), and the remaining creditors. Under this ownership, The New Piper Aircraft Inc was established; company name changed to Piper Aircraft Inc in September 2006. Earlier history of Piper last appeared in the 1995–96 *Jane's*.

During 1999, Piper delivered 329 aircraft, 395 in 2000; 441 in 2001, 290 in 2002, 229 in 2003, 189 in 2004 and 233 in 2005. Workforce 680 in March 2003. Sales revenue totalled USD243 million in 2001, up from USD157 million in 2000.

In July 2003, American Capital Strategies Ltd bought USD57 million of Piper's debt to acquire 94 per cent of the company; the remaining 6 per cent was acquired by affiliates of Exeter Capital Partners, a long-time investor in New Piper.

Kits and parts for classic Pipers are available from other outlets, not necessarily with Piper's approval. These include:

J3 Cub: Wag-Aero Sport trainer. Replacement fuselages (standard and with additional 10 cm; 4 in cockpit width) from Airframes Inc of Alaska (www.supercubs.com); flyaway from Legend Cub as AL3C-100.

PA-11 Cub Special: Available as Cub Crafters Sport Cub Legend Cub AL11C-100; kits from Smith Aviation of Canada (www.supercubkits.ca)

PA-12 Super Cruiser: Fuselages manufactured by Dakota Air Frame Inc of Iowa (www.dakotaairframe.com).

PA-14 Family Cruiser: Wag-Aero Sportsman.

PA-15 Vagabond: Wag-Aero Wag-A-Bond.

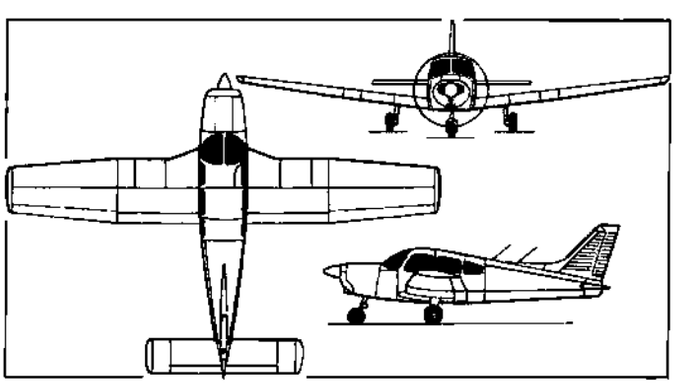
PA-18 Super Cub: Fuselages from Airframes Inc (as for J3 Cub); kits from Smith Aviation of Canada and Dakota Cub Aircraft of South Dakota (www.dakotacub.com); complete aircraft from Cub Crafters.

PIPER PA-28-161 WARRIOR III

TYPE: Four-seat lightplane.

PROGRAMME: As replacement for Cherokee 140 series, Piper redesigned airframe with several refinements, including fuselage stretch and new wing; first flight of prototype PA-28-151 17 October 1972; FAA certification 9 August 1973; PA-28-161 Warrior II first flown 27 August 1976; two/four-seat Cadet trainer version introduced April 1988, but no longer in production; Warrior III introduced late 1994.

CUSTOMERS: Five delivered in 1996, seven in 1997, 20 in 1998, 25 in 1999, 43 in 2000, 32 in 2001, 29 in 2002, 31 in 2003, 18 in 2004, 37 in 2005, and 18 in the first nine months of 2006. Piper has built some 30,000 of PA-28 series since prototype Cherokee flew on 10 January 1960. Recent customers include Dowling College's School of Aviation, which took delivery of two in November 2004; Ohio University, which ordered seven Avidyne FlightMax Entegra-equipped Warriors in December 2004; and the University of North Dakota, which took delivery of the first of seven Entegra-equipped aircraft at EAA AirVenture, Oshkosh, on 25 July 2005.



Piper PA-28-161 Warrior III (Lycoming O-320 flat-four) *(James Goulding)*

1159826

COSTS: Standard equipped price USD195,300 (2006).

DESIGN FEATURES: Classic tourer and trainer. Low, moderately tapered wing (with root glove) and low-set tailplane; sweptback fin.

NACA 65_2-415 wing section on inboard panels, Mod No. 5 of NACA TN 2228 on leading-edge of outboard panels; dihedral 7°, incidence 2° at root, −1° at tip; sweepback at quarter-chord 5°.

FLYING CONTROLS: Manual. Conventional ailerons and rudder, plus all-moving tailplane with combined anti-servo and trim tab. four-position manually operated flaps (0, 10, 25 and 40°).

STRUCTURE: Conventional light alloy, with semi-monocoque fuselage, single-spar wings and ribbed light alloy skins on fin and tailplane; glass fibre nose cowl and wing/tailplane/fintips.

LANDING GEAR: Tricycle type; fixed. Wing-mounted, trousered, cantilever main legs with Piper oleo-pneumatic shock-absorbers; single wheel, with glass fibre speed fairing, on each unit. Cleveland disc brakes and wheels with tyres size 6.00–6 (4 ply) on main units, pressure 1.65 bar (24 lb/sq in). Cleveland steerable nosewheel and tyre size 5.00–5 (4 ply), pressure 2.06 bar (30 lb/sq in). Parking brake.

POWER PLANT: One 119 kW (160 hp) Textron Lycoming O-320-D3G flat-four engine, driving a Sensenich 74DM6-0-60 two-blade fixed-pitch metal propeller. Fuel in two wing tanks, with total capacity of 189 litres (50.0 US gallons; 41.6 Imp gallons), of which 181.5 litres (48.0 US gallons; 40.0 Imp gallons) are usable. Refuelling point on upper surface of each wing. Oil capacity 7.5 litres (2.0 US gallons; 1.7 Imp gallons).

ACCOMMODATION: Four persons in pairs in enclosed cabin. Individual horizontally adjustable front seats with seat belts and shoulder harnesses; bench-type rear seat with seat belts and shoulder harnesses. Dual controls standard. Large door on starboard side. Baggage compartment at rear of cabin, with external baggage door on starboard side. Heating, ventilation and windscreen defrosting standard.

SYSTEMS: Hydraulic system for brakes only. Electrical system powered by 28 V 60 A engine-driven alternator. 24 V 10 Ah battery standard.

AVIONICS: Standard and optional Advanced packages by Garmin/Meggitt, as described. Avidyne FlightMax Entegra integrated flight deck available as option from late 2004.

Comms: Standard: Garmin GNS-430 com/nav/IFR GPS; GMA-340 audio panel with marker beacon lights and four-position intercom; GTX-330 transponder; ELT; avionics master switch; cabin speaker; Telex 100T microphone and Airman 760 headset. Advanced Training Group: as above but with dual GNS-430.

Flight: Standard: GI-106A VOR/LOC/GS/GPS indicator; Narco AR-850 altitude reporter. Advanced package as above, plus dual GNS-430 and GI-106A and single RCR 650D ADF with IND 650A indicator. ST-180 HSI with slaved compass system, and DME 450, optional.

Instrumentation: Piper true airspeed indicator, magnetic compass, sensitive altimeter, gyro horizon, directional gyro, rate of turn indicator, rate of climb indicator, OAT gauge, digital ammeter, electric clock, annunciator panel with push-to-test, recording tachometer, three-way oil temperature/pressure and fuel-pressure gauge, dual fuel quantity gauges and vacuum gauge.

Optional Avidyne FlightMax Entegra integrated flight deck comprises two 264 mm (10.4 in) high-resolution, sunlight-readable colour displays for PFD and MFD functions and EMax engine instrumentation system. EXP5000 PFD with solid-state air data and attitude/heading reference system (ADAHRS) presents standard flight information including EADI, EHSI, altitude, primary engine instruments, airspeed and vertical speed; EX5000 MFD provides situational awareness data on an integrated display that includes moving map with Jeppesen NavData Americas and International databases, lightning detection, terrain, traffic engine information and optional Narrowcast datalink with Nexrad weather information. EMax displays manifold pressure, rpm, fuel flow and oil pressure on the PFD, fuel totaliser, automatic learning function, percentage horsepower, fuel remaining, all-cylinders CHT, EGT, oil temperature, OAT and electrical bus voltages, and computes nautical miles per gallon, fuel-to-waypoint and fuel-to-destination on the MFD, plus data logging of critical engine parameters which are downloadable via a dataport in a standard spreadsheet format. Entegra provides full integrated S-Tec 55X autopilot control and mode annunciations, with altitude capture, vertical speed selection and heading control, and L3 Skywatch and L3 WX 500 Stormscope interfaces.

EQUIPMENT: Standard equipment includes engine hour recorder, alternate static source, heated pitot head, colour co-ordinated control wheels, internally lit rocker switches, external power receptacle, electrical engine primer system, instrument panel lighting package, cabin dome light, navigation lights, landing/taxying light, wingtip Comet strobe lights, avionics dimming switch, pilot's and co-pilot's vertically adjustable seats in fabric and vinyl with magazine storage pockets on backs, rear bench seat, four floor-mounted cabin fresh-air vents, vinyl cabin side panels, wall-to-wall carpet and headliner, crew armrests, pilot's storm window, two sun visors, two map pockets, 'Quietised' soundproofing, carpeted baggage compartment with security straps, halon fire extinguisher, tiedown points, jack

1159783

Piper PA-28-161 Warrior III with UK registration *(Paul Jackson)*

pads, static discharge wicks, and Du Pont Imron polyurethane exterior paint in base colour with two contrasting trim stripes. S-Tec electric trim, carburettor ice detector, second altimeter, wingtip recognition lights, low profile tail strobe light, two-tone base colour exterior paint, metallic paint, and foreign certification gross weight kit optional.

DIMENSIONS, EXTERNAL:

Wing span	10.67 m (35 ft 0 in)
Wing chord: at root, excl glove	1.60 m (5 ft 3 in)
at tip	1.07 m (3 ft 6¼ in)
Wing aspect ratio	7.2
Length overall	7.25 m (23 ft 9½ in)
Height overall	2.22 m (7 ft 3½ in)
Tailplane span	3.96 m (12 ft 11¾ in)
Wheel track	3.05 m (10 ft 0 in)
Wheelbase	2.03 m (6 ft 8 in)
Propeller diameter	1.88 m (6 ft 2 in)
Propeller ground clearance	0.21 m (8¼ in)
Cabin door: Height	0.89 m (2 ft 11 in)
Width	0.91 m (3 ft 0 in)
Baggage door: Height	0.51 m (1 ft 8 in)
Max width	0.56 m (1 ft 10 in)
Height to sill	0.71 m (2 ft 4 in)

DIMENSIONS, INTERNAL:

Cabin (instrument panel to rear bulkhead):	
Length	2.49 m (8 ft 2 in)
Max width	1.05 m (3 ft 5¼ in)
Max height	1.14 m (3 ft 8¾ in)
Floor area	2.28 m^2 (24.5 sq ft)
Volume (incl baggage)	3.0 m^3 (106 cu ft)
Baggage compartment volume	0.68 m^3 (24.0 cu ft)

AREAS:

Wings, gross	15.79 m^2 (170.0 sq ft)
Ailerons (total)	1.23 m^2 (13.20 sq ft)
Trailing-edge flaps (total)	1.36 m^2 (14.60 sq ft)
Fin	0.69 m^2 (7.40 sq ft)
Rudder	0.38 m^2 (4.10 sq ft)
Tailplane, incl tab	2.76 m^2 (29.70 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, equipped	701 kg (1,545 lb)
Baggage capacity	91 kg (200 lb)
Max T-O weight	1,106 kg (2,440 lb)
Max ramp weight	1,110 kg (2,447 lb)
Max wing loading	70.1 kg/m^2 (14.35 lb/sq ft)
Max power loading	9.28 kg/kW (15.25 lb/hp)

PERFORMANCE:

Max level speed	117 kt (216 km/h; 134 mph)
Normal cruising speed at 75% power	115 kt (213 km/h; 132 mph)
Stalling speed: flaps up	50 kt (93 km/h; 58 mph)
flaps down	44 kt (82 km/h; 51 mph)
Max rate of climb at S/L	196 m (644 ft)/min
Service ceiling	3,355 m (11,000 ft)
T-O to 15 m (50 ft)	494 m (1,620 ft)
Landing from 15 m (50 ft)	354 m (1,160 ft)
Range, 45 min reserves:	
at 75% power	426 n miles (789 km; 490 miles)
at 55% power at FL100	513 n miles (950 km; 590 miles)

PIPER PA-28-181 ARCHER III

TYPE: Four-seat lightplane.

PROGRAMME: Introduced (as Cherokee Challenger 180) 9 October 1972 as successor to Cherokee 180; Archer 180, featuring minor changes, available from 1974; PA-28-181 Archer II launched 1976, and since 1978 has featured the tapered wings of Warrior II; Archer III from 1994, with axisymmetric engine inlets, redesigned windscreen and cabin side windows, plus interior restyling and improvements.

1159784

Piper PA-28-181 Archer III *(Paul Jackson)*

CUSTOMERS: 37 Archer IIIs delivered in 1995, and 45 each in 1996 and 1997; 91 in 1998; 100 in 1999, 102 in 2000, 88 in 2001, 38 in 2002, 49 in 2003, 19 in 2004, 16 in 2005, and 22 in the first nine months of 2006.

Description of the Warrior III applies also to Archer III except as follows:

COSTS: Standard, equipped USD227,700 (2006).

LANDING GEAR: Tricycle type. Tyres size 6.00–6 (4 ply), on all three wheels. Mainwheel tyre pressure 1.65 bar (24 lb/sq in), nosewheel 1.24 bar (18 lb/sq in). Cleveland high-capacity disc brakes. Parking brake. Wheel speed fairings standard.

POWER PLANT: One 134 kW (180 hp) Textron Lycoming O-360-A4M flat-four engine, driving a Sensenich 76EM8S14-O-62 two-blade fixed-pitch metal propeller. Fuel in two tanks in wing leading-edges, with total capacity of 189 litres (50.0 US gallons; 41.6 Imp gallons), of which 181.5 litres (48.0 US gallons; 40.0 Imp gallons) are usable. Oil capacity 7.5 litres (2.0 US gallons; 1.7 Imp gallons).

ACCOMMODATION: Four persons in pairs in enclosed cabin. Individual adjustable front seats, with dual controls; individual rear seats. Large door on starboard side. Baggage compartment at rear of cabin; door on starboard side. Rear seats removable to provide 1.3 m^3 (44 cu ft) cargo space. Accommodation heated and ventilated. Windscreen defrosting.

SYSTEMS: 28 V 70 A alternator and 24 V 10 Ah battery.

AVIONICS: Standard Garmin International and Meggitt package, as for Warrior III. Optional Premium Select package adds second GNS-430 and GI-106A VOR/LOC/GS/GPS indicator, S-Tec System 55X dual-axis autopilot with automatic electric trim, DG with heading bug and trim indicator and Meggitt ST-360 altitude preselect. Avidyne FlightMax Entegra integrated flight deck available as option from late 2004 (details as for Warrior III).

Comms: Garmin GMA-340 audio panel with marker beacon receiver and stereo intercom; GTX-330 solid-state transponder; Telex 100T microphone and Airman 760 headset.

Flight: GI-106A VOR/LOC/GS/COM/GPS indicator standard. ADI/HSI, RCR 650D ADF and DME 450, optional.

Instrumentation: Standard GNS-430 high-resolution colour LCD MFD with GI-106A VOR/LOC/GS/GPS indicator. WX500 Stormscope, Sky 497 Skywatch with GNS interface, and ST-360 altitude select/alerter optional.

EQUIPMENT: Standard equipment generally as for Warrior III except: polished propeller spinner, metal instrument panel, illuminated side-mounted OAT gauge, overhead switch panel, EGT gauge, flush locking fuel caps, overhead vent fan system, restyled windscreen and window lines with tinted transparencies, full chemical corrosion protection, Aztec Silver interior decor, DuPont Imron 6000 clearcoat/basecoat and exterior paint with choice of non-metallic or metallic colours for trim stripes, wool carpeting and Hobnail side panels, passenger armrests and headrests. Additional options include Piper Aire air conditioning, carburettor ice detector, stainless steel cowling fasteners; Meggitt electric trim, low-noise exhaust system and leather seats in choice of three colours.

DIMENSIONS, EXTERNAL: As for Warrior III except:

Length overall	7.32 m (24 ft 0 in)
Tailplane span	3.92 m (12 ft 10½ in)
Wheelbase	2.00 m (6 ft 7 in)
Propeller diameter	1.93 m (6 ft 4 in)

DIMENSIONS, INTERNAL: As for Warrior III except:

Cabin Length:	2.49 m (8 ft 2 in)
Width	1.06 m (3 ft 5¾ in)
Height	1.14 m (3 ft 9 in)
Baggage compartment volume, incl hatshelf	0.74 m^3 (26.0 cu ft)

For details of the latest updates to ***Jane's All the World's Aircraft*** online and to discover the additional information available exclusively to online subscribers please visit
jawa.janes.com

Piper PA-28-181 Archer III *(Paul Jackson)* 0589370

AREAS: As for Warrior III
WEIGHTS AND LOADINGS:
Weight empty, equipped ..... 764 kg (1,684 lb)
Baggage capacity ..... 90 kg (200 lb)
Max T-O weight ..... 1,156 kg (2,550 lb)
Max ramp weight ..... 1,160 kg (2,558 lb)
Max wing loading ..... 73.2 kg/m² (15.00 lb/sq ft)
Max power loading ..... 8.62 kg/kW (14.17 lb/hp)
PERFORMANCE:
Max level speed ..... 133 kt (246 km/h; 153 mph)
Normal cruising speed at 75% power at FL79 ..... 128 kt (237 km/h; 147 mph)
Stalling speed, flaps down ..... 45 kt (84 km/h; 52 mph)
Max rate of climb at S/L ..... 211 m (692 ft)/min
Service ceiling ..... 4,300 m (14,100 ft)
T-O run ..... 346 m (1,135 ft)
T-O to 15 m (50 ft) ..... 490 m (1,608 ft)
Landing from 15 m (50 ft) ..... 427 m (1,400 ft)
Landing run ..... 280 m (920 ft)
Range at S/L, allowances for taxi, T-O, climb and descent and 45 min reserves, at FL60:
at 75% power ..... 444 n miles (822 km; 511 miles)
at 65% power ..... 487 n miles (901 km; 560 miles)
at 55% power ..... 522 n miles (966 km; 600 miles)

PIPER PA-28R-201 ARROW

TYPE: Four-seat lightplane.

PROGRAMME: Derived from Cherokee Archer II, but with retractable landing gear, more powerful engine and untapered wings of 1975 PA-28-180 Archer; replaced original retractable gear Cherokee, the PA-28R Arrow 180, which had first flown 1 February 1967; PA-28R-201 Arrow III with increased span, tapered wings first flown 16 September 1975; first production aircraft 7 January 1977; new Arrow IV and Turbo Arrow IV models introduced 1979 with all-moving T tails; these subsequently discontinued and earlier low-tail **Arrow III** version restored to production.

CUSTOMERS: Seven delivered in 1996, two in 1997, two in 1998, six in 1999, 18 in 2000, 23 in 2001, 26 in 2002, 16 in 2003, 12 in 2004, nine in 2005, and two in the first nine months of 2006. Recent customers include the University of North Dakota, which ordered one in April 2003.

Description of Archer III applies also to Arrow except as follows:

COSTS: Standard, equipped USD307,000 (2006).

LANDING GEAR: Tricycle type; retractable. Hydraulic actuation by an electrically operated pump. Main units retract inward into wings, nose unit rearward. All units fitted with oleo-pneumatic shock-absorbers. Mainwheels and tyres size 6.00–6 (6 ply), pressure 2.07 bar (30 lb/sq in). Nosewheel and tyre size 5.00–5 (4 ply), pressure 1.86 bar (27 lb/sq in). High-capacity dual hydraulic disc brakes and parking brake.

POWER PLANT: One 149 kW (200 hp) Textron Lycoming IO-360-C1C6 flat-four engine, driving a McCauley two-blade constant-speed metal propeller. Fuel tanks in wing leading-edges with total capacity of 291 litres (77.0 US gallons; 64.1 Imp gallons), of which 273 litres (72.0 US gallons; 60.0 Imp gallons) are usable. Oil capacity 7.5 litres (2.0 US gallons; 1.7 Imp gallons).

SYSTEMS: Generally as for Archer III and Warrior III except for electrohydraulic system for landing gear actuation.

AVIONICS: Standard and Deluxe avionics packages by Garmin, as described. Avidyne FlightMax Entegra integrated flight deck available as option from late 2004 (details as for Warrior III).

Comms: Standard package comprises Garmin GNS 430 com/nav/GPS, GMA 340 audio with marker beacon receiver and intercom, GTX-327, Telex 100T noise cancelling microphone and Telex Airman 760 headset. DeLuxe package adds second GNS 430.

Flight: Standard package comprises single GI-106A VOR/LOC/GSA/GPS indicator. DeLuxe package adds second GNS 430, GI-106A and VOR/LOC/GPS/HSI indicator with slaved compass system, replacing standard directional gyro. Optional equipment includes S-Tec System 55X dual-axis autopilot with automatic electric trim, turn indicator and DG with heading bug; ST-361 ADI; DME 40; and RCR 650D ADF with IND-650A indicator.

EQUIPMENT: Generally as for Warrior III and Archer III.

DIMENSIONS, EXTERNAL:
Wing span ..... 10.80 m (35 ft 5 in)
Wing chord: at root, excl glove ..... 1.60 m (5 ft 3 in)
at tip ..... 1.07 m (3 ft 6¼ in)
Wing aspect ratio 7.4
Length overall ..... 7.52 m (24 ft 8¼ in)
Height overall ..... 2.39 m (7 ft 10¼ in)
Tailplane span ..... 3.92 m (12 ft 10½ in)
Wheel track ..... 3.19 m (10 ft 5½ in)
Wheelbase ..... 2.39 m (7 ft 10¼ in)
AREAS:
Wings, gross ..... 15.79 m² (170.0 sq ft)
WEIGHTS AND LOADINGS:
Weight empty, equipped ..... 814 kg (1,795 lb)
Max T-O weight ..... 1,247 kg (2,750 lb)
Max ramp weight ..... 1,251 kg (2,758 lb)
Max wing loading ..... 79.0 kg/m² (16.18 lb/sq ft)
Max power loading ..... 8.37 kg/kW (13.75 lb/hp)
PERFORMANCE:
Max level speed ..... 145 kt (268 km/h; 166 mph)
Normal cruising speed ..... 137 kt (253 km/h; 157 mph)
Stalling speed: flaps up ..... 60 kt (112 km/h; 69 mph)
flaps down ..... 55 kt (102 km/h; 64 mph)
Max rate of climb at S/L ..... 253 m (831 ft)/min
Service ceiling ..... 4,935 m (16,200 ft)
T-O to 15 m (50 ft) ..... 488 m (1,600 ft)
Landing from 15 m (50 ft) ..... 463 m (1,520 ft)
Cruising range at 55% power, at FL90, 45 min reserves .....
880 n miles (1,630 km; 1,013 miles)

PIPER PA-32R-301 SARATOGA II HP

TYPE: Six-seat utility transport.

PROGRAMME: Saratoga family of fixed and retractable landing gear light aircraft announced 17 December 1979 to replace earlier PA-32 Cherokee SIX 300 and T-tail Lance series (using PA-32 Type Certificate issued 4 March 1965); fixed-gear versions were discontinued, but reinstated in 2003, becoming Piper 6X and 6XT.

Saratoga SP certified 7 November 1979; fixed-gear Saratoga followed on 9 January 1980. Saratoga II HP certified 26 May 1993, featuring axisymmetric engine inlets, aerodynamic clean-up and interior improvements and restyling.

CURRENT VERSIONS: **Saratoga II HP:** Standard version, *as described.*

Saratoga II TC: Turbocharged version with Textron Lycoming TIO-540 engine; *described separately.*

6X: fixed-gear version; *described separately.*

CUSTOMERS: Total of 38 HPs delivered in 1997, 28 in 1998, 30 in 1999, 28 in 2000, 22 in 2001, five in 2002, nine in 2003, nine in 2004, eight in 2005, and nine in the first nine months of 2006.

Piper has built over 7,200 of PA-32 family since prototype first flew on 6 December 1963.

COSTS: Standard, equipped USD529,200 (2006).

DESIGN FEATURES: Larger counterpart to PA-28 series, featuring stretched fuselage. Saratoga versions have 'semi-tapered' wing, with root glove, unswept inboard panel and tapered outer panel with small fence inboard of tip.

Wing section NACA 66_2-415, dihedral 7°, thickness/chord ratio 15 per cent, twist 2°, incidence 2°, washout 0°.

FLYING CONTROLS: Conventional. Ailerons, rudder and all-moving tailplane with combined anti-servo and trim tab. Rudder trim; four-position electrically actuated flaps with preselect. Control surface max deflections: ailerons +28/–22°; tailplane +14° 30'/–5° 30'; rudder ±28°; flaps 40°.

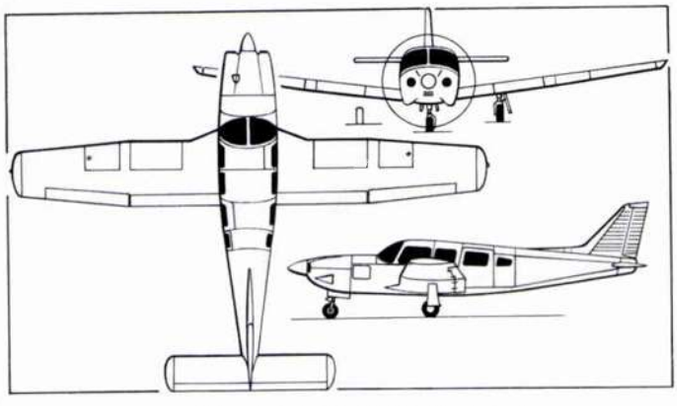
STRUCTURE: Conventional light alloy, with semi-monocoque fuselage, single-spar wings and ribbed light alloy skins on fin and tailplane; glass fibre nose cowl and wing/tailplane/fintips.

Retractable landing gear Piper PA-28R-210 Arrow *(Paul Jackson)* 1159785

Piper PA-32-301 Saratoga II HP *(Paul Jackson)* 1159787

1129465

Piper PA-32R-301 Saratoga II HP *(Paul Jackson)*



General arrangement of the Piper PA-32R-301 Saratoga II HP
(James Goulding)

1159825

LANDING GEAR: Hydraulically retractable tricycle type with single wheel on each unit. Main units retract inward, nosewheel aft. Emergency free-fall extension system. Piper oleo-pneumatic shock-absorbers. Steerable nosewheel. Mainwheels and tyres size 6.00–6 (8 ply), pressure 2.62 bar (38 lb/sq in). Nosewheel and tyre size 5.00–5 (6 ply), pressure 2.41 bar (35 lb/sq in).

POWER PLANT: One 224 kW (300 hp) Textron Lycoming IO-540-K1G5 flat-six engine, driving a Hartzell HC-I3YR-1RF/F7663DR three-blade, constant-speed, metal propeller with C3575-1 spinner. Two fuel tanks in each wing with combined capacity of 405 litres (107 US gallons; 89.1 Imp gallons), of which 386 litres (102 US gallons; 84.9 Imp gallons) are usable. Refuelling points on wing upper surface. Oil capacity 11.5 litres (3.0 US gallons; 2.5 Imp gallons).

ACCOMMODATION: Enclosed cabin seating six people, rear four in club arrangement; dual controls standard. Two forward-hinged doors, one on starboard side forward, overwing, and one on port side at rear end of cabin. Space for 45 kg (100 lb) baggage at rear of cabin, with external, lockable baggage/utility door on port side. Additional baggage space, capacity 45 kg (100 lb), between engine fireproof bulkhead and instrument panel, with external door on starboard side. Pilot's storm window. Accommodation heated and ventilated. Piper Aire air conditioning system optional. Windscreen defroster standard.

SYSTEMS: Electrically driven hydraulic pump for landing gear actuation. Electrical system includes 28 V 90 A engine-driven alternator and 24 V 10 Ah battery. Standby vacuum system standard. Optional oxygen system and Piper Aire air conditioning. Optional Piper Inadvertent Icing Protection System (PIIPS), is based on the TKS 'weeping wing' system, providing emergency de-icing of wing and horizontal tail leading-edges and propeller.

AVIONICS: Standard Avidyne FlightMax Entegra package.

Comms: Garmin GMA-340 audio panel with marker beacon receiver and intercom and stereo intercom; Garmin GTX-330 digital transponder with traffic information system; control wheel microphone switch, Telex Airman headset and 100T microphone, four PS Engineering headsets, and ELT, all standard.

Flight: Dual Garmin GNS-430 integrated COM/NAV/GS/GPS; S-Tec System 55× autopilot with electric trim, standard. Garmin GI-106A VOR/LOC/GS/GPS indicator, BFGoodrich Skywatch and WX-500 Stormscope, co-pilot's electric trim, optional.

Instrumentation: Avidyne FlightMax Entegra integrated flight deck comprising two 264 mm (10.4 in) high-resolution, sunlight readable, landscape format displays for PFD and MFD functions, and E-Max engine indicating system. EXP5000 PFD with solid-state air data and attitude/heading reference system presents standard flight indications including EADI, EHSI, airspeed, vertical speed, altitude, primary engine instrumentation, navigation and wind vector pointer; EX5000 MFD presents navigation data, engine monitoring, trip information, and optional lightning detection, traffic/terrain alerting, and datalink services including Multilink XM Satellite Weather and Narrowcast, C-Max electronic approach charts, two-way text messaging and flight tracking. EMax EICAS provides graphic representations of engine performance including manifold pressure, rpm, fuel flow and oil pressure on the PFD, fuel totaliser, automatic leaning function, percentage horsepower, fuel remaining, all-cylinders CHT, EGT, oil temperature, OAT and electrical bus voltages, and computes nautical-miles-per-gallon, fuel to waypoint and fuel to destination on the MFD, plus data logging of critical engine parameters which are downloadable via a dataport in standard spreadsheet format. FlightMax Entegra provides fully integrated autopilot control and mode annunciations, with altitude capture, vertical speed selection and heading control. Standby mechanical flight instruments standard. Bendix King KR 87 ADF with KI 227 indicator and KN 63 DME, optional.

EQUIPMENT: Standard equipment includes engine hour recorder, alternate static source, electric clock, internally lit rocker switches, heated pitot head, resettable circuit breakers in CB panel, standby electric vacuum pump, electric emergency fuel pump, external power receptacle, instrument panel lighting package, avionics dimming, map lights, navigation lights, landing/taxying light, wingtip strobe lights, pulsating recognition lights, pilot's and co-pilot's vertically adjustable all-leather seats, pilot's vent window, sun visors, four all-leather passenger seats with headrests, shoulder harnesses, seat belts, and quick-release facility, fold-down armrests (fifth and sixth seats), refreshment console, executive writing table, Hobnail fabric side panels, super 'Quietised' soundproofing, utility door for rear baggage access and cargo loading, static discharge wicks, and Du Pont Imron 6000 clearcoat/basecoat exterior paint. Optional equipment includes entertainment/executive console; provision for AM/FM radio and CD player, multimedia entertainment system and laptop computer workstation; optional exterior trim stripe patterns, and metallic paint as lower base colour.

DIMENSIONS, EXTERNAL:

Wing span	11.02 m (36 ft 2 in)
Wing aspect ratio	7.3
Length overall	8.43 m (27 ft 8 in)
Height overall	2.59 m (8 ft 6 in)
Tailplane span	3.94 m (12 ft 11 in)
Wheel track	3.38 m (11 ft 1 in)
Wheelbase	2.41 m (7 ft 11 in)
Cabin door (fwd, stbd): Height	0.89 m (2 ft 11 in)
Width	0.91 m (3 ft 0 in)
Cabin door (rear, port): Height	0.72 m (2 ft 4½ in)
Width	0.71 m (2 ft 4 in)
Baggage door (fwd): Height	0.41 m (1 ft 4 in)
Width	0.56 m (1 ft 10 in)
Baggage/utility door (fwd): Height	0.52 m (1 ft 8½ in)
Width	0.66 m (2 ft 2 in)

DIMENSIONS, INTERNAL:

Cabin: Length (instrument panel to rear bulkhead)	3.16 m (10 ft 4¼ in)
Max width	1.24 m (4 ft 0¾ in)
Max height	1.07 m (3 ft 6 in)
Volume (incl rear baggage area)	5.5 m³ (195 cu ft)
Baggage compartment volume:	
forward	0.20 m³ (7.0 cu ft)
rear	0.49 m³ (17.3 cu ft)

AREAS:

Wings, gross	16.56 m² (178.3 sq ft)
Ailerons (total)	0.98 m² (10.60 sq ft)
Trailing-edge flaps (total)	1.36 m² (14.60 sq ft)
Fin	0.70 m² (7.50 sq ft)
Rudder, incl tab	0.40 m² (4.30 sq ft)
Horizontal tail surfaces (total)	2.94 m² (31.60 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, equipped	1,094 kg (2,411 lb)
Baggage capacity	91 kg (200 lb)
Max T-O and landing weight	1,633 kg (3,600 lb)
Max ramp weight	1,639 kg (3,615 lb)
Max wing loading	98.6 kg/m² (20.19 lb/sq ft)
Max power loading	7.30 kg/kW (12.00 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	191 kt (353 km/h; 219 mph)
Max level speed	175 kt (324 km/h; 201 mph)
Normal cruising speed	166 kt (307 km/h; 191 mph)
Stalling speed: flaps up	67 kt (124 km/h; 78 mph) CAS
flaps down	63 kt (117 km/h; 73 mph)
Max rate of climb at S/L	398 m (1,305 ft)/min
Service ceiling	4,751 m (15,588 ft)
T-O run	366 m (1,200 ft)
T-O to 15 m (50 ft)	540 m (1,770 ft)
Landing from 15 m (50 ft)	464 m (1,520 ft)
Landing run	195 m (640 ft)
Range, long-range cruise power, allowances for start, taxi, T-O, climb and descent, and 45 min reserves	859 n miles (1,590 km; 988 miles)

PIPER PA-32-301FT 6X

TYPE: Six-seat utility transport.

PROGRAMME: First flight (N1326X) 24 February 2003. Announced at EAA Sun 'n' Fun at Lakeland, Florida 2 April 2003. FAA certification 22 July 2003.

CURRENT VERSIONS: **6X**: Standard version, *as described.*

6XT: Turbocharged version; *described separately.*

Piper PA-32-301FT 6X *(Paul Jackson)* 1159790

CUSTOMERS: 10 delivered in 2003, 24 in 2004, 18 in 2005, and eight in the first nine months of 2006.

COSTS: Standard, equipped, VFR, USD396,300 (2006).

The description for the Saratoga II HP applies also to the Piper 6X except:

DESIGN FEATURES: Generally similar to Saratoga II HP except for fixed landing gear, deletion of rearmost cabin window on each side and NASA air intake port side of nose.

POWER PLANT: One 224 kW (300 hp) Textron Lycoming IO-540-K1G5 flat-six engine, driving a Hartzell F7663D three-blade, constant-speed, metal propeller. Two interconnected fuel tanks in each wing, combined usable capacity 386 litres (102 US gallons; 84.9 Imp gallons).

LANDING GEAR: Non-retractable tricycle type. Speed fairings standard.

AVIONICS: Avidyne FlightMax Entegra integrated flight deck, as described under Saratoga II HP.

WEIGHTS AND LOADINGS:

Weight empty, equipped	1,005 kg (2,216 lb)
Standard useful load	635 kg (1,399 lb)

PERFORMANCE:

Never-exceed speed (VNE)	189 kt (350 km/h; 217 mph)
Max level speed	155 kt (287 km/h; 178 mph)
Normal cruising speed at FL72	148 kt (274 km/h; 170 mph)
Stalling speed, flaps down	59 kt (109 km/h; 68 mph)
Service ceiling	5,242 m (17,200 ft)
T-O run	391 m (1,284 ft)
T-O to 15 m (50 ft)	618 m (2,028 ft)
Landing from 15 m (50 ft)	555 m (1,822 ft)
Landing run	278 m (911 ft)
Range, long-range cruise power, at FL110, 45 min reserves	804 n miles (1,489 km; 925 miles)

PIPER PA-32R-301T SARATOGA II TC

TYPE: Six-seat utility transport.

PROGRAMME: Turbocharged parallel to Saratoga II HP; PA-32RT-300T Turbo Lance II certified 20 April 1978, followed by PA-32R-301T Turbo Saratoga SP on 7 November 1979 and fixed-gear Turbo Saratoga on 9 January 1980.

Current Saratoga II TC certified 9 July 1997; first customer deliveries August 1997.

CURRENT VERSIONS: **Saratoga IITC:** Standard version, *as described.*

6XT: Fixed-gear, *described separately.*

CUSTOMERS: Total of 26 delivered in 1997, 48 in 1998, 46 in 1999, 70 in 2000, 68 in 2001, 45 in 2002, 28 in 2003, 31 in 2004, 37 in 2005, and 34 in the first nine months of 2006.

COSTS: Standard, equipped USD572,400.

The description for the Saratoga II HP applies also to the Saratoga II TC except:

DESIGN FEATURES: New interior and relocated battery and ground power receptacle.

POWER PLANT: One 224 kW (300 hp) Textron Lycoming TIO-540-AH1A turbocharged flat-six engine, with automatic wastegate, driving a Hartzell HC-I3YR-1RF/F7663DR three-blade, constant-speed, metal propeller. Fuel as for Saratoga II HP.

WEIGHTS AND LOADINGS:

Weight empty, equipped	1,125 kg (2,481 lb)

PERFORMANCE:

Never-exceed speed (VNE)	191 kt (353 km/h; 219 mph)
Max level speed	187 kt (346 km/h; 215 mph)
Cruising speed:	
at FL80	172 kt (318 km/h; 198 mph)
at FL100	175 kt (324 km/h; 201 mph)
at FL150	185 kt (343 km/h; 213 mph)
Max certified altitude	6,100 m (20,000 ft)
T-O run	338 m (1,110 ft)
T-O to 15 m (50 ft)	552 m (1,810 ft)
Landing from 15 m (50 ft)	519 m (1,700 ft)
Landing run	269 m (880 ft)
Range, 45 min reserves and normal allowances, normal (N) or long-range (LR) cruise power: N at FL100	948 n miles (1,755 km; 1,091 miles)
LR at FL80	950 n miles (1,759 km; 1,093 miles)

PIPER PA-32-301XTC 6XT

TYPE: Six-seat utility transport.

PROGRAMME: Announced at EAA Sun 'n' Fun at Lakeland, Florida, 2 April 2003. Prototype (N326XT) flew shortly thereafter. FAA certification awarded 28 August 2003.

CUSTOMERS: 11 delivered in 2003, 14 in 2004, 16 in 2005, and nine in the first nine months of 2006.

COSTS: Standard, equipped, VFR, USD415,700.

The description for the Piper 6X applies also to the Piper 6XT except:

POWER PLANT: One 224 kW (300 hp) Textron Lycoming TIO-540-AH1A turbocharged flat-six engine, driving a Hartzell three-blade, constant-speed, metal propeller.

EQUIPMENT: Oxygen system optional.

WEIGHTS AND LOADINGS:

Weight empty, equipped	1,037 kg (2,286 lb)
Standard useful load	603 kg (1,329 lb)

PERFORMANCE:

Never-exceed speed (VNE)	189 kt (350 km/h; 217 mph)
Max level speed at mid-cruise weight	172 kt (319 km/h; 198 mph)
High cruising speed at FL100	161 kt (298 km/h; 185 mph)
Service ceiling	6,100 m (20,000 ft)
T-O run	426 m (1,397 ft)
T-O to 15 m (50 ft)	575 m (1,888 ft)
Landing from 15 m (50 ft)	555 m (1,822 ft)
Landing run	278 m (911 ft)
Range, long-range cruise power, 45 min reserves	931 n miles (1,724 km; 1,071 miles)

Piper 6XT, showing forward baggage space *(Paul Jackson)* 1159789

Piper PA-32R-301T Saratoga II TC *(Paul Jackson)* 1159788

PIPER PA-34-220T SENECA V

TYPE: Six-seat utility twin.

PROGRAMME: Original PA-34 Seneca certified 7 May 1971 and announced 23 September 1971, having been preceded by prototypes of fixed-gear PA-34-180 Twin Six (flown 25 April 1967) and retractable gear version in following year; 149 kW (200 hp) engines; redesignated Seneca II with increased MTOW, certified 18 July 1974 and introduced for 1975; improved Seneca III with more powerful counter-rotating (C/R) engines certified 17 December 1980 and introduced 15 February 1981; Seneca IV with axisymmetric engine inlets, aerodynamic refinements and interior improvements and restyling certified 17 November 1993 and introduced in 1994. Seneca V with L/TSIO-360-RB engines unveiled 16 January 1997 (having been secretly certified on 11 December 1996); engines, equipped with intercoolers and density control system (automatic wastegate), maintain S/L rated power to 5,945 m (19,500 ft). Other new features include redesigned instrument panel with digital display monitoring panel (DDMP), overhead switch/dome light/speaker panel, entertainment/executive console with extendable work table and in-flight phone/fax option replacing the second row seat on the starboard side. Senecas have also been built in Brazil and Poland.

CUSTOMERS: Total of 28 Seneca IVs delivered in 1995, and 18 in 1996; 39 Seneca Vs delivered in 1997, 55 each in 1998 and 1999, 42 in 2000, 38 in 2001, 43 in 2002, 28 in 2003, 10 in 2004, 12 in 2005, and 22 in the first nine months of 2006. Widely used as twin-conversion trainer; recent customers include Sabena Airlines, which took delivery of two in 1999 for its training centre at Scottsdale, Arizona.

Production of the PA-34 series in the USA totals some 4,700; the prototype first flew on 30 August 1968.

COSTS: Standard equipped price USD735,000 (2006).

DESIGN FEATURES: Twin-engined version of Cherokee SIX/Saratoga. Low-mounted, constant-chord wings and tailplane; leading-edge gloves inboard of engines; constant-chord tailplane.

Wing section NACA 65_2-415; dihedral 7°; thickness/chord ratio 15 per cent; washout 0° 41'; twist 2° 41'.

FLYING CONTROLS: Manual. Frise ailerons, rudder and one-piece all-moving tailplane with combined anti-balance and trim tab; anti-servo tab in rudder; wide-span electrically operated slotted flaps. Control surface movements: ailerons +35/–20°; tailplane +12° 3'/–7° 30'; rudder ±35°. Maximum flap deflection 40°.

STRUCTURE: Conventional light alloy, with semi-monocoque fuselage; single-spar wings; glass fibre wingtips.

LANDING GEAR: Hydraulically retractable tricycle type. Main units retract inward, nose unit forward. Oleo-pneumatic shock-absorbers. Steerable nosewheel. Emergency free-fall extension system. Mainwheels and tyres size 6.00–6 (8 ply), pressure 3.79 bar (55 lb/sq in); nosewheel and tyre size 6.00–6 (6 ply), pressure 2.76 bar (40 lb/sq in). Nosewheel safety mirror. High-capacity disc brakes. Parking brake.

POWER PLANT: One 164 kW (220 hp) Teledyne Continental TSIO-360-RB (port) and one 164 kW (220 hp) LTSIO-360-RB (starboard) flat-six turbocharged counter-rotating engine, each driving a Hartzell BHC-C2YF-2/FC8459(B)-8R (port) or /FJC8459(B)-8R (starboard) two-blade, constant-speed, fully feathering metal propeller; McCauley 82NJA-6 and L82NJA-6 three-blade propellers optional, but mandatory when de-icing equipment installed. Propeller synchrophasers standard. Fuel in four tanks in wings, with a total capacity of 485 litres (128 US gallons; 107 Imp gallons), of which 462 litres (122 US gallons; 102 Imp gallons) are usable. Oil capacity 7.5 litres (2.0 US gallons; 1.7 Imp gallons). Glass fibre engine cowlings.

ACCOMMODATION: Enclosed cabin, seating five people on individual seats with 0.25 m (10 in) centre aisle; sixth seat (second row, starboard side) optional, replacing entertainment/executive console. Dual controls standard. Pilot's storm window. Two forward-hinged doors, one on starboard side at front, the other on port side at rear. Large utility door adjacent rear cabin door provides an extra-wide opening for loading bulky items. Passenger seats easily removable to provide different seating/baggage/cargo combinations. Space for 39 kg (85 lb) baggage at rear of cabin, and for 45 kg (100 lb) in nose compartment with external door on port side. Cabin heated and ventilated. Windscreen defrosters standard.

SYSTEMS: Electrohydraulic system for landing gear actuation. Electrical system powered by two 28 V 85 A alternators; 24 V 19 Ah battery. Optional pneumatic de-icing boots on wing, tailplane and fin leading-edges. Oxygen system optional.

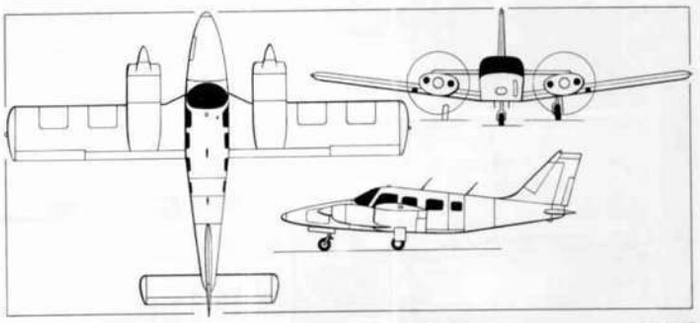
AVIONICS: Standard Avidyne FlightMax Entegra integrated flight deck, as described for Saratoga II HP.

EQUIPMENT: Standard equipment as listed for Saratoga II HP, plus emergency landing gear extension system, cabin dome light, pilot's storm window, sun visors with power setting table and checklist, chemical corrosion protection, flush fuel caps and nose gear safety mirror. Piper Aire air conditioning system, built-in oxygen system and foreign certification gross weight kit optional.

DIMENSIONS, EXTERNAL:

Wing span	11.85 m (38 ft 10¾ in)
Wing chord, constant	1.60 m (5 ft 3 in)
Wing aspect ratio	7.3
Length overall	8.72 m (28 ft 7½ in)
Height overall	3.02 m (9 ft 10¾ in)
Tailplane span	4.14 m (13 ft 6¾ in)
Wheel track	3.38 m (11 ft 1 in)
Wheelbase	2.13 m (7 ft 0 in)
Propeller diameter	1.93 m (6 ft 4 in)
Distance between propeller centres	3.80 m (12 ft 5½ in)
Cabin door (stbd, fwd): Height	0.89 m (2 ft 11 in)
Width	0.91 m (3 ft 0 in)
Cabin door (port, rear): Height	0.72 m (2 ft 4½ in)
Width	0.71 m (2 ft 4 in)
Baggage door (stbd, rear): Height	0.52 m (1 ft 8½ in)
Width	0.66 m (2 ft 2 in)
Baggage door (port, fwd): Height	0.53 m (1 ft 9 in)
Width	0.61 m (2 ft 0 in)

Piper PA-34-220T Seneca V *(Paul Jackson)* 1159791



Piper PA-34-220T Seneca V six-seat twin *(James Goulding)* 0016212

DIMENSIONS, INTERNAL:

Cabin (incl flight deck): Length	3.15 m (10 ft 4¼ in)
Max width	1.24 m (4 ft 0¾ in)
Max height	1.07 m (3 ft 6 in)
Volume	5.5 m^3 (195 cu ft)
Baggage compartment volume:	
forward	0.43 m^3 (15.3 cu ft)
rear	0.49 m^3 (17.3 cu ft)

AREAS:

Wings, gross	19.39 m^2 (208.7 sq ft)
Ailerons, incl tab (total)	1.17 m^2 (12.60 sq ft)
Trailing-edge flaps (total)	1.94 m^2 (20.84 sq ft)
Fin	1.14 m^2 (12.32 sq ft)
Rudder, incl tab	0.71 m^2 (7.62 sq ft)
Horizontal tail surfaces (total)	3.60 m^2 (38.74 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, equipped	1,545 kg (3,406 lb)
Baggage capacity	91 kg (200 lb)
Max T-O weight	2,154 kg (4,750 lb)
Max ramp weight	2,165 kg (4,773 lb)
Max zero-fuel weight	2,031 kg (4,479 lb)
Max landing weight	2,047 kg (4,513 lb)
Max wing loading	111.1 kg/m^2 (22.76 lb/sq ft)
Max power loading	6.57 kg/kW (10.80 lb/hp)

PERFORMANCE:

Max level speed	218 kt (404 km/h; 251 mph)
Cruising speed: at FL100: at max cruise power	182 kt (337 km/h; 209 mph)
at normal cruise power	176 kt (326 km/h; 202 mph)
at FL185: at max cruise power	197 kt (365 km/h; 227 mph)
Stalling speed, flaps down	64 kt (119 km/h; 74 mph)/IAS
Max rate of climb at S/L	446 m (1,462 ft)/min
Rate of climb at S/L, OEI	76 m (250 ft)/min
Max certified altitude	7,620 m (25,000 ft)
Service ceiling, OEI	5,030 m (16,500 ft)
T-O run	349 m (1,145 ft)
T-O to 15 m (50 ft)	521 m (1,710 ft)
Landing from 15 m (50 ft)	665 m (2,180 ft)
Landing run	427 m (1,400 ft)
Range at long-range cruise power, incl allowance for taxi, T-O, climb and 45 min reserves:	
at FL100	812 n miles (1,503 km; 934 miles)
at FL150	828 n miles (1,533 km; 952 miles)
at FL185	819 n miles (1,516 km; 942 miles)

PIPER PA-44-180 SEMINOLE

TYPE: Four-seat utility twin.

PROGRAMME: Prototype first flown May 1976; production version announced 21 February 1978; FAA certification 10 March 1978; two versions, Seminole, and Turbo Seminole (latter certified 29 November 1979), produced until 1982; normally aspirated Seminole restored to production in 1988, suspended in 1990 and restored again in 1995.

CUSTOMERS: Four delivered in 1995, eight in 1996, six in 1997, four in 1998, six in 1999, 11 in 2000, 62 in 2001, 60 in 2002, 16 in 2003, 11 in 2004, 29 in 2005, and six in the first nine months of 2006. Recent customers include the University of North Dakota, which ordered one in April 2003, and the Royal Jordanian Air Academy, which took delivery of three in 2003.

Manufacture of all PA-44 variants reached 600 in 2002. Many used in twin-conversion and IFR training.

COSTS: Standard, equipped USD484,900 (2006).

DESIGN FEATURES: Twin-engined derivation of PA-28 Arrow (which see). Constant-chord low wing and T tail; leading-edge gloves inboard of engines; sweptback fin with small fillet.

Wing section NACA 65_2-415; thickness/chord ratio 15 per cent; dihedral 7°; incidence 2°; twist 3°; washout–1°.

FLYING CONTROLS: Manual. Ailerons, rudder and all-moving tailplane with full-span anti-servo tab; rudder tab; four-position manually operated flaps. Control surface movements: ailerons +23/–17°; tailplane +15/–3°; rudder ±37°; maximum flap deflection 40°.

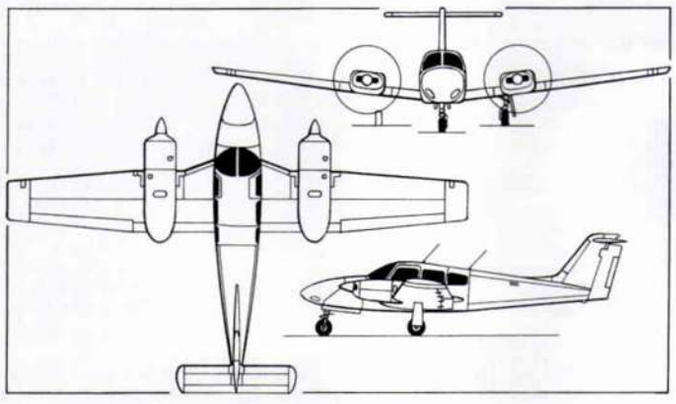
STRUCTURE: Conventional light alloy, with semi-monocoque fuselage; single-spar wings.

LANDING GEAR: Hydraulically retractable tricycle type. Free-fall emergency extension system. Piper oleo-pneumatic shock-absorbers. Mainwheels and tyres size 6.00–6 (8 ply), with tubes. Steerable nosewheel with tyre size 5.00–5 (6 ply), with tube. Dual toe-operated high-capacity disc brakes. Heavy-duty brakes and tyres optional.

POWER PLANT: Two 134 kW (180 hp) Textron Lycoming flat-four counter-rotating engines (one O-360-A1H6 to port and one LO-360-A1H6), each driving a Hartzell two-blade constant-speed fully feathering metal propeller: HC-C2Y(K,R)-2CEUF/FC7666A-2R and /FJC7666A-2R, respectively. One bladder-type fuel tank in each engine nacelle, with total capacity of 416 litres (110 US gallons; 91.6 Imp gallons), of which 409 litres (108 US gallons; 89.9 Imp gallons) are usable. Refuelling point on upper surface of each nacelle. Oil capacity 11.5 litres (3.0 US gallons; 2.5 Imp gallons).

ACCOMMODATION: Cabin seats four in two pairs of individual seats. Dual controls standard. Emergency exit on port side. Pilot's storm window. Baggage compartment at rear of cabin, capacity 91 kg (200 lb). Accommodation heated and ventilated. Windscreen defrosters.

Piper PA-44-180 Seminole *(Paul Jackson)* 1159792



Piper PA-44-180 Seminole four-seat light twin *(James Goulding)* 1159823

SYSTEMS: Electrohydraulic system for landing gear actuation and brakes. Electrical system includes two engine-driven 14 V 60 A alternators and 12 V 35 Ah battery. Janitrol combustion heater of 45,000 BTU capacity. Dual vacuum systems standard.

AVIONICS: Standard Avidyne FlightMax Entegra integrated flight deck, as described for Saratoga II HP.

EQUIPMENT: Metal instrument panel, engine hour recorders, alternate static source, heated pitot head, instrument panel lights and overhead blue lighting, avionics dimming, dome light, navigation lights, landing/taxying light, wingtip strobe lights, pilot's and co-pilot's vertically adjustable seats in fabric and vinyl, with optional lumbar support, two reclining rear passenger seats, vinyl cabin side panels, crew armrests, tinted windscreen and windows, pilot's storm window, 'Quietised' soundproofing, tiedown points, jack pads, nose gear safety mirror, external power receptacle, static discharge wicks, and Du Pont Imron polyurethane exterior paint in white base colour with two contrasting trim stripes. Metallic paint optional.

DIMENSIONS, EXTERNAL:

Wing span	11.75 m (38 ft 6½ in)
Wing aspect ratio	8.1
Length overall	8.41 m (27 ft 7¼ in)
Height overall	2.59 m (8 ft 6 in)
Tailplane span	3.05 m (10 ft 0 in)
Wheel track	3.21 m (10 ft 6½ in)
Wheelbase	2.56 m (8 ft 4¾ in)
Propeller diameter	1.88 m (6 ft 2 in)
Distance between propeller centres	3.86 m (12 ft 7¼ in)
Cabin door (stbd): Height	0.89 m (2 ft 11 in)
Width	0.91 m (3 ft 0 in)
Baggage door: Height	0.51 m (1 ft 8 in)
Width	0.56 m (1 ft 10 in)

DIMENSIONS, INTERNAL:

Cabin (instrument panel to rear bulkhead):	
Length	2.46 m (8 ft 1 in)
Max width	1.05 m (3 ft 5½ in)
Max height	1.25 m (4 ft 1 in)
Volume	3.0 m³ (106 cu ft)
Baggage compartment volume	0.74 m³ (26.0 cu ft)

AREAS:

Wings, gross	17.08 m² (183.8 sq ft)
Ailerons (total)	1.13 m² (12.12 sq ft)
Trailing-edge flaps (total)	1.36 m² (14.60 sq ft)
Fin	1.26 m² (13.56 sq ft)
Rudder, incl tab	0.76 m² (8.21 sq ft)
Horizontal tail surfaces (total)	2.27 m² (24.40 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, equipped	1,177 kg (2,596 lb)
Max T-O weight	1,723 kg (3,800 lb)
Max ramp weight	1,731 kg (3,816 lb)
Max wing loading	100.9 kg/m² (20.67 lb/sq ft)
Max power loading	6.42 kg/kW (10.55 lb/hp)

PERFORMANCE:

Max level speed	168 kt (311 km/h; 193 mph)
Cruising speed: at 75% power	162 kt (300 km/h; 186 mph)
at 65% power	157 kt (291 km/h; 181 mph)
Stalling speed: flaps up	57 kt (106 km/h; 66 mph) IAS
flaps down	55 kt (102 km/h; 63 mph) IAS
Max rate of climb at S/L	408 m (1,340 ft)/min
Rate of climb at S/L, OEI	65 m (212 ft)/min
Service ceiling	4,575 m (15,000 ft)
Service ceiling, OEI	1,155 m (3,800 ft)
T-O to 15 m (50 ft)	671 m (2,200 ft)
Landing from 15 m (50 ft)	454 m (1,490 ft)
Cruising range at 55% power, 45 min reserves	770 n miles (1,426 km; 886 miles)

PIPER PA-46-350P MALIBU MIRAGE

TYPE: Business prop.

PROGRAMME: Prototype Malibu first flew 30 November 1979; FAA certification of original PA-46-310P Malibu (TSIO-520 engine and two-blade propeller) received 27 September 1983; production deliveries began December 1983; 404 built before replaced by PA-46-350P Malibu Mirage October 1988. FAA certification having been received on 30 August 1988. Production temporarily suspended in 2000 to enable the company to concentrate on launching the turboprop Malibu Meridian; resumption then planned for late 2001.

CURRENT VERSIONS: **Malibu Mirage**: *As described.* Improvements introduced on 1995 model include pilot's heated glass windscreen, inflatable lumbar support on pilot/co-pilot's seats, colour co-ordinated control wheels and restyled interior trim, cabinetry and seats. Strengthened wing structure of Malibu Meridian (which see) introduced as standard from 1999, affording 18 kg (40 lb) increase in maximum take-off weight.

Malibu Meridian: Described separately.

JetPROP DLX: Supplemental Type Certificate awarded in 1998 to JetPROP LLC and Rocket Engineering, both of Spokane, Washington, for conversion of Malibu and Malibu Mirage with Pratt & Whitney PT6A-35 turboprop and Hartzell four-blade propeller.

CUSTOMERS: Total of 40 delivered in 1995, 57 in 1996, 54 in 1997, 55 in 1998, 61 in 1999, 63 in 2000, 10 in 2001, 19 in 2002, seven in 2003, 15 in 2004, 11 in 2005, and 18 in the first nine months of 2006.

COSTS: Standard, equipped USD1.1 million (2006).

DESIGN FEATURES: high-speed, long-range Piper single, with streamlined appearance and moderately high-aspect ratio wing, which is low mounted and tapered; mid-tailplane, also tapered; sweptback fin; wide track landing gear.

Wing section NASA 23016 at root, 23009 at tip; dihedral 4° 30'; thickness/chord ratio 16 per cent; twist 2° 57'; incidence 3° 38'.

FLYING CONTROLS: Conventional and manual. Horn-balanced elevators and rudder; stainless steel control cables. Electronic trim tab in elevator; electrically operated trailing-edge flaps. Precise Flight speed brakes standard. Control surface movements: ailerons ±18°; elevator ±23° 30'/–14° 30'; rudder 26° port/30° starboard; elevators +19/–14° 30'; maximum flap deflection 35°.

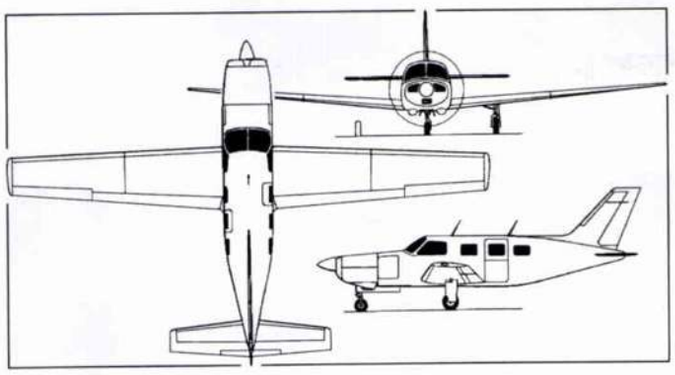
STRUCTURE: Cantilever high-aspect ratio all-metal wings; light alloy fuselage, fail-safe construction in pressurised area; light alloy tail surfaces.

LANDING GEAR: Hydraulically retractable tricycle type with single wheel on each unit; main units retract inward into wingroots, nosewheel rearward, rotating 90° to lie flat under baggage compartment. Mainwheel size 6.00–6 (8 ply), pressure 3.80 bar (55 lb/sq in); nosewheel 5.00–6 (6 ply) pressure 3.45 bar (50 lb/sq in). Toe-operated brakes.

POWER PLANT: One 261 kW (350 hp) Textron Lycoming TIO-540-AE2A turbocharged and intercooled flat-six engine, driving a Hartzell HC-13YR-1E/7890K three-blade constant-speed propeller with polished spinner. Composites (Kevlar) propeller replaced metal from 1998. Fuel system capacity 462 litres (122 US gallons; 102 Imp gallons), of which 454 litres (120 US gallons; 100 Imp gallons) are usable. Oil capacity 11.5 litres (3.0 US gallons; 2.5 Imp gallons).

ACCOMMODATION: Pilot and five passengers in pressurised, heated and air conditioned cabin; dual controls standard; front two occupants have vertical, fore-and-aft adjusting and reclining leather seats with inflatable lumbar supports, stowaway armrests, inertia reel shoulder harnesses and map-holders. Leather reclining passenger seats in club arrangement

Piper PA-46-350P Malibu Mirage *(Paul Jackson)* 1159793



Piper PA-46-350P Malibu Mirage (Textron Lycoming TIO-540-AE2A)
(Dennis Punnett) 1159822

with stowaway armrests and inertia reel shoulder harnesses; unpressurised baggage compartment in nose, and pressurised space at rear of cabin. Door with integral steps on port side aft of wing.

SYSTEMS: Pressurisation, maximum differential 0.38 bar (5.5 lb/sq in), to provide a cabin altitude of 2,400 m (7,900 ft) to a height of 7,620 m (25,000 ft). Hydraulic system pressure 107 bar (1,550 lb/sq in). Dual engine-driven vacuum pumps standard. Split bus electrical system has two 28 V/70 A alternators; 24 V 10 Ah battery; full icing protection standard. Optional electrically heated pilot's windscreen and fuel management system.

AVIONICS: Standard Avidyne FlightMax Entegra integrated avionics package, as described under Saratoga II HP, but with three displays, two for PFD functions and one MFD.

EQUIPMENT: Standard equipment includes heated lift detector; stall warning computer and horn; digital ammeter/voltmeter; six-channel CHT monitoring system with selectable cylinder readout; gyro air filter; alternate static source; heated pitot head; nosewheel light; wingtip taxying light; navigation lights, wingtip strobe lights; cockpit dome lights; solid-state dimming landing gear position and instrument panel lights; seven cabin overhead lights; PPG pilot's heated windscreen; windscreen defrosters; pilot's opening storm window; pilot's relief tube; supplemental electric heater; emergency oxygen system; leather sidewalls; stowaway executive writing table; forward refreshment/entertainment centres; super 'Quietised' soundproofing with inner passenger windows; halon fire extinguisher; Truax static discharge wicks; chemical corrosion protection; and Du Pont Imron polyurethane exterior paint in single- or two-tone base colour with graphics striping in choice of three trim colours. Optional equipment includes 'Infinity' paint scheme and stainless steel cowling fasteners.

DIMENSIONS, EXTERNAL:

Wing span	13.11 m (43 ft 0 in)
Wing aspect ratio	10.6
Length overall	8.81 m (28 ft 10¾ in)
Height overall	3.44 m (11 ft 3½ in)
Tailplane span	4.42 m (14 ft 6 in)
Wheel track	3.75 m (12 ft 3½ in)
Wheelbase	2.44 m (8 ft 0 in)
Propeller diameter	2.03 m (6 ft 8 in)
Passenger door (port, rear): Height	1.17 m (3 ft 10 in)
Width	0.61 m (2 ft 0 in)
Baggage door (port, nose): Height	0.58 m (1 ft 11 in)
Width	0.48 m (1 ft 7 in)

DIMENSIONS, INTERNAL:

Cabin (instrument panel to rear pressure bulkhead):	
Length	3.76 m (12 ft 4 in)
Max width	1.26 m (4 ft 1½ in)
Max height	1.19 m (3 ft 11 in)
Baggage compartment volume: nose	0.37 m³ (13.0 cu ft)
rear cabin	0.57 m³ (20.0 cu ft)

AREAS:

Wings, gross	16.26 m² (175.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty, equipped	1,412 kg (3,113 lb)
Baggage capacity: nose	45 kg (100 lb)
rear cabin	45 kg (100 lb)
Max T-O weight	1,968 kg (4,340 lb)
Max ramp weight	1,976 kg (4,358 lb)
Max landing and max zero-fuel weight	1,870 kg (4,123 lb)
Max wing loading	121.1 kg/m² (24.80 lb/sq ft)
Max power loading	7.55 kg/kW (12.40 lb/hp)

PERFORMANCE:

Max level speed at mid-cruise weight	220 kt (407 km/h; 253 mph)
Cruising speed at optimum altitude, mid-cruise weight, high-speed cruise power	213 kt (394 km/h; 245 mph)
Stalling speed, flaps and wheels down	59 kt (110 km/h; 68 mph)
Max rate of climb at S/L	372 m (1,220 ft)/min
Max certified altitude	7,620 m (25,000 ft)
T-O run	331 m (1,087 ft)
T-O to 15 m (50 ft)	637 m (2,090 ft)
Landing from 15 m (50 ft)	600 m (1,968 ft)
Landing run	311 m (1,020 ft)
Range with max fuel, allowances for start, T-O, climb and descent, plus 45 min reserves, at optimum altitude, long-range cruise power	1,345 n miles (2,490 km; 1,547 miles)

PIPER PA-46-500TP MALIBU MERIDIAN

TYPE: Business turboprop.

PROGRAMME: Launched at 1997 National Business Aviation Association Convention in Dallas, Texas, where a full-scale fuselage mockup was displayed; prototype (N400PT, converted from second Malibu Mirage) rolled out 13 August 1998; first flight 21 August 1998. Static test airframe and three further certification flight test aircraft (N403MM, first flown in July 1999, N402MM first flown 27 August 1999 and N401MM first flown in September 1999) built on production tooling. N401MM was dedicated to stability and autopilot testing and ice shape testing; N402MM, first with production standard interior and exterior paint finish, conducted performance and avionics testing and certification for flight into known icing, as well as serving as marketing demonstrator. N403MM was responsible for systems and power plant testing, high-speed flight testing and flutter testing. Public debut (N402MM) at the NBAA Convention in Atlanta, Georgia, in October 1999. First flight of production aircraft (c/n 003/N375RD) 30 June 2000. FAR Pt 23 certification achieved 27 September 2000, followed by UK CAA approval on 21 June 2001.

Increase in maximum take-off weight to 2,310 kg (5,092 lb), resulting in 15 per cent increase in useful load, certified at end of 2002; modifications include strengthening of airframe, modified stall strips and addition of vortex generators to the wings and undersurface of tailplane.

CURRENT VERSIONS: **Malibu Meridian:** *As described.*

20th Anniversary Special Edition: As described under Malibu Mirage entry.

CUSTOMERS: Total of 239 orders held by October 2000. First delivery (N375RD) to Richard Dumais of Richardson, Texas, in November 2000. Total of 98 delivered in 2001, 25 in 2002, 24 in 2003, 26 in 2004, 40 in 2005, and 32 in the first nine months of 2006. 200th Malibu Meridian delivered 2005 to Don and Jane Lockhard of Ontario, Canada.

COSTS: USD1.895 million typically equipped (2006).

Description generally as for Malibu Mirage, except that below.

DESIGN FEATURES: Strengthened wing, incorporating wingroot leading-edge gloves to increase area and reduce stalling speed; strengthened tail surfaces; and 37 per cent increase in area of horizontal stabiliser.

FLYING CONTROLS: Deflections as for Malibu Mirage except flaps 36°. Flight-adjustable trim tab in rudder. Ground-adjustable tab on starboard aileron.

POWER PLANT: One Pratt & Whitney Canada PT6A-42A turboprop, thermodynamic rating 767 kW (1,029 shp), flat rated at 373 kW (500 shp) maximum continuous, driving a Hartzell HC-E4N-3Q/E8501B-3.5 four-blade constant-speed reversible propeller. Fuel capacity 655 litres (173 US gallons; 144 Imp gallons), of which 644 litres (170 US gallons; 141.5 Imp gallons) are usable. Oil capacity 11 litres (3.0 US gallons; 2.5 Imp gallons).

ACCOMMODATION: Pilot and five passengers in standard club layout; passenger capacity reduced to four with optional entertainment centre comprising beverage cooler, storage cabinets, AM/FM/CD stereo and provision for VCR with flat-panel monitor. Fully automatic bleed-air conditioning and temperature control systems.

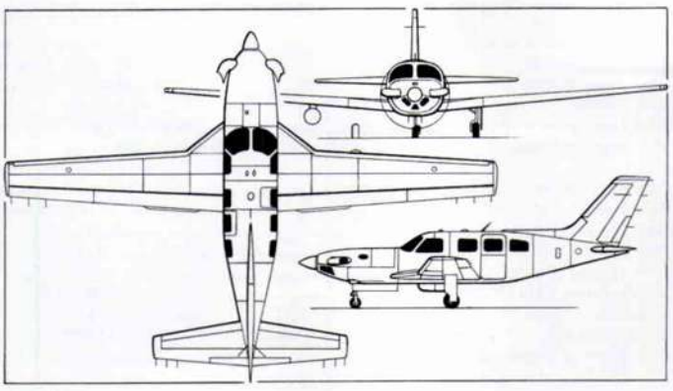
SYSTEMS: Upgraded electrical system, with 200 A starter/generator and 130 A standby alternator.

AVIONICS: Standard Garmin International and Meggitt package with dual Garmin GNS 530 nav/com/GPS as core system.

Comms: Garmin transceiver with 8.33 kHz spacing; GMA-340 audio panel; GTX-327 transponder.

Radar: Honeywell RDR 2000 vertical profile colour weather radar with KMD 850 MFD.

PA-46-500TP Malibu Meridian *(Paul Jackson)* 1159794



Piper Malibu Meridian (Pratt & Whitney Canada PT6A turboprop)
(James Goulding) 1159821

Flight: S-Tec Magic 1500 AFCS with integrated yaw damper; dual Meggitt air data, attitude, heading and reference systems (ADAHRS) provides digital readout of pitch and roll attitudes, roll and yaw rates, altitude, rate of altitude change, airspeed and heading.

Avidyne FlightMax Entegra integrated flight deck, introduced as standard from April 2005, comprises three 264 mm (10.4 in) high-resolution, sunlight-readable colour displays for PFD and MFD functions and EMax engine instrumentation system. Dual redundant EXP5000 PFDs with solid-state air data and attitude/heading reference system (ADAHRS) present standard flight information including EADI, EHSI, altitude, primary engine instruments, airspeed and vertical speed; EX5000 MFD provides situational awareness data on an integrated display that includes moving map with Jeppesen NavData Americas and International databases, lightning detection, terrain, traffic, engine information and optional Narrowcast datalink with Nexrad weather information. EMax displays torque, interstage turbine temperature, fuel flow and oil temperature and pressure on the PFD, propeller rpm, gas generator speed, fuel totaliser, percentage horespower, fuel remaining, six-cylinder CHT, EGT, oil temperature, OAT and electrical system performance on the MFD, plus data logging of critical engine parameters which are downloadable via a dataport in a standard spreadsheet format. Options include MultiLink graphical weather display, flight tracking and two-way air-to-ground text messaging, and CMax Jeppesen JeppView electronic chart display.

DIMENSIONS, EXTERNAL: As for Malibu Mirage except:
- Length overall ..... 9.02 m (29 ft 7¼ in)
- Height overall ..... 3.45 m (11 ft 4 in)
- Propeller diameter ..... 2.095 m (6 ft 10½ in)

DIMENSIONS, INTERNAL: As for Malibu Mirage

AREAS:
- Wings, gross ..... 17.00 m² (183.0 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty, equipped ..... 1,549 kg (3,414 lb)
- Baggage capacity ..... 45 kg (100 lb)
- Max T-O weight ..... 2,310 kg (5,092 lb)
- Max ramp weight ..... 2,329 kg (5,134 lb)
- Max wing loading ..... 135.8 kg/m² (27.82 lb/sq ft)
- Max power loading ..... 6.20 kg/kW (10.2 lb/shp)

PERFORMANCE:
- Max cruising speed at FL300 at mid-cruise weight ..... 260 kt (481 km/h; 299 mph)
- Stalling speed, flaps down ..... 69 kt (128 km/h; 80 mph)
- Max rate of climb at S/L ..... 474 m (1,556 ft)/min
- Max certified altitude ..... 9,150 m (30,000 ft)
- T-O run ..... 503 m (1,650 ft)
- T-O to 15 m (50 ft) ..... 743 m (2,438 ft)
- Landing from 15 m (50 ft) ..... 643 m (2,110 ft)
- Landing run ..... 311 m (1,020 ft)
- Max range at FL300, max cruise power, mid-cruise weight, 45 min reserves ..... more than 1,000 n miles (1,852 km; 1,151 miles)
- Endurance ..... 4 h 12 min

PIPER PIPERJET

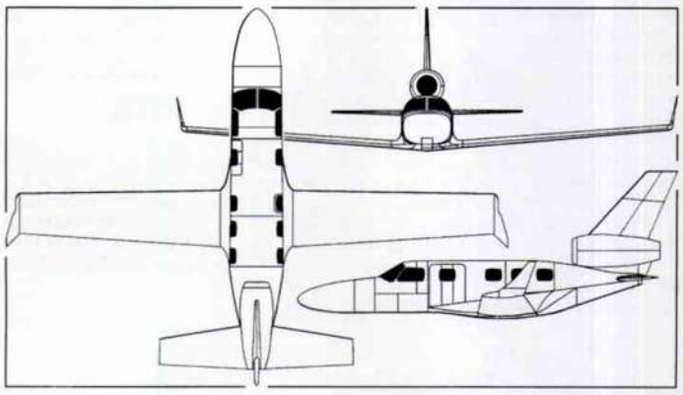
TYPE: Business mono-jet.

PROGRAMME: Announced 17 October 2006 at the NBAA Convention in Orlando, Florida, where a full-scale mockup was displayed; first flight planned 18 months thereafter. Certification, including approval for operation in known icing conditions and RVSM, and first customer deliveries, scheduled for the first half of 2010.

Artist's impression of the Piper PiperJet single-engined light jet 1159558

Standard six-seat club interior of the Piper PiperJet 1159559

PiperJet flight deck with three-tube EFIS display 1159560



Provisional general arrangement of PiperJet ***(Paul Jackson)*** 1159574

COSTS: USD2.199 million (2006).

DESIGN FEATURES: Low unswept tapered wing of natural laminar flow aerofoil section, with main spar mounted below cabin floor; outward canted sweptback winglets; low-mounted unswept tailplane; engine mounted centrally in pod above rear fuselage; sweptback fin mounted above engine.

FLYING CONTROLS: Conventional and manual. Dual sidestick controllers and single central thrust lever.

LANDING GEAR: Tricycle type; retractable.

POWER PLANT: One turbofan of unspecified type, with FADEC, performance computer and engine trend monitoring; autothrottle optional.

ACCOMMODATION: Standard accommodation for six, including single pilot, with main cabin in club-four configuration. Position forward, starboard, opposite door for optional seventh seat, or lavatory, or storage space or entertainment/beverage centre. Four cabin windows per side. Door on port side immediately forward of wing; emergency exit on starboard side above wing; seats can be removed for utility operations. Cabin features leather seats, zebra wood trim, cup holders and computer/iPod docking stations at each seat.

AVIONICS: Three-tube EFIS cockpit standard.

All data is provisional.

DIMENSIONS, EXTERNAL:
- Wing span over winglets ..... 13.59 m (44 ft 7 in)
- Length overall ..... 10.29 m (33 ft 9 in)
- Height overall ..... 5.03 m (16 ft 6 in)
- Fuselage: Max width ..... 1.40 m (4 ft 7 in)
  - Max height ..... 1.35 m (4 ft 5 in)
- Passenger door width ..... 0.91 m (3 ft 0 in)

DIMENSIONS, INTERNAL:
- Cabin volume ..... 8.3 m³ (293 cu ft)

WEIGHTS AND LOADINGS:
- Payload with max fuel ..... 363 kg (800 lb)
- Max T-O weight ..... 3,175 kg (7,000 lb)

PERFORMANCE:
- Max cruising speed ..... 360 kt (667 km/h; 414 mph)
- Max operating altitude ..... 10,670 m (35,000 ft)
- T-O run ..... 762 m (2,500 ft)
- Max range ..... 1,300 n miles (2,407 km; 1,496 miles)

PULSAR

PULSAR AIRCRAFT CORPORATION

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MANUFACTURING DIRECTOR: Rich Trickel

Pulsar Aircraft Corporation acquired rights to Pulsar series of light aircraft from SkyStar in July 1999 and announced the Super Pulsar 100, based on the Pulsar III (which remains available), at that time. It has also obtained rights to the former Tri-R KIS and KIS Cruiser, marketing of which began in 2001.

In 2004, the Pulsar XP-LSA and Super Pulsar-LSA were announced in anticipation of Light Sport Aircraft regulations introduced 1 September 2004; however, development is continuing and aircraft were not available by October 2006.

PULSAR SUPER PULSAR 100

TYPE: Side-by-side kitbuilt.

PROGRAMME: Designed by Mark Brown. Prototype Pulsar II first flew 3 April 1988 as two-seat version of Aero Designs Star-Lite (itself first flown in 1983). Originally with 47.8 kW (64.1 hp) Rotax 582 engine. Until suspended in 1999, in favour of Super Pulsar, parallel main production versions were Pulsar XP, with 59.6 kW (79.9 hp) Rotax 912 UL and Pulsar III with 84.6 kW (113.4 hp) turbocharged Rotax 914, giving improved performance. Larger canopy and redesigned cowling with chin intake; 100 per cent mass-balanced controls. Nose- and tailwheel versions of both were available. Programme acquired by SkyStar in late 1996 and by Pulsar in 1999.

CURRENT VERSIONS: **Super Pulsar 100:** Refined version of Pulsar III with repositioned tail unit for improved stability and higher, wider cabin having cutaway rear, but single-piece canopy. Prototype (N601SP) first flew August 2000 but damaged 20 August 2000; flight testing resumed 2 April 2001 and aircraft made public debut at Sun 'n' Fun 13 April 2001; by April 2002, 228 hours had been flown by prototype. Initial customer-built aircraft first flown 3 September 2002 in Poland. Tailwheel version under consideration, but no evidence of recent promotion.

Description applies to Super Pulsar 100.

Super Pulsar-LSA: Announced 2004, powered by 59.7 kW (80 hp) Jabiru 2200. Offered as kit or, from January 2005, as ready-to-fly; however, in abeyance by October 2005.

Wega: Version of Pulsar II-914 Turbo, certified to JAR-VLA with 600 kg (1,323 lb) maximum T-O weight, to have been marketed by HK Aircraft Technology in Germany; project abandoned.

Pulsar XP: Returned to production in 2001 as kit; cost USD22,950 (2005); available with Jabiru 2200 or Rotax 912 engine; Pulsar III has higher-powered Rotax 914 (Pulsar Turbo). Jabiru 3300 or Rotax 912S. Some versions have fixed rear windows in addition to canopy/windscreen.

Pulsar XP-LSA: As Super Pulsar-LSA; in abeyance by October 2005.

CUSTOMERS: More than 250 of all Pulsar variants flying by mid-2003, with a further 300 then under construction; over 150 current on US register in October 2005.

COSTS: Basic Super Pulsar kit (no engine) USD26,950 (2005); fast-build options add USD7,500.

DESIGN FEATURES: Highly streamlined low-wing configuration, with sweptback fin. Designed for ease of home construction with premoulded components where possible. Wings removable in about 15 minutes for mounting on trailer. Quoted build time 1,000 hours, or 600 hours for 'Super' kit.

Wing aerofoil NASA MS(1)-0313; tailplane aerofoil NACA 63_2-215.

FLYING CONTROLS: Conventional and manual; 60 per cent mass-balanced surfaces operated by rods and cables. Control surface deflections: elevator +30/–15°; aileron +25/–22°; rudder 30°. Flaps maximum deflection 40°.

STRUCTURE: GFRP with carbon fibre and foam cores. Wing skins of composites.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring cantilever mainwheel legs with wheel fairings. Mainwheels 500×5; tailwheel 400×5.

POWER PLANT: One 88.0 kW (118 hp) Pulsar Aeromaxx flat-four piston engine; alternatively 93 kW (125 hp) Teledyne Continental IO-240, 89 kW (120 hp) Jabiru 3300, 73.5 kW (98.6 hp) Rotax 912S or 84.6 kW (113.4 hp) Rotax 914. Fuel capacity 144 litres (38.0 US gallons; 31.6 Imp gallons).

DIMENSIONS, EXTERNAL:

Wing span	7.62 m (25 ft 0 in)
Wing aspect ratio	7.8
Length overall	6.10 m (20 ft 0 in)
Height overall	1.80 m (5 ft 11 in)

DIMENSIONS, INTERNAL:

Cabin: Max width	1.09 m (3 ft 7 in)
Max height	1.14 m (3 ft 9 in)

AREAS:

Wings, gross	7.43 m² (80.0 sq ft)

WEIGHTS AND LOADINGS (Rotax 912S):

Weight empty, equipped	318 kg (700 lb)
Max baggage weight	60 kg (132 lb)
Max T-O weight	635 kg (1,400 lb)
Max wing loading	85.4 kg/m² (17.50 lb/sq ft)
Max power loading	8.64 kg/kW (14.20 lb/hp)

PERFORMANCE (Rotax 912S):

Never-exceed speed (VNE)	191 kt (354 km/h; 220 mph)
Max level speed at S/L	156 kt (290 km/h; 180 mph)
Stalling speed, power off	46 kt (84 km/h; 52 mph)
Max rate of climb at S/L, solo	335 m (1,100 ft)/min
Service ceiling	4,875 m (16,000 ft)
T-O run	213 m (700 ft)
Landing run	244 m (800 ft)
Range	869 n miles (1,609 km; 1,000 miles)
g limits	+9/–6

PULSAR SPORT 150

TYPE: Side-by-side kitbuilt.

PROGRAMME: Designed by Rich Trickel and Vance Jaqua. First flown 1991 and initially known as Tri-R KIS; name derived from 'keep it simple'. Programme sold to Pulsar in 1999; new owner modified design with revised canopy (rear-hinged or sliding) and empennage.

CURRENT VERSIONS: **TR-1:** Tricycle landing gear version, *as described.*

TD: Tailwheel version, introduced 1992; powered by 88.0 kW (118 hp) Textron Lycoming O-235-C1B; seven flying by end of 1996; no longer marketed.

CUSTOMERS: At least 57 (50 tricycle and seven tailwheel) flying by 2005.

COSTS: Basic kit USD24,950, without engine, avionics, propeller, spinner, upholstery, battery, instruments and paint (2005).

DESIGN FEATURES: Conventional low-wing monoplane of composites construction. Upturned wingtips and sharply tapered fin. Quoted build time 1,000 hours.

FLYING CONTROLS: Conventional and manual. Plain ailerons and horn-balanced elevators, latter with tab on port side. Horn-balanced rudder, hinged on starboard side. Plain three-position flaps; deflect 0/12/28°. Control surface deflections: elevator +25/–16°; ailerons ±12°; rudder 24° port, 30° starboard.

STRUCTURE: Constructed of high-temperature epoxy pre-impregnated GFRP/CFRP premoulded components, with either Divinycell or honeycomb core. All metal components prewelded or premachined. Aerofoil NACA 63(2)-215 slightly modified; dihedral 2° 30'.

LANDING GEAR: Fixed. Fuselage-mounted spring cantilever mainwheel legs with optional speed fairings in tricycle or tailwheel layout. Matco 6.00×6 wheels and brakes; McCreary 5.00-5 tyres. Tricycle version has steerable nosewheel; size 5.00×5.

POWER PLANT: One piston engine driving a two- or three-blade propeller: typically 88 kW (118 hp) Textron Lycoming O-235-C1B; 93 kW (125 hp) Teledyne Continental IO-240; or 74.6 kW (100 hp) Teledyne Continental O-200. Alternatives include 59.7 kW (80 hp) Limbach L 2000 and 74.6 kW (100 hp) Fire Wall Forward CAM 100 four-cylinder converted Honda motorcar engine. Fuel capacity 95 litres (25.0 US gallons; 20.8 Imp gallons); optionally 129 litres (34.0 US gallons; 28.3 Imp gallons) for Lycoming- and Continental-powered versions, or 76 litres (20.0 US gallons; 16.7 Imp gallons) in Limbach.

ACCOMMODATION: Two, side by side. Upward-hinged door each side.

DIMENSIONS, EXTERNAL:

Wing span	7.01 m (23 ft 0 in)
Wing chord	1.17 m (3 ft 10 in)
Wing aspect ratio	6.0
Length overall	6.71 m (22 ft 0 in)
Height overall: TR-1	2.21 m (7 ft 3 in)
TD	1.89 m (6 ft 2½ in)
Tailplane span	2.24 m (7 ft 4 in)
Propeller diameter	1.42 m (4 ft 8 in)

DIMENSIONS, INTERNAL:

Cabin: Length	1.65 m (5 ft 5 in)
Max width	1.07 m (3 ft 6 in)
Max height	0.99 m (3 ft 3 in)

AREAS:

Wings, gross	12.54 m² (135.0 sq ft)
Tailplane	1.41 m² (15.26 sq ft)

1040417

Pulsar XP composites kitbuilt *(Paul Jackson)*

Pulsar Sport (Tri-R KIS) with appropriate registration *(Paul Jackson)* 1040414

WEIGHTS AND LOADINGS (L: Lycoming O-235 engine, C: Continental IO-240 engine):
- Weight empty: L ..... 357 kg (788 lb)
- C ..... 362 kg (798 lb)
- Max T-O weight: L ..... 635 kg (1,400 lb)
- C ..... 680 kg (1,500 lb)
- Max wing loading: L ..... 50.6 kg/m² (10.37 lb/sq ft)
- C ..... 54.2 kg/m² (11.11 lb/sq ft)
- Max power loading: L ..... 7.22 kg/kW (11.86 lb/hp)
- C ..... 7.30 kg/kW (12.00 lb/hp)

PERFORMANCE (L, C, as above):
- Never-exceed speed (VNE) ..... 186 kt (346 km/h; 215 mph)
- Max level speed: L ..... 165 kt (306 km/h; 190 mph)
- C ..... 174 kt (322 km/h; 200 mph)
- Cruising speed at 75% power: L ..... 148 kt (274 km/h; 170 mph)
- C ..... 156 kt (290 km/h; 180 mph)
- Stalling speed: L ..... 47 kt (86 km/h; 53 mph)
- C ..... 48 kt (89 km/h; 55 mph)
- Max rate of climb at S/L: L ..... 488 m (1,600 ft)/min
- C ..... 518 m (1,700 ft)/min
- Service ceiling: L ..... 4,267 m (14,000 ft)
- C ..... 4,572 m (15,000 ft)
- T-O run: L, C ..... 229 m (750 ft)
- Landing run: L, C ..... 244 m (800 ft)
- Range at cruising speed, standard tankage: L ..... 499 n miles (925 km; 575 miles)
- C ..... 695 n miles (1,287 km; 800 miles)
- *g* limits ..... +4.4/−2.2

PULSAR CRUISER and SUPER CRUISER

TYPE: Four-seat kitbuilt.

PROGRAMME: Designed by Rich Trickel and Vance Jaqua. First flown 1994, when known as Tri-R Cruiser TR-4. Design purchased by Pulsar in 1999.

CURRENT VERSIONS: **Cruiser:** Baseline model; being replaced by Super Cruiser.

Super Cruiser: Higher-powered version with minor redesign to dorsal fin to give larger area. First aircraft to this standard (N98WG) flew 8 March 1999.

CUSTOMERS: More than 60 kits sold and 18 flying by mid-2002 (latest data supplied); eleven on US register in October 2005.

COSTS: Kit USD34,950 (2005); fast-build options add USD7,000.

DESIGN FEATURES: Larger version of the Pulsar Sport 150, but without upturned wingtips. Quoted build time 1,500 hours.

Description generally as for Sport 150 except that below.

FLYING CONTROLS: As Sport 150, except elevator tab on starboard side and four-position flaps, deflections 0/10/23/31°.

LANDING GEAR: Tricycle type only.

POWER PLANT: *Cruiser:* One 134 kW (180 hp) Textron Lycoming O-360 flat-six, driving a two-blade, fixed-pitch propeller; alternatively a 119 kW (160 hp) Textron Lycoming O-320 can be fitted.

Super Cruiser: One 157 kW (210 hp) six-cylinder Teledyne Continental IO-360, driving a two-blade, constant-speed propeller.

Fuel capacity in both versions 197 litres (52.0 US gallons; 43.3 Imp gallons), of which 189 litres (50.0 US gallons; 41.6 Imp gallons) usable.

DIMENSIONS, EXTERNAL:
- Wing span ..... 8.83 m (29 ft 0 in)
- Wing aspect ratio 6.2
- Length overall ..... 7.16 m (23 ft 6 in)
- Height overall ..... 2.29 m (7 ft 6 in)

DIMENSIONS, INTERNAL:
- Cabin: Length ..... 1.98 m (6 ft 6 in)
- Max width ..... 1.14 m (3 ft 9 in)
- Max height ..... 1.17 m (3 ft 10 in)

AREAS:
- Wings, gross ..... 12.54 m² (135.0 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty: Cruiser ..... 544 kg (1,200 lb)
- Super Cruiser ..... 572 kg (1,260 lb)
- Max baggage weight ..... 29 kg (65 lb)
- Max T-O weight ..... 1,088 kg (2,400 lb)
- Max wing loading ..... 86.8 kg/m² (17.78 lb/sq ft)
- Max power loading:
  - Cruiser ..... 8.12 kg/kW (13.33 lb/hp)
  - Super Cruiser ..... 6.96 kg/kW (11.43 lb/hp)

PERFORMANCE:
- Never-exceed speed (VNE) ..... 186 kt (346 km/h; 215 mph)
- Cruising speed: at 75% power:
  - Cruiser ..... 165 kt (306 km/h; 190 mph)
  - Super Cruiser ..... 174 kt (322 km/h; 200 mph)
- at 60% power: Cruiser ..... 156 kt (290 km/h; 180 mph)
  - Super Cruiser ..... 165 kt (306 km/h; 190 mph)
- Stalling speed: Cruiser ..... 48 kt (89 km/h; 55 mph)
  - Super Cruiser ..... 50 kt (92 km/h; 57 mph)
- Max rate of climb at S/L: Cruiser ..... 396 m (1,300 ft)/min
  - Super Cruiser ..... 610 m (2,000 ft)/min
- Service ceiling ..... 6,400 m (21,000 ft)
- T-O run: Cruiser ..... 305 m (1,000 ft)
  - Super Cruiser ..... 274 m (900 ft)
- T-O to 15 m (50 ft): Cruiser ..... 366 m (1,200 ft)
  - Super Cruiser ..... 298 m (975 ft)
- Landing run: Cruiser ..... 395 m (1,300 ft)
  - Super Cruiser ..... 411 m (1,350 ft)
- Range: Cruiser ..... more than 782 n miles (1,448 km; 900 miles)
  - Super Cruiser ..... more than 695 n miles (1,287 km; 799 miles)

(Pulsar) TR-4 Super Cruiser *(Paul Jackson)* 1040418

QMA

QUARTZ MOUNTAIN AEROSPACE

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Original Luscombe company formed in 1934, specialising in all-metal private light aircraft; ownership passed to Temco in 1949, Silvaire Aircraft in 1955, and to Luscombe Aircraft Corporation on termination of aircraft production in 1960. Type certificate of Model 11 transferred to Luscombe Aircraft Corporation on 10 August 1995 and then to QMA on 13 March 2006. Relaunch of modified version undertaken from 1998 in newly built 11,150 m² (120,000 sq ft) factory at Altus. Company subsequently renamed Quartz Mountain Aerospace, remaining based at Altus, Oklahoma. First production aircraft scheduled for delivery in late 2006.

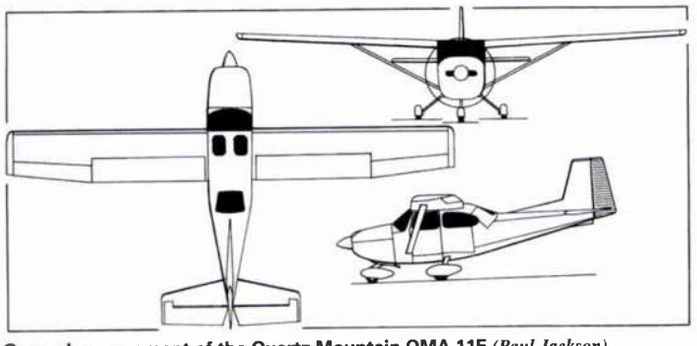
QMA 11E

TYPE: Four-seat lightplane.

PROGRAMME: Model 11A Sedan first flew (NX74202) 11 September 1946; certified 4 October 1948; total of 198 built with tailwheel and 123 kW (165 hp) Continental E-165 engine; production ended in 1949; 40 remained registered in US during 2006. Planned 1970 relaunch as Alpha Aviation Alpha IID failed to materialise.

Considerably redesigned Luscombe 185-11E being produced at Altus, Oklahoma, following conversion of Sedan N1674B as Proof-of-concept followed by construction of

QMA 11E (alias Luscombe 11E demonstrator) *(Paul Jackson)* 1158586



General arrangement of the Quartz Mountain QMA 11E *(Paul Jackson)* 1158554

preproduction prototype (N747BM, c/n 00995; later N11XE) for certification. Initially marketed under name of Spartan, which had been dropped by 2002. First production aircraft/demonstrator N11XA.

Structural test fuselage completed December 1997; production of new aircraft due to have started April 2000, but this slipped to early 2004 and subsequently to late 2006 as QMA 11E. Certification (Certificate No. A804) for sales and marketing purposes awarded November 1998, with full type certification (Certificate No. A804) received 17 December 2002.

Changes from original include engine, 24 V electrical system, nosewheel, composites engine cowling, modified windscreen, electric (formerly hydraulic) flaps, electric (formerly manual) elevator trim and three-point seatbelts.

CUSTOMERS: Two (including prototype) registered by October 2001. Announced customers include the US Civil Air Patrol, which has a requirement for eight.

COSTS: USD189,500 (2006).

DESIGN FEATURES: High-wing braced monoplane; original 1946 design modified for nosewheel and 0.30 m (1 ft 0 in) increase in constant-chord inner wing, with sweptforward outer trailing-edge and Hoemer-style wingtips; tapered tailplane; slightly sweptback fin with ventral fillet. Wing section NACA 43012A.

FLYING CONTROLS: Conventional and manual. Stainless steel control cables. All control surfaces aluminium skinned with external stiffeners. Horn-balanced elevators with flight-adjustable, electric trim tab on port side; ground-adjustable tab on starboard aileron. Control movements: ailerons +15/–9°, elevators +29/–13° and rudder ±15°. Three-position electric flaps; maximum deflection 25°.

STRUCTURE: Steel tube semi-monocoque corrosion-proofed fuselage and strut-braced two-spar wings, all covered with aluminium skins, except composites engine cowling. Dorsal tail fillet.

LANDING GEAR: Alloy spring leaf main legs with 6.00-6 tyres, pressure 2.4 bar (35 lb/sq in). Air/oil shock-absorbing strut nose gear with 5.00-5 tyre, pressure 1.7 bar (25 lb/sq in), steerable ±10°. Hydraulic disc brakes and parking brake on mainwheels; turning radius approximately 8.23 m (27 ft 0 in).

POWER PLANT: One 157 kW (210 hp) Teledyne Continental IO-360-ES six-cylinder fuel-injected piston engine derated to 138 kW (185 hp) and driving a McCaulley 1B235/EFC7667 two-blade fixed-pitch metal propeller with D4245 spinner. Fuel capacity 159 litres (42.0 US gallons; 35.0 Imp gallons) in two bladder wing tanks, of which 152 litres (40.0 US gallons; 33.3 Imp gallons) are usable. Filler port in each wing. Oil capacity 7.5 litres (2.0 US gallons; 1.6 Imp gallons). Proof-of-concept aircraft has three-blade propeller, which is optional on production airframes.

ACCOMMODATION: Pilot and three passengers in side-by-side pairs; door each side; front seats fully adjustable; dual controls. Inertia reel harnesses for all seats. Cabin windows are tinted, as are two vision ports in cabin roof.

SYSTEMS: 28 V 70 A alternator; 24 V 12.75 Ah battery; dual vacuum pumps.

AVIONICS: *Comms:* Garmin GNC 250XL GPS/com, GTX 327 transponder and GMA 340 audio panel standard. GTX 330 transponder and Senheiser HMEC 300/BP-03 or HME 100 headsets optional.

Flight: Dual Garmin GNS 430 or GNS 530 GPS/com/nav, GI 106A CDI with glideslope and flight data recorder optional.

Instrumentation: Altimeter, compass, ASI, VSI, turn co-ordinator, ammeter, OAT gauge, vacuum gauge, fuel gauge, tachometer, EGT gauge and oil pressure gauge standard.

EQUIPMENT: Position lights, strobe lights and white paint with accent colour all standard. Options include leather seats, deluxe interior, Rosen sun visors, noise cancelling headsets, wheel fairings, metallic paint and polished propeller spinner.

DIMENSIONS, EXTERNAL:

Wing span	11.73 m (38 ft 6 in)
Wing aspect ratio	8.9
Length overall	7.32 m (24 ft 0 in)
Height overall	2.69 m (8 ft 10 in)
Tailplane span	3.58 m (11 ft 9 in)
Wheel track	2.64 m (8 ft 8 in)
Wheelbase	2.24 m (7 ft 4 in)
Passenger door: Max height	1.19 m (3 ft 11 in)
Max width	0.81 m (2 ft 8 in)

DIMENSIONS, INTERNAL:

Cabin: Length	2.70 m (8 ft 10¼ in)
Max width	1.16 m (3 ft 9½ in)
Max height	1.30 m (4 ft 3¼ in)

AREAS:

Wings, gross	15.51 m² (167.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	658 kg (1,450 lb)
Baggage capacity	45 kg (100 lb)
Max T-O and landing weight	1,034 kg (2,280 lb)
Max ramp weight	1,037 kg (2,286 lb)
Max wing loading	66.7 kg/m² (13.65 lb/sq ft)
Max power loading	7.50 kg/kW (12.32 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	157 kt (290 km/h; 180 mph)
Max level speed	130 kt (241 km/h; 150 mph)
Normal cruising speed	116 kt (215 km/h; 133 mph)
Cruising speed at FL75:	
70% power	117 kt (217 km/h; 135 mph)
60% power	110 kt (204 km/h; 127 mph)
T-O speed	60 kt (111 km/h; 69 mph)
Stalling speed, power off	53 kt (99 km/h; 61 mph)
Max rate of climb at S/L	267 m (876 ft)/min
Service ceiling	4,877 m (16,000 ft)
T-O run	274 m (900 ft)
T-O to 15 m (50 ft)	419 m (1,375 ft)
Landing from 15 m (50 ft)	579 m (1,900 ft)
Landing run	264 m (866 ft)
Range with reserves	499 n miles (925 km; 575 miles)
Endurance	5 h 42 min
g limits	+3.8/–1.52
Noise level	72.4 dB(A)

QUEST

QUEST AIRCRAFT COMPANY LLC

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CHAIRMAN: Bruce R Kennedy
CEO: Paul D Schaller
CHIEF TECHNICAL OFFICER: Thomas S Hamilton
SALES AND MARKETING MANAGER: Kelly Mahon
MEDIA CONTACT: Julie Stone

Quest was established in 2001, specifically to develop and market the Kodiak utility transport. New, 2,500 m² (27,000 sq ft) plant at Sandpoint Municipal Airport opened 16 October 2002; 5,295 m² (57,000 sq ft) extension commissioned in October 2005. Personnel totalled 50 in 2005.

QUEST KODIAK

TYPE: Light utility turboprop.

PROGRAMME: Prototype (N490KQ) first flight 16 October 2004; achieved 27 hours in first month and 50 sorties by 14 January 2005. Total 200 hours by July 2005; 330 by January 2006. Public debut at Alaska State Aviation Trade Show, May 2005. Second airframe for ground tests. Certification due 2006.

CURRENT VERSIONS: **Kodiak 100:** Prototype.

CUSTOMERS: Total 28 deposits by July 2005, including 15 for missionary work.

COSTS: USD1,111,000 (2005).

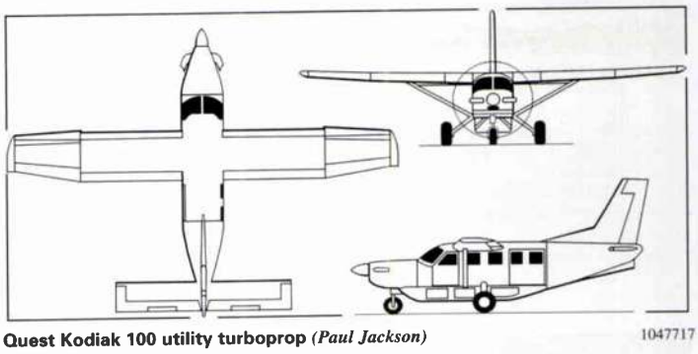
DESIGN FEATURES: Optimised for missionary work. High, braced wing with constant-chord central section and tapered from approximately 60 per cent span after leading-edge 'dogtooth' extension. Tall, sweptback fin with underfin, ventral fillet and large rudder horn. Constant-chord tailplane. Wide-track landing gear for rough field operation. Airframe life 30,000 h.

Certifiable to FAR Pt 23 for IFR operation. Custom-designed aerofoil section; dihedral 3°.

FLYING CONTROLS: Conventional and manual. Horn-balanced elevators and rudder. Balanced ailerons with electric trim tab, port. Trim tab in each elevator; electrical actuation. Fowler flaps; max deflection 35°.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring steel cantilever mainwheel legs; steerable nosewheel with Cleveland oleo-pneumatic shock-absorber. Tyre sizes 29×11.0-10 main; 22×8.0-8 nose. Optional floats, with addition of fuselage underfin.

POWER PLANT: One 559 kW (750 shp) Pratt & Whitney Canada PT6A-34 turboprop, driving a Hartzell D9511FBX four-blade, constant-speed, fully-reversible propeller. Fuel capacity 1,212 litres (320 US gallons; 267 Imp gallons) usable.



Quest Kodiak 100 utility turboprop *(Paul Jackson)* 1047717

Quest Kodiak 100 prototype over Port Alsworth, Alaska 1129181

ACCOMMODATION: Total of 10 persons, including pilot(s) at 79 cm (31 in) pitch. Forward-hinged crew door each side; upward-hinged freight door, port, rear. Optional baggage pannier below fuselage.
AVIONICS: Garmin G1000 suite installed December 2005 for trials.
DIMENSIONS, EXTERNAL:
- Wing span ... 13.72 m (45 ft 0 in)
- Wing aspect ratio ... 8.4
- Length overall ... 16.93 m (55 ft 6½ in)
- Height overall ... 4.70 m (15 ft 5 in)
- Tailplane span ... 6.10 m (20 ft 0 in)
- Tailplane chord (constant) ... 1.02 m (3 ft 4 in)
- Propeller diameter ... 2.44 m (8 ft 0 in)
- Propeller ground clearance ... 0.48 m (1 ft 7 in)
- Crew doors: Height ... 1.22 m (4 ft 0 in)
- Width ... 0.97 m (3 ft 2 in)
- Cargo door: Height ... 1.27 m (4 ft 2 in)
- Width ... 1.27 m (4 ft 2 in)
- Height to sill (all) ... 0.97 m (3 ft 2 in)

DIMENSIONS, INTERNAL:
- Cabin: Length ... 4.83 m (15 ft 10 in)
- Max width ... 1.37 m (4 ft 6 in)
- Max height ... 1.45 m (4 ft 9 in)
- Volume: excl cockpit ... 6.5 m^3 (231 cu ft)
- cockpit ... 0.28 m^3 (10.0 cu ft)
- Pannier volume (optional) ... 1.8 m^3 (63 cu ft)

AREAS:
- Wings, gross ... 22.31 m^2 (240.1 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty ... 1,520 kg (3,350 lb)
- Max cabin baggage weight ... 91 kg (200 lb)
- Max T-O weight ... 2,062 kg (6,750 lb)
- Max ramp weight ... 3,084 kg (6,800 lb)
- Max wing loading ... 137.3 kg/m^2 (28.11 lb/sq ft)
- Max power loading ... 5.48 kg/kW (9.00 lb/shp)

PERFORMANCE (without ventral pod):
- Normal cruising speed ... 190 kt (352 km/h; 219 mph)
- Econ cruising speed ... 185 kt (343 km/h; 213 mph)
- Stalling speed: flaps up ... 78 kt (145 km/h; 90 mph)
- flaps down ... 60 kt (111 km/h; 69 mph)
- Max rate of climb at S/L ... 518 m (1,700 ft)/min
- Max certified altitude ... 7,620 m (25,000 ft)
- T-O run ... 214 m (700 ft)
- Landing run without propeller reversal ... 229 m (750 ft)
- Range at econ cruising speed at FL125, 1 h reserves ... 1,075 n miles (1,990 km; 1,237 miles)
- Endurance (absolute) ... 6 h 50 min

QUIKKIT

RAINBOW FLYERS INC, QUIKKIT DIVISION

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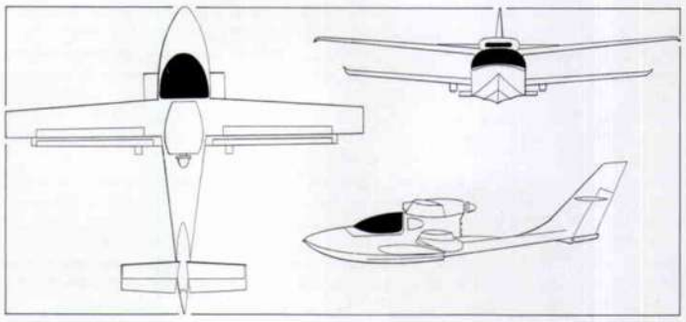
Web: www.glassgoose.com
PRESIDENT: Thomas W Scott
PRODUCTION MANAGER: Robert Giddens

WORKS: Lakeview Airport, Lake Dallas, Texas 75065

Quikkit was initially involved in the production of parts and modification kits for the Aero Composites Sea Hawk; the Glass Goose, while visually similar, is a new design.

Promotion was continuing in 2006.



Quikkit Glass Goose two-seat amphibian ***(Paul Jackson)*** 0084616

QUIKKIT GLASS GOOSE

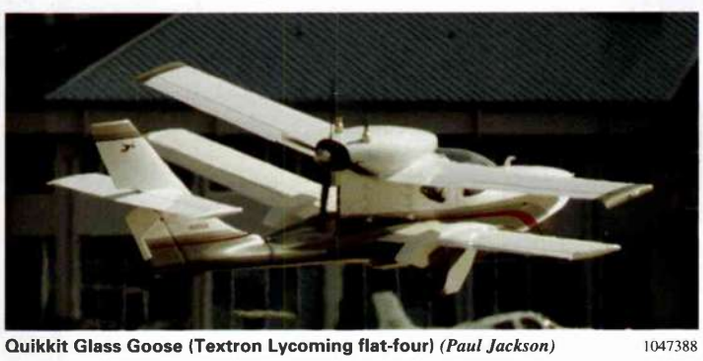
TYPE: Two-seat amphibian kitbuilt.
PROGRAMME: Extensively redesigned Aero Gare Sea Hawk/Aero Composites Sea Hawker, obviating deficiencies of that discontinued aircraft. Modifications initially applied to Tom Scott's Sea Hawker and later marketed for incorporation by other Sea Hawker operators, although no longer available.

Prototype new-build Glass Goose flew 1996, but lost to flaperon flutter. Second prototype, in definitive configuration, first flew (N96GG) 20 March 1999. Production undertaken on Sea Hawker tools and jigs, acquired by Quikkit in 1993.

CUSTOMERS: Total 42 under construction, of which seven flying, by October 2003. At least six others extant by 2000, reflecting Sea Hawk conversions; eight on US Register, October 2005; at least 200 reported under construction in 2006.
COSTS: USD32,500, excluding engine, avionics and equipment; quick-build options add USD13,000 (2006).
DESIGN FEATURES: Pusher, cantilever biplane, with single-step hull, sponsons and underwing pods for retractable main landing gear. Dished upper rear fuselage; mid-mounted tailplane. Wing positive stagger of 20 cm (8 in); upswept lower wingtips; downswept upper wingtips.

Modifications to Sea Hawker design include extended (91 cm; 3 ft 0 in) upper wing span; sponsons of aerofoil section (replacing wingtip floats); and extended pylon chord, with associated fillets, vortex generators and augmentation slots in reshaped cowling to eliminate propeller vibration.

FLYING CONTROLS: Conventional and manual, with drooping ailerons on all wings, max deflection +10/–40°. Actuation by pushrods and cables.
STRUCTURE: Glass fibre, with Kevlar reinforcement. Forward wing spars of glass fibre beam type, with carbon caps, at 27 per cent chord; glass fibre C-type rear spar at 85 per cent chord; glass fibre/foam core sandwich ribs. Pre-moulded flaperons aid construction. Intersecting fuselage bulkheads for additional strength. Quoted build time 1,000 hours.



Quikkit Glass Goose (Textron Lycoming flat-four) ***(Paul Jackson)*** 1047388

LANDING GEAR: Retractable tricycle type for land operation. Two, side-by-side Cheng Shin 11×4.00–5 tyres on each main unit, underside of landing gear stowage pod also being forward-hinged leg/door. Mainwheel brakes.

Rearward retracting, stainless steel, fully castoring nose leg, with 4.00–5 tyre, extends against spring-loaded single door. Electrohydraulic actuation. Ventral rudder, cable operated, for water manoeuvring.

POWER PLANT: One 119 kW (160 hp) Textron Lycoming O-320-B2B flat-four driving a Warp Drive, four-blade, ground-adjustable pitch propeller. Four equal-size, integral fuel tanks in wings (upper pair main; lower pair for long range), total capacity 265 litres (70.0 US gallons; 58.3 Imp gallons). No crossfeed. Optional provision for total of 455 litres (120 US gallons; 100 Imp gallons) involves fuselage tank.
ACCOMMODATION: Two, side by side, with baggage stowage areas behind seats and between lower wings.
DIMENSIONS, EXTERNAL:
- Wing span: upper ... 8.23 m (27 ft 0 in)
- lower ... 7.62 m (25 ft 0 in)
- Wing chord: at root ... 0.84 m (2 ft 9 in)
- at tip ... 0.65 m (2 ft 1½ in)
- Length overall ... 5.94 m (19 ft 6 in)
- Height overall ... 2.29 m (7 ft 6 in)
- Tailplane span ... 2.44 m (8 ft 0 in)

DIMENSIONS, INTERNAL:
- Cockpit max width ... 1.07 m (3 ft 6 in)
- Baggage volume: cockpit ... 0.24 m^3 (8.5 cu ft)
- between wings ... 0.45 m^3 (16.0 cu ft)

AREAS:
- Wings, gross ... 12.17 m^2 (131.0 sq ft)
- Sponsons (lifting) ... 1.44 m^2 (15.50 sq ft)
- Flaperons (total) ... 1.86 m^2 (20.0 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty ... 454 kg (1,000 lb)
- Max T-O weight ... 816 kg (1,800 lb)
- Max wing loading ... 67.1 kg/m^2 (13.74 lb/sq ft)
- Max power loading ... 6.85 kg/kW (11.25 lb/hp)

PERFORMANCE:
- Max level speed ... 139 kt (257 km/h; 160 mph)
- Max cruising speed at 75% power ... 122 kt (225 km/h; 140 mph)
- Stalling speed: flaps up ... 44 kt (81 km/h; 50 mph)
- flaps down ... 37 kt (68 km/h; 42 mph)
- Max rate of climb at S/L ... 366 m (1,200 ft)/min
- Service ceiling ... 3,660 m (12,000 ft)
- T-O run ... 244 m (800 ft)
- Landing run ... 274 m (900 ft)
- Max range, 30 min reserves ... 955 n miles (1,770 km; 1,100 miles)
- *g* limits ... ±9

RANS

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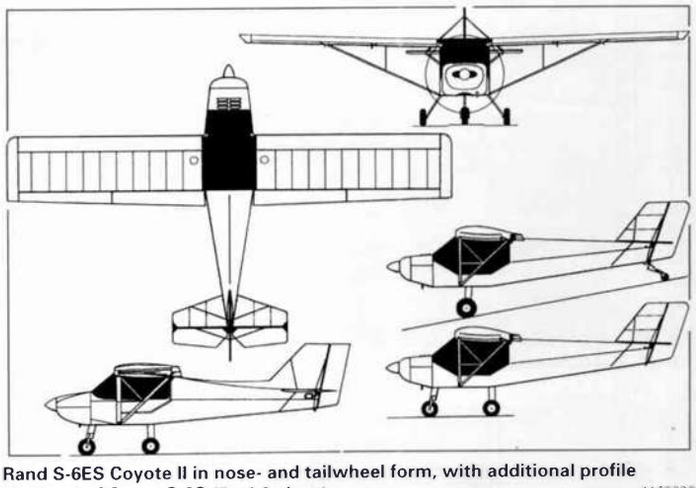
PRESIDENT AND CEO: Randy J Schlitter
VICE-PRESIDENT: Paula Schlitter

Formed in 1974, initially to build sand yachts, Rans was marketing 11 types of aircraft in early 2006, namely S-4/5 Coyote, S-6 Coyote II, S-7 Courier, S-9 Chaos, S-10 Sakota, S-12 Airaile, S-14 Airaile, S-16 Shekari, S-17 Stinger and S-18 Stinger II. At Sun 'n' Fun, Lakeland, Florida, April 2006, S-19 was launched, coincident with announcement of withdrawal of most earlier types with effect from 1 July 2006. S-12XL Airaile was initially included in discontinuations, but rapidly reinstated due to popular demand. Marketing now concentrated on S-6, S-7, S-12 and S-19, while two-stroke engine option also withdrawn and S-7 only available with Sport Wing.

In October 2003, Rans employed 45 at its 4,645 m² (50,000 sq ft) factory. By June 2005, 4,000 kits had been delivered.

In addition, Rans also produces recumbent bicycles.

S-6S version of Rans Coyote displaying doped skin, longer chord fin and partly unglazed door *(Paul Jackson)* 1158024



Rand S-6ES Coyote II in nose- and tailwheel form, with additional profile (bottom) of Super S-6S *(Paul Jackson)* 1158030

RANS S-6 COYOTE II

TYPE: Side-by-side ultralight kitbuilt.

PROGRAMME: First flown November 1988; S-6ES production prototype flew April 1990 and S-6ES TD tailwheel version in October 1990, S-6S flown October 1993 and with improved fuselage in February 1999, Sport Wing flown April 2005 and became standard on all versions in July 2006.

CURRENT VERSIONS: **S-6ES Coyote II**: 'Extended span' versions previously available with Standard (14.42 m²; 155.25 sq ft, constant chord) and '116' (10.78 m²; 116.0 sq ft, cruise speed optimised, forward-swept trailing edge) wings and choice of Rotax 503, 582, 912 and 912 S engines. Current wing based on Standard, but with tapered ailerons and flaps. Pre-sewn, laced Dacron covering. *As described.*

S-6S Super Coyote II: Doped fabric covering; otherwise as S-6ES, although longer fin chord; squared fintips; partly opaque doors.

CUSTOMERS: More than 1,700 sold in some 50 countries by December 2005.

COSTS: Kit S-6ES USD30,850 with Rotax 912 UL or USD32,450 with Rotax 912 ULS; S-6S USD33,075 and USD34,675, respectively; plus tax (2006).

DESIGN FEATURES: High, almost constant-chord wing braced to lower longerons by streamlined V struts and intermediate struts. Sweptback fin and low-mounted tailplane. Optional wing folding. Quoted built time 300 to 500 hours.

FLYING CONTROLS: Conventional and manual. Four-position flaps.

STRUCTURE: Generally of material-covered, blind-riveted and wire-braced aluminium tube with sheet bulkheads and welded 4130 steel cockpit cage. Root rib tension system on wings, ailerons and flaps. Wing main and trailing spars of tubular aluminium, 76 mm (3 in) and 51 mm (2 in), respectively; stamped aluminium ribs and sheet aluminium leading edge. Composites wingtips.

LANDING GEAR: Fixed; nosewheel or tailwheel options. Fuselage-mounted, tapered spring steel cantilever mainwheel legs. Telescoping spring nosewheel, where fitted as alternative to steerable tailwheel.

POWER PLANT: One Rotax flat-four, liquid-cooled piston engine: 59.6 kW (79.9 hp) Rotax 912 UL with 2.27:1 reduction or 73.5 kW (98.6 hp) Rotax 912 ULS with 2.43:1 reduction. Two-or three blade propeller to customer's requirements. Fuel tank in each wing; combined capacity 68 litres (18.0 US gallons; 15.0 Imp gallons).

DIMENSIONS, EXTERNAL:

Wing span	9.27 m (30 ft 5 in)
Wing mean chord	1.37 m (4 ft 6 in)
Wing aspect ratio	6.7
Width, wings folded (wheel outer track)	1.85 m (6 ft 1 in)
Length overall: rigged	6.10 m (20 ft 0 in)
folded	7.34 m (24 ft 1 in)
Height overall: tricycle	2.74 m (9 ft 0 in)
tailwheel	1.83 m (6 ft 0 in)

DIMENSIONS, INTERNAL:

Cockpit max width	1.14 m (3 ft 9 in)

AREAS:

Wings, gross	12.78 m² (137.6 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	295 kg (650 lb)
Max baggage weight	23 kg (50 lb)
Max T-O weight	544 kg (1,200 lb)

PERFORMANCE (Rotax 912 ULS engine and Sport Wing):

Never-exceed speed (VNE)	113 kt (209 km/h; 130 mph)
Normal cruising speed	96 kt (177 km/h; 110 mph)
Stalling speed: flaps up	36 kt (66 km/h; 41 mph)
flaps down	32 kt (58 km/h; 36 mph)
Max rate of climb at S/L	381 m (1,250 ft)/min
Service ceiling	5,335 m (17,500 ft)
T-O run	**64 m (210 ft)**
Landing run	80 m (260 ft)
Range	382 n miles (708 km/h; 440 miles)
Endurance	**4 h 0 min**
g limits	+4/–2

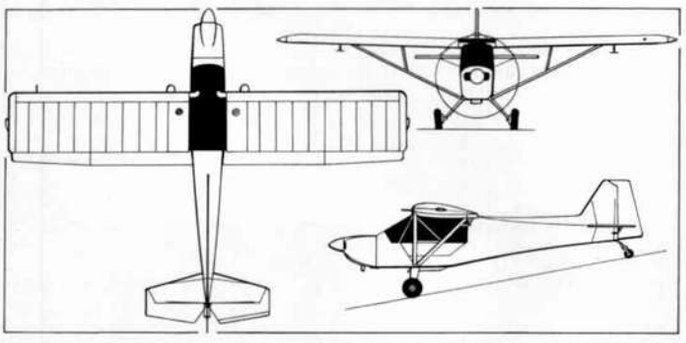
RANS S-7 COURIER

TYPE: Two-seat lightplane; tandem-seat kitbuilt.

PROGRAMME: Prototype first flew November 1985; with Rotax 503 of 34.0 kW (45.6 hp) and 177 kg (390 lb) empty weight; in production from January 1986. Considerably revised S-7S and LS are current versions.

Rans S-6ES Coyote II with Dacron covering 1158023

Rans S-7LS Courier, approved in US LSA category 1158012



Rans S-7LS Courier two-seat factory-built light aircraft *(James Goulding)* 0089516

CURRENT VERSIONS: **S-7:** Original kitbuilt version, superseded by S-7S.

S-7LS: Factory-built version; changes include additional fuselage side stringers, smaller ailerons, larger flaps, taller (15 cm; 6 in) fin and rudder, extended dorsal strake, control surface gap seals, improved low-friction control cable runs, tab for pitch trim, tapered spring steel main landing gear legs with improved fairings, dual calliper brakes, larger baggage compartment and corrosion-proofing as standard. Known until 2005 as S-7C; first flight (N11632; second airframe) 20 December 1996; re-flown March 1999 with Rotax 912 ULS and fuselage stretch. Conforming prototype N2506A flew July 2000. Type certificate awarded 14 September 2001, permitting start to deliveries; however, production was on hold until January 2003, pending definitive Sport Pilot regulations; first S-7LS flew 24 October 2005 and approved as LSA; deliveries began December 2005. *As described.*

S-7S: Kitbuilt version of S-7C, conforming to FAA 51 per cent rule. Kit production began January 2003. LSA compliant as kit.

CUSTOMERS: Total of 396 S-7 kits sold, of which 315 completed by October 2005.

COSTS: S-7LS USD75,000 flyaway; kit USD18,900 or USD37,100 including Rotax 912 ULS engine (2006).

DESIGN FEATURES: High-wing, mid-tailplane configuration with sweptback fin, constant-chord wings and tapered tailplane. Wings braced by A-struts; empennage mutually wire-braced. Wings fold rearwards and tailplanes upwards for stowage; usual rigging/de-rigging time 30 to 45 minutes. Quoted build time for kit version is 500 to 700 hours; quick-build kit version 250 to 300 hours.

NACA 2412 wing section, thickness/chord ratio 14 per cent; dihedral 1°; twist 25°.

FLYING CONTROLS: Conventional and manual. Cable-operated rudder and ailerons, the last-named spade-assisted, and torque tube-operated elevators; trim tab on starboard elevator; cable-operated four-position flaps (0, 8, 16 and 26°).

STRUCTURE: Wings have two tubular 6061-T6 alloy spars, preformed aluminium tube ribs riveted and clipped to spars and sheet alloy leading-edges; fuselage and tail surfaces of welded 4130 steel; glass fibre forward decking and engine cowling. Airframe is fabric-covered.

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted spring tubular steel mainwheel legs with streamlined trouser; steerable, full-swivelling tailwheel; mainwheel size 16×5 (6.00–6 on S-7C), maximum pressure 2.41 bar (35 lb/sq in); tailwheel with solid tyre, size 8×2; Matco/Cleveland wheels with hydraulic brakes. Optional speed fairings on main legs increase cruising speed by 2 to 4 kt (5 to 8 km/h; 3 to 5 mph). Tundra tyres, skis, floats and Aerocet amphibious floats optional.

POWER PLANT: One 59.6 kW (79.9 hp) Rotax 912 UL or one 73.5 kW (98.6 hp) Rotax 912 ULS four-cylinder piston engine in early versions, each with 2.27:1 reduction gear, driving a two-blade, ground-adjustable propeller (Tennessee on 912 UL and Sensenich on 912 ULS). S-7LS and S-7S have Rotax 912 ULS with 2.43:1 reduction gear; driving Sensenich two-blade propeller (wood standard; ground-adjustable, composites, optional). Fuel contained in two wing tanks, combined capacity 68 litres (18.0 US gallons; 15.0 Imp gallons), of which 63 litres (16.75 US gallons; 14.0 Imp gallons) are usable. Oil capacity 2.9 litres (0.75 US gallon; 0.6 Imp gallon); coolant capacity 4.2 litres (1.1 US gallons; 0.9 Imp gallons).

ACCOMMODATION: Pilot and passenger in tandem on fore- and aft-adjustable seats; lap and shoulder harness standard; optional deluxe seats. Dual controls standard. Cabin is heated and ventilated. Upward-hinged door on each side is flight-openable with uplocks; quick-release hinge pins optional. Baggage compartment at rear of cabin.

AVIONICS: To customer's choice; optional Bendix/King or Garmin GPS, VHF com and intercom.

Data follow for S-7LS with Rotax 912 ULS engine.

DIMENSIONS, EXTERNAL:

Wing span	8.92 m (29 ft 3 in)
Wing mean chord	1.52 m (5 ft 0 in)
Wing aspect ratio	5.8
Length overall	7.09 m (23 ft 3 in)
Height overall	1.90 m (6 ft 3 in)
Tailplane span	2.44 m (8 ft 0 in)
Wheel track	1.93 m (6 ft 4 in)
Wheelbase	5.18 m (17 ft 0 in)
Propeller diameter	1.83 m (6 ft 0 in)
Cabin door: Max height	0.97 m (3 ft 2 in)
Max width	1.52 m (5 ft 0 in)
Height to sill	0.81 m (2 ft 8 in)

DIMENSIONS, INTERNAL:

Cabin: Length	1.93 m (6 ft 4 in)
Max width	0.76 m (2 ft 6 in)
Max height	1.07 m (3 ft 6 in)
Floor area	1.11 m^2 (12.00 sq ft)
Volume	1.4 m^3 (48 cu ft)
Baggage compartment volume	0.28 m^3 (10.0 cu ft)

AREAS:

Wings, gross	13.67 m^2 (147.1 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	340 kg (750 lb)
Max T-O weight	559 kg (1,232 lb)
Max baggage weight	23 kg (50 lb)
Max wing loading	40.9 kg/m^2 (8.38 lb/sq ft)
Max power loading	7.60 kg/kW (12.49 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	113 kt (209 km/h; 130 mph)
Cruising speed	96 kt (177 km/h; 110 mph)
Stalling speed: flaps up	44 kt (81 km/h; 50 mph)
flaps down	40 kt (73 km/h; 45 mph)
Max rate of climb at S/L	259 m (850 ft)/min
Service ceiling	4,420 m (14,500 ft)
T-O run	99 m (325 ft)
Landing run	104 m (340 ft)
Range	296 n miles (548 km; 341 miles)
Endurance	3 h 25 min
g limits	+4/–2

RANS S-12XL AIRAILE

TYPE: Side-by-side ultralight kitbuilt.

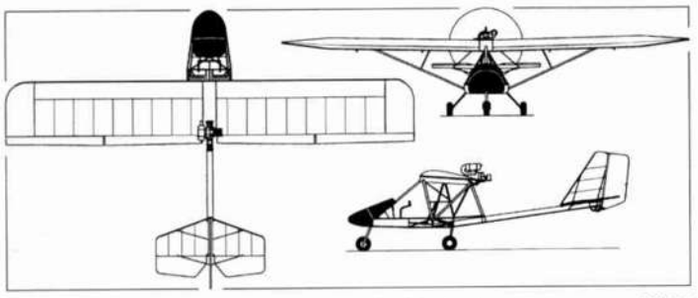
PROGRAMME: Basic S-12 first flown March 1990. Improved S-12XL (N8045X) first flown March 1995; made its debut at Sun 'n' Fun in Lakeland, Florida, April 1995. S-12S first flown January 1999. Rans announced discontinuation of S-12 family in 2006, but almost immediately reinstated S-12XL.

CUSTOMERS: 991 S-12s (all models) ordered by October 2005, of which 910 flying.

COSTS: Airframe kit, less engine, but with equipment appropriate to proposed installation, USD15,000 to USD17,200, according to Rotax type (2006). Quick-build options also available.

DESIGN FEATURES: Pod and boom fuselage; V-strut-braced wings; wire-braced tail surfaces; wings fold rearwards and tailplanes upwards for storage. Quoted build time 175 to 225 hours; or 325 to 500 hours with full enclosure cockpit. (Extra 200 hours for S-12S.)

Rans S-12XL Airaile in traditional, open configuration 1158437



Rans S-12XL Airaile general arrangement *(Paul Jackson)* 1158445

FLYING CONTROLS: Conventional and manual. Cable-operated; ground-adjustable flaps primarily used for setting best trim, but can also be lowered for landing; tailplane incidence is ground-adjustable. Dual controls standard.

STRUCTURE: Welded steel tube cockpit cage; aluminium alloy tubular tailboom; wings have two tubular alloy spars and preformed ribs; ailerons, flaps and tail surfaces of alloy tube with stamped alloy or moulded ABS ribs; option of Dacron or doped fabric covering.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted tubular spring steel cantilever mainwheel legs (with streamlined trouser on S-12S); with small tailwheel/bumper; spring-loaded telescoping nose leg; pedal-operated hydraulic brakes on mainwheels; steerable nosewheel. All wheels 15 cm (6 in) aluminium on S-12XL and 13 cm (5 in) on S-12S. Optional spats, tundra tyres and Puddle Jumper floats.

POWER PLANT: One air-cooled 34.0 kW (45.6 hp) Rotax 503 or liquid-cooled 47.8 kW (64.1 hp) Rotax 582 two-cylinder engine with 2.58:1 reduction gear, or 59.6 kW (79.9 hp) Rotax 912 or 73.5 kW (98.6 hp) Rotax 912 ULS flat-fours with 2.27:1 reduction gear, driving a two-blade Tennessee wooden propeller; three-blade Warp Drive propeller optional; electric start optional on 503 and 582, standard on 912. Version with 48.5 kW (65 hp) Hirth 2706 two-cylinder two-stroke is available in Germany. Fuel in single wing tank, maximum capacity 34 litres (9.0 US gallons; 7.5 Imp gallons); dual tanks optional, (standard in S-12S) combined capacity 68 litres (18.0 US gallons; 15.0 Imp gallons).

ACCOMMODATION: Pilot and passenger side by side in open cockpit; transparent mini pod fairing standard; optional partial- and full-enclosure cockpits provide increased leg, shoulder and head room and lower noise levels and, combined with flow fences attached to fuselage pod and boom, raise cruising speed.

DIMENSIONS, EXTERNAL:

Wing span	9.45 m (31 ft 0 in)
Length overall	6.25 m (20 ft 6 in)
Height overall	2.36 m (7 ft 9 in)
Propeller diameter:	
S-12XL	1.73 to 1.83 m (5 ft 8 in to 6 ft 0 in)
S-12S	1.73 m (5 ft 8 in)

AREAS:

Wings, gross	14.12 m² (152.0 sq ft)

WEIGHTS AND LOADINGS (A: S-12XL with Rotax 912 UL, B: S-12S with Rotax 912 ULS):

Weight empty: A	261 kg (575 lb)
B	295 kg (650 lb)
Max T-O weight: A	499 kg (1,100 lb)
B	521 kg (1,150 lb)

PERFORMANCE (A and B as above):

Never-exceed speed (VNE): A	87 kt (161 km/h; 100 mph)
B	104 kt (193 km/h; 120 mph)
Cruising speed: A	74 kt (137 km/h; 85 mph)
B	87 kt (161 km/h; 100 mph)[1]
Stalling speed, flaps down: A, B	31 kt (57 km/h; 35 mph)
Max rate of climb at S/L: A	274 m (900 ft)/min
B	366 m (1,200 ft)/min
T-O run: A	87 m (285 ft)
B	81 m (265 ft)
Landing run: A, B	61 m (200 ft)
Range: A	325 n miles (601 km; 374 miles)
B	312 n miles (579 km; 360 miles)
Endurance: A	4 h 24 min
B	3 h 54 min

[1] *With cockpit and wheel fairings*

RANS S-19

TYPE: Two-seat kitbuilt.

PROGRAMME: Announced at Sun 'n' Fun, April 2006 when two years into development.

COSTS: Kit USD37,800, including engine and engine instruments (2006).

DESIGN FEATURES: Similar to earlier S-16 Shekari. Low wing and tailplane, both of constant chord with rounded tips. Sweptback fin. Conforms to US LSA-E criteria. Wings and stabilator detachable for storage.

FLYING CONTROLS: Manual. All-moving stabilator with anti-balance tab. Mass-balanced rudder. Flaps. Ailerons and stabilator actuated by pushrods; rudder by cables.

STRUCTURE: Generally of riveted aluminium, with composites wing- and empennage tips, engine cowling and wingroot fairings.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted, aluminium cantilever spring mainwheel legs. Steerable nosewheel. Matco wheels (W-51) and hydraulic brakes; all tyres 5.00-5. Optional wheel fairings.

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS liquid-cooled flat-four driving a Sensenich two-blade, ground-adjustable pitch propeller via 1:2.43 reduction gear. Composites fuel tank in each wing; combined capacity 91 litres (24.0 US gallons; 20.0 Imp gallons).

ACCOMMODATION: Two, side by side. Fixed windscreen and rearward-sliding canopy. Dual controls. Baggage area behind seats.

DIMENSIONS, EXTERNAL:

Wing span	8.53 m (28 ft 0 in)
Wing chord constant	1.40 m (4 ft 7 in)
Wing aspect ratio	6.2
Height overall	2.43 m (7 ft 11½ in)
Propeller diameter	1.73 m (5 ft 8 in)

DIMENSIONS, INTERNAL:

Cockpit max width	1.10 m (3 ft 7½ in)

AREAS:

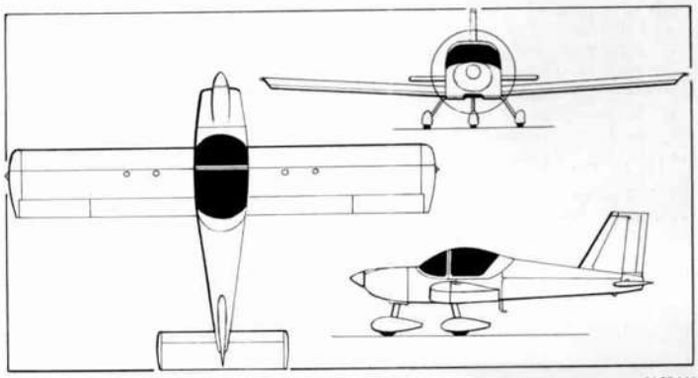
Wings, gross	11.79 m² (126.9 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	340 kg (750 lb)
Max baggage weight	32 kg (70 lb)
Max T-O weight	598 kg (1,320 lb)
Max wing loading	50.8 kg/m² (10.40 lb/sq ft)
Max power loading	8.15 kg/kW (13.38 lb/hp)

PERFORMANCE (estimated):

Never-exceed speed (VNE)	130 kt (241 km/h; 150 mph)
Cruising speed at 75% power at FL75	111 kt (206 km/h; 128 mph)
Stalling speed: flaps up	45 kt (83 km/h; 51 mph)
flaps down	40 kt (73 km/h; 45 mph)
Max rate of climb at S/L	274 m (900 ft)/min
Service ceiling	4,420 m (14,500 ft)
T-O and landing run	100 m (325 ft)
Range at 65% power at FL75	530 n miles (981 km; 610 miles)
Endurance at 65% power	5 h 6 min
g limits	+4.4/–2.0



Rans S-19 two-seat lightplane *(James Goulding)* 1158441

RAYTHEON

RAYTHEON AIRCRAFT COMPANY

Among the divisions and subsidiaries of this major aerospace/defence contractor are Raytheon Aircraft Company and Raytheon Systems Limited.

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Randy Groom (Global Customer Service and Support)
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James B Smith (Government Business)

Refer to **Beechcraft** and **Hawker** entries for aircraft descriptions.

Raytheon Aircraft Company (RAC) formed 15 September 1994, combining Raytheon Company subsidiaries Beech Aircraft Corporation and Raytheon Corporate Jets Inc. Raytheon acquired British Aerospace's Corporate Jets division 6 August 1993. RAC builds civil and military aircraft, and components; Salina division supplies wings for most models, non-metallic interior components, ventral fins, nosecones and tailcones.

Final assembly of Hawkers transferred from UK to new 41,800 m² (450,000 sq ft) plant at Wichita beginning last quarter of 1995 and finalised by April 1997, when last UK-built Hawker was completed; 17,745 m² (191,000 sq ft) Training Systems Division plant added for Texan II assembly line. Little Rock continues to provide custom interiors, avionics, sales and customer support services for Hawker models and aircraft painting services for Hawkers. Beech and Hawker product names are retained and separate Beechcraft and Hawker divisions

were established in mid-2002 for marketing purposes, Raytheon title having been dropped from aircraft designations.

Wholly owned subsidiaries include Raytheon Aircraft Credit Corporation Inc (business aircraft retail financing and leasing); Travel Air Insurance Company Ltd (aircraft liability insurance); Raytheon Aircraft Services network of fixed-base operations; Raytheon Travel Air, formed in 1997, which offers fractional ownership; and Raytheon Aircraft Charter and Management, which offers aircraft charter and full-service management.

In 2005 RAC had 8,000 employees worldwide and occupied 650,321 m^2 (7,000,000 sq ft) of plant area.

On 21 December 2006 Raytheon Company announced that it had signed an agreement to sell Raytheon Aircraft Company to Hawker Beechcraft Corporation, a new company formed by GS Capital Partners, an affiliate of Goldman Sachs and Onex Partners, for USD3.3 billion. The sale, which was expected to be concluded during the first half of 2007, includes RAC facilities and other assets in Kansas, Arkansas and Texas as well as its fixed-base operations in the UK, US and Mexico.

RAYTHEON SENTINEL

RAF designation: Sentinel R. Mk 1

TYPE: Airborne ground surveillance system.

PROGRAMME: On 15 June 1999 Raytheon Systems Limited was chosen as the preferred bidder for the UK Ministry of Defence's Airborne Stand-Off Radar (ASTOR) programme, for which five Global Express airframes are being modified by Bombardier's Belfast division to provide the airborne platform for radar and communications systems. Contract value GBP800 million (1999). Preliminary Design Review (PDR) scheduled for completion in March 2001; 200-hour flight test programme of an aerodynamically representative airframe, modified from Global Express prototype C-FBGX, began on 3 August 2001, leading to Critical Design Review (CDR) and design freeze in fourth quarter 2002. Height is 7.95 m (26 ft 1 in) due to extension of fintip, other dimensions being as for Global Express. Known as ASTOR until 'Sentinel' name assigned June 2003.

First production airframe (C-GJRG/ZJ690) delivered 7 February 2002 to Raytheon Systems Limited at Greenville, Texas, for airframe modification and systems integration. First flight in Sentinel configuration 26 May 2004; intended radar equipment seriously damaged during bench testing in August 2004; new radar eventually installed at Greenville by June 2005, at which time all other airframe trials had been completed. Second production airframe (C-FZVM/ZJ691) delivered to Hawarden, UK, on 29 January 2003. First flight in Sentinel configuration 25 July 2005; repainted grey in August 2005; to US for trials. Third and fourth airframes (C-FZWW/ZJ692 and C-FZXC/ZJ693) delivered Hawarden 16 January 2004. Of these, ZJ692 completed March 2006, painted grey April 2006 and used for RAF pilot training at Hawarden; type's public debut at RAF Waddington air show 1 to 2 July 2006; radar installed; exhibited at Farnborough 17 to 23 July 2006.

Fifth airframe (C-FZYL/ZJ694) used for No. 5 Squadron familiarisation, flying from Hawarden still as unpainted Global Express; initial sortie, on 11 May 2005, visiting Waddington. Transferred to conversion line.

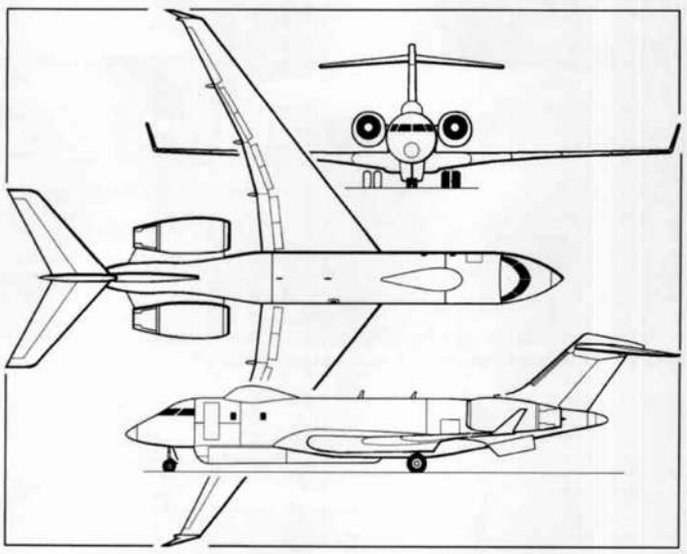
In-service date originally fixed for September 2005, with aircraft based at RAF Waddington, Lincolnshire, and operated by No. 5 Squadron, which re-formed on 1 April 2004. This not achieved; first delivery re-scheduled for October 2006, although full operational capability target remains 2007. Final delivery to RAF due in 2007.

Detailed description in *Jane's Electronic Mission Aircraft*; brief details follow:

UK Air Staff Requirement (ASR) 925 for Airborne Stand-Off Radar (ASTOR) platform is designed to provide near real-time radar intelligence in support of air/land and/or tri-service operations; includes the following requirements:

- carriage of a combined Ground Moving Target Indicator (GMTI)/Synthetic Aperture Radar (SAR) as the platform's primary surveillance sensor. ASARS-2 Plus radar installed
- a communications suite that incorporates a satellite communications subsystem, an air-to-air datalink (Link 16 standard - see following), 8 to 12.5 GHz and 12.5 to 18 GHz band primary imagery datalinks and secure, two-way radios for air-to-ground and air-to-air voice traffic
- an operating altitude of between 12,800 m (42,000 ft) and 15,545 m (51,000 ft)
- a maximum surveillance range of between 134 and at least 160 n miles (250 to 296 km; 154 to 184 miles)
- SAR swath and spotlight (0.5 m resolution) operating modes
- a GMTI facility that is capable of tracking ground targets moving at speeds of less than 7 kt (10 km/h; 6 mph)
- the ability to detect and track in-flight helicopters
- interleaved (but not concurrent) radar operating modes
- the ability to operate 'off-tether' from the air vehicle's associated ground stations
- the ability to process acquired data in real- or near real-time
- interoperability with non-national surveillance systems.

Sentinel R Mk 1 is externally characterised by a dorsal satellite communications antenna radome; a ventral 'canoe' fairing (housing the platform's radar and datalink antennas); a pair of stabilising fins beneath its rear fuselage; an extended fairing (housing the aircraft's aft-facing RWR antenna heads at the junction of its vertical and horizontal tail surfaces; missile warning system sensor units on each side of its tailcone; provision for a countermeasures dispensing system (CMDS) on the sides of its rear fuselage; and a ventral towed decoy launcher aft of its wing trailing-edges. Provision is made for a flight crew of two, three system operators (two image analysts and a mission controller) and (possibly) two relief operators. The platform is intended to have an unrefuelled flight duration of up to 11 hours.



Raytheon Sentinel R. Mk 1 airborne surveillance platform *(Paul Jackson)*

1159123

Aside from the radar, other onboard equipment includes:

- a BAE Systems managed Defensive Aids Group (DAG) that incorporates a BAE Systems AN/ALR-56M RWR, the BAE Systems' AN/AAR-57(V) missile warning system, the Thales Aerospace Division's Shrike techniques generator, a variant of Raytheon's AN/ALE-50(V) advanced airborne expendable decoy and a CMDS (thought to be the Thales Optronics' Vicon 78 Series 455 equipment). DAG management is by means of a Radstone embedded defensive aids suite manager
- a re-ducted baseline cooling system together with liquid cooling provision for the radar sensor
- Mercury Computer Systems RACE++ embedded, real-time, digital signal/image processing computers (for use in the ASTOR DMR)
- a mission communications suite that includes:
- a Logica Joint Tactical Information Distribution System (JTIDS/Link 16 host processor
- a Cubic/Ultra Electronics Narrowband DataLink Subsystem (NDLS - based on the Cubic Surveillance and Control DataLink that is used aboard the E-8 Joint STARS aircraft)
- L-3 Communications-sourced wide-band datalinks and Super High-Frequency—likely to be the company's X-band airborne system—satellite communications terminals
- Very/Ultra High-Frequency band voice radios
- an avionics fit that is based on the Honeywell Primus 2000XP integrated cockpit equipment package, as installed aboard the baseline Global Express aircraft. Here, the system incorporates 'minor changes' to the baseline architecture together with V/UHF band radios for air traffic control purposes
- Sun Microsystems operator workstations.

Interior layout includes (from nose to tail): a two-man flight deck; a crew rest area (incorporating a galley, lavatory and two rest seats); three operator consoles (located to port) and a rear cabin electronics bay with a total of six equipment racks.

Sentinels are supported by a General Dynamics Decision Systems-managed ground station architecture and a Raytheon-managed support package. In the first instance, a total of eight ground stations are divided into transportable Operational Level (OLGS) and Tactical (TGS) formats. Of the eight, two are configured to OLGS standard, with the complete OLGS package comprising:

- two, 7 m long, shelter-mounted communications modules
- five, 7 m long, shelter-mounted workstation modules
- two deployable Broadcast Mode DataLink (BMDL) antenna units
- two trailer-mounted linking/datalink modules
- seven trailer-mounted generator modules
- four remote terminals.

Raytheon ASARS-2 Plus is a dual-mode radar developed from equipment used in the Lockheed U-2S surveillance aircraft. Aboard the Sentinel R. Mk 1, the architecture is understood to incorporate the USAF's latest standard ASARS-2 receiver/exciter, an upgraded processor and a combined mechanical/electronic scanning antenna array. Alongside Raytheon, the Sentinel dual-mode radar effort is believed to involve UK contractors BAE Systems (radar antenna gimbal controls and radomes) and QinetiQ (processing algorithms).

Second UK-converted Raytheon Sentinel R. Mk 1

1159192

ROBINSON

ROBINSON HELICOPTER COMPANY

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Web: www.robinsonheli.com
PRESIDENT: Franklin D Robinson
VICE-PRESIDENTS:
Kurt Robinson (Product Support)
Wayne Walden (Production)
MARKETING DIRECTOR: Tim Goetz

By March 2004, Robinson had produced 5,283 helicopters, including 390 in 2000, 328 in 2001, 255 in 2002, 422 in 2003, 690 in 2004, and 806 in 2005. 6,000th production helicopter, an R44 Raven II delivered in April 2005. 4,000th production R22 delivered in December 2005. Production rate 15 helicopters per week in 2004. Factory floor area 44,130 m^2 (475,000 sq ft). Workforce 1,150 in November 2006. Company is ISO 9001 certified.

ROBINSON R22 BETA II

TYPE: Two-seat helicopter.

PROGRAMME: Design began 1973; first flight 28 August 1975; first flight of second R22 early 1977; FAA certification 16 March 1979; UK certification June 1981; Japanese certification 18 November 2002; deliveries began October 1979; early versions were R22 (O-320-A2B engine; 199 built) and R22HP (O-320-B2C; 151 built), both with 621 kg (1,300 lb) max T-O weight. R22 Alpha (O-320-B2C and 621 kg; 1,370 lb MTOW) certified October 1983 (further 151 built); R22 Beta certified 5 August 1985. Current Beta II introduced in 1995. More powerful Textron Lycoming O-360 engine provides better high-level hover performance and allows take-off power to be sustained up to 2,285 m (7,500 ft). Previously optional, tinted windscreen and door windows fitted as standard. Production began at c/n 2571 in 1995.

CUSTOMERS: Total production 4,100 by September 2006. 3,000th handed over 15 October 1999; 4,000th in late December 2005 to Heliflite Australia; deliveries in 1999 totalled 128, followed by 126 in 2000, 134 in 2001, 107 in 2002, 128 in 2003, 234 in 2004, and 243 in 2005.

COSTS: USD209,800 for basic R22 Beta II (2006). Direct operating cost USD44.10 per hour; total cost (500 hours annually) USD101.83 per hour (2006).

DESIGN FEATURES: Simple, pod-and-boom light helicopter; horizontal stabiliser, starboard side only; vertical stabiliser above and below boom; offset to starboard; tall rotor mast. Horizontally mounted piston engine drives transmission through multiple V belts and sprag-type overrunning clutch; main and tail gearboxes use spiral bevel gears; maintenance-free flexible couplings of proprietary manufacture used in both main and tail rotor drives. two-blade semi-articulated main rotor, with tri-hinged underslung rotor head to reduce blade flexing, rotor vibration and control force feedback, and an elastic teeter hinge stop to prevent blade-boom contact when starting or stopping rotor in high winds; blade section NACA 63-015 (modified); two-blade tail rotor on port side; rotor brake standard.

FLYING CONTROLS: Manual. Removable dual controls standard; piston-grip type cyclic controls.

STRUCTURE: All-metal bonded blades with stainless steel spar and leading-edge, light alloy skin and light alloy honeycomb filling; frame section of steel tube with light alloy skinning; full monocoque light alloy tailboom.

LANDING GEAR: Welded steel tube and light alloy skid landing gear, with energy-absorbing crosstubes.

POWER PLANT: One Textron Lycoming O-360 flat-four engine, derated to 97.5 kW (131 hp), mounted in the lower rear section of the main fuselage, with cooling fan. Light alloy main fuel tank in upper rear section of the fuselage on port side, usable capacity 72.5 litres (19.2 US gallons; 16.0 Imp gallons). Optional auxiliary fuel tank, capacity 39.75 litres (10.5 US gallons; 8.7 Imp gallons). Oil capacity 5.7 litres (1.5 US gallons; 1.25 Imp gallons). Transmission overhaul interval 2,200 hours or 12 years.

ACCOMMODATION: Two seats side by side in enclosed cabin, with inertia reel shoulder harness. Curved two-panel, tinted windscreen. Removable door, with tinted window, on each side. Baggage space beneath each seat. Cabin heated and ventilated.

SYSTEMS: Electrical system, powered by 12 V DC alternator, includes navigation, panel and map lights, dual landing lights, anti-collision light and battery.

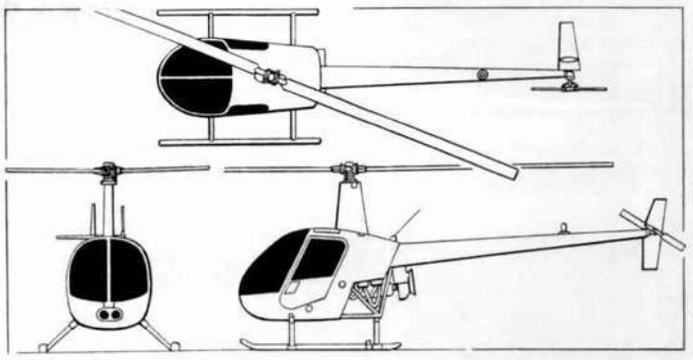
AVIONICS: *Comms:* Bendix/King KY 197A VHF com radio; KT 76C transponder with Mode C altitude encoder; and NAT AA 80 intercom system with floor and hand switches. Options include Garmin 430 GPS/COM/VOR/LOC/GS with 106A CDI, replacing KY 197A; Pointer 3000–10 or 4000–10 (Canadian spec) ELT; NAT AA 12 intercom controller; and David Clark H10-13H or Bose Series X headsets.

Flight: Garmin 150XL, 250XL and 400 GPS optional.

Instrumentation: Standard equipment includes ASI; VSI; rotor/engine dual tachometer; sensitive altimeter; magnetic compass; digital OAT gauge; CHT gauge; oil temperature and pressure gauges; ammeter; hours meter; manifold pressure gauge; quartz clock; and warning lights for low voltage, low oil pressure, low fuel, low rotor rpm and horn, main gearbox temperature, main and tail rotor gearbox chips, starter engaged, and rotor brake engaged.

Optional instruments include BFG (AIM) 1100 artificial horizon with/without slip indicator; BFG (AIM) 205-1A DG; turn co-ordinator; PAI-700 vertical compass (replaces standard compass); United Instruments IVSI (replaces standard VSI); LC-2 digital clock (replaces standard clock); and Millibar altimeter.

Robinson R22 Beta used for pilot training *(Paul Jackson)* 1158594



Robinson R22 Beta II two-seat helicopter *(James Goulding)* 1158556

EQUIPMENT: Standard equipment includes rotor brake; tinted windscreen and windows; belly hardpoint; dual landing lights; navigation, panel and map lights; anti-collision light; ground handling wheels; rotor blade tiedowns; and windscreen cover.

Optional equipment includes three-cylinder engine priming system; RHC oil filter; cabin heater/defogger; metallic base or trim exterior colours; and leather seats.

DIMENSIONS, EXTERNAL:

Main rotor diameter	7.67 m (25 ft 2 in)
Tail rotor diameter	1.07 m (3 ft 6 in)
Main rotor blade chord	0.18 m (7¼ in)
Distance between rotor centres	4.39 m (14 ft 5 in)
Length overall, rotors turning	8.76 m (28 ft 9 in)
Fuselage: Length	6.30 m (20 ft 8 in)
Max width	1.12 m (3 ft 8 in)
Height: overall	2.72 m (8 ft 11 in)
to top of cabin	1.75 m (5 ft 9 in)
Skid track	1.93 m (6 ft 4 in)

DIMENSIONS, INTERNAL:

Cabin max width	1.12 m (3 ft 8 in)

AREAS:

Main rotor blades (each)	0.70 m^2 (7.55 sq ft)
Tail rotor blades (each)	0.04 m^2 (0.40 sq ft)
Main rotor disc	46.21 m^2 (497.4 sq ft)
Tail rotor disc	0.89 m^2 (9.63 sq ft)
Fin	0.21 m^2 (2.28 sq ft)
Stabiliser	0.14 m^2 (1.53 sq ft)

WEIGHTS AND LOADINGS:

Weight empty (without auxiliary fuel tank)	388 kg (855 lb)
Fuel weight: standard	52 kg (115 lb)
auxiliary	28.6 kg (63 lb)
Max T-O and landing weight	621 kg (1,370 lb)
Max disc loading	13.4 kg/m^2 (2.75 lb/sq ft)
Max power loading at T-O	6.37 kg/kW (10.46 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE):	
without sling load	102 kt (190 km/h; 118 mph)
with sling load	75 kt (139 km/h; 86 mph)
Max level speed	97 kt (180 km/h; 112 mph)
Cruising speed at 70% power at FL80	96 kt (177 km/h; 110 mph)
Econ cruising speed	82 kt (153 km/h; 95 mph)
Max rate of climb at S/L	more than 305 m (1,000 ft)/min
Rate of climb at FL100	more than 183 m (600 ft)/min
Service ceiling	4,265 m (14,000 ft)
Hovering ceiling IGE	2,865 m (9,400 ft)
Range with max payload, no reserves:	
normal fuel	more than 173 n miles (321 km; 200 miles)
max fuel	more than 260 n miles (482 km; 300 miles)
Endurance at 65% power, auxiliary fuel, no reserves	3 h 20 min

ROBINSON R44

TYPE: Four-seat helicopter.

PROGRAMME: Development began 1986; first flight (N44RH) 31 March 1990; first flight of third R44 March 1992; marketing began 22 March 1992; certification completed 10 December 1992. In August 1997 an R44 became first piston helicopter flown around the world. In June 2002 an R44 Raven (G-NUDE) became the first piston-engined helicopter to land at the North Pole. Japanese certification achieved 18 November 2002.

CURRENT VERSIONS: **R44 Astro:** Initial version; no longer produced.

R44 Raven I: Basic version, introduced in April 2000 to replace Astro; features 194 kW (260 hp) Textron Lycoming O-540 engine derated to 168 kW (225 hp) at T-O, 153 kW (205 hp) continuous; hydraulic control system standard; plus elastomeric tail rotor bearings and adjustable pedals for pilot.

R44 Raven II: Upgraded version introduced in June 2002. FAA certification 10 October 2002; first deliveries November 2002. Features a Textron Lycoming IO-540 engine, 28 V 70 A electrical system, increased lifting area on main rotor blades, and aerodynamic tip caps on main and tail rotor blades. Total of 580 ordered and 390 delivered by May 2004, including two ENG variants. *As described.*

R44 Clipper II: Float-equipped version, initially certified (as R44 Clipper) 17 July 1996. Available with twin utility floats or pop-out floats.Total of 141 Clippers sold by 1 June 2001.

R44 Police Helicopter: Specially modified Raven II for law enforcement, with Inframetrics 445G Mk II IR sensor, TV camera and ×7 zoom lens mounted in gyrostabilised nose turret; LCD video monitor; Spectrolab SX-5E 15 to 20 million candlepower searchlight; FM radio package; bubble door windows; Bendix/King KFM 985 dual-band transceiver, KY 196A VHF, II Morrow Apollo SL-60 standby comms, KT 76C transponder, 28 V electrical system and extended landing gear struts. Empty weight, equipped, approx 715 kg (1,570 lb). Optional equipment, available from October 2005, includes GPS moving map system which features a Stealth personal computer, custom keyboard, moving map software and Transvideo fold-down monitor for GPS and FLIR displays. By typing in an address the operator can call up a road map of the selected location with direction, distance and estimated time of arrival displayed on-screen. First delivery of an R44 Police Helicopter

Robinson R44 four-seat, piston-engined helicopter *(Paul Jackson)* 1158598

Robinson R44 Raven II light helicopter *(Mike Keep)* 0507289

equipped with the system took place in February 2006 to Silver State Helicopters of Texas for use in their Sheriff Airborne Law Enforcement (SABLE) programme. Certified July 1997; first customer El Monte Police Agency of Los Angeles. Recent customers include the Estonian Air Force, which ordered two in February 2002 for delivery commencing May 2002. China's Zheng Zhou Public Security Bureau, which took delivery of one in June 2002 following its appearance at the China Expo 2002 exhibition, Fontana Police Department, California, which took delivery of one in October 2003, and Merced County Sheriff's Department, California, which took delivery of one in November 2003, and the National Police of El Salvador, which took delivery of one on 25 June 2004.

R44 Newscopter: Digital electronic news gathering (ENG) version of Raven II intended for media companies and fitted with Ikegami HL-59WNA digital camera with ×21 lens and 360° continuous rotation with five-axis gyro stabilisation; and microwave transmitter; four video monitors, two micro cameras, KY 196A VHF, KT 76C transponder (Mode C), GPS, two FM radios and bubble window in port door. Deliveries began January 1998; 29 sold by 1 June 2002. First digital ENG Raven II delivered on 9 February 2003 to Sky Helicopters of Garland, Texas, and was the 30th ENG Newscopter delivered. Other customers include flying TV Ltd of the UK, which took delivery of one (G-PIXX) in May 2004.

R44 IFR: Equipped for IFR helicopter training IFR package adds US$27,200 to standard cost. 18 Sold by 1 June 2001.

CUSTOMERS: Total of 3,000 delivered by 18 September 2006. Deliveries totalled 150 in 1999, 264 in 2000, 194 in 2001, 294 in 2003, 456 in 2004, and 563 in 2005. 3,000th R44 delivered 18 September 2006 to Segrave Aviation of North Carolina for customer Chris Bond. 6,000th Robinson helicopter delivered was an R44 Raven II (C-FDQG) for Airborne Energy Solutions of Alberta, Canada, in April 2005. Recent customers include the Lebanese Army, which took delivery of four Raven IIs in 2005. City of San Bernardino Police, California, which took delivery of an R44 Police Helicopter in September 2006, and the Republic of Kazakhstan, which took delivery of an R44 Raven II on 14 December 2006 for police support work in the nation's capital, Astana.

COSTS: Raven I USD307,000, Raven II USD364,000. Clipper II with utility floats USD381,000, Clipper II with pop-out floats USD387,000, R44 Police Helicopter USD535,000, R44 Newscopter USD579,000 (all 2006). Direct operating cost USD72.60 per hour; total (500 hours annually) USD161.33 per hour (both 2006). IFR avionics USD35,480 extra.

DESIGN FEATURES: New design, incorporating general configuration (but larger cabin) and some proven concepts of R22; designed to requirements of FAR Pt 27; features for comfort and safety include electronic throttle governor to reduce pilot workload by controlling rotor and engine rpm during normal operations, rotor brake, advanced warning devices, automatic clutch engagement to simplify and reduce start-up procedure and reduce chance of overspeed, T-bar pistol grip cyclic control, and crashworthy features including energy-absorbing landing gear and lap/shoulder strap restraints designed for high forward *g* loads. High reliability and low maintenance; patented rotor design with tri-hinge (see R22); low noise levels.

FLYING CONTROLS: Conventional, with Robinson central cyclic stick; rpm governor; rotor brake standard; left-hand collective lever and pedals removable.

LANDING GEAR: Fixed skids; or, on R44 Clipper II, twin utility floats, or pop-out helium floats, which inflate in 2 seconds.

POWER PLANT: One 224 kW (300 hp) Textron Lycoming IO-540 AE1A5 flat-six engine, derated to 183 kW (245 hp) for 5 minutes, 153 kW (205 hp) maximum continuous. Standard fuel capacity 116 litres (30.6 US gallons; 25.5 Imp gallons) in tank on port side; optional 69 litres (18.3 US gallons; 15.2 Imp gallons) in starboard tank. No transmission limit; transmission TBO 2,200 hours or 12 years.

ACCOMMODATION: Four persons seated 2 + 2. Baggage stowage beneath each seat. Dual controls. Cabin heated and ventilated. Tinted windscreen and door windows.

AVIONICS: *Comms:* Bendix/King KY 196A VHF radio; KT 76C transponder with Mode C altitude encoder; and NAT AA 80 intercom system with floor and hand switches. Options include Garmin 420 GPS/COM; Garmin 430 GPS/COM/VOR/LOC/GS with 106A CDI; Pointer 3000–10 or 4000–10 (Canadian spec) ELT; NAT AA 12 intercom controller; and David Clark H10-13H or Bose Series X headsets.

Flight: Garmin 150XL, and 400 GPS optional.

Instrumentation: Standard equipment includes ASI; VSI; rotor/engine dual tachometer; sensitive altimeter; magnetic compass; digital OAT gauge; CHT gauge; oil temperature and pressure gauges; ammeter; hours meter; manifold pressure gauge; quartz clock; and warning lights for low voltage, low oil pressure, low fuel, low rotor rpm and horn, main gearbox temperature, main and tail rotor gearbox chips, starter engaged, and rotor brake engaged.

Optional instruments include 'heads-up' side console for GPS display; BFG (AIM) 1100 artificial horizon with/without slip indicator; BFG (AIM) 205-1A DG; turn co-ordinator; PAI-700 vertical compass (replaces standard compass); United Instruments IVSI (replaces standard VSI); LC-2 digital clock (replaces standard clock); and millibar altimeter.

EQUIPMENT: Standard equipment includes rotor brake; tinted windscreen and windows; belly hardpoint; dual landing lights; navigation, panel and map lights; anti-collision light; ground handling wheels; tow cart adapter, rotor blade tie-downs; and windscreen cover. Optional equipment includes three-cylinder engine priming system; RHC oil filter; observation bubble windows; cabin heater/defogger; metallic base or trim exterior colours; and leather seats.

DIMENSIONS, EXTERNAL:

Main rotor diameter	10.06 m (33 ft 0 in)
Tail rotor diameter	1.47 m (4 ft 10 in)
Length overall, rotors turning	11.76 m (38 ft 7 in)
Fuselage: Length	9.07 m (29 ft 9 in)
Max width	1.28 m (4 ft 2½ in)
Height: overall	3.28 m (10 ft 9 in)
to top of cabin	1.83 m (6 ft 0 in)
Skid track	2.18 m (7 ft 2 in)

DIMENSIONS, INTERNAL:

Cabin max width	1.19 m (3 ft 11 in)

AREAS:

Main rotor disc	79.46 m² (855.3 sq ft)
Tail rotor disc	1.70 m² (18.35 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: standard	683 kg (1,506 lb)
Fuel weight: standard	83 kg (184 lb)
auxiliary	50 kg (110 lb)
Max T-O and landing weight	1,134 kg (2,500 lb)
Max disc loading	14.27 kg/m² (2.92 lb/sq ft)
Max power loading at T-O	6.21 kg/kW (10.20 lb/hp)

PERFORMANCE:

Cruising speed at 75% power	117 kt (217 km/h; 135 mph)
Max rate of climb at 1,830 m (6,000 ft)	over 305 m (1,000 ft)/min
Service ceiling	4,270 m (14,000 ft)
Hovering ceiling:	
IGE at 1,134 kg (2,500 lb)	2,728 m (8,950 ft)
OGE: at 1,043 kg (2,300 lb)	2,286 m (7,500 ft)
at 1,134 kg (2,500 lb)	1,372 m (4,500 ft)
Max range, at 105 kt (194 km/m; 121 mph) no reserves	approx 347 n miles (643 km; 400 miles)

ROCKY MOUNTAIN

ROCKY MOUNTAIN WINGS INC

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PRESIDENT: Stace E Schrader

Rocky Mountain was formed in 1999 to market the Ridge Runner. In August 2004, the Bushwhacker was introduced and marketed separately by Bushwhacker Aircraft. Plans are under way to produce an LSA-compliant version of the latest, enlarged cockpit Ridge Runner 3.

ROCKY MOUNTAIN RIDGE RUNNER

TYPE: Tandem-seat ultralight kitbuilt.

PROGRAMME: Ridge Runner 1 awarded Grand Champion at AirVenture 2001 and Arlington 2001; Ridge Runner 2 awarded outstanding lightplane award at Sun 'n' Fun 2004.

CURRENT VERSIONS: **Ridge Runner 1:** Single-seat ultralight model.

Ridge Runner 2: As Ridge Runner 1 but 1+1-seat version; *as described.*

Ridge Runner 3: Slightly larger, fully two-seat version of Ridge Runner 2; wider fuselage. Prototype N39ZT, built 2004.

Bushwhacker: See separate entry.

CUSTOMERS: Total of 54 of all versions sold by November 2006, including at least 10 Ridge Runner 3s.

Rocky Mountain Ridge Runner 3 1040440

COSTS: Ridge Runner 1 USD9,900; Ridge Runner 2 USD10,900; Ridge Runner 3 USD12,900 (2006).

DESIGN FEATURES: Wings fold for transportation and storage with no need to disconnect controls. Quoted build time 600 hours.

FLYING CONTROLS: Conventional and manual. Full-span ailerons and slotted flaps. Trim tab on port elevator. Horn-balanced fin and elevators.

STRUCTURE: Fabric-covered 4130 chromoly steel tube fuselage and wooden wings with tubular steel V-struts. Composites engine cowling. Tailplane has V-strut supports below.

LANDING GEAR: Tailwheel type; fixed. Two side Vs hinged to lower longerons, plus half-axles, each with bungee cord shock-absorber, attached to compression frame with fabric-covered side panels and half axle. Mainwheels 8.00–6. Maule solid tailwheel. Cable operated brakes.

POWER PLANT: Choice of 19.0 kW (25.5 hp) Rotax 277; 29.5 kW (39.6 hp) Rotax 477, 37.0 kW (49.6 hp) Rotax 503, 47.8 kW (64.1 hp) Rotax 582, or 20.9 kW (28.0 hp) Hirth F33 engines. Fuel tank(s) in inboard section of wings, capacity 18.9 litres (5.0 US gallons; 4.2 Imp gallons) in Ridge Runner 1; 38 litres (10.0 US gallons; 8.3 Imp gallons) in Ridge Runner 2 and 3.

ACCOMMODATION: Pilot and passenger in tandem. Fully enclosed cockpit.

DIMENSIONS, EXTERNAL:

Wing span	7.98 m (26 ft 2¼ in)
Length overall	5.18 m (17 ft 0 in)
Height overall	1.57 m (5 ft 2 in)

DIMENSIONS, INTERNAL (A: Ridge Runner 1, B: Ridge Runner 2, C: Ridge Runner 3):

Cabin max width: A, B	0.61 m (2 ft 0 in)
C	0.74 m (2 ft 5 in)

AREAS:

Wings, gross	9.23 m² (99.4 sq ft)

WEIGHTS AND LOADINGS (A, B and C as above):

Weight empty: A	113 kg (250 lb)
B	159 kg (350 lb)
C	163 kg (360 lb)
Max T-O weight: A	249 kg (550 lb)
B, C	408 kg (900 lb)

PERFORMANCE (A, B and C as above, Rotax 582):

Never-exceed speed (VNE)	95 kt (177 km/h; 110 mph)
Normal cruising speed	70 kt (129 km/h; 80 mph)
Stalling speed: flaps up	28 kt (52 km/h; 32 mph)
flaps down	25 kt (45 km/h; 28 mph)
Max rate of climb at S/L: A	244 m (800 ft)/min
B	366 m (1,200 ft)/min
C	488 m (1,600 ft)/min
T-O run	23 m (75 ft)
Landing run	31 m (100 ft)
Range with max fuel: A	152 n miles (281 km; 175 miles)
B, C	282 n miles (523 km; 325 miles)

ROTORWAY

ROTORWAY INTERNATIONAL

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VICE-PRESIDENT, PRODUCTION: Rusty Mueller
VICE-PRESIDENT, SALES: Brent Marshall
MARKETING DIRECTOR: Susie Bell

Initial RotorWay Company set up by the late B J Schramm in early 1960s; successively produced the Javelin, Scorpion I and Scorpion II before launching Exec in 1980. Company purchased and re-established on 1 June 1990 by the late John Netherwood; assets acquired in 1996 by company's employees, who are current owners.

RotorWay currently manufactures Exec 162F helicopter kits for final assembly by amateur builders and operators. The Exec is powered by the company's own engine, which has been in production for more than 20 years and has recently been upgraded to improve performance at altitude. Other companies offer modifications which are not approved by the manufacturer.

Some foreign distributors also sell helicopters; approximately 40 per cent of sales are outside the US. RotorWay, which had 40 employees in mid-2004, offers flight orientation and maintenance training, and customer service programme; 3,440 m² (37,000 sq ft) facility near Phoenix, Arizona, incorporates all departments, including manufacturing, sales and flight school.

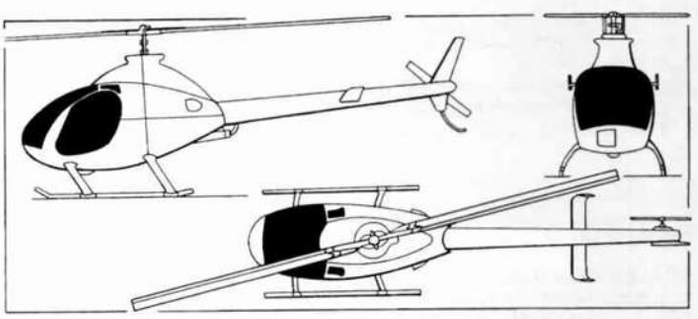
ROTORWAY EXEC 162F

TYPE: Two-seat helicopter kitbuilt.

PROGRAMME: Development of first RotorWay helicopter (Scorpion) began in 1967; followed by Scorpion Too in 1971 and Exec in 1980. With some 23 modifications, became Exec 90, certified in UK in 1990 and in Poland in 1993. Exec 162 introduced in 1994, although latter's improvements can be retrofitted.

Kits, which lack only avionics and paint, are currently marketed in USA and 50 other countries; 40 per cent of production is shipped abroad. French certification received in October 2001 following approval of modifications to meet DGAC requirements, including improved fire protection, repositioned instrumentation and foot controls.

RotorWay Exec 162F with unapproved Pro-Drive modifications as 162SF
(Paul Jackson) 1040419



RotorWay 162F homebuilt (RotorWay International RI 162 engine)
(Paul Jackson) 1158950

CURRENT VERSIONS: **Exec 162F:** *As described.* Marketed in Australia as **Exec 162FA.**

Exec 162 Pro: Not approved by RotorWay. Optional improvement package from Pro-Drive Inc, comprising modified main rotor drive system, 'E Z Start' clutch and carbon fibre tail rotor.

JetExec: Not approved by RotorWay. Turbine conversion offered by Kiss Aviation of Perris, California; powered by 112 kW (150 hp) Solar T-62T-32 Titan. Fuel capacity 151 litres (40.0 US gallons; 33.3 Imp gallons); max rate of climb 548 m (1,800 ft)/min; range 260 n miles (482 km; 300 miles).

CUSTOMERS: Over 250 Exec 90 and 750 Exec 162F kits sold and over 600 flying; 500th 162F delivered to Mexican Navy June 2000, 600th to Heli Diffusion of France in June 2002, 700th to Australia in August 2003 and 800th to South Africa on 11 August 2004. International uses include police surveillance, forestry observation, powerline inspection, ranch work, crop-spraying, recreation and flight training.

COSTS: Kit: USD67,750 including engine (2006). ACIS (see Power Plant) USD4,675 extra. Also available in four batches of parts to spread cost.

DESIGN FEATURES: Asymmetrical RotorWay-designed aerofoil section two-blade main rotor. All-metal aluminium alloy blades attached to aluminium alloy teetering rotor hub by retention straps. Teetering tail rotor, with two blades each comprising steel spar and aluminium alloy skin. Elastomeric bearing rotor hub system with dual push/pull cable-controlled swashplate for cyclic pitch control. Horizontal stabilisers, with winglets, mounted on tailboom. Quoted build time 450 hours. Company offers on-line diagnostic testing by modem.

STRUCTURE: Blades as detailed under Design Features. Basic 4130 steel tube airframe structure, with wraparound glass fibre fuselage/cabin enclosure. Aluminium alloy monocoque tailboom.

LANDING GEAR: Twin-skid type. Floats optional (from outside source).

POWER PLANT: One 113 kW (152 hp) RotorWay International RI 162F 2.66 litre (162 cu in) liquid-cooled engine with FADEC. Optional Altitude Compensation Induction System (ACIS) supercharger supplies pressurised air to engine at altitude, obviating need for turbocharging and prolonging engine life. Standard fuel capacity 64.4 litres (17.0 US gallons; 14.2 Imp gallons).

ACCOMMODATION: Two persons side by side; optional external HeliPak baggage pod fits between skids, capacity 0.21 m^3 (7.4 cu ft).
AVIONICS: Extra navigational equipment optional on US market helicopters.
EQUIPMENT: Optional crop-spraying kit, including two 42 litre (11.0 US gallon; 9.2 Imp gallon) tanks.
DIMENSIONS, EXTERNAL:
Main rotor diameter ..... 7.62 m (25 ft 0 in)
Tail rotor diameter ..... 1.28 m (4 ft 2½ in)
Length: fuselage ..... 6.71 m (22 ft 0 in)
overall, rotors turning ..... 8.99 m (29 ft 6 in)
Height to top of main rotor ..... 2.44 m (8 ft 0 in)
Skid track ..... 1.65 m (5 ft 5 in)
DIMENSIONS, INTERNAL:
Cabin max width ..... 1.12 m (3 ft 8 in)
AREAS:
Main rotor disc ..... 45.60 m^2 (490.9 sq ft)
Tail rotor disc ..... 1.17 m^2 (12.57 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 442 kg (975 lb)
Crew weight ..... 193 kg (425 lb)
Max T-O weight ..... 680 kg (1,500 lb)
Max disc loading ..... 14.9 kg/m^2 (3.06 lb/sq ft)
Max power loading at T-O ..... 6.01 kg/kW (9.87 lb/hp)
PERFORMANCE:
Never-exceed (VNE) and max level speed ..... 100 kt (185 km/h; 115 mph)
Normal cruising speed ..... 82 kt (153 km/h; 95 mph)
Max rate of climb at S/L ..... 305 m (1,000 ft)/min
Service ceiling ..... 3,050 m (10,000 ft)
Hovering ceiling, with two persons: IGE ..... 2,135 m (7,000 ft)
OGE ..... 1,525 m (5,000 ft)
Range with max fuel at optimum cruising power ..... 156 n miles (289 km; 180 miles)
Endurance with max fuel at optimum cruising power ..... 2 h

SAI

SUPERSONIC AEROSPACE INTERNATIONAL LLC

2250 E Tropicana Avenue, 19-121, Las Vegas, Nevada 89119
e-mail: info@saiqsst.com
Web: www.saiproject.com
PRINCIPAL: J Michael Paulson

Programme for supersonic business jet announced October 2004, but no further information released in following two years.

SAI QUIET SUPERSONIC BUSINESS JET

TYPE: Supersonic business jet.
PROGRAMME: Design studies began 2001 when company founded with funding from Allen E Paulson Living Trust; QSST announced 12 October 2004 at the NBAA Convention in Las Vegas; initial Phase I design study then completed by Lockheed Martin Skunk Works; Phase II, lasting two years, will focus on forming an international consortium of risk-sharing manufacturing partners; Phase III will include detailed design and engineering; Phase IV production launch; Phase V certification and initial deliveries. Lockheed Martin will be design authority but will not be involved in manufacturing. First flight could occur in 2010 or 2011, with certification in 2012. Market for 300-400 aircraft envisaged over 15-year period.
COSTS: Target price USD80 million (2004).
DESIGN FEATURES: Sharply swept delta wing with high dihedral canard aft of flight deck; inverted V-tail provides bracing between fin and engine pods. Design goals include sonic boom signature less than 1 per cent of that of Concorde, facilitating overland supersonic flight and meeting noise and global environmental requirements. Potential stretch to 30-passenger version.
STRUCTURE: Conventional, aluminium alloy fuselage and composites wings.
LANDING GEAR: Retractable tricycle type; twin wheels on nose unit, four wheels on each main bogie.

Artist's impression of SAI Quiet Supersonic Business Jet 1159705

POWER PLANT: Two turbofans pod-mounted under wings, each rated at 146.8 kN (33,000 lb st) to 155.7 kN (35,000 lb st). General Electric, Pratt & Whitney and Rolls-Royce have offered non-afterburning power plants based on existing cores, but with tailored inlets, fans and nozzles.
ACCOMMODATION: Eight to 12 passengers.
DIMENSIONS, EXTERNAL:
Wing span ..... 19.2 m (63 ft 0 in)
Length overall ..... 40.2 m (132 ft 0 in)
WEIGHTS AND LOADINGS:
Max T-O weight ..... 69,400 kg (153,000 lb)
PERFORMANCE (estimated):
Cruising speed ..... M1.6 to M1.8
Cruising altitude ..... 14,325 m (47,000 ft)
Range: ..... 4,000 n miles (7,408 km; 4,603 miles)

SCALED

SCALED COMPOSITES LLC

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Web: www.scaled.com
PRESIDENT: Burt (Elbert L) Rutan
VICE-PRESIDENT AND GENERAL MANAGER: Michael W Melvill

Scaled Composites founded 1982; bought by Beech Aircraft Corporation (now part of Raytheon) June 1985; sold back to Burt Rutan November 1988 and integrated in joint venture with Wyman-Gordon Company of North Grafton, Massachusetts; is now owned by private investors following buy-out by Burt Rutan and 10 other investors; continues to provide R&D facilities to individuals and companies; several projects developed for Beech retained by Scaled.

Scaled Composites is responsible for research and development and prototype construction; company also active in UAV field. Current programmes include proprietary products; the most recent have included White Knight, SpaceShipOne and Capricorn, details of which follow.

Scaled produced the prototype and undertook early test flights of the Visionaire Vantage business jet. Similarly, Scaled was involved in the Adam A500, which it designed, built and flight tested.

Company has 130 employees and annual revenue of around USD22 million.

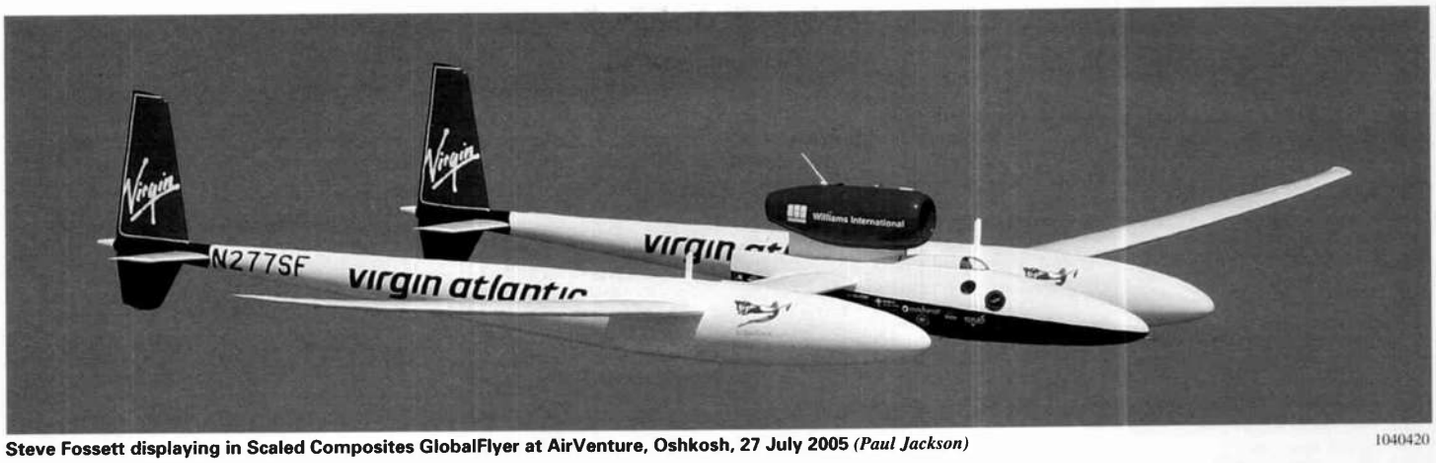
SCALED COMPOSITES 311 CAPRICORN

TYPE: Technology demonstrator.
PROGRAMME: Announced 23 October 2003 and unveiled at roll-out on 8 January 2004; named *Virgin Atlantic GlobalFlyer*. Construction began in late 2002. Vehicle for attempt at first solo, non-stop, eastbound aeroplane global circumnavigation (minimum 19,863.692 n miles; 36,787.559 km; 22,858.739 miles between 66° 33' South and 66° 33' North, as stipulated by FAI) by celebrated balloon pilot Steve Fossett, with Sir Richard Branson of sponsor Virgin Atlantic Airways as 'reserve pilot'. First flight (N277SF), lasting 1½ hours, took place at Mojave 5 March 2004; four more flights by early June 2004; record attempt planned for 2004/05 winter, to capture optimum jetstream assistance), launching from central US and flying round the world in less than 80 hours.

Take-off was made from the municipal airport at Salina, Kansas, at 1847 Central Standard Time on 28 February 2005, completing the global circuit before landing back at Salina at 1348 CST on 3 March, a total flying time of 67 hours 1 minute 46 seconds. The flight was successful despite the leakage of some 1,406 kg (3,100 lb) of fuel shortly after take-off; approximately 680 kg (1,500 lb) of fuel remained at the end of the flight. Three new world records were established by the flight, as follows:

Speed around the world, non-stop and non-refuelled (297.4 kt; 550.78 km/h; 342.2 mph);
Distance without landing (17,703.2 n miles; 32,786.43 km; 20,372.5 miles); and
Distance over a closed circuit (19,923.3 n miles, 36,898.04 km; 22,927.3 miles).

In July 2005, Fossett and Branson announced a further ambition for the aircraft: to exceed the present all-class absolute distance record by 4,000 n miles (7,408 km; 4,603 miles), in an attempt targeted for February 2006. Repairs to a damaged wingtip in January delayed the aircraft's positioning flight to Kennedy Space Center by six days, but it eventually took off from Cape Canaveral, Florida, at 0722 EST on 18 February 2006 with some 8,255 kg (18,200 lb) of fuel contributing to its 10,024 kg (22,100 lb) take-off weight. During the flight, the aircraft suffered two bird strikes and an early fuel leak, but continued to complete a full circuit of the Earth and beyond, including two Atlantic crossings. The flight was curtailed in the final stages by a generator failure, and a diversionary landing was made at Bournemouth, Hampshire, UK, instead of the intended site at Manston in Kent. Landing was made just after 1700 GMT on 11 February after a flying time of 76 hours 45 minutes. An absolute world distance record was claimed of 22,390.4 n miles (41,467 km; 25,766.3 miles), this qualifying also in subclasses C-1 and C-1g.
DESIGN FEATURES: Typical, innovative Scaled Composites configuration. Single-piece, high aspect ratio wing carrying central accommodation module and dorsal power plant pod, plus two separate pontoons, each with fin, underfin and two-piece tailplane. Lift/drag ratio approximately 37:1.
FLYING CONTROLS: Conventional and manual (cables and pushrods). Six-segment, narrow-chord aileron on each outer wing; rudder and elevators on tail unit of each boom. No flaps, slats or spoilers.
STRUCTURE: Composites throughout, with graphite/epoxy skins and aramid honeycomb core. Single graphite/epoxy I-beam wing spar.
LANDING GEAR: Tricycle type; retractable. Single mainwheels, on aluminium oleos with steel sliders and hydraulic disc brakes; fully castoring twin nosewheels. Due to large wing span, main gear can be rotated 90° to allow aircraft to exit hangar sideways. Paratech braking parachute (diameter 1.83 m; 6 ft) in canister on each wing inboard trailing-edge.
POWER PLANT: One 10.23 kN (2,300 lb st) Williams FJ44-3 ATW (Around The World) turbofan. Fuel (JP-4) in 2,161.5 litre (571 US gallon; 475.5 Imp gallon) forward tank and 2,055.5 litre (543 US gallon; 452 Imp gallon) aft tank in each boom; further 1,241.5 litres (328 US gallons; 273 Imp gallons) in four outboard tanks in each wing; and 117.3 litres (31.0 US gallons; 25.8 Imp gallons) in fuselage tank, giving total capacity (13 tanks) of 11,034 litres (2,915 US gallons; 2,427 Imp gallons). Fuel load represents more than 82 per cent of total T-O weight.
ACCOMMODATION: Pressurised and soundproofed cockpit for one occupant, including horizontal sleeping space and stowage for food and personal equipment. Cockpit pressure differential 0.55 bar (8.0 lb/sq in) gives 3,050 m (10,000 ft) environment at FL450.



Steve Fossett displaying in Scaled Composites GlobalFlyer at AirVenture, Oshkosh, 27 July 2005 *(Paul Jackson)* 1040420

AVIONICS: Chelton FlightLogic EFIS; Wulfsberg Series III VHF radios; NAT audio control panel. Dual TruTrak Flight Systems digital autopilots. Inmarsat C satellite datalink.

DIMENSIONS, EXTERNAL:
- Wing span ..... 34.75 m (114 ft 0 in)
- Wing aspect ratio 32.5
- Length overall ..... 13.44 m (44 ft 1¼ in)
- Height overall ..... 4.05 m (13 ft 3½ in)

DIMENSIONS, INTERNAL:
- Cabin length ..... 2.13 m (7 ft 0 in)

AREAS:
- Wings, gross ..... 37.16 m² (400.0 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty ..... 1,520 kg (3,350 lb)
- Max fuel weight ..... 8,165 kg (18,000 lb)
- Max T-O weight ..... 9,981 kg (22,006 lb)
- Landing weight (all fuel expended) ..... less than 1,814 kg (4,000 lb)
- Max wing loading ..... 268.6 kg/m² (55.01 lb/sq ft)
- Max power loading ..... 976 kg/kN (9.57 lb/lb st)

PERFORMANCE (estimated):
- Normal cruising speed ..... 250 kt (463 km/h; 288 mph)
- Normal cruising altitude ..... 13,720 m (45,000 ft)
- Service ceiling ..... 15,850 m (52,000 ft)
- T-O field length ..... 3,660 m (12,000 ft)
- Range:
  - in still air ..... 18,250 n miles (33,799 km; 21,001 miles)
  - with optimum jetstream assistance ..... 20,000 n miles (37,040 km; 23,015 miles)
- Endurance ..... 80 h

SCALED COMPOSITES 318 WHITE KNIGHT

TYPE: High-altitude platform.

PROGRAMME: Design conception started 1996, but existence unknown until shortly before first flight (N318SL) on 1 August 2002; officially unveiled 18 April 2003 as launch platform for suborbital SpaceShipOne and, possibly, other payloads. First captive-carry flight with SpaceShipOne attached, 20 May 2003; this programme completed in October 2004.

Following reallocation of the Boeing X-37 programme from NASA to DARPA, the White Knight was adapted as carrier for that aircraft, making its first captive-carry flight with the X-37 on 21 June 2005.

Two White Knight 2s, a larger version of the aircraft, will be built for carrying the next generation Scaled Composites space vehicle, the eight-seat SpaceShipTwo. Further details of WK2 not expected before late 2007.

SCALED COMPOSITES 316 SPACESHIPONE

TYPE: Technology demonstrator.

PROGRAMME: Design concepts for 'Tier One' suborbital manned spacecraft inaugurated 1996; SpaceShipOne development programme began with award of customer contract in April 2001; aircraft registered N328KF (signifying non-metric equivalent of 100,000 m) on 20 March 2003 and existence revealed 18 April 2003. Initial two sorties (first unmanned, second manned) on 20 May and 29 July 2003 were captive-carry flights under company's White Knight aircraft; followed by first manned glide 7 August 2003; first 'feather' conversion made on fourth flight, 27 August 2003. Pitch-up problem encountered during third gliding flight on 23 September; rectified, and flying resumed, 17 October 2003. First supersonic flight was made on the 17 December 2003 Wright brothers centennial anniversary, after release from White Knight at 14,630 m (48,000 ft), aircraft suffering minor damage when port mainwheel leg collapsed on landing. On same date, telecommunications and entertainments businessman Paul G Allen identified as project's sponsor.

On 1 April 2004, FAA Office of Commercial Space Transportation issued SpaceShipOne with licence as suborbital manned rocket (first of its kind), paving way for attempt on Ansari X-Prize. During the course of flight 15P (see table) on 21 June 2004, N328KF achieved an altitude under rocket power of 86,106 m (282,500 ft), which was submitted to the FAI for ratification in Classes C-1 and C-1d as a record for a landplane launched from a mother-ship.

Flights on 29 September and 4 October 2004 successfully qualified for the USD10,000 X-Prize, considerably exceeding in the process both the official and unofficial absolute records for altitude achieved in 1962 and 1963 by the North American X-15A. Shortly before this, on 27 September, Sir Richard Branson's Virgin Group announced its entry into agreement to license the SpaceShipOne technology (owned by sponsor Paul Allen's Mojave Aerospace Ventures) to develop the world's first privately funded spaceships to carry commercial passengers. Separately, it formed new company Virgin Galactic to become the world's first commercial space tourism operator. Initial discussions with Scaled concerned suborbital spacecraft with accommodation for up to nine passengers, with configuration to be finalised in 2005. Anticipated design changes may include an attempt to eliminate bouts of uncommanded roll encountered on both of the X-Prize flights.

On 8 February and 9 March 2005 respectively, the SpaceShipOne team received the prestigious Robert J Collier Trophy and the NASM Trophy for Current Achievement. Shortly afterwards, it was announced that the aircraft had been donated to the National Air and Space Museum. Presentation to the NASM was made on 2 August 2005; inauguration, in a prominent position between the Ryan NYP *Spirit of St Louis* and the Bell X-1, was conducted on 5 October 2005.

A larger, second-generation **SpaceShipTwo**, for two pilots and six passengers, is to be produced by The Spaceship Company, a joint venture between Scaled Composites and Virgin Galactic. Five have been ordered. Further details not expected before late 2007.

SCHWEIZER

SCHWEIZER AIRCRAFT CORPORATION

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GENERAL MANAGER: Randy Simpson
MARKETING CO-ORDINATOR: Peter S Schweizer
MARKETING DIRECTORS:
David K Savage
Barbara J Tweedt

Established 1939 by Ernest Schweizer (1912–2000) to produce sailplanes; from mid-1957 to 1995 made Grumman (later Gulfstream American) Ag-Cat, initially under subcontract, but as Schweizer-owned product from January 1981; manufacturing rights sold to Ag-Cat Corporation of Malden, Missouri, but production terminated soon thereafter.

Schweizer acquired rights for sole US manufacture of Hughes 300 light helicopter 13 July 1983; continues to support earlier Hughes 300s; first Elmira-built 300C completed June 1984; Schweizer purchased US rights for whole 300C programme from McDonnell Douglas Helicopter Company (formerly Hughes Helicopters) 21 November 1986. Deliveries totalled 56 helicopters in 1996, 44 in 1997, 41 in 1998, 43 in 1999, 36 in 2000, 33 in 2001, 32 in 2002 and 38 in 2003, by which time Schweizer had delivered nearly 930 helicopters.

The 1,000th production Schweizer helicopter, a Model 300CBi, was delivered on 21 October 2005 to BC Helicopters of Abbotsford, British Columbia, Canada.

Schweizer also manufactures the Model 300C, 300CB, 300CB*i* and 333 helicopters and the 2–37 and 2-38 surveillance aircraft. An unmanned version of the 300CB, known as the RoboCopter 300, was developed in collaboration with Kawada Industries Inc of Japan and was described in *Jane's Unmanned Aerial Vehicles and Targets*.

At the Heli-Expo show at Orlando, Florida, in February 2002 Schweizer, Sikorsky Aircraft and Shanghai Little Eagle Science and Technology (SLEC) of the People's Republic of China announced an agreement whereby a new joint-venture company, Shanghai Sikorsky Aircraft Co (SSAC), in which SLEC and Sikorsky hold 51 per cent and 49 per cent shares respectively, will produce Schweizer Model 300 series helicopters under licence. Initially, Schweizer 300C/CBCBis and 333s are being assembled from Schweizer-supplied kits (as Shen3A, Shen2B and Shen4T respectively), leading to manufacture of detail parts and eventually to full manufacture in China. First three kits arrived in Shanghai on 26 August 2002, followed by two more in September. Target production in China is 24 helicopters per year.

On 26 August 2004 Sikorsky Aircraft announced that it had reached agreement to acquire Schweizer as a wholly owned subsidiary. Completion of the acquisition was announced in the following month.

Subcontracts include aircraft structural components and assemblies for Northrop Grumman, Sikorsky and Boeing. The company employed 421 in 2004 in its 18,580 m² (200,000 sq ft) facility.

For details of the latest updates to *Jane's All the World's Aircraft* online and to discover the additional information available exclusively to online subscribers please visit
jawa.janes.com

SCHWEIZER SA 2-37

US military designation: RG-8A

TYPE: Multisensor surveillance lightplane.

PROGRAMME: First flight 1985; prototype fitted with Hughes AN/AAQ-16 and other manufacturers' thermal imaging systems.

CURRENT VERSIONS: **SA 2-37A:** Baseline version.

SA 2-37B: Powered by 186 kW (250 hp) Textron Lycoming TIO-540-AB1AD engines. First aircraft (N6150U, c/n 015) registered February 2001; most subsequent production is to this standard. *As described.*

CUSTOMERS: Details in table. Three for US Army, of which one lost in accident; remaining two transferred in 1987 to US Coast Guard at Opa Locka for anti-narcotics operations; one converted to SA 2-38A.

Fifth, sixth and seventh 2-37As built for Central Intelligence Agency late 1989/early 1990; others to Colombian (CACOM 2), Jordanian (14 Squadron) and Mexican (EA 502) air forces, possibly to assist US drugs interdiction efforts as transfers not announced. Colombian purchase of one aircraft was followed by US government provision of five more.

CIA aircraft employed as airborne communications relay platforms for long-range reconnaissance UAVs; believed used over former Yugoslavia in 1994, supporting General Atomics Gnat 750 vehicles; also fitted with surface surveillance equipment to identify sites for NATO air strikes in same operational theatre. Participated in hostage rescue at Japanese embassy in Peru, 1997.

SCHWEIZER SA 2-37 PRODUCTION

c/n	Reg/serial	Date	Operator
1	N3623C	1985	Schweizer; to
	85–0047	1986	US Army; to
	8101	1987	USCG; to SA 2-38A
2	N3623F	1985	Schweizer; to
	85–0048	1986	US Army; lost 22 Sep 86
3	N9237A		Schweizer; to
	OES-2251	1994	Mexican AF; to
	5051	2000	Mexican AF
4	86–0404	1987	US Army; to
	8102	1987	USCG; lost 1996
5	N7508U	Jul 89	CIA; to
	N701AN	Dec 96	CIA
6	N7508W	Nov 89	CIA; to
	N87260	Feb 97	CIA
7	N7508Y	Jan 90	CIA; to
	N4122L	Dec 96	CIA
8	N7508Z	Feb 91	Schweizer; to
	FAC 2046		Colombian AF; to
	N12139	Mar 97	CIA
9	N7510U	May 94	Schweizer; to
	OES-2252	Jul 94	Mexican AF; to
	EAOE-2252		Mexican AF; to
	5052		Mexican AF; crashed 20 Mar 03
010	N6147U	Oct 97	LAIRD International; to
	1450	Dec 01	Royal Jordanian AF
011	N61474	Nov 97	Crashed 19 Feb 98
012	N61499	Oct 98	Schweizer; to
	FAC 5751	May 02	Colombian AF
014	N20086	May 99	Schweizer; to
	1451	May 00	Royal Jordanian AF
015	N6150U	Jun 00	Schweizer; to
	N2061L	Feb 01	Schweizer; to
	FAC	May 02	Colombian AF
016	N40623	Sep 01[1]	Schweizer; to
	FAC	02	Colombian AF
017	N10673	Feb 02[1]	Schweizer; to
	FAC	02	Colombian AF
018	N5206W	Oct 03[2]	Schweizer
019	N30745	May 02[1]	Schweizer; to
	FAC	02	Colombian AF
020	N2067F	Aug 02[1]	Schweizer; to
	FAC	02	Colombian AF

Notes: CIA aircraft registered to Vantage Leasing Inc of Dover, Delaware.
No. 1 remains currently registered (2006) as N3623C apparently due to administrative oversight. Similarly, Nos 016, 017, 019 and 020 remain on the US civil aircraft register.
No. 010 LAIRD International at Marietta, Georgia.
No. 013: This serial number not allocated by Schweizer company.
Nos. 015 to 017 and 019 upwards are SA 2-37Bs.
Nos. 015 to 017 and 019 to 020 believed to be Colombian FAC5752 onwards.

[1] Issue of Airworthiness Certificate
[2] Registration date; no airworthiness certificate by late 2006.

DESIGN FEATURES: Modification of Schweizer SGM 2-37 motor glider, but with slightly greater wing span, drooped leading-edge and leading-edge fences on outer wing panels to improve stall, much more powerful engine with large exhaust silencers on fuselage sides, three-blade quiet propeller, fuselage modified to accept bulged canopy and larger engine, streamlined fairings and hydraulic parking brake on mainwheels; more than treble standard fuel capacity, but optional extra tank also available; later aircraft have outward-canted finlets on lower tips of tailplane. Removable underfuselage skin and hatches give access to 1.84 m^3 (65 cu ft) payload bay behind cockpit, in which pallets holding LLLTV, FLIR or camera payloads can be quickly removed and installed; other engines and larger payloads available for surveillance, basic and advanced training, operator training, glider and banner towing, and priority cargo delivery. Certified to FAR Pt 23 for day and night IFR; inaudible when overflying at 'quiet mode' speed at about 610 m (2,000 ft) over land and 183 m (600 ft) over water with propeller turning at 1,100 rpm to 1,300 rpm and engine producing 48.5 kW (65 hp) of its maximum 186 kW (250 hp).

Wing section Wortmann FX-61-163 at root and FX-60-126 (modified) at tip; outer wing panels and horizontal tail can be removed for transport.

FLYING CONTROLS: Manual. All-moving tailplane with anti-balance tab; externally mass-balanced ailerons; rudder.

LANDING GEAR: Tailwheel type; fixed. Wing-mounted, cantilever main legs. Cantilever tailwheel. Cleveland disc brakes.

POWER PLANT: Current production SA 2-37B has one 186 kW (250 hp) 175 kW (235 hp) Textron Lycoming TIO-540-AB1AD turbocharged flat-six engine, driving a McCauley three-blade constant-speed propeller. Usable fuel capacity 375 litres (99 US gallons; 82.4 Imp gallons). Shadin fuel flow system.

ACCOMMODATION: Seats for two persons side by side under two-piece upward-opening canopy, hinged on centreline. Dual controls, seat belts and inertia reel harnesses standard. Compartment aft of seats enlarged to accommodate pallet containing up to 340 kg (750 lb) of sensors or other equipment.

DIMENSIONS, EXTERNAL:
- Wing span ..... 21.70 m (71 ft 2½ in)
- Wing aspect ratio 25
- Fuselage length ..... 8.79 m (28 ft 10 in)
- Height overall ..... 2.36 m (7 ft 9 in)

AREAS:
- Wings, gross ..... 18.68 m^2 (201.1 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty ..... 1,157 kg (2,550 lb)
- Payload ..... 322 kg (710 lb)
- Max mission payload ..... 227 kg (500 lb)
- Max fuel ..... 272 kg (600 lb)
- Max T-O weight ..... 1,950 kg (4,300 lb)
- Max wing loading ..... 104.4 kg/m^2 (21.38 lb/sq ft)
- Max power loading ..... 10.47 kg/kW (17.2 lb/hp)

PERFORMANCE:
- Never-exceed speed (VNE) ..... 165 kt (305 km/h; 189 mph)
- Mission speed ..... 85 kt (157 km/h; 98 mph)
- Optimum climbing speed ..... 85 kt (157 km/h; 98 mph) CAS
- Stalling speed ..... 67 kt (125 km/h; 78 mph)
- Service ceiling ..... 7,315 m (24,000 ft)
- T-O run ..... 449 m (1,473 ft)
- T-O to 15 m (50 ft) ..... 742 m (2,433 ft)
- Landing from 15 m (50 ft) ..... 726 m (2,383 ft)
- Landing run ..... 375 m (1,230 ft)
- Endurance: standard, 200 n mile (370 km; 230 mile) mission radius ..... 7 h
  - quiet mode ..... up to 12 h

SCHWEIZER SA 2-38

US military designations: RU-38A/B Twin Condor

TYPE: Multisensor surveillance lightplane.

PROGRAMME: Development started 1993; substantial redesign of single-engined SA 2-37A/RG-8A; first US Coast Guard 2-37A returned to Schweizer 24 January 1994 for conversion beginning in April; first flight (N61428) 31 May 1995; second aircraft was due to fly in mid-1996, but was destroyed in a crash earlier the same year while still an RG-8; third was to be first 'new' build, but with wing taken from stock; all three for USCG. Type publicly revealed 20 July 1995. First delivery due to US Coast Guard in late 1996; however, programme suspended following RG-8 crash and not resumed until December 1996 when contract amended to two aircraft with engines uprated with turbochargers. Modifications introduced in 1997 comprised a redesigned tailplane and improved inlet ducts for the rear engine. Latest known airworthiness certificate issued 24 September 2002.

Second (new-build) aircraft registered N61449 in July 1997 and gained airworthiness certificate on 23 October 1997. Flight testing (aircraft reserialled 8103) for USCG acceptance began at Edwards AFB on 10 July 1998 by 445th Flight Test Squadron, USAF programme was 100 sorties in three/four months; however test programme was terminated in the following year. Both aircraft remain registered to Schweizer.

Development of SA 2-38B first revealed in June 2003, when three aircraft were registered (N2101J, c/n 001; N2082C, c/n 002; and N2083N, c/n 003), all destined for undisclosed 'US government customer', although registered to Schweizer. First flight was expected in early 2004; initial aircraft declared airworthy on 4 March 2004 and certified 1 April 2004; second declared airworthy 14 April 2005 and certified 24 August 2005. Airworthiness certificates renewed 13 March and 25 April 2006, respectively, but third aircraft had not received a registration certificate by early 2007 and may not have been built.

CURRENT VERSIONS: **SA 2-38A:** Two-seat version, *as described except where otherwise indicated.*

SA 2-38B: Two/four-seat version powered by two 336 kW (450 shp) Rolls-Royce 250-B17F turboprops. Compared with SA 2-38A has increased wing span, overall length and MTOW.

CUSTOMERS: US Coast Guard (two); second US customer, and one overseas, also reported. However, by late 1999, only two SA 2-38As known to have been built.

COSTS: US$450,000 (1993) for initial redesign, US$35 million (1994) USAF contract to convert existing two aircraft; approximately US$1 million each (excluding sensors) for any additional procurement. Renegotiated contract (December 1996) covered two aircraft for US$53 million.

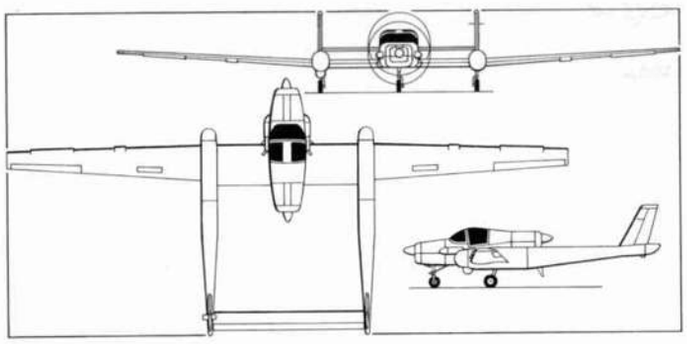
DESIGN FEATURES: Main objectives of SA 2-38A were to increase night patrol capability and reduce engine coking problems compared with SA 2-37A; additional engine also increases safety factor for overwater operation, though normal mode is single-engine cruise with second engine shut down.

Utilises wings and cockpit forward section of SA 2-37A; wing section Wortmann FX-61-163 at root and FX-60-126 (modified) at tip; principal design changes are adoption of pod and twin tailboom configuration with two engines in push-pull layout; cabin slightly widened.

LANDING GEAR: Tricycle type; fixed. Boom-mounted cantilever main legs; strut-braced nosewheel leg; single wheel on each unit. Main units Cleveland 6.50–10 wheel assemblies with Cleveland 30-95A brakes; nosewheel is Cleveland 6.00–8.

POWER PLANT: Prototype SA 2-38A originally with two heavily muffled Teledyne Continental GIO-550A flat-six engines, each rated at 261 kW (350 hp) at 3,400 rpm, with 3:2 reduction

Schweizer RU-38A Twin Condor surveillance aircraft 1129477



Schweizer SA 2-38A twin-engined surveillance aircraft *(Mike Keep)* 0064927

gear to limit propeller speed to 2,267 rpm. One engine in nose and one in rear of fuselage pod, respectively driving a tractor and pusher constant-speed, fully feathering three-blade propeller. Turbocharged engines in service version. Usable fuel capacity 375 litres (99.0 US gallons; 82.5 Imp gallons).

SA 2-38B has two 336 kW (450 shp) Rolls-Royce 250-B17F turboprops, geared to drive propellers at 800-1,000 rpm at mission speed. Rear engine is essentially redundant, to reduce risk of engine failure and to provide higher cruising speeds en route to and from missions. Front engine drives four-blade, constant-speed propeller; rear propeller is three-blade, constant-speed and full-feathering to enable rear engine to be shut down in flight in quiet surveillance mode, when aircraft noise is said to be undetectable from the ground during overflight at 610 m (2,000 ft); engine exhaust is directed over wings to reduce infra-red signature. Usable fuel capacity 1,060 litres (280 US gallons; 233 Imp gallons).

ACCOMMODATION: SA 2-38A accommodates pilot and sensor operator, side by side. SA 2-38B accommodates up to four, with seats for sensor operators behind the pilots' seats, but will operate with two crew with initial customer.

SYSTEMS: Three independent 28 V power sources.

AVIONICS: *Comms:* Rockwell Collins AN/ARC-182 VHF/UHF and Honeywell HF 990 radios, Bendix/King KY 196 VHF, KMA 24H-65 audio selector (two) and KFS 594 HF control; Wolfsburg RT9600 marine band radio.

Radar: Honeywell AN/APN-215(V) colour weather radar with search and mapping modes in nose of port tailboom.

Flight: Bendix/King KI 229 RMI, KI 256 flight director, KI 525A HSI, KI 250 radar altimeter, KDI 572 DME, KC 192 autopilot, KR 87 ADF and KNS 81 VOR/LOC/GS/RNAV. BAE Systems 7880 Omega/GPS.

Mission: Surveillance radar, as above. FLIR/LLLTV and dual recorder in nose of starboard boom; Bendix/King KY 58 and KY 75 communications encryption devices. Fully integrated sensor suite under development.

DIMENSIONS, EXTERNAL (A: SA 2-38A; B: SA 2-38B):

Wing span: A	19.51 m (64 ft 0 in)
B	25.64 m (84 ft 1½ in)
Wing aspect ratio: A	18.1
B	21.2
Length overall: A	9.19 m (30 ft 2 in)
B	10.70 m (35 ft 1¼ in)
Height overall: A	2.90 m (9 ft 6 in)
Wheelbase: A	5.79 m (19 ft 0 in)

AREAS:

Wings, gross: A	20.98 m² (225.9 sq ft)
B	31.05 m² (334.2 sq ft)
Fins (total): A	2.26 m² (24.30 sq ft)
Tailplane: A	3.26 m² (35.10 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: A	1,524 kg (3,360 lb)
B	1,935 kg (4,265 lb)
Max payload: A	408 kg (900 lb)
B	363 kg (800 lb)
Max fuel weight: A	272 kg (600 lb)
B	669 kg (1,475 lb)
Max T-O weight: A	2,404 kg (5,300 lb)
B	3,265 kg (7,200 lb)
Max wing loading: A	114.6 kg/m² (23.46 lb/sq ft)
B	105.2 kg/m² (21.54 lb/sq ft)
Max power loading: A	4.61 kg/kW (7.57 lb/hp)
B	4.87 kg/kW (8.00 lbs/hp)

PERFORMANCE:

Never-exceed speed (VNE): A	165 kt (305 km/h; 189 mph)
B	168 kt (311 km/h; 193 mph)
Cruising speed at 1,525 m (5,000 ft): A	
at 75% power	136 kt (252 km/h; 157 mph)
at 63% power	127 kt (235 km/h; 146 mph)
Mission speed: A	90 kt (167 km/h; 104 mph)
B	83 kt (154 km/h; 96 mph)
Best climbing speed: A	87 kt (161 km/h; 100 mph)
B	83.5 kt (155 km/h; 96 mph)
Stalling speed: A	75 kt (139 km/h; 87 mph)
B	62 kt (115 km/h; 72 mph)
Max rate of climb at S/L: A	670 m (2,200 ft)/min
Rate of climb at S/L, nose engine only: A	350 m (1,150 ft)/min
Service ceiling: A	7,315 m (24,000 ft)
B	9,144 m (30,000 ft)
T-O run: A	295 m (960 ft)
B	294 m (965 ft)
T-O to 15 m (50 ft): A	430 m (1,400 ft)
B	311 m (1,020 ft)
Landing from 15 m (50 ft): A	755 m (2,475 ft)
B	945 m (3,100 ft)
Landing run: A	410 m (1,350 ft)
B	600 m (1,970 ft)
Endurance with no reserves: typical mission: A	6 h
max: A	10 h

SCHWEIZER 300C

Engineering designation: Model 269

TYPE: Three-seat helicopter.

PROGRAMME: Hughes 269 first flew 2 October 1956; production deliveries began October 1961; marketed later as Model 300. Developed 300C first flew August 1969; first flight Hughes production model December 1969; FAA certification May 1970. Production of 300C transferred from Hughes Helicopters to Schweizer July 1983; first flight Schweizer 300C (1,166th 300C) June 1984; Schweizer bought entire programme November 1986. Deliveries of 300CB began in August 1995 with initial three of 10 ordered by launch customer Helicopter Adventures, of Concord, California. More than 3,600 Hughes/Schweizer 300/330s have been produced. Production rate stood at one per week in 2004. The 1,000th Schweizer-built helicopter, a Model 300CBi was delivered on 21 October 2005 to BC Helicopters of Abbotsford, Canada.

CURRENT VERSIONS: **300C:** Standard civil version.

Main description applies to 300C, unless otherwise indicated.

300C Sky Knight: Special police version; options include safety mesh seats with inertia reel shoulder harnesses, public address/siren system, searchlight, integrated communications, infra-red sensor, Heavy-duty 28 V 100 A electrical system, cabin heater, night lights with strobe beacons, cabin utility light, fire extinguisher, first aid kit and map case. Chinese designation **Shen3A**.

TH-300C: Military training version.

300CB: 'Basic' version (otherwise designated 269C-1) for training role; 134 kW (180 hp) Textron Lycoming HO-360-C1A engine, 132 litre (35 US gallon; 29.1 Imp gallon) fuel tank and 2,000 hour TBO; stated to be cheaper to operate than 300C. First flight (N6002X) 28 May 1993; type certificate awarded August 1995. Changes from standard model include one-piece upper pulley hub; improved air filtration system; lightweight exhaust; and improved oil filter. 200,000 hours flown by October 2002, at which time 11 had been involved in accidents without fatalities. Chinese designation **Shen2B**.

300CB*i*: Enhanced version of 300CB, which it was scheduled to replace from 2002; introduced at Heli-Expo 2002 at Orlando, Florida, in February 2002. Features fuel-injected engine, new splined (replacing bolted) main rotor driveshaft and hub with 4,000-hour life, and electronic automatic engagement system (AES). First delivery (G-OCBI, c/n 0139) to CSE Aviation at Oxford, UK, in August 2002. One delivered to Great Slave Helicopters at Yellowknife, NWT, October 2002.

RoboCopter: Unmanned version developed by Kawada Industries in Japan for cropspraying, pipeline patrol, aerial crane and reconnaissance; first flight October 1996; Schweizer teamed with Northrop Grumman to offer helicopter for US Navy VTOL UAV requirement (subsequently met by RQ-8A Fire Scout version of Schweizer 333, which see); RoboCopter promoted in late 2002 under US marketing name **Argus**; further details were in *Jane's Unmanned Aerial Vehicles and Targets*.

CUSTOMERS: Hughes produced 2,775 of all versions, including TH-55A Osage for US Army, before transfer to Schweizer. Royal Thai Army received 58 TH-300C helicopters between March 1986 and mid-1989; 500th Schweizer-manufactured 300C delivered at Heli Expo 1994. Sky Knight customers include police departments of Baltimore, Maryland; Lakewood, California; and Kansas City, Missouri. Recent customers include Helicopter Adventures Inc of California, which ordered 23 300CB*i*s, plus 10 options, for its rotary-wing training schools in California and Florida; High Desert Helicopters of West Jordan, Utah, which ordered two 300Cs in March 2004; and the Civil Aviation University of China, which took delivery of two 300Cs in early 2004, bringing to nine the total of Schweizer 300Cs delivered to China in 2003-04. By late 2006, Schweizer had built some 734 300Cs and 268 300CBs; during 2000, 13 300Cs and 17 300CBs were delivered, followed by 17 and 12 in 2001; 13 and 17 in 2002; 20 and 15 in 2003; 13 and 27 in 2004; and 12 and 40 in 2005.

COSTS: 300C: USD235,650 (2001); 300CB USD204,750 (2001). Direct operating cost: 300C USD87.01 per hour; 300CB*i* USD70.52 per hour (both 2005).

DESIGN FEATURES: Simple, pod-and-boom configuration, with exposed power plant and fuel tanks. Aerofoil-section stabiliser, starboard side, rear, at approx 45° dihedral; triangular underfin. Fully articulated three-blade main rotor, turning at 471 rpm; fully interchangeable blades; blade section NACA 0015; elastomeric dampers; two-blade teetering tail rotor; limited blade folding; no rotor brake; multiple V-belt and pulley reduction gear/drive system between horizontally mounted engine and transmission, with electrically controlled belt-tensioning system instead of clutch; braced tubular tailboom; separate dihedral tailplane and fin.

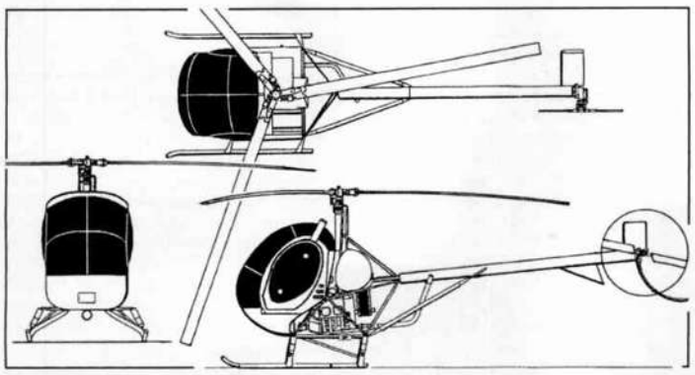
FLYING CONTROLS: Manual. Electric two-axis cyclic trim, cyclic and collective friction control.

STRUCTURE: Main rotor blades bonded with constant-section extruded aluminium spar, wraparound skin and trailing-edge; tail rotor blades have steel tube spar and glass fibre skin; steel tube cabin section with light alloy and stainless steel skin and Plexiglas transparencies.

LANDING GEAR: Tubular skids carried on booted oleo-pneumatic shock-absorbers. Replaceable Heavy-duty skid shoes. Two ground handling wheels with 0.25 m (10 in) balloon tyres, pressure 4.14 to 5.17 bar (60 to 75 lb/sq in). Available optionally on floats made of polyurethane-coated nylon fabric, 4.70 m (15 ft 5 in) long and with a total installed weight of 27.2 kg (60 lb). Heavy-duty skid plates optional.

POWER PLANT: One 168 kW (225 hp) Textron Lycoming HIO-360-D1A flat-four engine, derated to 142 kW (190 hp), mounted horizontally aft of seats. Normal fuel capacity of 300C and 300CB is 123 litres (32.5 US gallons; 27.1 Imp gallons) of which 114 litres (30.0 US gallons; 25.0 Imp gallons) are usable; auxiliary tank of 133 litres (35.0 US gallons; 29.2 Imp gallons) can be fitted to 300C and tank of 114 litres (30.0 US gallons; 25.0 Imp

Schweizer 300CB*i* three-seat helicopter *(Paul Jackson)* 1159744



General arrangement of the Schweizer 300 *(Paul Jackson)* 1159692

gallons) to 300CB. Normal fuel capacity of 300 CB*i* is 132 litres (35.0 US gallons; 29.1 Imp gallons); auxiliary tank of 114 litres (30 US gallons; 25.0 Imp gallons) can be fitted. Oil capacity 9.5 litres (2.5 US gallons; 2.1 Imp gallons).

ACCOMMODATION: Three persons side by side on sculptured and cushioned bench seat, with shoulder harness, in Plexiglas enclosed cabin. Accommodation ventilated. Carpet and tinted canopy standard. Forward-hinged, removable door on each side. Dual controls optional in 300C, standard in 300CB and 300 CB*i*; captain sits on left in 300C and on right in 300CB. Offset anti-torque pedals. Exhaust muff heating kit available.

SYSTEMS: Standard electrical system includes 24 V 70 A alternator, 24 V 17 Ah battery, lightweight high-torque starter and external power socket. Night lights with strobe beacons standard on 300CB. Automatic engagement system (AES) introduced as an option from February 2002 incorporates a start-up overspeed governor, computer-controlled rotor engagement device and low rotor rpm warning.

AVIONICS: *Comms:* Avionics include Honeywell KY 96A com transceiver and headsets, KR 86 ADF and GTX 320 transponders and ACK A-30 blind encoder.

EQUIPMENT: Standard for all models are fire extinguisher, first aid kit and engine hour meter. Model 300C has external power plug and fuel pressure indicator; Model 300CB has night lights with strobes. Optional equipment includes stretcher kits, cargo racks with combined capacity of 91 kg (200 lb), external load sling of 408 kg (900 lb) capacity, Simplex Model 5200 agricultural spray or dry powder dispersal kits, instrument training package, throttle governor, start-up overspeed control unit, night flying kit, single or dual exhaust mufflers, door lock and dual oil coolers.

DIMENSIONS, EXTERNAL:

Main rotor diameter	8.18 m (26 ft 10 in)
Main rotor blade chord	0.17 m (6¾ in)
Tail rotor diameter	1.30 m (4 ft 3 in)
Distance between rotor centres	4.66 m (15 ft 3½ in)
Length: fuselage	6.77 m (22 ft 2½ in)
overall, rotors turning	9.40 m (30 ft 10 in)
Height: to top of rotor head	2.66 m (8 ft 8¾ in)
to top of cabin	2.19 m (7 ft 2 in)
Width: rotor partially folded	2.44 m (8 ft 0 in)
cabin	1.30 m (4 ft 3 in)
Skid track	1.99 m (6 ft 6½ in)
Length of skids	2.51 m (8 ft 3 in)
Passenger doors (each): Height	1.09 m (3 ft 7 in)
Width	0.97 m (3 ft 2 in)
Height to sill	0.91 m (3 ft 0 in)

DIMENSIONS, INTERNAL:

Cabin: Length	1.50 m (4 ft 11 in)
Max width	1.45 m (4 ft 9 in)

AREAS:

Main rotor blades (each)	0.70 m^2 (7.55 sq ft)
Tail rotor blades (each)	0.08 m^2 (0.86 sq ft)
Main rotor disc	52.54 m^2 (565.5 sq ft)
Tail rotor disc	1.32 m^2 (14.20 sq ft)
Fin	0.23 m^2 (2.50 sq ft)
Horizontal stabiliser	0.246 m^2 (2.65 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: 300C	499 kg (1,100 lb)
300CB, 300CB*i*	494 kg (1,088 lb)
Baggage capacity	45 kg (100 lb)
Max T-O weight:	
Normal category: 300C	930 kg (2,050 lb)
300CB, 300CB*i*	794 kg (1,750 lb)
external load	975 kg (2,150 lb)
Max disc loading:	
Normal category: 300C	17.7 kg/m^2 (3.63 lb/sq ft)
300CB, 300CB*i*	15.1 kg/m^2 (3.09 lb/sq ft)
external load	18.6 kg/m^2 (3.80 lb/sq ft)
Max power loading at T-O:	
Normal category: 300C	6.57 kg/kW (10.79 lb/hp)
300CB, 300CB*i*	5.61 kg/kW (9.21 lb/hp)
external load	6.89 kg/kW (11.32 lb/hp)

PERFORMANCE (at max Normal T-O weight, ISA):

Never-exceed speed (VNE) at S/L:	
300C	95 kt (176 km/h; 109 mph) IAS
300CB, 300CB*i*	94 kt (174 km/h; 108 mph) IAS
Max cruising speed: 300C	86 kt (159 km/h; 99 mph)
300CB, 300CB*i*	80 kt (148 km/h; 92 mph)
Speed for max range, at FL40	67 kt (124 km/h; 77 mph)
Max rate of climb at S/L: 300C	229 m (750 ft)/min
300CB, 300CB*i*	381 m (1,250 ft)/min
Hovering ceiling: IGE: 300C	3,290 m (10,800 ft)
300CB, 300CB*i*	2,135 m (7,000 ft)
OGE: 300C	2,620 m (8,600 ft)
300CB, 300CB*i*	1,465 m (4,800 ft)
Range at FL40, 2 min warm-up, max normal fuel, no reserves	208 n miles (386 km; 240 miles)
Max endurance at S/L: 300C	3 h 48 min
300CB, 300CB*i*	3 h 18 min

SCHWEIZER 330 and 333

TYPE: Four-seat helicopter.

PROGRAMME: Announced 1987; first flight in public (N330ST; converted from a 300C) 14 June 1988; FAA certification September 1992. Italian certification April 2002. Deliveries started mid-1993. Three sets of controls available for student training. Model 330SP is marketing designation; type is 269D. Production rate one per month in 2004.

CURRENT VERSIONS: **330:** Original version delivered from 1993.

330SP: Announced May 1997, incorporates larger main rotor hub, increased blade chord and raised landing gear. Modifications can be retrofitted to existing 330s.

333: Announced early 2000 as an upgraded version of the 330SP; lead customer was San Antonio Police Department (two aircraft). FAA certification awarded 28 September 2000, at which time first three already delivered. 330SP can be upgraded to 333 standard. Differences include new cambered wider chord aerofoil main rotor blades, larger diameter rotor system, increased height landing gear and increased transmission rating. Chinese designation **Shen 4T**.

Five-seat version under study in 2003 for Indonesian Police Force requirement for up to 35 helicopters, with initial procurement expected to total 16 to 18.

Details apply to 333 unless otherwise stated.

RQ-8A MQ-8B Fire Scout: Schweizer 333 selected as airframe basis for Northrop Grumman Model 379 VTOL tactical UAV for US Army and Navy (see *Jane's Unmanned Aerial Vehicles and Targets*) for which a USD93.7 million contract was awarded on 10 February 2000. In late March 2003, Schweizer began flight tests of a 333 (original prototype N330ST) equipped with a four-blade main rotor destined for the Q-8.

CUSTOMERS: Operated in Belgium, India, Japan, Netherlands, Panama, Poland, Sweden, Switzerland and US. Recent customers include Chesapeake Bay Helicopters of Virginia and Aero Optics Inc of Wisconsin, which have each taken delivery of a 333 for powerline/pipeline inspection and other aerial work duties; the Dominican Air Force, which took delivery of four 333s in 2004 for pilot training and airborne patrol; the Mexican Procuraduria General de la Republica's Agencia General de Investigacion, which ordered eight (and may receive up to 28) delivered from 2004 for law enforcement, border patrol and drug interdiction; and Total Air Management Services (TAM) of the UK, which has ordered four to be used on gas pipeline patrols.

Three aircraft delivered in 1993; five in 1994, plus one prototype and one demonstrator; five in 1996, five in 1997, three in 1998, one in 1999, six in 2000, four in 2001; two in 2002; three in 2003; eight in 2004 and six in 2005, for a total of 53, excluding two Fire Scout prototypes.

COSTS: USD607,500 for 333 (2001). Direct operating cost USD100.64 per hour; operating cost including reserves USD178.54 per hour (both 2006).

DESIGN FEATURES: Developed from Model 300C, with turbine power, enclosed engine and tapered tailboom. Civil roles include law enforcement, scout/observation, aerial photography, light utility, agricultural spraying and personal transport; uses turbine fuel rather than scarcer Avgas; extremely low flat rating of engine for good hot-and-high performance; streamlined external envelope and large tailplane with endplate fins added during development; rotor rpm 471.

FLYING CONTROLS: Similar to 300C; see Design Features.

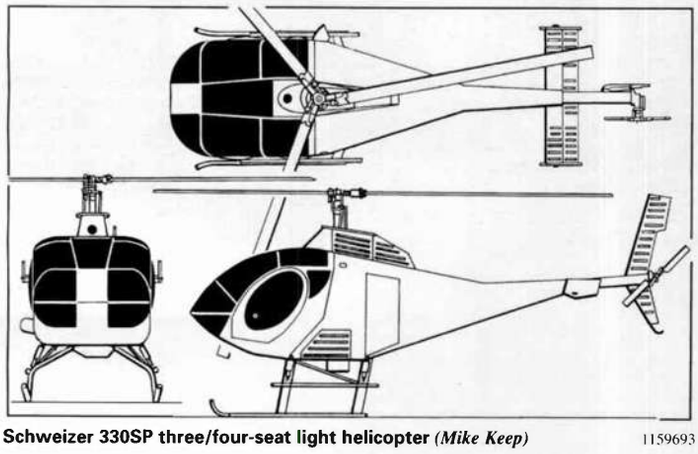
STRUCTURE: Generally similar to 300C.

POWER PLANT: *330/330SP:* One 313.2 kW (420 shp) Rolls-Royce 250-C20W turboshaft derated to 175 kW (235 shp). Transmission rating 175 kW (235 shp) for T-O; 164 kW (220 hp) maximum continuous. Fuel contained in cash-resistant tank, maximum usable capacity 276 litres (73.0 US gallons; 60.8 Imp gallons).

333: One 313.2 kW (420 shp) Rolls-Royce 250-C20W turboshaft derated to 173 kW (232 shp). Transmission rating 209 kW (280 shp) for T-O; 173 kW (232 shp) maximum continuous. Fuel capacity as 330SP.

ACCOMMODATION: Three persons side by side (central occupant slightly forward), with up to three sets of controls; four point inertia reel seat belts. Fourth occupant in 'high density' configuration (central seat replaced by double seat). Cabin ventilated.

Schweizer 333 operated by Aero Optics of Wisconsin *(Paul Jackson)* 1159745



Schweizer 330SP three/four-seat light helicopter *(Mike Keep)* 1159693

SYSTEMS: Engine inlet anti-ice system; 24 V 30 Ah lead-acid battery; 150 A starter/generator; external APU plug; circuit breaker protection.

AVIONICS: *Instrumentation:* Tachometer, engine torquemeter, engine oil temperature and pressure indicators; electric digital OAT, turbine outlet temperature indicator; annunciator warning panel.

Mission: Law enforcement options include FLIR, video recorder, Spectrolab SX-5 Starburst searchlight, Pronet and Litton computer system.

DIMENSIONS, EXTERNAL:

Main rotor diameter	8.38 m (27 ft 6 in)
Tail rotor diameter	1.30 m (4 ft 3 in)
Length overall, rotors turning	9.50 m (31 ft 2 in)
Fuselage: Length	6.82 m (22 ft 4½ in)
Max width	1.72 m (5 ft 7¾ in)
Height overall	3.35 m (11 ft 0 in)
Width overall	2.04 m (6 ft 8½ in)
Tailplane span	2.04 m (6 ft 8½ in)
Skid track	1.92 m (6 ft 3½ in)

DIMENSIONS, INTERNAL:

Cabin: Max width	1.84 m (6 ft 0½ in)
Length	1.98 m (6 ft 6 in)
Height at seat	1.35 m (4 ft 5¼ in)

AREAS:

Main rotor disc area	55.20 m² (594.2 sq ft)
Tail rotor disc area	1.32 m² (14.20 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	567 kg (1,250 lb)
Max T-O weight	1,156 kg (2,550 lb)
Max disc loading	20.95 kg/m² (4.29 lb/sq ft)
Transmission loading at max T-O weight and power	5.54 kg/kW (9.11 lb/shp)

PERFORMANCE:

Never-exceed speed (VNE)	120 kt (222 km/h; 138 mph)
Normal cruising speed	105 kt (194 km/h; 121 mph)
Econ cruising speed	94 kt (174 km/h; 108 mph)
Max rate of climb at S/L	420 m (1,380 ft)/min
Hovering ceiling at MTOW: IGE	2,713 m (8,900 ft)
OGE	1,798 m (5,900 ft)
Max range at FL40, no reserves	310 n miles (574 km; 356 miles)
Max endurance, no reserves	4 h 6 min

SEASTAR

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Seastar has undertaken a fundamental redesign of the Seawind amphibian which it now offers complete or as a kit. The next product will be the Adventurer turbo-powered version; other versions planned include an armed version for patrol work and a search and rescue equipped model.

The company is establishing a 5,000 m² (53,820 sq ft) facility in Hungary where certified aircraft will be built before being transferred to the USA for completion.

SEASTAR SEASTAR and LAKESTAR

TYPE: Six-seat amphibian kitbuilt.

PROGRAMME: Production prototype Seawind first flew 23 August 1982. Progressed through several versions, last of which built by Seawind International Inc of Canada.

Compared to Seawind, the completely new design SeaStar offers a changed aerofoil, single-piece Fowler flaps, gull-wing cabin doors and stainless steel landing gear. Adapted for optional pressurisation and alternative diesel and turboprop engines. Prototype (N601SS) exhibited, partly complete, at Sun 'n' Fun, April 2000; first flown 12 November 2000; by April 2002, 111 hours had been flown and certification programme begun with certification expected 2005–06; however, by April 2004 certification was no longer planned. By this date, prototype reported to have flown 601 hours.

CURRENT VERSIONS: **SeaStar TSP-350:** Piston-engined version, *as described.* Initially marketed as SeaStar 7T and SeaStar 200.

SeaStar TSP-350P: As TSP-350 but pressurised. Initially marketed as SeaStar 7P and SeaStar 300.

SeaStar T-724: Non-pressurised turbine model. Option of longer-span wing.

SeaStar T-724P: Pressurised turbine model. Option of longer-span wing.

SeaStar 400: Certified version, under development.

SeaStar 500: Military rescue, patrol and law enforcement version. Initially marketed as SeaStar 400.

LakeStar: Lower-powered four seat version.

CUSTOMERS: Several kits under construction by end 2001; company assisting with completion of first ten; over 30 deposits taken by April 2002; however, by October 2005 none appeared to be complete.

COSTS: Kits: LakeStar USD89,950; TSP-350 USD109,000; TSP-350P USD129,000; T-724 USD119,000; T-724P USD129,000 (all 2006). Estimated total cost to first flight USD300,000, depending on engine choice.

SeaStar SeaStar multipurpose amphibian *(Paul Jackson)* 1047387

DESIGN FEATURES: Unconventional configuration; shoulder wing with stabilising floats at tips; long-chord fin mounts engine and tailplane at mid-position, shielding propeller from water spray. Optional longer-span wing for high-altitude operations. Quoted build time 3,000 hours.

FLYING CONTROLS: Conventional and manual. Full-span elevator with two flight-adjustable tabs; ground-adjustable tab on rudder; flight-adjustable tab in port aileron. Electrically operated two-section slotted flaps, max deflection 40°.

STRUCTURE: Carbon fibre throughout; stainless steel landing gear. Wing aerofoil GA37A315.

POWER PLANT: *TSP-350:* One 261 kW (350 hp) Textron Lycoming IO-540-J2BD driving four-blade reversible pitch MT propeller. Normal fuel capacity of 379 litres (100 US gallons; 83.3 Imp gallons); option of adding extra 151 litre (40.0 US gallons; 33.3 Imp gallons) auxiliary tank.

T-724P: One 562 kW (754 shp) Walter 601E driving a three- or five-blade reversible pitch Avia propeller. Other options include Walter 601F and, for military versions, Pratt and Whitney Canada PT-6. Normal fuel capacity 606 litres (160 US gallons; 133 Imp gallons); option of adding extra 227 litre (60.0 US gallon; 50.0 Imp gallon) auxiliary tank.

LakeStar: One 172 kW (230 hp) Wankel Diesel engine.

LANDING GEAR: Tricycle type; electrically retractable; spring steel legs. Mainwheels are 7.00–6, have hydraulic brakes and retract upwards into wing; steerable 6.00–6 nosewheel retracts forwards.

ACCOMMODATION: Two front seats and bench for three passengers in rear. Four centreline-hinged, upward-opening doors in piston-engined version.

ARMAMENT: Military version has provision for total of four underwing pylons.

DIMENSIONS, EXTERNAL:

Wing span: standard	11.58 m (38 ft 0 in)
optional	12.80 m (42 ft 0 in)
Length overall	10.06 m (33 ft 0 in)
Height overall: TSP-350P	3.20 m (10 ft 6 in)
T-724P	3.35 m (11 ft 0 in)
Baggage door: Width	0.76 m (2 ft 6 in)
Height	0.69 m (2 ft 3 in)

DIMENSIONS, INTERNAL:

Cabin: Length	3.25 m (10 ft 8 in)
Width: at front	1.35 m (4 ft 5 in)
at rear	1.52 m (5 ft 0 in)
Height	1.08 m (3 ft 6½ in)
Baggage compartment: Length	1.83 m (6 ft 0 in)
Volume	0.48 m³ (16.88 cu ft)

AREAS:

Wings, gross	15.89 m² (171.0 sq ft)

WEIGHT AND LOADINGS:

Weight empty: TSP-350P	1,293 kg (2,850 lb)
T-724P	1,338 kg (2,950 lb)
LakeStar	975 kg (2,150 lb)
Max T-O weight: TSP-350P	1,814 kg (4,000 lb)
T-724P	2,268 kg (5,000 lb)
LakeStar	1,383 kg (3,050 lb)
Max wing loading: TSP-350P	114.2 kg/m² (23.39 lb/sq ft)
T-724P	142.8 kg/m² (29.24 lb/sq ft)
LakeStar	87.1 kg/m² (17.84 lb/sq ft)
Max power loading: TSP-350P	6.96 kg/kW (11.43 lb/hp)
T-724P	4.04 kg/kW (6.63 lb/shp)
LakeStar	8.07 kg/kW (13.26 lb/hp)

PERFORMANCE:

Normal cruising speed: at FL20: TSP-350P	185 kt (343 km/h; 213 mph)
T-724P	231 kt (428 km/h; 266 mph)
at FL15: LakeStar	149 kt (277 km/h; 172 mph)
Stalling speed, flaps down: TSP-350P, T-724P	54 kt (100 km/h; 62 mph)
LakeStar	47 kt (87 km/h; 54 mph)
Max rate of climb at S/L: TSP-350P, LakeStar	267 m (875 ft)/min
T-724P	610 m (2,000 ft)/min
Service ceiling: TSP-350P, T-724P	7,010 m (23,000 ft)
T-O run from water: TSP-350P	290 m (950 ft)
T-724P	235 m (770 ft)
LakeStar	412 m (1,350 ft)
Range: TSP-350P	1,215 n miles (2,251 km; 1,399 miles)
T-724P	1,203 n miles (2,228 km; 1,385 miles)
LakeStar	999 n miles (1,850 km; 1,150 miles)

SEAWIND

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PRESIDENT AND CEO: Richard Silva
SALES DIRECTOR: Dave Arnold

Seawind announced in 2003 that it was pursuing certification for its Seawind 300C amphibian, a derivative of the earlier Seawind 2000 and 3000. Production will be in a new 7,620 m² (82,000 sq ft) plant at St Jean-sur-Richelieu Canada, for which a government loan of CAD2.8 million was awarded in mid-2006; marketing sales and service are handled by a facility at Chester County Airport, Pennsylvania.

In third quarter of 2004, Seawind announced a delay in operations because of a 20 per cent shortfall in funding; by August 2005, operations had recommenced and the first conforming test aircraft made its first flight on 31 August 2006; VFR certification then expected by year end with further options following soon after.

SEAWIND SEAWIND 300C

TYPE: Four-/five-seat amphibian.

PROGRAMME: Developed from Seawind 2000 through Seawind 3000, which first flew 23 August 1982; both versions sold as kits; now discontinued.

Factory-constructed Seawind 300C was being prepared for certification in late 2004 by FAA and Transport Canada, with deliveries to start in mid-2006, but these targets were not met. Trials aircraft N46SW had flown 2,000 hours and made 1,308 water landings by July 2005. Certification flying by two preproduction aircraft, first (C-GDBS) having been due to fly in March 2004 but failed to do so and subsequently schduled to start third quarter 2005; first flight took place on 31 August 2006. Authorisation to produce seven aircraft prior to completion of flight testing awarded; these aircraft to be used for tooling and training purposes.

CUSTOMERS: Total of 130 kits sold and 75 flying by August 2005, at which time six certified aircraft had been sold and deposits on a further 33 taken. Further sales achieved AirVenture '05 to bring total to 46 and had reached 80 by the end of September 2006. Deliveries set at 24 for first year, rising to 60 the following year and 100 thereafter.

COSTS: USD324,900. VFR-equipped; IFR USD38,000 extra; glass cockpit adds further USD28,000 (2006).

DESIGN FEATURES: Intended to be first-ever composites amphibian to receive certification. Rotation of engine pod enables aircraft to back away from beach or dock; four flotation compartments and composite foam core design intended to make aircraft almost unsinkable.

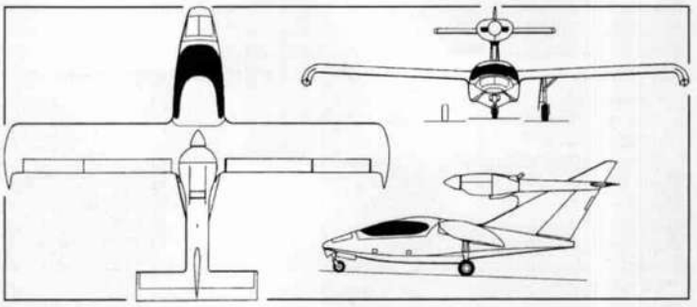
FLYING CONTROLS: Conventional and manual. Slotted flaps on laminer flow wing.

STRUCTURE: Entire aircraft constructed from glass fibre, vinylester resin and foam composites. Glass fibre main and aft spars. Vertical tail is stressed skin and bulkhead structure to support cantilevered engine.

LANDING GEAR: Tricycle type; retractable. Trailing-link main gear, nosewheel retracts rearwards. Single-step hull with stabilising floats in downturned wingtips. Honda outboard motor mounted internally for manoeuvring on water.

POWER PLANT: One 231 kW (310 hp) Textron Lycoming IO-550N flat-six, driving Hartzell Scimitar three-blade, constant-speed propeller in prototype: optional FADEC. Fuel capacity 303 litres (80.0 US gallons; 66.6 Imp gallons) in main fuel tanks with option to increase to 416 litres (110 US gallons; 91.6 Imp gallons).

First preproduction Seawind 300C on maiden flight 1040478



Seawind 300C ***(Paul Jackson)*** 1164903

ACCOMMODATION: Pilot and three or four passengers in enclosed cabin. Front bucket seats move forward and aft; rear seats hinge forward for access to cabin baggage area and are easily removable. Retractable cargo net.

SYSTEMS: 28 V electrical system with 70A alternator.

AVIONICS: Two packages available. Optional IFR layouts include full 'glass cockpit' from SAGEM with GMX200 moving map, GNS430 GPS/com, SL 30 nav/com and GL 106A CDI. and EFIS displays.

Comms: Garmin GMA 340 audio panel, GNC 250XL GPS/com, GTX 327 transponder. Optional traffic information service.

Radar: Optional XM GDL 69 weather radar.

Flight: Optional S-Tec autopilot; optional lightning detection, optional GDL 90 ADS-B.

EQUIPMENT: Automatic bilge pump; optional 1.8 kW (2.5 hp) retractable water-cooled engine for manoeuvring.

DIMENSIONS, EXTERNAL:

Wing span	10.67 m (35 ft 0 in)
Wing aspect ratio	7.4
Length overall	8.28 m (27 ft 2 in)
Height overall	3.10 m (10 ft 2 in)
Propeller diameter	1.93 m (6 ft 4 in)
Baggage door: Height	0.48 m (1 ft 7 in)
Width	1.02 m (3 ft 4 in)
Propeller diameter	1.93 m (6 ft 4 in)

DIMENSIONS, INTERNAL:

Cabin: Length	2.67 m (8 ft 9 in)
Max width	1.37 m (4 ft 6 in)
Max height	1.09 m (3 ft 7 in)
Baggage volume: cabin	0.28 m³ (10.0 cu ft)
nose	0.14 m³ (5.0 cu ft)
Freight hold: Length	1.80 m (5 ft 11 in)
Volume	0.85 m³ (30.0 cu ft)

AREAS:

Wings, gross	15.41 m² (165.9 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	1,021 kg (2,250 lb)
Max T-O weight	1,542 kg (3,400 lb)
Max wing loading	100.1 kg/m² (20.49 lb/sq ft)
Max power loading	6.68 kg/kW (10.97 lb/hp)

PERFORMANCE:

Max operating speed	173 kt (321 km/h; 200 mph)
Max cruising speed at 75% power	166 kt (307 km/h; 191 mph)
Normal cruising speed at 65% power	156 kt (290 km/h; 180 mph)
Econ cruising speed at 55% power	147 kt (272 km/h; 169 mph)
Stalling speed, power off:	
flaps up	63 kt (116 km/h; 72 mph)
flaps and wheels down	52 kt (95 km/h; 59 mph)
Max rate of climb at S/L	381 m (1,250 ft)/min
Service ceiling	5,486 m (18,000 ft)
T-O run: land	358 m (1,175 ft)
water	442 m (1,450 ft)
Landing run: land	396 m (1,300 ft)
water	351 m (1,150 ft)
Range, no reserves:	
with normal fuel	903 n miles (1,673 km; 1,040 miles)
with max fuel	1,260 n miles (2,333 km; 1,450 miles)

SEQUOIA

SEQUOIA AIRCRAFT CORPORATION

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PRESIDENT: Alfred P Scott

Sequoia has marketed the F.8L Falco since 1979, both as plans and kit.

SEQUOIA FALCO F.8L

TYPE: Side-by-side lightplane/kitbuilt.

PROGRAMME: Designed by Stelio Frati, Falco first flew (I-RAID) in Italy on 15 June 1955. Initial batch of 10 Series I (101 kW; 135 hp Lycoming 0-290-D2B) built by Aviamilano at Milan, followed by 10 Series II (112 kW; 150 hp 0-320-A2A). Production rights acquired by Caproni and manufacture transferred to Aeromere at Trento, where 36 Series III Falco Americas built for US market, gaining FAA certification on 26 June 1961. Programme taken over by successor company Laverda in 1964; Super Falco Series IV (119 kW; 160 hp 0-320-B3) production totalled 20 up to 1968.

Design rights acquired by 1978 by Alfred Scott; drawings converted to 'US' Imperial standards by Scott and David Thurston and initially marketed as plans by Sequoia; first plans aircraft (N33LW) built by Larry Wohlers and flown 14 June 1982. Shortly after, Sequoia added kit option and first thus constructed (N545SF) was flown by builder Dave Aronson on 20 July 1984, also being second Sequoia aircraft airborne.

CUSTOMERS: Total of 86 Sequoia aircraft flown by 23 September 2006, in Australia, Brazil, Canada, Chile, France, Germany, Italy, Netherlands, New Zealand, Norway, South Africa, UK and USA.

COSTS: Kit: 160 hp USD106,440, 180 hp USD106,455, including propeller but excluding engine, main landing gear wheels and brakes.

DESIGN FEATURES: Streamlined low-wing, retractable-gear monoplane. Quoted build time 2,000 hours.

NACA $64_2212.5$ wing section at root, NACA 64_2210 at tip. Wing dihedral 5° 30', washout 3°. Tailplane section NACA 65009.

FLYING CONTROLS: Conventional and manual. No aerodynamic balances. Control surface movements: ailerons +24/–16°; elevators +22/–16°; rudder ±20°; flap deflection 45° max. Elevator trim tab flight-adjustable.

STRUCTURE: Entire airframe has plywood-covered wood structure, with overall fabric covering and glass fibre wing fillets. Optional metal control surfaces.

LANDING GEAR: Tricycle type; retractable. Mainwheels retract inwards; nosewheel rearwards. Steerable nosewheel. Cleveland single calliper disc brakes. 5.00–5 mainwheels and 4.00–5 nosewheel. Oleo shock-absorbers on all legs.

POWER PLANT: One 119 kW (160 hp) Textron Lycoming IO-320-B1A is standard for kitbuilt aircraft, driving Hartzell HCC-ZYL-1BF/F7663-4 two-blade constant-speed metal propeller. Optional engines for which Sequoia offers installation kits are the 112 kW (150 hp) IO-320-A1A and 134 kW (180 hp) IO-360-B1E. Fuel in two tanks, fore and aft, combined capacity 151 litres (40.0 US gallons; 33.3 Imp gallons). Optional 11.4 litre (3.0 US gallon; 2.5 Imp gallon) header tank to permit inverted flight.

Sequoia F.8L Falco with fintop camera *(Paul Jackson)* 1158595

ACCOMMODATION: Two seats, side by side; child's seat or baggage area to rear. Dual controls. Low profile Nustrini canopy optional.

DIMENSIONS, EXTERNAL:

Wing span	8.00 m (26 ft 3 in)
Wing chord: at root	1.65 m (5 ft 5 in)
at tip	0.83 m (2 ft 8½ in)
Wing aspect ratio	6.4
Length overall	6.63 m (21 ft 9 in)
Height overall	2.29 m (7 ft 6 in)
Tailplane span	2.71 m (8 ft 10½ in)
Wheel track	2.08 m (6 ft 10 in)
Wheelbase	1.50 m (4 ft 11 in)
Propeller diameter	1.83 m (6 ft 0 in)

DIMENSIONS, INTERNAL:

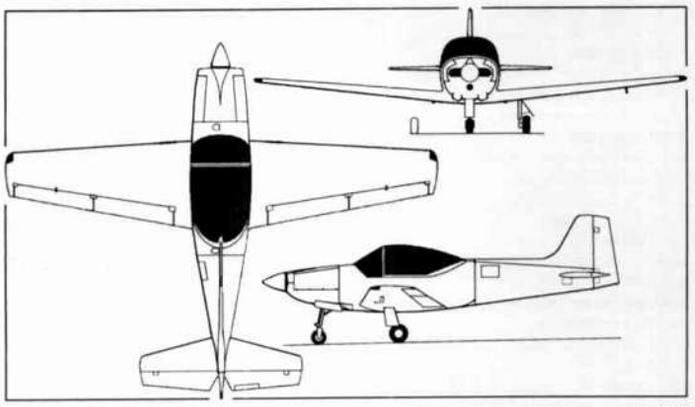
Cabin max width	1.07 m (3 ft 6 in)

AREAS:

Wings, gross	10.00 m² (107.6 sq ft)
Fin	1.01 m² (10.88 sq ft)
Rudder	0.48 m² (5.20 sq ft)
Tailplane	1.34 m² (14.44 sq ft)
Elevator	0.83 m² (9.00 sq ft)

WEIGHTS AND LOADINGS (119 kW; 160 hp engine):

Weight empty	550 kg (1,212 lb)
Payload with max fuel	194 kg (428 lb)
Baggage capacity	41 kg (90 lb)



Sequoia F.8L Falco *(Paul Jackson)* 1158558

Max aerobatic weight	748 kg (1,650 lb)
Max T-O weight	852 kg (1,880 lb)
Max wing loading	85.3 kg/m² (17.47 lb/sq ft)
Max power loading	7.15 kg/kW (11.75 lb/hp)

PERFORMANCE (119 kW; 160 hp engine):

Never-exceed speed (VNE)	208 kt (386 km/h; 240 mph)
Max level speed at S/L	184 kt (341 km/h; 212 mph)
Cruising speed at 75% power	165 kt (306 km/h; 190 mph)
Stalling speed: clean	66 kt (121 km/h; 75 mph)
flaps and wheels down	54 kt (100 km/h; 62 mph)
Max rate of climb at S/L	347 m (1,140 ft)/min
Service ceiling	5,790 m (19,000 ft)
T-O run	174 m (570 ft)
T-O to 15 m (50 ft)	351 m (1,150 ft)
Landing from 15 m (50 ft)	351 m (1,150 ft)
Landing run	229 m (750 ft)
Range at econ cruising speed	869 n miles (1,609 km; 1,000 miles)
Endurance	4 h 24 min
g limits	+6/−3

SHERPA

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DIRECTORS:
Byron Root
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Sherpa Aircraft is in the process of certifying the Sherpa 300 derivative of its earlier six-seat aircraft version. In 2001, the company announced that it had entered into a joint venture agreement with Khrunichev (Russia) which would result in parts being manufactured in Moscow and Sherpa marketing the T-411 Aist and Aviotechnica SL-90. Sherpa is expanding its manufacturing facility at Scappoose, Oregon, at present 1,400 m² (15,000 sq ft), to accommodate increased production; in August 2006 it announced that builders would attend a mandatory builder assist programme at Scappoose.

SHERPA SHERPA

TYPE: Light utility transport.

PROGRAMME: Development of the Sherpa series began in 1991, with first prototype (N1415B) making debut at Oshkosh in July 1994; by August 2006 it had accumulated 1,600 flying hours. Second prototype (N711SA) first flown 1995; both prototypes five-seat versions. Third prototype (N712SA), shown at AirVenture 2001, is the eight-seat Sherpa C-400 version. All versions use same airframe, except for modified wings on K-200, K-300 and C-400. By August 2003, construction of the first K-200 was underway.

In August 2004, the first two aircraft from Russia were delivered to Sherpa for assembly.

CURRENT VERSIONS: **Sherpa:** Original six-place version; kit production under consideration.

Sherpa K-200: Five/six-seat version; under development. Reduced wing span and area. Prototype was due to fly third quarter 2005; this later slipped to April 2006, following redesign to accept new engines.

Sherpa K-300: Six-seat version; main differences from K-200 are in cabin and CG envelope; third airframe due to be complete by June 2005, later slipped to March 2006.

Sherpa C-400: Eight-seat version; *as described unless otherwise stated.*

Floatplane Sherpa second prototype N711SA *(Paul Jackson)* 1040497

Sherpa C-500T: Proposed certified eight/10-seat version.

Sherpa K-500T: Turbine-powered eight-seater; same airframe as C-400; wing displayed at AirVenture '04, at which time it was hoped that the first K-500T would be flying by April 2005; at AirVenture '06 a new, improved set of wings had been fitted to N712SA, which had previously served as the C-400 prototype.

Sherpa C-700T: Proposed 10-seat version.

CUSTOMERS: Three flying by end 2001.

COSTS: Sherpa K-200: USD119,000; Sherpa K-300: USD139,000; Sherpa K-500T: USD225,000, Sherpa C-400: USD425,000; Sherpa C-500T: USD750,000; C-700T: USD895,000 (2005).

DESIGN FEATURES: Optimised for use in inhospitable terrain, with STOL performance, strengthened landing gear, option for large tyres and easy maintenance access.

Constant-chord, high-mounted wing with V bracing struts and auxiliary struts; wire-braced empennage. Tail surfaces have rounded tips and horn balances. Fully glazed flight deck door.

FLYING CONTROLS: Conventional and manual. Two-track Fowler flaps increase wing area by 15 per cent when fully deployed at 40°. Inboard trim tab each side above flap. Tabs on rudder and starboard elevator adjustable in flight, as is tailplane incidence.

STRUCTURE: Steel 4130 fuselage frame has fabric covering aft and metal sheet covering forward of cabin. Fabric-covered 4130 steel tube wing has metal leading-edges and control surfaces. Fabric-covered steel tube empennage. Graphite composites nose cowlings. Single-piece 6 mm (¼ in) thick wrap-round windscreen.

LANDING GEAR: Tailwheel type; fixed. Standard tyre size 29×11.0–10; optional 1.07 m (42 in) Tundra tyres can be fitted. Cleveland hydraulic brakes. Optional floats, wheeled floats and skis; conversion time quoted as 90 minutes.

POWER PLANT: *Sherpa K-200:* One 265 kW (355 hp) VOKBM M-14X nine-cylinder radial. Fuel capacity 530 litres (140 US gallons; 117 Imp gallons).

Sherpa K-300T, C-500T and *C-700T*: One 560 kW (751 shp) Walter M 601 turboprop driving a three-blade propeller. Fuel capacity 852 litres (225 US gallons; 187 Imp gallons).

Sherpa K-300 and *C-400*: One 347 kW (465 hp) Textron Lycoming TIO-720-X152 flat-eight driving a three-blade Hartzell F8483 propeller. Normal fuel capacity 568 litres (150 US gallons; 125 Imp gallons) in six individually removable tanks.

ACCOMMODATION: Pilot and up to seven passengers on individual seats with central aisle; seats can be removed individually to allow carriage of freight (up to 10 empty 208 litre (55.0 US gallon; 45.8 Imp gallon) drums or two casualties plus two attendants. Double door on starboard side of fuselage for cabin; individual doors for crew positions. Additional baggage door on starboard side aft of cabin area.

SYSTEMS: 12 V electrical system.

AVIONICS: Honeywell avionics suite plus S-Tek autopilot.

DIMENSIONS, EXTERNAL (all, except where indicated):

Wing span: C-500T, K-500T	13.72 m (45 ft 0 in)
K-200, K-300, C-400	13.41 m (44 ft 0 in)
Wing chord, constant	1.85 m (6 ft 1 in)
Wing aspect ratio	7.3
Length overall	9.96 m (32 ft 8 in)
Height overall	2.87 m (9 ft 5 in)
Tailplane span	5.03 m (16 ft 6 in)
Wheel track	2.69 m (8 ft 10 in)
Propeller diameter	2.54 m (8 ft 4 in)
Propeller ground clearance	0.69 m (2 ft 3 in)
Cabin door: Height	1.12 m (3 ft 8 in)
Width	1.55 m (5 ft 1 in)
Baggage door: Height	0.51 m (1 ft 8 in)
Width	0.76 m (2 ft 6 in)

DIMENSIONS, INTERNAL (all):
- Cabin volume ... 4.42 m³ (156 cu ft)
- Baggage hold ... 0.36 m³ (12.7 cu ft)

AREAS (all, except where indicated):
- Wings, gross: C-500T, K-500T ... 25.55 m² (275.0 sq ft)
- K-200, K-300, C-400 ... 24.71 m² (266.0 sq ft)
- Ailerons (total) ... 1.83 m² (19.7 sq ft)
- Trailing-edge flaps (total) ... 4.51 m² (48.5 sq ft)
- Spoilerons (total) ... 0.39 m² (4.2 sq ft)
- Fin ... 1.24 m² (13.4 sq ft)
- Rudder, incl tab ... 1.37 m² (14.7 sq ft)
- Tailplane ... 2.81 m² (30.3 sq ft)
- Elevators, incl tab ... 2.39 m² (25.7 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty: K-200 ... 1,252 kg (2,760 lb)
- K-300 landplane ... 1,390 kg (3,065 lb)
- K-300T ... 1,393 kg (3,070 lb)
- C-400 ... 1,445 kg (3,185 lb)
- C-500T ... 1,427 kg (3,146 lb)
- Max T-O weight: K-200 ... 1,846 kg (4,070 lb)
- K-300: landplane ... 2,268 kg (5,000 lb)
- floatplane ... 2,404 kg (5,300 lb)
- K-300T ... 2,494 kg (5,500 lb)
- C-500T ... 2,844 kg (6,270 lb)
- Max wing loading: K-200 ... 74.7 kg/m² (15.30 lb/sq ft)
- K-300: landplane ... 87.8 kg/m² (17.99 lb/sq ft)
- floatplane ... 93.1 kg/m² (19.06 lb/sq ft)
- K-300T ... 96.6 kg/m² (19.78 lb/sq ft)
- C-500T ... 110.1 kg/m² (22.55 lb/sq ft)
- Max power loading: K-200 ... 6.98 kg/kW (11.46 lb/hp)
- K-300: landplane ... 6.54 kg/kW (10.75 lb/hp)
- floatplane ... 6.94 kg/kW (11.40 lb/hp)
- K-300T ... 4.46 kg/kW (7.33 lb/hp)
- C-500T ... 5.09 kg/kW (8.36 lb/hp)

PERFORMANCE:
- Max operating speed:
- K-200 ... 123 kt (229 km/h; 142 mph)
- K-300T ... 182 kt (338 km/h; 210 mph)
- Max cruising speed: K-300 ... 132 kt (245 km/h; 152 mph)
- K-300T ... 162 kt (301 km/h; 187 mph)
- C-400 ... 140 kt (259 km/h; 161 mph)
- Normal cruising speed at 75% power: K-200 ... 105 kt (195 km/h; 121 mph)
- C-400 ... 144 kt (267 km/h; 166 mph)
- C-500T ... 162 kt (301 km/h; 187 mph)
- Econ cruising speed: K-300 ... 120 kt (222 km/h; 138 mph)
- K-300T ... 146 kt (270 km/h; 168 mph)
- C-400 ... 129 kt (238 km/h; 148 mph)
- Stalling speed:
- flaps up: K-200 ... 51 kt (94 km/h; 58 mph)
- K-300, K-300T, C-400 ... 54 kt (100 km/h; 62 mph)
- flaps down: K-200 ... 35 kt (65 km/h; 40 mph)
- K-300 ... 40 kt (73 km/h; 45 mph)
- K-300T, C-400 ... 42 kt (78 km/h; 48 mph)
- C-500T ... 46 kt (84 km/h; 52 mph)
- Max rate of climb at S/L:
- K-200, C-400 ... 300 m (985 ft)/min
- K-300 ... 274 m (900 ft)/min
- K-300T ... 509 m (1,670 ft)/min
- Service ceiling: K-200 ... 5,030 m (16,500 ft)
- K-300 ... 5,640 m (18,500 ft)
- K-300T, C-400 ... 7,620 m (25,000 ft)
- T-O run: K-200 ... 119 m (390 ft)
- K-300 ... 159 m (522 ft)
- K-300T ... 108 m (355 ft)
- C-400 ... 151 m (494 ft)
- Landing run: K-200 ... 104 m (340 ft)
- K-300 ... 122 m (400 ft)
- K-300T ... 81 m (265 ft)
- C-400 ... 86 m (283 ft)
- Range at max cruising speed:
- K-300 ... 938 n miles (1,738 km; 1,080 miles)
- K-300T ... 1,147 n miles (2,124 km; 1,320 miles)
- C-400 ... 833 n miles (1,543 km; 959 miles)
- Range at econ cruising speed:
- K-300T ... 1,364 n miles (2,526 km; 1,570 miles)
- C-400 ... 943 n miles (1,747 km; 1,086 miles)

SIKORSKY

SIKORSKY AIRCRAFT (SUBSIDIARY OF UNITED TECHNOLOGIES CORPORATION)

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VICE-PRESIDENT, FINANCE AND CFO: Peter Longo
VICE-PRESIDENT, GOVERNMENT BUSINESS DEVELOPMENT: Joseph Haddock
COMMUNICATIONS MANAGER: Ed Steadham

Founded as Sikorsky Aero Engineering Corporation in 1923 by late Igor I Sikorsky; has been division of United Technologies Corporation since 1929, but established as a subsidiary with effect 1 January 1995; began helicopter production in 1940s.

Headquarters and main plant at Stratford, Connecticut; also has manufacturing facilities elsewhere in Connecticut; other smaller facilities in Alabama, Florida and New York. Main current programmes include UH-60 Black Hawk and derivatives, S-76 series and, in co-operation with international partners, S-92 Helibus. Revenues in 2005 totalled USD2.8 billion, representing a 12% increase on 2004.

Sikorsky licensees include Agusta of Italy, Eurocopter of France and Germany, Korean Air Lines of South Korea, Mitsubishi of Japan, Pratt & Whitney Canada Ltd and UK element of AgustaWestland. Sikorsky and Embraer of Brazil signed agreement in mid-1983 to transfer technology covering design and manufacture of composites components. Sikorsky and CASA of Spain signed MoU in June 1984 covering long-term helicopter industrial co-operation programme; CASA builds tail rotor pylon, tailcone and stabiliser components for H-60 and S-70, with first CASA S-70 components delivered to Sikorsky January 1986. Another overseas venture, in collaboration with the Alpata Group of Turkey, concerns creation of Alp Aviation, which manufactures high-technology, precision-machined aerospace and defence components in 6,500 m² (70,000 sq ft) facility in Eskisehir. Most recent international venture launched 20 September 2006, when Sikorsky signed strategic MoU with PZL Mielec of Poland; this expected to lead to agreements whereby PZL would establish an assembly centre for production of the International Black Hawk helicopter. At that time, it was anticipated that a firm contract would follow in November, with the first Polish-assembled fuselage to be completed within 18 to 24 months of contract signature and the first complete helicopter in 2010.

In October 1998, Sikorsky purchased Helicopter Support Inc, so as to offer enhanced support to helicopter operators on worldwide basis. In latter half of 1998, Sikorsky also secured US$150 million deal with US Navy covering contractor maintenance of jet trainer aircraft as well as HH-1N Iroquois and UH-3H Sea King helicopters. Overall responsibility for latter allocated to Sikorsky Support Services Inc, with the work undertaken at Meridian, Mississippi; Pensacola, Florida; and Corpus Christi, Texas. Sikorsky portfolio and product line significantly expanded with acquisition of Schweizer Aircraft Corporation in latter half of 2004. Schweizer name to be retained, along with production facilities at Elmira, New York; construction of new facilities at Elmira due for completion in early 2007 and will function as primary completion centre for all UH-60 and MH-60 derivatives for US Army, US Navy and overseas customers. Previously, in 2003, joint venture Shanghai Sikorsky Aircraft Company established to manufacture and market Schweizer light helicopters in China.

SIKORSKY CH-53K SUPER STALLION

TYPE: Heavy lift helicopter.

PROGRAMME: Variant of proven CH-53E Super Stallion (refer to *Jane's Aircraft Upgrades*) to meet US Marine Corps' need for more than 150 new-build heavy lift helicopters for delivery between 2014 and 2022, when last examples of CH-53E due to be withdrawn from use. Operational requirements document prepared by Marine Corps by first quarter of 2004 and submitted to US Department of Defense for clearance to proceed with proposal then known as **CH-53X**. Authorisation to go ahead was expected in September 2004, but was initially deferred for six months until second quarter of 2005 and then again delayed until final quarter of 2005. In meantime, Sikorsky awarded risk-reduction contract for renamed **Heavy Lift Replacement (HLR)** in December 2004, using USD34 million of USD103 million allocated by Congress in FY05 budget.

On 22 December 2005, decision taken to proceed immediately with development of HLR, which given **CH-53K** designation; USD8.8 million initial system development and demonstration (ISDD) contract awarded to Sikorsky on 3 January 2006 to cover risk-reduction efforts and selection of partners to produce key subsystems such as cockpit, engines and fuselage. Full funding of SDD came on 5 April 2006, when Sikorsky awarded USD3.0 billion contract for manufacture of five YCH-53Ks (including one dedicated ground test article).

Under original schedule, Sikorsky intended to complete preliminary design review (PDR) by 30 June 2006 and critical design review (CDR) by 30 September 2008, with first flight targeted for mid-2011 and IOC of first operational unit in September 2015. These dates have slipped by several months as a consequence of delay in starting SDD, with PDR now expected to take place late in FY07, followed by CDR in mid-FY09. First flight is still anticipated in 2011, with approval for low rate initial production (LRIP) due early in FY13. IOC is still planned for 2015, with full operational capability to follow in 2021.

CURRENT VERSIONS: **CH-53K:** Version proposed for US Marine Corps.

CUSTOMERS: US Marine Corps anticipates receiving 156 examples of basic CH-53K version. A suitably adapted derivative may eventually be produced to replace MH-53E Sea Dragon mine countermeasures helicopters with US Navy. Export potential also exists, with Sikorsky reported to have had discussions with Eurocopter about co-operation that could extend to establishment of assembly line in Europe to satisfy French and German combined requirement for over 100 heavy lift helicopters.

PLANNED CH-53K PROCUREMENT
(as at mid-2006)

Lot	Ordered	Quantity	Deliveries
1	FY12	6	Late FY14
2	FY13	9	FY15
3	FY14	14	FY16
4	FY15	21	FY17
5	FY16	24	FY18
6	FY17	24	FY19
7	FY18	24	FY20
8	FY19	24	FY21
9	FY20	10	FY22
Total		**156**	

COSTS: Research, development and evaluation expected to cost USD4.4 billion (including USD3.0 billion for SDD phase), with further USD18.8 billion outlay anticipated for procurement; at end of 2005, average flyaway unit cost projected to be USD56.6 million.

DESIGN FEATURES: CH-53K to have 10,000 hour airframe life and will incorporate low maintenance elastomeric rotor hub and high efficiency composites rotor blades with revised aerofoil section and anhedral tips, coupled with new gearbox and new tail rotor head and blades. Improved internal and external cargo handling systems and enhanced survivability features also to be adopted. Air-to-air refuelling capability to be provided, but CH-53K also air transportable by C-5 and C-17. CH-53K has same footprint as CH-53E, but possesses twice the payload/range characteristics.

Model of Sikorsky CH-53K as envisaged in 2006 *(Paul Jackson)* 1158589

POWER PLANT: Three turboshaft engines; proposed HLR was initially expected to have new power plant in the 4,474 kW (6,000 shp) class, although concerns emerging over weight growth in early 2005 may necessitate adoption of a significantly more powerful engine, with a rating of around 5,593 kW (7,500 shp). Marine Corps originally understood to favour Rolls-Royce AE1107C turboshaft on grounds of commonality with Bell Boeing MV-22 Osprey tiltrotor; other contenders include Honeywell's T55-715, Pratt & Whitney Canada's PW 150 and a growth version of the General Electric T64-GE-416 that powers the CH-53E. Power plant selection announcement expected in August or September 2006, with total programme requirement involving about 650 engines at cost of USD1.5 billion. Transmission rating 11,186 kW (15,000 shp). Fuel capacity 8,653 litres (2,286 US gallons; 1,903 Imp gallons).

ACCOMMODATION: Crew of four, plus up to 30 troops on crashworthy seats. Alternatively, can accommodate up to 24 litters in casualty evacuation role. Internal cargo handling system installed, with hold able to take two 463L pallets. Three cargo hooks provided for carriage of external loads, up to maximum of 16,329 kg (36,000 lb); centre hook rated to carry maximum load of 16,329 kg (36,000 lb), with forward and aft hooks each rated at 11,340 kg (25,000 lb) capacity.

AVIONICS: Selection of Rockwell Collins as prime sub-contractor, with responsibility for provision of Avionics Management System (AMS) announced in June 2006. CH-53K to possess joint interoperable 'glass cockpit' including five fully integrated AMLCD multi-function displays, dual integrated processing cabinets (IPCs), dual control display units (CDUs) and dual data transfer units (DTUs). System will provide fully integrated primary flight instrumentation plus crew alerting system and management of displays, vehicle, civil/military flight, navigation and communications equipment. Embedded tactical mission aids include digital moving map, AN/AAQ-29 FLIR video, defensive ECM and tactical display functions.

ARMAMENT: Self-defence gun positioned in each forward door, with FN 0.5 in machine gun on rear ramp.

WEIGHTS AND LOADINGS:

Max underslung load	16,329 kg (36,000 lb)
Max T-O weight	38,419 kg (84,700 lb)

PERFORMANCE:

Unrefuelled radius of action with 12,340 kg (27,204 lb) payload	110 n miles (204 km; 127 miles)

SIKORSKY S-70A

US Army designations: UH-60A, UH-60C, UH-60L, UH-60M and UH-60Q Black Hawk, AH-60L, EH-60A, HH-60L, HH-60M, MH-60K, MH-60L and MH-60M
US Air Force designation: HH-60G Pave Hawk
US Navy designation: MH-60S KnightHawk
US Marine Corps designation: VH-60N
Israel Defence Force name: Yanshuf (Owl)
Japan Self-Defence Forces designations: UH-60J and UH-60JA
South Korean Army designations: HH-60P, UH-60P
Turkish Armed Forces name: Yarasa (Bat)

TYPE: Multirole medium helicopter.

PROGRAMME:

DEVELOPMENT MILESTONES

Request for proposals	Jan 72
Requirement issued	Aug 72
Selected by US Army	23 Dec 76
First flight	17 Oct 74
First flight, production	17 Oct 78
First delivery (US Army)	31 Oct 78
Entered service (101st AD)	Jun 79

UH-60A declared winner of US Army Utility Tactical Transport Aircraft System (UTTAS) competition against Boeing Vertol YUH-61A 23 December 1976; first flight of first of three YUH-60A competitive prototypes 17 October 1974; 2,000th H-60 delivered May 1994; 2,500th followed at end of 2001.

AgustaWestland in UK, Korean Air Lines of South Korea and Mitsubishi of Japan have licences to build the S-70 series, although UK programme not activated. Negotiations with Turkish Aerospace Industries concerning possible establishment of production line in Turkey began December 2003, but no recent news has been received. However, Sikorsky did conclude agreements with Vought Aircraft Industries and Kaman Aerospace in early 2005, whereby former would manufacture cabin structures for up to 1,100 Black Hawks, while latter is to supply up to 349 cockpit shipsets over next few years.

Sikorsky investigating possibility of establishing Black Hawk production lines at overseas locations when manufacture of UH-60L version is terminated at Stratford in about 2008; anticipated demand for as many as 500 UH-60Ls and derivatives could make this worthwhile. Korean Air Lines Aerospace is one candidate and was seeking opportunity for fuselage production in mid-2005 as subcontractor, but could also reactivate assembly line; PZL Mielec of Poland emerged in September 2006 as second potential partner.

CURRENT VERSIONS: **UH-60A Black Hawk**: Initial production version, designed to carry crew of three and 11 troops; also can be used without modification for medevac, reconnaissance, command and control, and troop supply; cargo hook capacity 4,082 kg (9,000 lb); one UH-60A can be carried in C-130, two in C-141 and six in C-5.

Medevac kits delivered from 1981; missile qualification completed June 1987, with day and night firing of Hellfire in various flight conditions; airborne target handover system (ATHS) qualified; cockpit lighting suitable for night vision goggles fitted to production UH-60s since November 1985 and retrofitted to those built earlier; US Army began testing Alliant Techsystems Volcano mine dispensing system July 1987; modular Volcano container is disposable and dispenses 960 Gator anti-tank and anti-personnel mines; deployment of 2,940 kg (6,482 lb) system began in FY95; usage monitor to measure certain rotor loads installed in 30 UH-60As; wire strike protection added to UH-60s and EH-60s during 1987; accident data recorders also fitted. Total 1,048 built for US Army (including 66 conversions to EH-60A but excluding six development aircraft funded in FY73) before production of UH-60L began in 1989. UH-60A 85-24441, delivered in 1985, became first Black Hawk to complete 10,000 flight hours, with milestone passed in December 2002.

Detailed description applies to UH-60A/L except where indicated.

Enhanced Black Hawk: Incorporates active and passive self-defence systems, retrofitted by Corpus Christi Army Depot, Texas, to new-build UH-60A/Ls; first 15 delivered to US Army in South Korea November 1989. Equipment includes BAE Systems AN/ARN-148 Omega navigation receiver, Motorola AN/LST-5B satellite UHF communications transceiver, Honeywell AN/ARC-199 HF-SSB, and AEL AN/APR-44(V)3 specific threat RWR complementing existing AN/APR-39 general threat RWR; M134 Minigun can be fitted on each of two pintle mounts, replacing M60 machine gun.

JUH-60A: At least seven used temporarily for trials.

GUH-60A: At least 20 grounded airframes in use as technical training aids.

HH-60D Night Hawk: One prototype (82-23718) completed for abandoned USAF combat search-and-rescue variant; subsequently became an HH-60G.

EH-60A: (Designation **EH-60C** reserved, but not adopted by US Army.) Prototype YEH-60A (79-23301) ordered in October 1980 to carry 816 kg (1,800 lb) Quick Fix IIB battlefield ECM detection and jamming system. TRW Electronic Systems Laboratories was prime contractor for AN/ALQ-151(V)2 ECM kit, with installation by Tracor Aerospace; four dipole antennas on fuselage and deployable whip antenna; hover IR suppressor system (HIRSS) standard. YEH-60A first flight 24 September 1981; order for Tracor Aerospace to modify 40 UH-60As to EH-60A standard under USD51 million contract placed October 1984; first delivery July 1987 as part of US Army Special Electronics Mission Aircraft (SEMA) programme; 66 funded by FY87 excluding prototype; programme completed 1989. EH-60A phased out in 2005, but helicopters remain in use in utility role.

Intercepts/locates AM, FM, CW and SSB radio emissions from upper HF to mid-VHF ranges over bandwidths of 8, 30 or 50 kHz; jams VHF communications. Protective systems of UH-60A/L (M-130 chaff/flare and AN/ALQ-144 IR jammer) augmented by Sanders AN/ALQ-156(V) missile approach warning system, ITT AN/ALQ-136(V) pulsed transmitter, Northrop Grumman AN/ALQ-162(V) CW transmitter and Litton AN/APR-39(V) RWR.

AN/ALQ-151(V)3 Advanced Quick Fix mission system tasked with providing ESM capability to forward ground units at division level; at least six EH-60As (84-24027, 85-24468, 85-24473, 87-24657, 87-24662 and 87-24670) adapted to **EH-60L** configuration. As fielded for Task Force XXI trials (1997), the EH-60L utilised the following equipment: sensor subsystem comprised Sanders TACJAM-A ESM for detection, direction-finding, identification and tracking of communications signals in HF, UHF, VHF and SHF frequency bands; Lockheed Martin Federal Systems communications high-accuracy locating system — exploitable (CHALS-X) for direction-finding in HF, UHF and SHF frequency bands; and signal location subsystem (SILO) for direction-finding in VHF frequency band. Navigation and timing subsystem featured INS, GPS and control display unit in cockpit. Mission control and interface subsystem comprised control, navigation, workstation and graphics processors, mass storage unit, keyboards with trackball and 483 × 483 mm (19 × 19 in) colour monitors. Communications subsystem comprised modified PRC-118 wideband control datalink, two AN/ARC-201A SINCGARS radios, AN/ARC-164 tasking and reporting datalink, intercom and AN/UYH-15 digital temporary storage recorder/reproducer set. Antenna subsystem. Airborne survivability subsystem comprised AN/ALQ-144(V)1 IR jammer, AN/ALQ-156(V)2 missile approach warning system (MAWS), AN/ALQ-162(V)2 CW transmitter and AN/APR-39(V)2 RWR.

Improvements to airframe include installation of UH-60L engines and gearbox for increase in maximum weight from 7,845 kg (17,295 lb) to 10,206 kg (22,500 lb).

Sikorsky UH-60 Black Hawk seconded to US Bureau of Immigration & Customs 1158813

Australian Army Sikorsky S-70A-9 *(Paul Jackson)* 1158801

HSC-25 (squadron) Sikorsky MH-60S KnightHawk *(MCSS Joshua Wayne LeGrand, US Navy)* 1158811

MH-60A: About 30 modified for Army 160th Special Operations Aviation Regiment (SOAR); fitted with Raytheon Systems AN/AAQ-16 FLIR, BAE Systems AN/ARN-148 Omega/VLF navigation, M-130 chaff/flare dispensers, AN/ALQ-144 IR jammer, night vision equipment, multifunction displays, auxiliary fuel tanks and door-mounted Minigun; fitted with-701C engines; interim equipment, pending MH-60K. Replaced by MH-60L in late 1990 and reverted to UH-60A configuration.

HH-60G Pave Hawk: Replaced US Air Force HH-60D Night Hawk rescue helicopters, which were not funded; converted from UH-60A/L, including 10 originally delivered to 55th Aerospace Rescue and Recovery Squadron (later Special Operations Squadron) at Eglin AFB, Florida, in 1982–83, initially remaining as UH-60As; all progressively fitted by Sikorsky Support Services at Troy, Alabama, with aerial refuelling probe, 443 litre (117 US gallon; 97.5 Imp gallon) internal auxiliary fuel tank and fuel management panel; then to Pensacola NAD for mission avionics and modified instrument panel; some retrofitted with replacement internal tank of 700 litres (185 US gallons; 154 Imp gallons) capacity; -701C engines fitted to 10 special operations examples and later production aircraft (FY89 onwards); recent retrofit programme, begun in November 1999, entailed installation of -701C engine on older HH-60Gs. Final retrofits subject of USD8.5 million contract awarded to Sikorsky in late 2005.

Further procurement began with batch of nine in FY87, followed by purchases of 16, 18, 22, 15 and 13 in FY88-92; eight more funded in FY97 and delivered in 1998. All designated MH-60G until 1 January 1992, when 82 in combat rescue role redesignated HH-60G, with balance of 16 remaining as MH-60G for special operations units; by fourth quarter of 1998, only nine still in MH-60G configuration and at start of 2000, all were using HH-60G designation. All have rescue hoist, Doppler/INS, electronic map display, Tacan, Honeywell AN/APN-239 lightweight weather/ground-mapping radar, secure HF, and satcom; MH-60G had ESSS (see Armament paragraph) for weapons and additional fuel carrying capability, plus door-mounted 0.50 in machine guns and Raytheon AN/AAQ-16 Pave Low III FLIR.

Upgraded version of HH-60G, known as **Block 152**, made debut at Stratford, Connecticut, on 29 April 1999, when first of 49 planned aircraft rolled out in Upgraded Communication, Navigation/Integrated Electronic Warfare (UCN/IEW) configuration; new features include enhanced com/nav system and EW suite integrated into MIL-STD-1553 databus to reduce crew workload. Contractor trials in May and June 1999, after which modified HH-60G (possibly 92-26460) delivered to Nellis AFB, Nevada, for operational test and evaluation with 422nd TES. Retrofit included installation of revised, externally mounted, armament system with 0.50 in machine guns, expendable chaff/flare defensive countermeasures and repositioned nose radar.

Further extensive upgrade under consideration by USAF for HH-60G fleet from about 2003, with various options being examined; these include remanufacture to new **Block 162** standard with 'glass cockpit', new defensive aids and other changes; and less ambitious structural life extension programme.

MH-60K: US Army special operations aircraft (SOA); prototype (89-26194) ordered in January 1988; first flight 10 August 1990. US Army funded two batches of 11 with options for another 38, which not taken up; first production aircraft (91-26368) completed, February 1992; trials at Patuxent River and Edwards AFB before intended first deliveries in June 1992 to 160th Special Operations Aviation Group (part of 160 SOA Regiment). Deliveries delayed by software problems with special operations equipment; first 10 accepted in 1992 in non-operational state; remaining 12 initially stored, then delivered with new software installed, October to December 1993, to permit start of training by 160 SOA Group, February 1994.

Features include provision for additional 3,141 litres (829 US gallons; 691 Imp gallons) of internal and external fuel (see Power Plant), plus flight refuelling capability, integrated avionics system with electronic displays, Raytheon AN/AAQ-16 FLIR and AN/APQ-174B terrain-following, ground-mapping and air-to-ground ranging radar, T700-GE-701C engines and uprated transmission, external hoist, wire-strike protection, rotor brake, tiedown points, folding tailplane, AFCS similar to that of SH-60B, strengthened pintle mounts for 0.50 in machine guns, provision for Stinger missiles, missile warning receiver, pulse radio frequency jammer, CW radio jammer, laser detector, chaff/flare dispensers, and IR jammer.

May undergo service life extension programme and emerge as MH-60Ms.

SH-60B Seahawk: US Navy ASW/ASST helicopter, *described separately*.

SH-60F Seahawk: US Navy carrierborne inner-zone ASW helicopter to replace SH-3D Sea King. See Seahawk entry.

HH-60 and MH-60 Jayhawk: Search and rescue/special warfare helicopters; see Seahawk entry.

UH-60J: Designation of Japanese-built S-70A-12 for Air and Maritime Self-Defence Forces; procurement details under Mitsubishi in Japanese section.

UH-60JA: Japanese Ground Self-Defence Force version; procurement began in 1995. Manufactured by Mitsubishi.

UH-60L: Replaced UH-60A in production for US Army from October 1989 (aircraft 89-26179 onwards); prototype (84-23953) first flight 22 March 1988; two pre-series aircraft (89-26149 and 26154); first delivery 7 November 1989 to Texas ArNG. Powered by T700-GE-701C engines with uprated 2,535 kW (3,400 shp) transmission. More than 600 delivered to US Army, with production expected to continue until replaced by new-build UH-60M version. Current production aircraft fitted with hover IR suppression system (HIRSS) to cool exhaust in hover as well as forward flight; older UH-60s retrofitted. Composites wide-chord main rotor blades of improved design flight tested at West Palm Beach, beginning 8 December 1993; new blade 16 per cent wider than current titanium rotor and has anhedral tip angled down at 20°; testing revealed much lower vibration plus anticipated benefits in payload, speed and manoeuvrability; projected retrofit from 1997 did not occur, but new rotor fitted to UH-60M. Underslung load capability increased to 4,082 kg (9,000 lb).

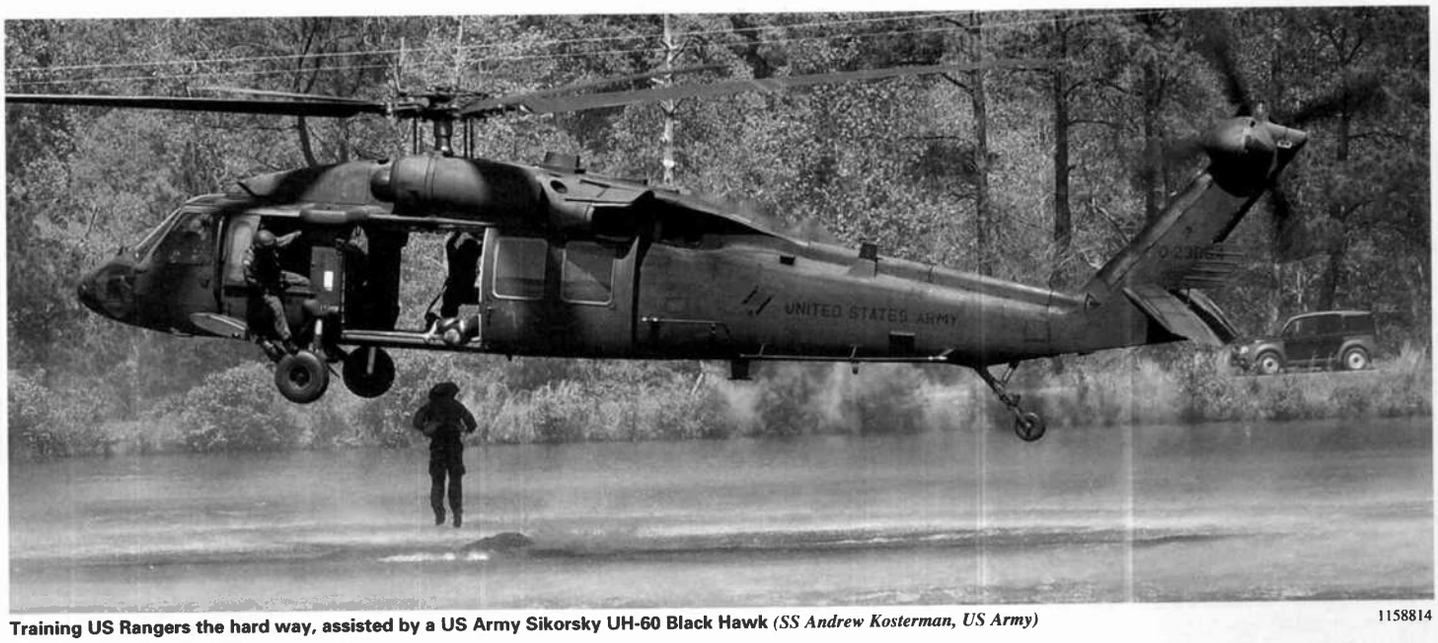
EUH-60L: Designation for command and control (C2) version; was under development at the US Naval Research Laboratory on behalf of the US Army. This version subsequently abandoned but project continues, with Raytheon as prime contractor for C2 system. First three systems delivered in first half of 2003. First five modified helicopters served as prototypes to validate performance in advance of initial operational test and evaluation, which began in 2004; prototype systems deployed with 4th Infantry Division in Iraq during 2004-05, accumulating more than 2,000 hours under combat conditions. Initial version to be known as **Block I**, with more sophisticated **Block II** expected to enter development in 2005; latter will be configured for UH-60M, which should facilitate system integration, while Block II also expected to use Joint Tactical Radio system. Contract worth USD110 million for development and production awarded in late 2001. Original plan was to obtain 207 helicopters, although this reduced to 121 by start of 2001. Rockwell Collins AN/ASC-15B/C consoles have been fitted to more than 50 US Army aircraft as interim **UH-60A(C)**. Communications suite to be finalised, but expected to include Have Quick II, SINCGARS/SIP and JTIDS; other capabilities also to be incorporated, including FLIR, NVG compatibility, digital map display, mission planner facility, improved ECCM and storage space for ground power generators and antennas. Five workstations will be provided for system operators.

HH-60L: Alternative designation for new-build medical evacuation version based on UH-60L airframe but incorporating UH-60Q specialised mission equipment. Sikorsky awarded USD11 million contract on 22 February 2000 for design definition and conversion of four UH-60Ls to this standard. Initial delivery expected in 2000, but delayed until March 2001, when three helicopters assigned to 507th Medical Company (Air Ambulance) at Fort Hood, Texas. Additional 18 aircraft ordered between FY00 and FY04. In October 2005, Colombia requested two UH-60Ls to be delivered in medevac configuration for use in SAR and battlefield evacuation roles; these expected to be outfitted similarly to US Army HH-60L.

MH-60L: Similar to MH-60A; approximately 40 helicopters modified for 160th SOAR, US Army; some helicopters upgraded to MH-60L 'Defensive Armed Penetrator' configuration in 1990 with FLIR, radar and standard UH-60 external stores support system; two Black Hawk companies of 160th SOAR each have MH-60K platoon and MH-60L platoon. Armament includes multiple 30 mm Chain Gun, racks of four Hellfires and 2.75 in rocket pods, 40 mm grenade launcher or trainable 7.62 mm Gatling guns. Expected to undergo service life extension programme and emerge as MH-60Ms.

HH-60M: Medical evacuation version based on UH-60M; as many as 357 could be acquired for service with first- and second-line medical evacuation units. First four included in FY07 request for 38 helicopters.

MH-60M: Special forces derivative, intended to replace existing MH-60 fleet with 160th SOAR. Few details available, but majority of existing MH-60Ks and MH-60Ls expected to be subjected to service life extension programme and emerge as MH-60Ms to common configuration. Development contract was due to be awarded in second quarter of FY04;



Training US Rangers the hard way, assisted by a US Army Sikorsky UH-60 Black Hawk *(SS Andrew Kosterman, US Army)* 1158814

Milestone C go-ahead for refurbishment then scheduled for final quarter of FY06. However, in April 2005, Integrated Systems subsidiary of L-3 Communications awarded USD42 million contract by US Special Operations Command for conversion of one UH-60M to prototype MH-60M configuration and modification of second UH-60M to flight test alternative engine integration; this suggests that definitive UH-60M could emerge as new-build rather than remanufactured helicopter. At least 62 will be acquired, although US Army is hopeful of increasing fleet to total of 96 by 2010. Remanufacture was expected to provide new 20-year airframe life; improved avionics, electrical and dynamic systems also anticipated, with replacement engine to be developed, tested and procured. RFP for latter issued in mid-2004, with Rolls-Royce and General Electric both expected to respond to requirement to re-engine about 100 helicopters from 2006 onwards.

In July 2006, it was reported that Taiwan was considering replacing its existing fleet of AH-1W SuperCobra attack helicopters with 30 MH-60Ms; officials from Taiwan's Ministry of National Defence declined to comment.

UH-60M: First use of designation was for proposed enhanced version for US Army. Cancelled early 1989 in favour of UH-60L. Designation subsequently re-used in 2000; see immediately below for details.

UH-60M: Improved Black Hawk version (originally known as the **UH-60L+**) for service with US Army; involves avionics and power plant modernisation offering benefits in terms of payload (up to 907 kg; 2,000 lb advantage over UH-60A) and performance (up to 15 kt; 28 km/h; 17 mph faster). Sikorsky awarded USD7.45 million contract in August 2000 for preliminary risk reduction effort. US Army initially envisaged procurement via major upgrade programme, whereby approximately 906 UH-60As would be brought to UH-60M standard, while another 311 UH-60Ls were expected to be similarly upgraded. Some new-build examples were also to be acquired, but in early 2005 US Army revealed intent to abandon remanufacture programme and instead obtain at least 1,227 new-build helicopters by 2020.

Improvements for the UH-60M include more powerful General Electric T700-GE-701D engines, improved durability main gearbox, wide-chord, composite-spar main rotor, a digitised 'glass cockpit' featuring four Rockwell Collins multifunction displays (MFDs) based on the MIL-STD-1553 databus and new avionics, Stormscope weather mapping system, an advanced flight control computer, new diagnostic monitoring systems (including Goodrich integrated vehicle health management system), a strengthened centre fuselage, larger fuel tanks and advanced infra-red suppression.

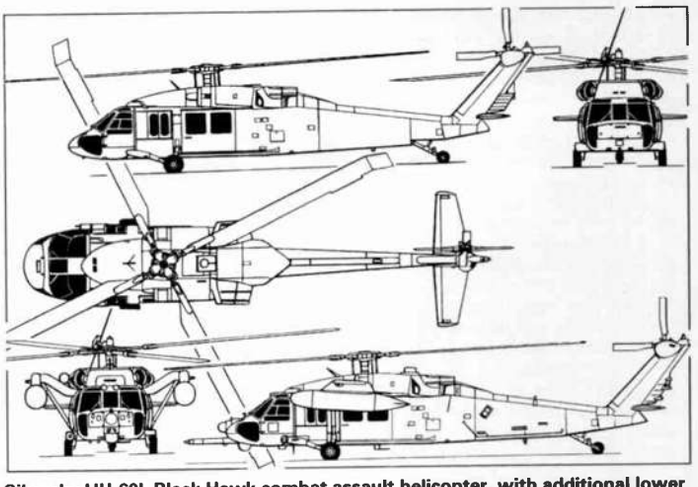
On 30 March 2001, Defense Acquisition Board approved Milestone B system development and demonstration phase; this followed in May by USD219.7 million contract for research, development, test and evaluation. Total of four UH-60M prototypes planned, comprising three conversions of existing Black Hawks (first, second and fourth aircraft) and one new-build helicopter (third aircraft; serial number 02-26969). Upgrade programme began in November 2001, with arrival of three UH-60s at Troy, Alabama, for dismantling and evaluation. Some structural reconditioning undertaken at Troy, before components and assemblies shipped to Stratford for reconditioning of dynamic components and reassembly. First aircraft to be upgraded was UH-60A 85-24432; second was conversion of UH-60L 89-26217; third (actually the fourth UH-60M) was conversion of UH-60A 77-22716 to **HH-60M** medical evacuation configuration. Maiden flight of first UH-60M prototype (now serialled 02-26976) took place at Sikorsky's West Palm Beach, Florida, facility on 17 September 2003; 75-minute sortie included flight at 120 kt (222 km/h; 138 mph) and 45 degree turns, as well as verifying performance of systems and instrumentation. Second aircraft (now serialled 02-26977) flew in October 2003, with remaining two (02-26969 and 02-26978, the former 77-22716) following in 2005.

First pair of aircraft primarily concerned with flight testing, while third used for electromagnetic interference chamber testing and fourth to evaluate specialised medical equipment. Four pre-production UH-60Ms (04-26998 to 04-27001, all previously UH-60As) also produced for US Army operational evaluation, which began at end of FY06, coincident with availability of LRIP helicopters, the first of which was formally rolled out and delivered to the US Army at Stratford on 31 July 2006. By that time, the eight development aircraft had accumulated over 850 hours flight time.

Development phase to take four years, with full-rate production decision due in 2007. Initial contract for 22 new-build UH-60Ms valued at USD245.4 million signed June 2005; includes five LRIP 1 aircraft funded in FY05, five LRIP 2 aircraft funded in FY06 and production line conversion of 12 UH-60L to UH-60M, also funded in FY06. Delivery from July 2006, with IOT&E (initial operational test and evaluation) beginning in October 2006. See table for details of planned procurement for FY07 to FY11. Fielding of first combat unit due in early 2008.

First export customer expected to be United Arab Emirates, which has requested total of 26 UH-60Ms under FMS programme; total value of deal expected to be around USD800 million if authorisation forthcoming.

VH-60N: Nine for US Marine Corps Executive Flight Detachment of squadron HMX-1 at Quantico, Virginia, to replace UH-1Ns; deliveries started November 1988; known as



Sikorsky UH-60L Black Hawk combat assault helicopter, with additional lower side view and lower front view of MH-60K special operations variant *(Dennis Punnett)* 1158766

VH-60A until redesignated 3 November 1989. Name **White Hawk** adopted by Marine Corps.

Additional equipment includes more durable gearbox, weather radar, SH-60B-type flight control system and ASI, -401 engines as in SH-60B, cabin soundproofing, VIP interior, cabin radio operator station, EMP hardening, 473 litre (125 US gallon; 104 Imp gallon) internal fuel tank and extensive avionics upgrading. SPAR (Special Progressive Aircraft Rework) undertaken on VH-60N fleet from 1998.

HH-60P: Local designation allocated to four UH-60P helicopters modified to perform combat search-and-rescue (CSAR) mission with Korean armed forces; upgrade to be accomplished in-country by Korean Aerospace Industries using kits supplied by Elbit Systems of Israel. Initial contract worth USD30 million awarded in late 2005, with further conversions expected to follow.

UH-60P: South Korean Army version of UH-60L (S-70A-18) with minor avionics modifications to meet local requirements; first (KA-1602) of three UH-60Ls delivered by Sikorsky 10 December 1990; balance of 81 UH-60Ps on initial contract assembled locally by Korean Air Lines with increasing indigenous content, in USD500 million, five year programme. Deliveries from follow-on batch of 57 since completed, but acquisition of third batch, to replace remaining UH-1 Iroquois, has not taken place. South Korea has requirement for about 12 medical evacuation helicopters and could obtain UH-60Q or equivalent.

UH-60Q: 'Dustoff' (Dedicated Unhesitating Service To Our Fighting Forces) medical evacuation/search and rescue version for US Army. Development began in early 1990s, after Gulf War, when it was realised that a requirement existed for a longer-range medevac helicopter to replace the UH-1V Iroquois. A proof-of-principle conversion of a UH-60A (86-24560) was undertaken by Serv-Air Inc of Richmond, Kentucky, and flown for the first time as the **YUH-60A(Q)** on 31 January 1993. This aircraft was subsequently delivered to the Tennessee Army National Guard at Lovell Field, Chattanooga, on 12 March 1993, where it underwent a 12-month evaluation programme beginning in September 1993, with an organisation known as CECAT (Combat Enhancing Capable Aviation Team).

Sikorsky eventually selected as prime integrator for production and was awarded an initial contract on 9 February 1996 for two Phase 2 conversions in FY96, with second contract for further two in FY97; YUH-60A(Q) designation also applied to these aircraft, which participated in two-year qualification programme, with initial flight tests successfully completed in second quarter of 1997; formal operational test followed at Fort Campbell, Kentucky, between July and September 1998, using three YUH-60A(Q)s, with fourth delivered to CECAT in early 1999. Major subcontractors are Air Methods (medical interiors); Breeze-Eastern (HS-29900 external electric rescue hoist); BAE Systems Canada (mission management system); FLIR Systems Inc (SAFIRE thermal imaging system); Litton (LITOX onboard oxygen generating system); Simula (medical attendant seats) and Telephonics (intercom).

Definitive UH-60Q configuration included a medical interior able to accommodate six stretcher patients, with integrated suction and oxygen systems plus defibrillation, ventilation and intubation equipment, as well as apparatus for monitoring of vital signs. It also featured

a 'glass cockpit' incorporating Litton smart multifunction displays (SMFDs); Doppler 128C with embedded GPS; NVG-compatible lighting; AN/ARS-6(V)2 personnel locator system; HIRSS; chaff/flare dispensers; ESSS; -701C engines; plus an improved data modem and SINCGARS radios, which allow it to transmit and receive digital data. Subsequently, limited production of HH-60L version undertaken by Sikorsky, with HH-60M expected to enter service in substantial numbers from late in the present decade.

MH-60R Seahawk: US Navy ASW/ASST helicopter, *described separately*.

MH-60S KnightHawk: Shipboard transport helicopter. Key element in 1996 US Navy Helicopter Master Plan, entailing retirement of CH/HH-46Ds, HH-60Hs and SH-3s by FY12 and their replacement by navalised MH-60S (previously designated CH-60S until 6 February 2001). Design is fundamentally baseline UH-60L Black Hawk with T700-GE-401C engines and dynamics of SH-60 Seahawk, plus automatic rotor blade folding system, folding tail pylon, improved durability gearbox, rotor brake, automatic flight control system (AFCS), HIFR capability and rescue hoist for SAR/CSAR missions. Also has 'glass cockpit', with active matrix liquid crystal displays (AMLCDs); common cockpit on MH-60S and MH-60R, with Lockheed Martin securing USD61 million contract in August 1998 to develop and produce two prototypes for flight testing from late 1999. Equipment includes two integrated inertial navigation/GPS units, mass memory unit, mission computer, flight management computer, operational software and four Litton flat-panel displays replacing all but standby instruments; MH-60S cockpit is 'scaled-down' version, with potential for upgrading if combat SAR mission is added at later date. MH-60S also has provision for external stores support system (ESSS), allowing carriage of additional fuel and forward-firing weapons.

Design includes a convertible cargo handling system; when configured for pure cargo operations, MH-60S can carry two 1.02× 1.22 × 1.02 m (40 × 48 × 40 in) tri-wall pallets with total weight of 1,588 to 1,814 kg (3,500 to 4,000 lb); as a personnel transport, is able to accommodate a crew of four, plus 13 passengers. Underslung loads up to 4,082 kg (9,000 lb) may also be carried, with total payload capacity about 4,536 kg (10,000 lb).

MH-60S potential demonstrated by modified UH-60L in June 1995, when internal and external cargo-carrying capability studied by Sikorsky and the US Navy. Detail design began October 1996, with award in April 1997 of USD5.75 million contract to Sikorsky for demonstrator. This was hybrid vehicle, based around UH-60L (96-26673) borrowed from the US Army, married to components from SH-60F furnished by US Navy. Resulting YCH-60S (Navy identity 966673) made first flight on 6 October 1997 and was used for joint Navy/Sikorsky 35 hour flight test programme that ended on 10 January 1998. First shipboard demonstration on 19 November 1997, with YCH-60S completing 17 landings aboard combat store ship USS *Saturn*; initial trial included 12 vertical replenishment lifts with 680 kg (1,500 lb) slung load and three hot refuellings.

YCH-60S evaluated in 1999–2000 as potential airborne mine countermeasures (AMCM) platform to replace MH-53E. Initial trials at Stratford in third quarter of 1999, followed by transfer to Patuxent River in fourth quarter for tow tests, plus carriage, winch deployment and recovery of AN/AQS-20/X mine detection sonar. Thicker frames for helicopter's rear-cabin structure will permit cable loads up to 2,722 kgf (6,000 lbf). Raytheon Airborne Mine Neutralisation System (AMNS) selected in first quarter of 2003, with first AMCM-configured MH-60S making initial flight on 20 July 2003. Trials with Northrop Grumman Airborne Laser Mine Detection System (ALMDS) began in April 2004, this being one of five sensors that will be utilised by the MH-60S. AMCM version is basic MH-60S with operator station in cabin, plus additional internal fuel and ability to tow detection equipment; neutralisation accomplished by BAE Systems Archerfish expendable underwater vehicle, which guided into position and then detonated to destroy mine. System Development and Demonstration (SDD) phase subject of USD18 million contract awarded in first quarter of 2003. MH-60S AMCM platform to achieve IOC in 2005, with ultimate total of 66 MH-60Ss planned for AMCM mission.

Features not embodied in demonstrator include fuel dump vents, flotation gear, HIFR and navalised T700 engines. Avionics also unrepresentative, although featuring a databus and four 127 × 127 mm (5 × 5 in) Rockwell Collins AMLCDs for pilot and co-pilot vertical and horizontal situation data, plus two control display/navigation units and an LN-100G embedded GPS/INS.

Decision to proceed with MH-60S low-rate initial production (LRIP) taken in early 1998, although firm fixed-price contract for first lot not awarded to Sikorsky until September 1999; valued at USD67.4 million, this was for initial five aircraft, plus option for one more (taken up in November 1999) and associated engineering and logistic services. Maiden flight of initial production MH-60S (165742) at Stratford, Connecticut on 27 January 2000; delivered to Patuxent River, Maryland, on 15 May to begin US Navy development testing and operational evaluation. At least four helicopters involved in trials, with initial technical evaluation completed by November 2000; three-month Opeval began November 2001 and yielded disappointing result, with MH-60S considered neither operationally "effective" nor "suitable"; further evaluations conducted in mid-2003 by VX-1 at Patuxent River resulted in MH-60S being described as "operationally effective and operationally suitable" in October 2003. Changes to software and operational requirements ensued, allowing approval to be given for start of full-rate production at end of August 2002.

Navy has requirement for 267 MH-60Ss. First example funded in FY98, with five more (Lot 1) in FY99, 16 (Lot 2) in FY00, 15 (Lot 3) for FY01, 13 (Lot 4) for FY02, 15 (Lot 5) for FY03, 13 (Lot 6) for FY04 and 15 and 26 respectively requested for FY05 and FY06; see table for details of planned procurement for FY07 to FY11. First squadron was HC-3 (since redesignated HSC-3) at North Island, California, which received initial example (165745) for use as ground maintenance trainer in early 2001 and which assumed responsibility for flight training in February 2002; second squadron was HC-5 (now HSC-25) at Andersen AFB, Guam, which began converting from H-46 in mid-2002. HC-6 (now HSC-26) at Norfolk, Virginia, also accepted its first MH-60S in second quarter of 2002. USN undertaking major reorganisation of fleet helicopter squadrons in next few years, resulting in creation of Helicopter Sea Combat (HSC) squadrons; see table for details of implementation plan and future assignments. Approximately 40 MH-60s delivered by end of 2002, with first operational deployment, by HC-5 in USS *Essex*, completed at end of January 2003; 50th MH-60S delivered June 2003. By end April 2004, US Navy had received 64 helicopters and completed 50,000 flight hours, with number on hand having risen to about 75 at end of 2004 and 90 at end of September 2006.

Thailand became first overseas customer for MH-60S in second quarter of 2006, when it announced intention to purchase initial two helicopters of eventual total of six, for use in utility role; delivery of these is expected in 2008, with additional examples to be acquired as and when funding becomes available.

UH-60X: Designation allocated to potential follow-on to UH-60M, but now known as Future Utility Rotorcraft (FUR), for which UH-60M may provide basis. Total of 256 required for service with 'first-to-fight' units, but currently unfunded and unlikely to enter inventory until at least 2025.

LUH-60: Unsuccessful Sikorsky proposal of late 2004 to satisfy US Army requirement for light utility helicopter; proposal envisaged refurbishing UH-60A version with UH-60L engine and transmission, plus digital cockpit of UH-60M and vehicle health management system. Bell 210 selected by US Army during 2005.

BattleHawk: Offered unsuccessfully to Australian Army for Project Air 87 armed reconnaissance requirement; based on MH-60K. Name re-used in 2006, with new iteration revealed at Farnborough International in July; proposal envisages armed helicopter featuring integrated EW suite and comprehensive array of weaponry. To be offered in new-build form or as kit for retrofit to existing UH-60 and S-70A variants.

Firehawk: Trials of specialist firefighting version began in July 1998, using modified UH-60L (96-26728) with extended landing gear and removable 3,785 litre (1,000 US gallon; 833 Imp gallon) ventral watertank manufactured by Aero Union of Chico, California. Replenishment of tank accomplished in two ways: by landing next to water source for water to be pumped into tank via side connector, or by hovering over source and using snorkel hose and pump assembly to suck up water. Subsequent three month demonstration of firefighting capability by Los Angeles County Fire Department proved validity of system. Demonstrator then returned to US Army for further testing, before delivery to Oregon Army National Guard in 1999. Two examples delivered to Los Angeles County Fire Department in 2001, with Army National Guard units in California and Florida also receiving single examples during 2002–03; Los Angeles County Fire Department subsequently received third Firehawk, with others delivered to Nevada and New York Army National Guard. In early 2005, Sikorsky concluded teaming agreement with Heritage Aviation Ltd of Grand Prairie, Texas, covering future S-70A conversions to Firehawk configuration for commercial operators, municipalities, local government agencies and foreign governments.

International Black Hawk: Proposed new variant announced at Farmborough International in July 2006; to be produced in collaboration with overseas partners and assembled outside the US. PZL Mielec of Poland is potential assembly centre, following signature of MoU in September 2006. Design will be based on modular concept, with basic platform adapted to satisfy unique customer requirements, but featuring common cockpit configuration with four-axis advanced flight control system, coupled flight director, active vibration control and dual pilot IFR.

Maple Hawk: Unsuccessful contender in contest to supply Canadian Forces with new SAR helicopter; offer reportedly priced at CAD300 million for 15 helicopters, but EHI EH 101 Cormorant selected in December 1997.

Exports comprise:

S-70A-1: FMS deal for Royal Saudi Land Forces Army Aviation Command; 12 delivered January to April 1990 to squadron based at King Khaled Military City; modified to **Desert Hawk** and one (delivered December 1990) fitted with VIP interior; Desert Hawk has 15 troop seats, blade erosion protection using polyurethane tape and spray-on coating, Racal Jaguar 5 frequency-hopping radio, provision for searchlights, internal auxiliary fuel tanks, and external hoist.

S-70A-1L: Medical evacuation version for Saudi Arabia; IR filtered searchlight, rescue hoist, improved AN/ARC-217 HF com, AN/ARN-147 VOR/ILS, AN/ARN-149 ADF, air conditioning and provision for six stretchers; eight delivered from December 1991; further eight required.

S-70A-5: Two for Philippine Air Force, delivered March 1984.

S-70A-9: Royal Australian Army; 39 replaced Bell UH-1s; deliveries from October 1987 to 1 February 1991; first completed by Sikorsky, remainder assembled by Hawker de Havilland in Australia; aircraft transferred to Australian Army in February 1989, but RAAF continues to maintain them.

S-70A-11: Three to Jordan in 1986-87.

MH-60S PLANNED ASSIGNMENT

New Identity	Current Identity	Planned Date	Fleet Assignment	Type of Deployment
HSC-2	HC-2	Jan 06	Atlantic	Training
HSC-3	HC-3	Mar 05	Pacific	Training
HSC-4	HS-4	Feb 07	Pacific	Carrier Force
HSC-5	HS-5	Feb 09	Atlantic	Carrier Force
HSC-6	HS-6	Apr 10	Pacific	Carrier Force
HSC-7	HS-7	Jan 08	Atlantic	Carrier Force
HSC-8	HS-8	Mar 08	Pacific	Carrier Force
HSC-9	HS-3	Feb 10	Atlantic	Carrier Force
HSC-11	HS-11	Feb 11	Atlantic	Carrier Force
HSC-12	HS-2	Apr 09	Pacific	Carrier Force
HSC-14	HS-14	Apr 11	Pacific	Carrier Force
HSC-15	HS-15	Feb 12	Atlantic	Carrier Force
HSC-21	HC-11	Mar 05	Pacific	Expeditionary
HSC-22	(new)	Sep 06	Atlantic	Expeditionary
HSC-23	(new)	Jan 07	Pacific	Expeditionary
HSC-25	HC-5	Mar 05	Pacific	Expeditionary
HSC-26	HC-6	Mar 05	Atlantic	Expeditionary
HSC-28	HC-8	Mar 05	Atlantic	Expeditionary
HSC-84	HCS-4	TBA	Reserve (Atlantic)	
HSC-85	HC-85	Mid-2006	Reserve (Pacific)	

Notes:
HSC-3, HSC-21, HSC-25, HSC-26 and HSC-28 already equipped with MH-60S; date given refers to change of unit identity; all other dates refer to planned conversion to MH-60S

US BLACK HAWK PROCUREMENT UP TO AND INCLUDING FY06

Fiscal Year	Lot	UH-60A	EH-60A	HH-60G	UH-60L	MH-60K	HH-60L	UH-60M	MH-60S	FMS	Year Total	Cum Total
FY73	N/A	6									6	6
FY77	1	15									15	21
FY78	2	56									56	77
FY79	3	92									92	169
FY80	4	94									94	263
FY81	5	80		5							85	348
FY82	6	96		6							102	450
FY83	7	96									96	546
FY84	8	84	12								96	642
FY85	9	86	18								104	746
FY86	10	78	18								96	842
FY87	11	84	18	9							111	953
FY88	12	72		16						21[1]	108	1,061
FY89	13	49		18	23					5[2]	95	1,156
FY90	14			22	76					1[3]	99	1,255
FY91	15			15	45	22				8[4]	90	1,345
FY92	16			13	52						65	1,410
FY93	17				60						60	1,470
FY94	18				63						63	1,533
FY95	19				68						68	1,601
FY96	20				65					9[5]	74	1,675
FY97	21			8	30		4			15[6]	57	1,732
FY98	22				34				1		35	1,767
FY99	23				18				5		23	1,790
FY00	24				19		3		16	9[7]	47	1,837
FY01	25				16		2		15	34[8]	67	1,904
FY02	26				19		2	4[9]	13	24[10]	62	1,966
FY03	27				12		7		15		34	2,000
FY04	28				13		4	4[12]	13	16[11]	50	2,050
FY05	29				34		4	5	15		58	2,108
FY06	30				32			17	26	6[13]	81	2,189
Totals		**988**	**66**	**112**	**679**	**22**	**26**	**30**	**119**	**147**		**2,189**

[1] For Colombia (5), Egypt (2) and Saudi Arabia (13)
[2] For Colombia
[3] For Bahrain
[4] For Saudi Arabia
[5] For Colombia (7?) and Egypt (2)
[6] For Israel
[7] For Colombia (7) and Egypt (2)
[8] For Colombia (31) and Thailand (3)
[9] Prototypes. One new-build example plus three remanufactured from UH-60A (2) and UH-60L (1)
[10] For Israel
[11] For Colombia via USDoS (2), Egypt (2), Jordan (8) and Thailand (4)
[12] All remanufactured from UH-60A
[13] For Brazil

PROPOSED US MULTI-YEAR PROCUREMENT FOR FY07-11

FY	Lot	UH-60M	MH-60S	Sub-Total	MH-60R	Total
07	31	38	26	64	25	89
08	32	51	18	69	27	96
09	33	75	18	93	30	123
10	34	64	18	82	30	112
11	35	45	18	63	31	94
Total		**273**	**98**	**371**	**143**	**514**

Notes: Current plan calls for UH-60M and MH-60S to be acquired during FY07 to FY11 under terms of Multi-Year Procurement (MYP) programme. FY07 procurement for US Army expected to comprise four HH-60M and 34 UH-60M, with latter including two to be configured for use by Commanders-in-Chief (CinCHawk). Consideration is being given to also including MH-60R in same MYP programme. Figures shown above are provisional and may change. Data sourced from documentation supporting FY07 defence budget. Follow-on procurement of another 932 UH-60M, 50 MH-60S and 82 MH-60R is anticipated if current plans are pursued in full.

S-70A-12: Japan Self-Defence Forces acquiring **UH-60J/JA** versions of Mitsubishi SH-60J for search and rescue. Sikorsky-built prototype (N7267D), plus two CKD kits, delivered late 1990. Further production by Mitsubishi (which see).

S-70A-16: Reserved for Westland Helicopters.

S-70A-17: Turkish Jandarma ordered six in September 1988; deliveries completed December 1988; further six (including two VIP) delivered from late 1990 to Turkish National Police. See also S-70A-28.

S-70A-18: Korea (see UH-60P).

S-70A-19: Reserved for GKN Westland of UK.

S-70A-21: Two VIP versions to Egypt, 1990. Two VIP-configured UH-60L ordered by Egypt in third quarter of 1999; further two VIP-configured UH-60Ls requested in September 2002. Latter pair were delivered in November and December 2003.

S-70A-22: Korean VIP version. Three aircraft built by Sikorsky.

S-70A-24: Two UH-60Ls for Mexico. Delivered 1991. Further four received in about 1996.

S-70A-25/26: Moroccan Gendarmerie ordered two Black Hawks with different seating arrangements in 1991; delivered October 1992; began operations 11 November 1992; fitted with colour weather radar.

S-70A-27: Hong Kong. Two delivered 16 December 1992 to Royal Hong Kong Auxiliary Air Force; unit became Government Flying Service 1 April 1993. Fitted with FLIR and searchlight. Requirement for further four reportedly existed in 1995, but only one additional aircraft delivered. Subsequently, all three sold in 2005 to Brown Helicopters of Leesburg, Florida, for modification to S-70A Firehawk standard by Firehawk Helicopters Inc.

S-70A-28: Turkish follow-on batch; 90 ordered 8 December 1992, of which first five to Jandarma on 4 January 1993, followed by 40 to armed forces during 1993–94; balance of 45 to have been co-produced in Turkey by TAI (which see) but programme suspended. However, fresh negotiations for 50 additional Black Hawks concluded in latter half of 1998, with first five airlifted to Turkey by An-124 in mid-June 1999 and deliveries completed in 2001. Final 30 produced with 'glass cockpit', which to be retrofitted to earlier machines; first flight of **S-70A-28D** in this guise on 29 March 2000. Installation includes four Rockwell Collins MFDs, dual flight management system and LN-100G INS/GPS; four to incorporate Tadiran Spectralink ASR-700 airborne search and rescue system (ASARS) for use by Turkish Army Special Forces in combat search and rescue and covert operations.

S-70A-30: One VIP transport ordered for Argentine Air Force, January 1994; delivered 4 September 1994.

S-70A-33: Four ordered by Brunei in 1995; delivered 1997–98. Equipment includes radar, AN/AAQ-21 FLIR and external stores support system.

S-70A-34: Malaysia ordered two S-70A Black Hawks in 1996 as replacements for AS 332 Super Puma in VIP transport role; first of pair delivered by end of 1997, with second following in February 1998.

S-70A-36: Brazil received four S-70As in August 1997 for use in Peru/Ecuador peacekeeping support mission; equipment includes GPS, HF radio, internal rescue hoist and weather radar.

S-70A-37: Version of Firehawk; two to Sultan of Brunei, 2000, replacing S-70Cs.

S-70A-39: Chilean order for one, announced in March 1998; delivered in July 1998.

S-70A-41: Colombia. Believed to refer to 22 aircraft delivered during 1994 (two), 1995 (two), 1997 (seven) and 1998 (11); these are UH-60L derivative, unlike initial delivery of 1988–89 which was baseline UH-60A. Further helicopters requested in November 1999; two contracts received by Sikorsky in mid-December 2000 cover purchase of 21 helicopters for Colombian Army, plus four for Air Force and six for National Police. Ultimately, as many as 60 in prospect as part of US drive to combat increased narcotics trafficking in this region. Request for eight UH-60Ls via FMS notified to US Congress in mid-2005; firm order expected to follow.

S-70A-42: Austria signed contract in December 2000 for nine aircraft to begin replacement of Agusta-Bell 204/212; total cost of deal put at USD184 million. First example handed over in USA on 10 June 2002.

S-70A-43: Thailand. Initial three helicopters delivered to Thai Army in December 2001 (two) and January 2002 (one); two more handed over in November 2004. Further two requested via FMS in mid-2005 for Thai Army, with Thai Air Force reportedly negotiating in late 2004 for up to 16 to satisfy requirement for SAR helicopter.

S-70A-50: Israel. Request for 15 UH-60Ls revealed by US DoD in April 1997; first so-called 'Peace Hawk' handed over at Stratford, Connecticut, on 23 March 1998, being airlifted (with four others) to Israel by C-5 on 27 May 1998. Deliveries completed by end of 1998. Additional 35 requested in September 2000 at estimated cost of USD525 million, but subsequent contract received on 31 January 2001 covered supply of 24 **S-70A-55** aircraft at total cost of USD211.8 million. Delivery of these was accomplished in second

half of 2002. Israeli Black Hawks subject of major upgrade that began in 2002; accomplished indigenously, much of the work undertaken on IDF/AF UH-60As and UH-60Ls is classified, but does include addition of in-flight refuelling probes and external fuel tanks as well as more powerful environmental conditioning systems.

Other recent customers include Los Angeles County Fire Department, which accepted two S-70A Firehawks in the first half of 2001 and ordered a third in 2003, for delivery in December 2004.

Direct transfers include one UH-60L to Bahrain, early 1991; five UH-60As delivered to Colombian Air Force in July 1988 for anti-narcotics operations; five more sold February 1989. Israel received 10 former US Army UH-60As in August 1994, for 124 Squadron at Palmachim, under local name of Yanshuf (Owl).

Taiwan requires new utility helicopter as replacement for existing UH-1H Iroquois; S-70A in contention and reportedly preferred option over competing Bell 412; up to 80 of chosen type to be obtained, with local manufacture expected to be a key factor in selection. Decision originally anticipated in 1998 but has been deferred, with initial contract for 20 to 25 helicopters likely. Jordan also to acquire UH-60L version, with initial batch of eight helicopters delivered in second half of 2006 under FMS programme, following award of contract to Sikorsky on 9 July 2004. Most recent FMS customer is Brazil, which took delivery of the first of 10 UH-60L for CSAR and other duties on 26 July 2006; this helicopter left for Brazil on 2 August and arrived at Manaus on 7 August to join 7 Esquadrao.

S-70C: Commercial version; no recent news to report.

CUSTOMERS: By 1999, over 2,400 H-60s of all variants had flown more than 3.6 million hours; by mid-2006, US Army fleet alone had surpassed 4.6 million flight hours. US Army total includes EH-60As and diversions to USAF, Bahrain, Colombia, Egypt and Saudi Arabia; 1,000th of S-70 series accepted 17 October 1988 and 2,000th May 1994; US Army Black Hawks in service in US, Germany, Hawaii and South Korea and with Army National Guard and Army Reserve.

US Army UH-60As loaned to the US Drug Enforcement Agency, augmenting five bought direct from Sikorsky. Fleet in 1999 totalled 13 (all with military serial numbers), plus three in storage and further two lost in accidents.

See Current Versions for export models and details.

COSTS: UH-60L USD8.6 million (1997) US Army unit cost; MH-60G USD10.2 million. Two VIP aircraft for Egypt cost about USD47 million (2002), with spare engines, spare parts, tools and support equipment and other logistical support. Cost of single S-70A Firehawk for Los Angeles County Fire Department quoted as USD14.5 million (2003). Projected flyaway unit cost in FY07 of UH-60M and MH-60S quoted as USD14.2 million and USD18.6 million respectively.

DESIGN FEATURES: Represented new generation in technology for performance, survivability and ease of operation when introduced to replace UH-1 as US Army's main squad-carrying helicopter; adapted to wide variety of other roles, including several maritime applications. Four-blade main rotor; one-piece forged titanium rotor head with elastomeric blade retention bearings providing all movement and requiring no lubrication; hydraulic drag dampers; bifilar self-tuning vibration absorber above head; blades have 18° twist, and tips swept at 20°; thickness and camber vary over the length of blades, based on Sikorsky SC-1095 aerofoil; blades tolerant up to 23 mm hits and spar tubes pressurised with gauges to indicate loss of pressure following structural degradation.

Two pairs of tail rotor blades fastened in cross-beam arrangement, mounted to starboard; tail rotor pylon tilted to port to produce lift as well as anti-torque thrust and to extend permissible CG range; fixed fin large enough to allow controlled run-on landing following loss of tail rotor.

FLYING CONTROLS: Rotor pitch control powered by two independent hydraulic systems; Hamilton Sundstrand AFCS with digital three-axis autopilot provides speed and height control and coupled modes. Full-time autostabilisation includes feet-off heading hold cancelling torque-induced yaw at all airspeeds and during hover; positive fuselage attitude control provided by electrically driven variable incidence tailplane moving from +34° in hover to −6° during autorotation; angle is controlled by combined sensing of airspeed, collective-lever position, pitch attitude rate and lateral acceleration.

STRUCTURE: Main blade spar is formed and welded into oval titanium tube, with Nomex core, graphite trailing-edge, and covered by glass fibre/epoxy skin; titanium leading-edge abrasion strip and Kevlar tip. New composites main rotor blades, with modified tips and 16 per cent increase in chord, installed on UH-60M; retrofit to UH-60L model was under consideration but has not occurred Cross-beam composites tail rotor, eliminating all rotor head bearings. Light alloy airframe designed to retain 85 per cent of its flight deck and passenger space intact after vertical impact at 11.5 m (38 ft)/s, lateral impact at 9.1 m (30 ft)/s, and longitudinal impact at 12.2 m (40 ft)/s; also withstands simultaneous 20 *g* forward and 10 *g* downward impact; glass fibre and Kevlar used for cockpit doors, canopy, fairings and engine cowlings; glass fibre/Nomex floors; tailboom folds to starboard and main rotor mast can be lowered for transport/storage.

LANDING GEAR: Non-retractable tailwheel type with single wheel on each unit. Energy-absorbing main gear with a tailwheel which gives protection for the tail rotor in taxying over rough terrain or during a high-flare landing. Axle assembly and main gear oleo shock-absorbers by General Mechatronics. Mainwheel tyres size 26×10.00–11, pressure 8.96 to 9.65 bar (130 to 140 lb/sq in); tailwheel tyre size 15×6.00–6, pressure 6.21 to 6.55 bar (90 to 95 lb/sq in). Alaskan-based H-60s have Airglass Engineering ski landing gear.

POWER PLANT: Two 1,163 kW (1,560 shp) General Electric T700-GE-700 turboshafts on UH-60A. From late 1989 (UH-60L), two T700-GE-701C engines, each developing 1,402 kW (1,880 shp). UH-60M has two T700-GE-701D engines, each rated at 1,652 kW (2,215 shp). (T700-GE-701A engines with maximum T-O rating of 1,285 kW; 1,723 shp optional in export models.) Transmission rating 2,109 kW (2,828 shp) in UH-60A, uprated to 2,535 kW (3,400 shp) in models with T700-GE-701C engines.

Two crashworthy, bulletproof fuel cells, with combined usable capacity of 1,361 litres (360 US gallons; 300 Imp gallons), aft of cabin. Single-point pressure refuelling, or gravity refuelling via point on each tank. Auxiliary fuel can be carried internally in one of several optional arrangements, or externally by the ESSS system. Two external tanks each of 871 litres (230 US gallons; 192 Imp gallons); up to two internal tanks, each of 700 litres (185 US gallons; 154 Imp gallons).

ACCOMMODATION: Two-man flight deck, with pilot and co-pilot on armour-protected seats. A third crew member is stationed in the cabin at the gunner's position adjacent forward cabin windows. Forward-hinged jettisonable door on each side for access to flight deck area. Main cabin open to cockpit to provide good communication with flight crew and forward view for squad commander. Accommodation for 11 fully equipped troops, or 14 in high-density configuration; 20 minimally armed personnel in optional configuration. Eight troop seats can be removed and replaced by four litters for medevac missions, or to make room for internal cargo. An optional layout is available to accommodate a maximum of six litter patients. Executive interiors for seven to 12 passengers available for the S-70A. Cabin heated and ventilated. Simula Safety Systems Inc received USD7.1 million contract in April 1999 covering supply of 290 cockpit airbag systems for installation in US Army UH-60A/L; this was low-rate initial production phase and total comprised 275 aircraft units and 15 spares.

External cargo hook, having a 3,630 kg (8,000 lb) lift capability, enables UH-60A to transport a 105 mm howitzer, its crew of five and 50 rounds of ammunition. Rescue hoist of 272 kg (600 lb) capacity optional. Large rearward-sliding door on each side of fuselage for rapid entry and exit.

SYSTEMS: Solar 67 kW (90 hp) T-62T-40-1, Honeywell or Hamilton Sundstrand APU. An optional winterisation kit provides a second hydraulic accumulator installed in parallel with the APU hydraulic start accumulator, maintaining engine start capability at low ambient temperatures; Honeywell 30 to 40 kVA and 20 to 30 kVA electrical power generators; 17 Ah Ni/Cd battery. Engine fire extinguishing system. Rotor blade de-icing system standard on US Army aircraft, optional for export. Electric windscreen de-icing.

AVIONICS: Configurations vary between aircraft. Additional avionics and self-protection equipment installed in Enhanced Black Hawk, as described under Current Versions. Improvement options offered from 1996 for new-build and retrofit on S-70 series include 'glass cockpit' and digital avionics; equipment available includes EFIS and digital automated flight computer system (AFCS).

Comms: Raytheon AN/ARC-186 VHF-FM, Raytheon AN/ARC-115 VHF-AM, Raytheon AN/ARC-164 UHF-AM, Rockwell Collins AN/ARC-186(V) VHF-AM/FM, Honeywell AN/APX-100 IFF transponder, Raytheon TSEC/KT-28 voice security set, and intercom. HH-60G has AN/URC-108 satcom and is being upgraded with Rockwell Collins AN/ARC-210 integrated communications system; Rockwell Collins AN/ARC-220 nap of the earth digital radio and AN/ARC-222 installed on Block 152 Upgrade HH-60G. UH-60M has Telephonics secure digital intercom system.

Radar: MH-60K has Raytheon AN/APQ-147A terrain-following/terrain-avoidance radar, HH-60G has Honeywell AN/APN-239 (RDR-1400C) radar. MH-60L and some export S-70s also equipped with radar.

Flight: Hamilton Sundstrand AFCS with digital three-axis autopilot, Honeywell AN/ARN-123(V)1 VOR/marker beacon/glideslope receiver, Emerson AN/ARN-89 ADF, BAE Systems AN/ASN-128 Doppler, AN/ASN-43 gyrocompass, Honeywell AN/APN-209(V)2 radar altimeter. HH-60G has BAE Systems AN/ASN-137 Doppler, Rockwell Collins AN/ASN-149 GPS and Litton ring laser gyro INS (replacing Carousel IV). Northrop Grumman LISA-200 AHRS to be retrofitted to US Army helicopters. UH-60M has two Canadian Marconi (CMC) CMA-2082M electronic flight management systems and CMA-2088 emergency control panel, plus dual Honeywell embedded global positioning/inertial navigation systems.

Instrumentation: HH-60G has Teldix KG-10 map display. US Army MH-60 special operations versions gained Elbit ANVIS 7 NVG/HUD system as retrofit; system already fitted in UH-60A and L. Elbit ANVIS/HUD system ordered by Australia in August 1999; 12 units acquired for installation by Raytheon Australia on S-70A-9. NVG-compatible version of Lockheed Martin GH-3000 electronic standby instrument system installed on MH-60K. UH-60M has four Rockwell Collins 152 × 203 mm (6 × 8 in) landscape colour AMLCDs, providing primary flight, navigation and tactical information and also including fully integrated digital map display.

Mission: HH-60G has Raytheon AN/AAQ-16 FLIR. UH-60Q and HH-60L have (and HH-60M will have), FLIR Systems Inc AN/AAQ-22 SAFIRE thermal imaging system. Raytheon ZSQ-1(V) electro-optic sensor system installed on US Army MH-60s; two versions exist, with suite of equipment including laser rangefinders or laser spot trackers/designators, laser pointers, FLIR sensors, image-intensifying TV and associated processing and control electronics. Israeli S-70As have Elbit armament control system as well as an observation and targeting system, plus display and sight helmet with line-of-sight cueing. UH-60M incorporates US Army Blue Force tracking system.

Self-defence: Baseline UH-60 Black Hawk has Raytheon AN/APR-39(V)1 RWR, Sanders AN/ALQ-144 IR countermeasures set and BAE Systems M-130 chaff/flare dispenser. MH-60K has BAE Systems AN/AAR-47 missile warning system, Northrop Grumman AN/ALQ-136 pulse radio frequency jammer, Northrop Grumman AN/ALQ-162 CW radio jammer, Raytheon AN/APR-39A and AN/APR-44 pulse/CW warning receivers, Raytheon AN/AVR-2 laser detector, BAE Systems M-130 chaff/flare dispenser and BAE Systems AN/ALQ-144 IR countermeasures set. HH-60G has chaff/flare dispenser (BAE Systems M-130 being replaced by AN/ALE-47 since 1998) and BAE Systems AN/ALQ-144 IR countermeasures set. Development testing of BAE Systems AN/ALQ-212 Advanced Threat IR Countermeasures (ATIRCM) system on EH/MH-60s of US Army began in 1999. Future US Army UH-60s to incorporate BAE Systems Combined Common Missile Warning System/Advanced Threat Infrared Countermeasures (CMWS/ATIRCM), which subject of October 2004 contract. AN/AAR-47 missile warning system, AN/ALR-69(V) RWR, AN/ALE-47 chaff/flare dispensers and AN/ALQ-213 EW management system installed on Block 152 Upgrade HH-60G. Israeli S-70As have locally designed self-protection suite, including Elta EL/M-2160 missile approach warning system plus laser warning system, radar warning receivers, IR jammers and Roker chaff/flare dispensers. Australian S-70As to be upgraded with Project Echidna package, including EADS AN/AAR-60 missile launch detection system and BAE Systems Australia ALR-2002D radar warning receivers.

EQUIPMENT: HH-60G has Lucas Aerospace internal rescue hoist with 76 m (250 ft) of cable. UH-60Q has external Breeze-Eastern HS-29900 electric rescue hoist, with same company's BL-27100-85 hydraulic rescue hoist ordered by US Navy in November 2002 for installation on H-60 helicopters. MH-60S using Raytheon Airborne Mine Neutralisation System (AMNS) from 2005. Rafael external airbag system to be installed on Israeli Black Hawks for additional protection in event of crash or hard landing.

ARMAMENT: New production UH-60As and Ls from c/n 431 onward incorporate hardpoints for an external stores support system (ESSS). This consists of a combination of fixed provisions built into the airframe and four removable external pylons from which fuel tanks and a variety of weapons can be suspended. Able to carry more than 2,268 kg (5,000 lb) on each side of the helicopter, the ESSS can accommodate two 871 litre (230 US gallon; 192 Imp gallon) fuel tanks outboard, and two 1,703 litre (450 US gallon; 375 Imp gallon) tanks inboard. This allows the UH-60A to self-deploy 1,200 n miles (2,222 km; 1,381 miles) without refuelling. The ESSS also enables the Black Hawk to carry Hellfire laser-guided anti-armour missiles, gun or M56 mine dispensing pods, FIM-92 Stinger AAMs, ECM packs, rockets and motorcycles. Up to 16 Hellfires can be carried externally on the ESSS, with another 16 in the cabin to provide capability to land and reload. Two pintle mounts in cabin can each accommodate a 0.50 in calibre General Electric GECAL 50 or 7.62 mm six-barrel Minigun.

DIMENSIONS, EXTERNAL:

Main rotor diameter	16.36 m (53 ft 8 in)
Main rotor blade chord	0.53 m (1 ft 8¾ in)
Tail rotor diameter	3.35 m (11 ft 0 in)
Length overall: rotors turning	19.76 m (64 ft 10 in)
rotors and tail pylon folded	12.60 m (41 ft 4 in)
Length of fuselage:	
UH-60A/HH-60G, excl flight refuelling probe	15.26 m (50 ft 0¾ in)
HH-60G, incl retracted refuelling probe	17.38 m (57 ft 0¼ in)
Fuselage max width: UH-60A	2.36 m (7 ft 9 in)
Max depth of fuselage	1.75 m (5 ft 9 in)

Height: overall, tail rotor turning ..... 5.13 m (16 ft 10 in)
to top of rotor head ..... 3.76 m (12 ft 4 in)
in air-transportable configuration ..... 2.67 m (8 ft 9 in)
Tailplane span ..... 4.38 m (14 ft 4½ in)
Tailplane chord ..... 0.88 m (2 ft 10½ in)
Wheel track ..... 2.705 m (8 ft 10½ in)
Wheelbase ..... 8.83 m (28 ft 11¾ in)
Tail rotor ground clearance ..... 1.98 m (6 ft 6 in)
Cabin doors (each): Height ..... 1.37 m (4 ft 6 in)
Width ..... 1.75 m (5 ft 9 in)

DIMENSIONS, INTERNAL:
Cabin: Volume ..... 11.6 m^3 (410 cu ft)

AREAS:
Main rotor blades (each) ..... 4.34 m^2 (46.70 sq ft)
Tail rotor blades (each) ..... 0.41 m^2 (4.45 sq ft)
Main rotor disc ..... 210.15 m^2 (2,262.0 sq ft)
Tail rotor disc ..... 8.83 m^2 (95.03 sq ft)
Fin ..... 3.00 m^2 (32.30 sq ft)
Tailplane ..... 4.18 m^2 (45.00 sq ft)

WEIGHTS AND LOADINGS:
Weight empty: UH-60A ..... 5,118 kg (11,284 lb)
UH-60L ..... 5,344 kg (11,782 lb)
UH-60M ..... 5,670 kg (12,500 lb)
Payload: internal, UH-60A/L ..... 1,197 kg (2,640 lb)
underslung, UH-60A ..... 3,629 kg (8,000 lb)
underslung, UH-60L/Q and MH-60S ..... 4,082 kg (9,000 lb)
Mission T-O weight: UH-60A ..... 7,708 kg (16,994 lb)
UH-60L ..... 8,031 kg (17,706 lb)
HH-60G ..... 8,119 kg (17,900 lb)
MH-60K ..... 11,113 kg (24,500 lb)
UH-60M ..... 8,792 kg (19,382 lb)
Max alternative T-O weight (ferry mission), UH-60A/L: ..... 11,113 kg (24,500 lb)
Max disc loading:
UH-60L at mission T-O weight ..... 36.7 kg/m^2 (7.52 lb/sq ft)
UH-60L at max alternative T-O weight ..... 52.9 kg/m^2 (10.83 lb/sq ft)
Transmission loading:
UH-60L at mission T-O weight and max power ..... 3.04 kg/kW (5.00 lb/shp)
UH-60L at max alternative T-O weight and power ..... 4.20 kg/kW (6.91 lb/shp)

PERFORMANCE (UH-60A at mission T-O weight, except where indicated):
Never-exceed speed (VNE):
UH-60A/L/Q ..... 195 kt (361 km/h; 224 mph)
MH-60S ..... 180 kt (333 km/h; 207 mph)
Max level speed at S/L ..... 160 kt (296 km/h; 184 mph)
Max level speed at max T-O weight ..... 158 kt (293 km/h; 182 mph)
Max cruising speed at 1,220 m (4,000 ft) and 35°C (95°F):
UH-60A ..... 139 kt (257 km/h; 160 mph)
UH-60L ..... 152 kt (282 km/h; 175 mph)
Single-engine cruising speed at 1,220 m (4,000 ft) and 35°C (95°F) ..... 105 kt (195 km/h; 121 mph)
Vertical rate of climb at 1,220 m (4,000 ft) and 35°C (95°F):
UH-60A ..... 119 m (390 ft)/min
UH-60L ..... 472 m (1,550 ft)/min
Service ceiling: UH-60A ..... 5,700 m (18,700 ft)
UH-60L ..... 5,835 m (19,150 ft)
Hovering ceiling:
OGE at 35°C: UH-60A ..... 1,645 m (5,400 ft)
UH-60L ..... 2,330 m (7,650 ft)
Range with max internal fuel at max T-O weight, 30 min reserves:
UH-60A ..... 319 n miles (592 km; 368 miles)
UH-60L ..... 315 n miles (584 km; 363 miles)
Range with external fuel tanks on ESSS pylons:
with two 870 litre (230 US gallon; 191.5 Imp gallon) tanks ..... 880 n miles (1,630 km; 1,012 miles)
with two 870 litre (230 US gallon; 191.5 Imp gallon) and two 1,703 litre (450 US gallon; 375 Imp gallon) tanks ..... 1,200 n miles (2,222 km; 1,381 miles)
Endurance: UH-60A ..... 2 h 18 min
UH-60L ..... 2 h 6 min

SIKORSKY S-70B

US Navy designations: SH-60B and MH-60R Seahawk, SH-60F and HH-60H
US Coast Guard designations: HH-60J, MH-60J and MH-60T Jayhawk
Japan Maritime Self-Defence Force designation: SH-60J and SH-60K
Spanish Navy designation: HS.23
Republic of China Navy designation: S-70C(M)-1 and S-70C(M)-2 Thunderhawk

TYPE: Naval combat helicopter.

PROGRAMME:

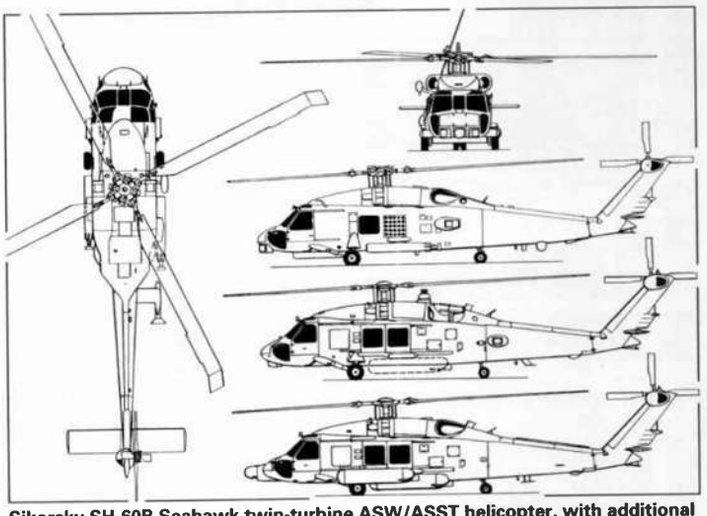
DEVELOPMENT MILESTONES

Programme launched	1977
First order (US Navy)	FY82
First flight	12 Dec 79
First flight, production	11 Feb 83
Entered service (US Navy)	1984
Subsequent versions:	
MH-60R	
First flight	11 Dec 99
First flight, production	28 Jul 05
First delivery	19 Aug 05

Naval development of Sikorsky UTTAS (UH-60A Black Hawk) utility helicopter; won US Navy LAMPS Mk III competition for shipboard helicopter in 1977; first flight of first of five YSH-60B prototypes (161169) 12 December 1979; first 18 SH-60Bs authorised FY82. Changed USN planning in 1993 resulted in premature end to SH-60B/F production; original intent was to remanufacture SH-60B/Fs and HH-60Hs as SH-60R (redesignated MH-60R in mid-2001), but acquisition strategy changed in 2001 and all but a handful of MH-60Rs will be new-build helicopters.

CURRENT VERSIONS: **SH-60B**: Initial production version for ASW/ASST; 181 built for US Navy, excluding prototypes.

First new-built Sikorsky MH-60R *(Lockheed Martin)* 1116430



Sikorsky SH-60B Seahawk twin-turbine ASW/ASST helicopter, with additional side views of HH-60H (centre) and HH-60J Jayhawk (bottom) *(Dennis Punnett)* 0507464

Detailed description applies to SH-60B, unless otherwise stated.

NSH-60B: Designation applied to two SH-60Bs (162337 and 162974) assigned to permanent test duties at Patuxent River, Maryland.

SH-60F: CV Inner Zone ASW helicopter, known as CV-Helo, for close-in ASW protection of aircraft carrier groups; US$50.9 million initial US Navy contract for full-scale development and production options placed 6 March 1985; replacing SH-3H Sea King; Seahawk prototype modified as SH-60F test aircraft; first flight 19 March 1987; initial fleet deployment by HS-2 aboard USS *Nimitz* in 1991. Currently assigned to 10 deployable squadrons (HS-2 to HS-8, HS-11, HS-14 and HS-15) plus one training unit (HS-10) and one Reserve Force squadron (HS-75). Production terminated with delivery of 82nd example 1 December 1994.

SH-60F has all LAMPS Mk III avionics, fairings and equipment removed, including cargo hook and RAST system main and tail probes, but installation provisions retained. Replaced by integrated ASW mission avionics including Honeywell AN/AQS-13F dipping sonar, MIL-STD-1553B databus, dual Litton AN/ASN-150 tactical navigation computers and AN/ASM-614 avionics support equipment, automatic flight control system with quicker automatic transition and both cable and Doppler autohover, tactical datalink with other aircraft, communications control system, multifunction keypads and displays for each of four crew members; internal/external fuel system and extra weapon station to port allowing carriage of three Mk 50 homing torpedoes; provision for surface search radar, FLIR, night vision equipment, passive ECM, MAD, air-to-surface missile capability, sonobuoy datalink, chaff/sonobuoy dispenser, attitude and heading reference system (AHRS), Navstar GPS, fatigue monitoring system and increase of maximum T-O weight to 10,659 kg (23,500 lb); secondary missions include SAR and plane guard.

UH-60F: Unconfirmed (and apparently unofficial) designation applicable to SH-60Fs modified for search and rescue duty with US Navy. At least one SH-60F (163282) has had specialised ASW equipment removed before flying for first time in this form on 25 October 2004; it was subsequently assigned to Naval Air Station Key West, Florida, but appears to have retained SH-60F designation throughout 2006.

YSH-60F: Designation applied to second production SH-60F (163283) which served as 'prototype' on test duties at Patuxent River, Maryland. To be fitted with lifting wing with flaperons and 2.44 m (8 ft) diameter vectored thrust ducted propeller ('ring tail') by Piasecki Aircraft Corporation (which see) as **X-49A** for trials project as part of advanced technology demonstration programme. Known as SpeedHawk, this programme originated with Naval Air Systems Command, but was transferred to US Army control in late 2003; a 14-month flight test effort was expected to begin in about July 2005. No recent news received concerning this project.

HH-60H: US Navy procurement of 42 completed in 1996; used for strike-rescue/special warfare support (HCS); designated HH-60H in September 1986; first flight (163783) 17 August 1988; accepted by USN 30 March 1989; in service with HCS-4 at Norfolk, Virginia, January 1990; initial procurement ended with 18th delivery July 1991, completing HCS-5 at Point Mugu, California; both squadrons are part of Navy Reserve. Regular SH-60F squadrons later added pairs of HH-60Hs for deployed duty when embarked aboard aircraft carriers; missions are to recover four-man crew at 250 n miles (463 km; 288 miles) from launch point or fly 200 n miles (371 km; 230 miles) and drop eight SEALs from 915 m (3,000 ft).

Close derivative of SH-60F, with T700-GE-401C engines and HIRSS as SH-60B/F; equipment includes Litton AN/APR-39A(XE)2 RWR, Raytheon AN/AVR-2A(V) laser

Sikorsky SH-60F Seahawk of HS-14 lifting from USS *Kitty Hawk*, with USS *Ronald Reagan* as backdrop *(PMA Joshua Wayne LeGrand, US Navy)* 1158812

Sikorsky HH-60H strike rescue and special warfare helicopter *(MCS2C Rebecca Moat, US Navy)* 1158815

warning receiver, Honeywell AN/AAR-47 missile plume detector, Lockheed Martin AN/ALE-47 chaff/flare dispenser, Sanders AN/ALQ-144 IR jammer, Elbit ANVIS 7 NVG/HUD system and two cabin-mounted M60D 7.62 mm machine guns; provision for weapon pylons; required to operate from decks of FFG-7, DD-963, CG-47 and larger vessels, as well as unprepared sites. Cubic AN/ARS-6 personnel locator system installed from FY91. Some equipped with Indal RAST (recovery assist, secure and traverse) equipment. Armament development authorised October 1991 for installation of Hellfire ASM, 70 mm (2.75 in) rockets and forward-firing guns. Some HH-60H now fitted with nose-mounted Raytheon AN/AAS-44(V) FLIR/laser designator system for use with Hellfire missile.

HH-60J Jayhawk: Ordered in parallel with HH-60H; adapted for US Coast Guard medium-range recovery (MRR) role; last of 42 delivered in 1996. First flight (USCG 6001) 8 August 1989; first delivery to USCG (6002 at Elizabeth City CGAS) 16 June 1990; subsequently to Mobile, Traverse City, San Diego, Astoria, San Francisco, Cape Cod, Sitka, Kodiak and Clearwater CGAS. When carrying three 455 litre (120 US gallon; 100 Imp gallon) external tanks, HH-60J can fly out 300 n miles (556 km; 345 miles) and return with six survivors in addition to four-man crew, or loiter for 1 hour 30 minutes when investigating possible smugglers; other duties include law enforcement, drug interdiction, logistics, aids to navigation, environmental protection and military readiness; compatible with decks of 'Hamilton' and 'Bear' class USCG cutters. Equipment includes Honeywell RDR-1300C search/weather radar, AN/ARN-147 VOR/ILS, KDF 806 direction-finder, GPS, Tacan, VHF/UHF-DF, TacNav, dual U/VHF-FM radios, HF radio, IFF, V/U/HF IFF crypto computers, NVG-compatible cockpit, rescue hoist and external cargo hook. **MH-60J** designation applies to HH-60J helicopters that have been modified to carry weaponry allied to the AUF (Airborne Use of Force) equipment package. An initial batch of five aircraft were deployed during 2004, with four more due to be similarly modified by the end of 2005; weaponry comprises door-mounted M240 machine guns and an M-14 sniper rifle.

XSH-60J: Japan Maritime Self-Defence Force (JMSDF) placed US$27 million order for two **S-70B-3** s for installation of Japanese avionics and mission equipment; first flights 31 August and early October 1987; 1,007 hour test programme by Japan Defence Agency Technical Research and Development Institute between 1 June 1989 and 7 April 1991 to evaluate largely Japanese avionics for SH-60J, but AN/APS-124 radar.

SH-60J: Mitsubishi manufactured more than 100 SH-60J Seahawks for JMSDF.

SH-60K: Improved version of Seahawk for JMSDF. Production was expected to begin in FY01 but was delayed; JMSDF funded batches of seven helicopters in each of FY02, FY03 and FY04, while reportedly seeking initial batch of 50, with second batch of 50 to follow, as well as upgrade project involving SH-60J version.

Operational evaluation of Sikorsky MH-60R by HSM-41 *(MCS2C Rebecca J Moat, US Navy)* 1158816

Royal Australian Navy Sikorsky S-70B-2 Seahawk *(Paul Jackson)* 1158855

MH-60R: Originally designated SH-60R and also known as LAMPS Block II; combines SH-60B capabilities with dipping sonar of SH-60F; original plan was for rebuild of existing fleet; first two conversions were to be funded in FY98; 15 in FY99 and more thereafter; however, concerns over cost led to one year delay in launch of remanufacture programme, which began in FY00 with batch of seven helicopters for test duties (ordered 25 April 2000) . Training unit HSL-41 at North Island, California, planned to be first squadron under new identity as HSM-41.

Development delays and cost concerns in 2000–01 prompted Navy to restructure programme in favour of mostly new-build MH-60Rs, which will be purchased for USD1 million to USD3 million more than remanufactured examples and also allow the Navy to implement measures to improve power to weight performance. Total of 252 MH-60Rs required by 2015.

MH-60R systems orientated towards littoral warfare operations, with ability to process and prosecute large number of air and sea contacts in a comparatively confined space, the latter in relatively shallow water. New systems added to enhance countermeasures and passive and active detection capability. Initial upgrade package abandoned on grounds of high cost in 1998, when less expensive programme, making extensive use of COTS technology, was adopted.

Lockheed Martin secured USD61 million contract in third quarter of 1998 for development of common cockpit prototype applicable to MH-60R and MH-60S variants. Under terms of contract, Lockheed Martin provided flight instrument displays, two MFDs, two operator keysets and digital communications suite as well as Litton integrated INS/GPS, mass memory unit, mission and flight management computers and applicable operational software for both versions. New 'glass cockpit' centred around Lockheed Martin-developed computer systems, but using commercial PowerPC processors, with data presented to pilots via electronic flight instrument display and multifunction mission display.

Other changes on MH-60R include deletion of MAD, addition of AGM-114 Hellfire anti-armour missile and two more stores stations, databus, Telephonics AN/APS-147 multimode radar, Raytheon/Thales AN/AQS-22 (FLASH) advanced airborne low-frequency dipping sonar, AN/AYK-14 mission processor and AN/UYS-2A enhanced modular signal processor, Lockheed Martin AN/ALQ-210 ESM, Raytheon AN/AAS-44 FLIR/laser ranger and NVG compatibility. MTOW expected to rise to 10,659 kg (23,500 lb). May eventually be fitted with new, more powerful engine.

Two SH-60Bs (162976 and 162977) selected as prototypes; conversion undertaken by Lockheed Martin Systems Integration at Owego, New York, where first (then designated SH-60R, later becoming NMH-60R) was rolled out on 5 August 1999. First flight scheduled for October 1999, following electronic systems functional test and checkout on the ground, but delayed until 11 December; first prototype half analogue/half 'glass cockpit' for initial testing, with full 'glass cockpit' installed after about three months. After initial trials at Owego, first prototype delivered to Patuxent River, Maryland, in early May 2000 for start of two-year Navy/contractor developmental test programme.

Initial engineering development model (EDM) aircraft (166402), remanufactured by Sikorsky, first flew 19 July 2001 and formally accepted by Navy (still in manufacturer's hands) later in same month. Subsequently to Patuxent River, on 10 August 2001 for installation of flight test instrumentation and then to Lockheed Martin at Owego for fitting of new mission systems. First flight with 'total weapon system' made on 4 April 2002.

A second EDM aircraft (166403) was delivered to the US Navy by the start of February 2002; thereafter, a total of five Low Rate Initial Production (LRIP I) helicopters followed, with the first (166404) making its maiden flight on 9 July 2002. Two further LRIP I MH-60Rs had been accepted by the Navy before the end of 2002, with the final pair following in 2003; in all cases, remanufacture was accomplished by Sikorsky, with the helicopter then going to Lockheed Martin at Owego for installation of mission systems. It was originally intended to obtain another four remanufactured aircraft in FY01, but this was abandoned when the Navy opted to acquire new-build helicopters starting with the LRIP II batch, which was funded in FY04. The first new-build MH-60R (166515) made its maiden flight on 28 July 2005 and was formally accepted by US Navy at Stratford, Connecticut on 19 August, being flown to Owego for fitting out in early October 2005, after initial flight testing by Sikorsky; this machine retained by Lockheed Martin for trials, with second new-build MH-60R (166516) being first to join US Navy on assignment to HX-21 at Patuxent River after hand-over on 31 March 2006.

Before that, the US Navy had completed a six-month technical evaluation (TechEval) programme in February 2005; during this trials effort, the MH-60R test fleet accumulated about 630 flight hours with HX-21 and VX-1 Squadrons; much of this was accomplished at NAS Patuxent River, Maryland, other locations used during TechEval including NAS China Lake, California, and Eglin AFB, Florida, with some testing undertaken in the Caribbean.

Final hurdle before start of full-rate production is US Navy OpEval (operational evaluation), which began with VX-1 Squadron at Patuxent River on 9 May 2005 and concluded in September of same year. Successful conclusion of OpEval cleared way for Milestone III approval on 31 March 2006 of full-rate production starting with Lot 4 (12 aircraft) in FY06. Total of six helicopters purchased in FY05, with 12 in FY06 and 25 planned for FY07; rate will ultimately build to peak of 30 per year. USN to reorganise fleet and redesignate units as Helicopter Maritime Strike (HMS) squadrons; see table for details of implementation plan and future assignments. Some slippage has already occurred, with first (training) squadron actually receiving its first four aircraft (166402, 166404, 166407 and 166408) of eventual 17 in December 2005 and thereafter achieving IOC on 19 January 2006; this is HSM-41 at North Island, California. First students to undergo training with HSM-41 commenced transition course on 1 October 2006.

First operational deployment as part of Navy carrier battle group now expected to take place in FY09; unit involved will probably be HSM-71.

MH-60R PRODUCTION

Batch	FY	Quantity	First Aircraft
Test	00	2	166402
LRIP I	00	5	166404
LRIP II	04	4	166515
LRIP III	05	6	166519
FRP I	06	12	n/a
Total		**29**	

Notes: Excludes two SH-60Bs modified as SH-60R (later MH-60R) prototypes. Subsequent full-rate production (FRP) to be subject of a multiyear procurement (MYP) programme alongside UH-60M and MH-60S versions; refer to table in S-70A entry for details.

HH-60T Jayhawk: A modernisation programme to be accomplished between 2007 and 2011 is expected to result in all 41 surviving HH-60Js being brought to **MH-60T** standard, compatible with AUF (Airborne Use of Force) weaponry as detailed in MH-60J entry. In the intervening period, a number of other improvements, including provision of digital cockpits, FLIR and new radar sensors, Nightsun searchlights and airframe modifications, will bring a number of aircraft to HH-60T configuration, with the first example scheduled to begin operational test and evaluation by the end of 2006. Consideration is also being given to upgrading current T700-GE-401C engines to T700-GE-401D standard, offering increased power and enhanced durability. The definitive MH-60T will be required to deploy 200 n miles (370 km; 230 miles) from shore base with a six-man counter-terrorism team.

Exports comprise: S-70B-1: Spanish Navy received six from December 1988 (designated **HS.23**) for operation from four FFG-7 frigates by Escuadrilla 010 at Rota; similar to USN SH-60B, but with Honeywell AN/AQS-13F dipping sonar. Spanish government approval to order additional six granted in December 1998, with order placed in third quarter 2000; five of them delivered to Rota, in October 2002, with final aircraft retained at Owego, New York, for additional trials before being handed over in early 2003. Deal for new helicopters also included funds to upgrade original six to same standard, including armament kits and compatibility with AGM-114 Hellfire and AGM-119 Penguin ASMs. First two upgraded helicopters completed modernisation process in July and October 2003.

S-70B-2: Royal Australian Navy (RAN) selected Seahawk for role adaptable weapon system (RAWS) full-spectrum ASW helicopter with autonomous operating capability; order for eight confirmed 9 October 1984; eight more ordered May 1986. S-70B-2 has substantially different avionics from USN version: Racal Super Searcher radar (capable of tracking 32 surface targets) and Rockwell Collins advanced integrated avionics including cockpit controls and displays, navigation receivers, communications radios, airborne target handoff datalink and tactical data system (TDS). Upgrade of Australian Seahawks, known as Project Sea 1405, includes installation of Raytheon AN/AAQ-27 FLIR and an electronic warfare support measures package based on Elisra's AES-210 system; also installation of Smiths NVG-compatible aircraft standby attitude indicators and Northrop Grumman AN/AAR-54(V) passive MAWS. All 16 Seahawks upgraded by third quarter of 2003; first helicopter handed over to Tenix Defence Systems in first quarter 2000. Mid-life upgrade (MLU) expected in due course, with project definition study beginning in 2003–04; MLU likely to involve provision of dipping sonar and integration of ASM, with Penguin Mk2 anti-ship missile a strong possibility as this already purchased for use by RAN Seasprite helicopters.

S-70B-6: Hybrid SH-60B/F for Greece, unofficially known as **Aegean Hawk**; selected December 1991 and initial quantity of five ordered 17 August 1992 for MEKO 200 frigates. Option for three more subsequently converted to firm order and contract for further two (later increased to three) signed on 12 June 2000. Armament includes NFT Penguin Mk2 ASMs; avionics include AN/AQS-18(V)-3 dipping sonar, AN/APS-143(V3) radar and AN/ALR-66(V)-2 ESM; towed MAD and sonobuoy launcher omitted. First two delivered fourth quarter of 1994, with three more in 1995, one in 1997 and two in 1998; two helicopters from latest order were delivered to Greece in June 2004, with final machine following by end of 2005. Original eight aircraft being modified to operate with AN/AAQ-22Q Star SAFIRE FLIR sensor; three final aircraft have Raytheon AN/AAS-44 FLIR/laser rangefinder.

S-70B-7: Six Seahawks ordered by Royal Thai Navy in October 1993; equipped for coastal surveillance, maritime patrol and SAR from aircraft carrier HTMS *Chakri Naruebet;* first handed over at Stratford on 6 March 1997, with all six delivered by June.

S-70B-28: Initial batch of four ordered by Turkish Navy on 14 February 1997, with option on another four subsequently converted to firm order; the first example made its maiden flight on 18 January 2001 and all eight were delivered in 2002 for service aboard frigates in ASW and surveillance roles. They are first export Seahawks with a Rockwell Collins 'glass cockpit' and also have L-3 Communications Ocean Systems HELRAS long-range active dipping sonar and Telephonics AN/APS-143(V) radar installed. Original order includes supply of AGM-114 Hellfire II ASM. Turkey has ultimate requirement for up to 28 S-70Bs, of which further 12 formed subject of MoU announced by Sikorsky in June 2005; delivery set to begin in 2008, with a further five helicopters subject to option. Finalisation of order delayed because of protracted negotiations concerning previous offset arrangement relating to Black Hawk helicopters; for a time, it looked as if S-70B order would not go ahead, but settlement eventually achieved in March 2006; delivery of these helicopters may, however, take place later than originally anticipated.

S-70C(M)-1/2 Thunderhawk: S-70C designation used for H-60 purchases not qualifying for FMS. Principally assigned to aircraft delivered to Taiwan. Production complete.

CUSTOMERS: Total US Navy requirement originally 260 SH-60Bs; 186 on order, including five prototypes, when procurement terminated in FY94. First flight production Seahawk 11 February 1983; last SH-60B delivered to US Navy on 25 September 1996; first squadron was HSL-41 at NAS North Island, San Diego, California; operational deployment began 1984; 10 US Navy squadrons operating by March 1991 (HSLs 41, 43, 45, 47 and 49 at NAS North Island; 40, 42, 44, 46 and 48 at NAS Mayport, Florida); subsequently HSL-51 formed at Atsugi, Japan, 1 October 1991, and HSL-37 at NAS Barbers Point, Hawaii, began converting from SH-2Fs on 6 February 1992; most recent unit to equip is HSL-60 of the Reserve Force, also at Mayport. SH-60Bs deployed in 'Oliver Hazard Perry' (FFG-7) class frigates, 'Spruance' class and Aegis-equipped destroyers and 'Ticonderoga' class guided missile cruisers. US Navy originally required 150 SH-60Fs; total 82 completed, comprising seven pre-series plus 18 each in FY88, 89 and 91, 12 in FY92 and nine in FY93; procurement then halted; in West Coast service with HS-2, 4, 6, 8, 10 and 14 squadrons at NAS North Island, California; HS-3 at Jacksonville, Florida, equipped from 27 August 1991 as first East Coast squadron, followed by HS-1, 5, 7, 11 and 15, of which training squadron HS-1 since disestablished, leaving HS-10 of Pacific Fleet to conduct all US Navy SH-60F instruction. Reserve Force unit HS-75 at Jacksonville now also has SH-60F. US Navy planning acquisition of 252 MH-60Rs (excluding two test articles).

Exported to Australia, Greece, Japan, Spain, Taiwan, Thailand and Turkey (see Current Versions). S-70B-4 and -5 are derivatives of SH-60F and HH-60H, respectively; not taken up. Singapore announced purchase of six S-70Bs on 21 January 2005; delivery to be accomplished in 2008-10 for service on new La Fayette class frigates, but helicopters will be flown by air force personnel. Brazil expected to acquire at least six S-70Bs to replace SH-3 Sea King with naval air arm; US Congress advised of request for FMS deal on 27 September 2006.

COSTS: USD20.25 million (1992) USN programme unit cost. Flyaway cost of final USN SH-60B about USD16 million. MH-60R RDT&E costs expected to be around USD1.5 billion in FY06 base year dollars, with unit flyaway cost of MH-60Rs to be acquired in FY06 projected to be USD33.7 million, reducing to USD30.1 million in FY07. Total procurement cost in FY06 base year dollars estimated at USD9.2 billion.

DESIGN FEATURES: SH-60B Seahawk designed to provide all-weather detection, classification, localisation and interdiction of surface ships and submarines, either controlled through datalink from parent ship or operated independently; secondary missions include SAR, vertical replenishment, medevac, fleet support and communications relay.

Revised features, compared with UH-60A, include more powerful navalised GE T700-GE-401 engines, additional fuel, sensor operator's station, port-side internal launchers for 25 sonobuoys, pylon on starboard side of tailboom for MAD bird, lateral pylons for two torpedoes or external tanks, chin-mounted ESM pods, sliding cabin door, rescue hoist, electrically actuated blade folding, rotor brake, folding tail, short-wheelbase tailwheel landing gear with twin tailwheels stressed for lower crash impact, DAF Indal RAST recovery assist, secure and traversing for haul-down landings on small decks and moving into hangar, hovering in-flight refuelling system, and emergency flotation system; pilots' seats not armoured. SH-60B gives 57 minutes' more listening time on station and 45 minutes' more ship surveillance and targeting time than SH-2F Seasprite LAMPS Mk I.

For operation in Gulf during mid-1980s Iran-Iraq war, 25 SH-60Bs fitted with upper and lower Sanders AN/ALQ-144 IR jammers, BAE Systems AN/ALE-39 chaff/flare dispensers, Honeywell AN/AAR-47 electro-optical missile warning, and a single 7.62 mm machine gun in door, for a weight penalty of 169 kg (369.5 lb); seven Seahawks fitted with Raytheon AN/AAS-38 FLIR on root weapon pylon with instantaneous relay to parent ship.

First Block I SH-60B update, introduced in production Lot 9, delivered from October 1991, includes provision for NFT AGM-119 Penguin anti-ship missile, Mk 50 advanced lightweight torpedo, Flightline AN/ARR-84 99-channel sonobuoy receiver (replacing ARR-75), Rockwell Collins AN/ARC-182 V/UHF FM radio and Rockwell Collins Class 3A Navstar GPS.

FLYING CONTROLS: As for UH-60.

STRUCTURE: Basically as for UH-60 plus marine corrosion protection; single cabin door, starboard side, narrower than on UH-60.

LANDING GEAR: Generally as for UH-60, but with twin tailwheel positioned further forward to facilitate operation from landing platforms on warships.

POWER PLANT: Two 1,260 kW (1,690 shp) intermediate rating General Electric T700-GE-401 turboshafts in early aircraft; 1,342 kW (1,800 shp) T700-GE-401C turboshafts introduced in 1988 and on HH-60H/J. Transmission rating 2,535 kW (3,400 shp). Internal fuel capacity 2,233 litres (590 US gallons; 491 Imp gallons). Hovering in-flight refuelling capability.

MH-60R PLANNED ASSIGNMENT

New Identity	Current Identity	Planned Date	Fleet Assignment	Type of Deployment
HSM-37	HSL-37	Jan 14	Pacific	Expeditionary
HSM-40	HSL-40	Jan 10	Atlantic	Training
HSM-41	HSL-41	Mar 05	Pacific	Training
HSM-42	HSL-42	Mar 14	Atlantic	Expeditionary
HSM-48	HSL-48	Feb 15	Atlantic	Expeditionary
HSM-49	HSL-49	Apr 14	Pacific	Expeditionary
HSM-51	HSL-51	Mar 13	Pacific	Expeditionary
HSM-60	HSL-60	Mar 14	Reserve	Reserve
HSM-70	(new)	Jan 08	Atlantic	Carrier Force
HSM-71	(new)	Apr 09	Pacific	Carrier Force
HSM-72	(new)	Feb 09	Atlantic	Carrier Force
HSM-73	HSL-43	Feb 07	Pacific	Carrier Force
HSM-74	HSL-44	Feb 10	Atlantic	Carrier Force
HSM-75	HSL-45	Mar 08	Pacific	Carrier Force
HSM-76	HSL-46	Feb 11	Atlantic	Carrier Force
HSM-77	HSL-47	Apr 10	Pacific	Carrier Force
HSM-78	(new)	Feb 12	Atlantic	Carrier Force
HSM-79	(new)	Apr 11	Pacific	Carrier Force

Notes:
Dates refer to planned conversion to MH-60R according to programme announced in late 2003; some changes have already occurred, with HSM-71 now identified as first operational squadron, scheduled to take delivery of MH-60R in FY08 at North Island. It also appears that responsibility for Atlantic Fleet training will be assigned to HSM-70 rather than HSM-40 as stated in table.

Two 455 litre (120 US gallon; 100 Imp gallon) auxiliary fuel tanks on fuselage pylons optional (three on HH-60J). Hover IR suppressor subsystem (HIRSS) exhaust cowling fitted to HH-60H.

ACCOMMODATION: Pilot and airborne tactical officer/back-up pilot in cockpit, sensor operator in specially equipped station in cabin. Dual controls standard. Sliding door with jettisonable window on starboard side. Accommodation heated, ventilated and air conditioned.

SYSTEMS: Generally as for UH-60A.

AVIONICS: Refer also to Current Versions for variants other than SH-60B.

Comms: Rockwell Collins AN/ARC-159(V)2 UHF, Rockwell Collins AN/ARC-174(V)2 HF, Hazeltine AN/APX-76A(V) and Honeywell AN/APX-100(V)1 IFF transponders, TSEC/KG-45(E-1) communications security set, TSEC/KY-75 voice security set, Telephonics OK-374/ASC communications system control group. Satellite communications planned for MH-60R, which also has Mode S IFF transponder and Harris Hawklink Ku-band sensor datalink.

Radar: Raytheon AN/APS-124 search radar on SH-60B and Telephonics AN/APS-147 on MH-60R (Racal Super Searcher for Australia; Telephonics AN/APS-128PC for Taiwan; Telephonics AN/APS-143(V) for Turkey).

Flight: Rockwell Collins AN/ARN-118(V) Tacan, Northrop Grumman AN/APN-127 Doppler, Rockwell Collins AN/ARA-50 UHF DF, Honeywell AN/APN-194(V) radar altimeter. US Navy began testing version of Raytheon Joint Precision Approach and Landing System (JPALS) on an SH-60 in 2002; this system was expected to begin replacing existing radar-based shipboard precision approach system from 2005–06, but funding shortages have resulted in it being indefinitely delayed. MH-60R has Northrop Grumman LN-100G GPS/INS.

Mission: Sikorsky sonobuoy launcher, Flightline AN/ARR-75 and R-1651/ARA sonobuoy receiving sets (AN/ARR-84 receiver in Australian Seahawks and for USN Block 1 upgrade), Raytheon AN/ASQ-81(V)2 towed MAD (CAE AN/ASQ-504(V) internal MAD in Australian Seahawks), Raymond MU-670/ASQ magnetic tape memory unit, Astronautics IO-2177/ASQ altitude indicator, Fairchild AN/ASQ-164 control indicator set, Fairchild AN/ASQ-165 armament control indicator set, IBM AN/UYS-1(V)2 Proteus acoustic processor (Computing Devices UYS-503 for Australia) and CV-3252/A converter display, GD Information AN/AYK-14 (XN-1A) digital computer, Raytheon AN/ALQ-142 ESM, Sierra Research AN/ARQ-44 datalink and telemetry (Rockwell Collins DHS-901 in Australian Seahawks). SH-60F has Honeywell AN/AQS-13F dipping sonar (AN/AQS-18 in Taiwanese S-70s). During 1991 Gulf War, pod-mounted Hughes (now Raytheon) AN/AAQ-16 FLIR fitted to five SH-60Bs and Raytheon AN/AAQ-17 FLIR deployed on one SH-60B; BAE Systems Sea Owl IR turret evaluated later in 1991. Raytheon AN/AAS-44 FLIR/laser ranger and AN/AQS-22 airborne low frequency sonar on MH-60R. Australian examples also acquired AN/AAQ-16 FLIR for 1991 Gulf War. Raytheon AN/AAQ-27 FLIR system adopted as part of upgrade of Australian Seahawks to be undertaken by Tenix Defence Systems. US Navy to acquire airborne laser mine detection system for SH-60B and MH-60R; Northrop Grumman system selected in mid-2000, with 36 month engineering and manufacturing development (EMD) from 2001. Greek aircraft retrofitted with AN/AAQ-22Q Star SAFIRE FLIR sensor between November 2002 and June 2003; Raytheon AN/AAS-44 installed on final three Aegean Hawks.

Self-defence: ESM systems include Raytheon AN/APR-39 RWR on HH-60H; none on SH-60F. MH-60R has Lockheed Martin AN/ALQ-210 ESM. Australian Seahawks fitted with AN/ALE-47 chaff/flare dispensers and AN/AAR-47 missile detectors for 1991 Gulf War. Upgrade of Australian Seahawks to include ESM based on Elisra AES-210 system.

EQUIPMENT: External cargo hook (capacity 2,722 kg; 6,000 lb) and rescue hoist (272 kg; 600 lb) standard. SH-60B/F and MH-60R have provision for eight sonobuoys.

ARMAMENT: US Navy armament includes up to three Mk 46 torpedoes and NFT AGM-119B Penguin Mk 2 Mod 7 anti-shipping missiles. Block I upgrade integrated Penguin and Honeywell Mk 50 Advanced Lightweight Torpedo from 1993. HH-60H has two pintle-mounted M240G 7.62 mm machine guns and was cleared in 1996 to operate with AGM-114 Hellfire ASM. HH-60H can operate with 70 mm (2.75 in) rocket pods and GAU-17/A 7.62 mm forward-firing guns. Hellfire to be included in SH-60B and MH-60R armament for attacking small ships. MH-60J and future MH-60T include provisions for carriage of door-mounted M240 7.62 mm machine guns and M-14 sniper rifle. MH-60R to have Raytheon Mk 54 lightweight hybrid torpedo and provision for crew-served weapons including M60, M240, GAU-16 and GAU-21 machine guns.

DIMENSIONS, EXTERNAL: As UH-60A except:

Length overall, rotors and tail pylon folded:	
SH-60B	12.47 m (40 ft 11 in)
HH-60H	12.51 m (41 ft 0⅞ in)
HH-60J	13.13 m (43 ft 0⅞ in)
Length of fuselage: HH-60J	15.87 m (52 ft 1 in)
Width, rotors folded	3.26 m (10 ft 8½ in)
Height:	
overall, tail rotor turning	5.18 m (17 ft 0 in)
overall, pylon folded	4.04 m (13 ft 3¼ in)
to top of rotor head	3.79 m (12 ft 5⅝ in)
Wheelbase	4.83 m (15 ft 10 in)
Tail rotor ground clearance	1.83 m (6 ft 0 in)
Main/tail rotor clearance	6.6 cm (2⅝ in)

AREAS: As UH-60A

WEIGHTS AND LOADINGS:

Weight empty: SH-60B ASW	6,191 kg (13,648 lb)
HH-60H	6,114 kg (13,480 lb)
HH-60J	6,086 kg (13,417 lb)
Useful load: HH-60J	3,551 kg (7,829 lb)
Internal payload: HH-60H	1,860 kg (4,100 lb)
Mission gross weight:	
SH-60B	9,575 kg (21,110 lb)
Max T-O weight:	
SH-60B Utility, HH-60H	9,926 kg (21,884 lb)
SH-60F, MH-60R	10, 659 kg (23,500 lb)
HH-60J	9,637 kg (21,246 lb)
Max disc loading:	
SH-60B Utility, HH-60H	47.2 kg/m² (9.67 lb/sq ft)
SH-60F, MH-60R	50.7 kg/m² (10.39 lb/sq ft)
HH-60J	45.9 kg/m² (9.39 lb/sq ft)
Transmission loading at max T-O weight and power:	
SH-60B Utility, HH-60H	3.92 kg/kW (6.44 lb/shp)
SH-60F, MH-60R	4.21 kg/kW (6.91 lb/shp)
HH-60J	3.80 kg/kW (6.25 lb/shp)

PERFORMANCE:

Cruising speed at S/L:	
HH-60H	147 kt (272 km/h; 169 mph)
HH-60J	146 kt (271 km/h; 168 mph)
Dash speed at 1,525 m (5,000 ft), tropical day:	
SH-60B	126 kt (234 km/h; 145 mph)
Vertical rate of climb at S/L, 32.2°C (90°F):	
SH-60B	213 m (700 ft)/min
Vertical rate of climb at S/L, 32.2°C (90°F), OEI: SH-60B	137 m (450 ft)/min

SIKORSKY S-76

TYPE: Multirole medium helicopter.

PROGRAMME: S-76A announced 19 January 1975; first flight (N762SA) 13 March 1977; certification to FAR Pt 29, Category B, on 21 November 1978; Category A on 9 January 1979; deliveries started early 1979; delivery of Mk II began 1 March 1982; S-76B programme initiated October 1983; first flight (N3123U) 22 June 1984; certified in category B on 31 October 1985 and in Category A on 3 February 1987; final S-76B delivered December 1997; see 1997–98 and previous *Jane's All the World's Aircraft* for details of these early models.

S-76C announced June 1989; replaced S-76B's P&WC PT6B turboshafts with Arriel engines; first flight 18 May 1990; FAA certification in Category B on 15 March 1991 and in Category A on 12 April 1991, deliveries beginning immediately thereafter.

Following manufacture of c/n 760514 in mid-2000, production of S-76C+ fuselages progressively transferred to Aero Vodochody of the Czech Republic under a USD200 million contract, beginning with Sikorsky-built c/n 760515, which was shipped to the Czech Republic for final assembly and scheduled to return to the USA in January 2001. Three further shipsets to be sent from Sikorsky, with first wholly Czech-built fuselage completed in late 2001; 100th Czech-built airframe delivered to Sikorsky in July 2006. Fiescher Advanced Composites of Austria supplies composites components to Aero Vodochody. Keystone Helicopter Corporation of West Chester, Pennsylvania, selected in April 2000 as principal completion centre for S-76C+s, following flight testing and certification at Sikorsky's Stratford, Connecticut, facility, and completed its 50th S-76C+ on 8 September 2004.

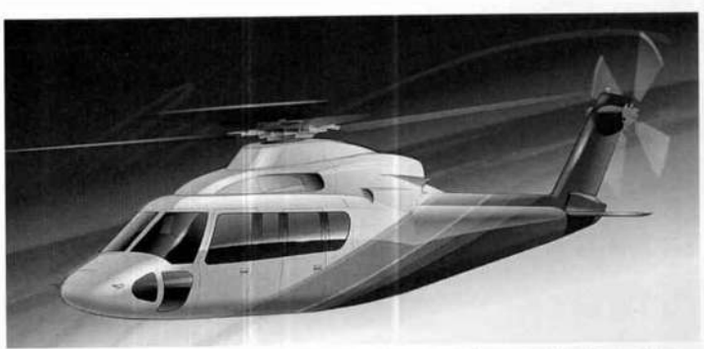
By May 2006 some 600 S-76s of all models were in service with 220 operators in 59 countries, and had accumulated more than four million flight hours, with 99.9 per cent despatch reliability.

CURRENT VERSIONS: **S-76C:** Initial production version with Arriel 1S1 engines; now superseded by S-76C+.

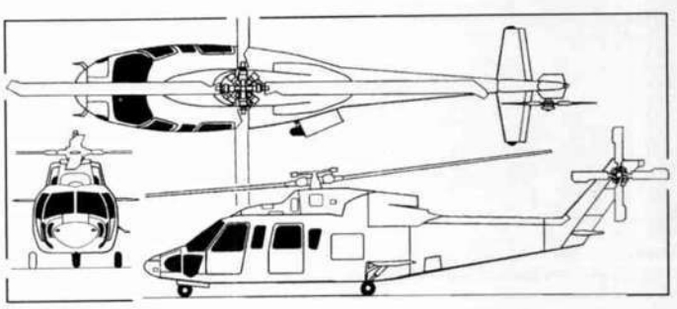
S-76C+: FAA and CAA certification and first delivery, mid-1996; features Arriel 2S1 turboshafts with FADEC for improved single-engine performance and fuel efficiency. 'Quiet Zone' gearbox transmission introduced in 2005. *As described.*

S-76C++: Improved version, announced February 2005; FAA certification granted 3 January 2006. Combines airframe of S-76C+ with Turbomeca Arriel 2S2 engines, each rated at 688 kW (922 shp) for T-O, 621 kW (833 shp) maximum continuous, 770 kW (1,032 shp) OEI for 30 seconds; 'Quiet Zone' gearbox; Honeywell VXP HUMS; 159 to 204 kg (350 to 450 lb) increase in Category A max T-O weight at 90°F at sea level; improved inlet protection via full-coverage barrier filters; and enhanced safety features including EGPWS and TCAS, airframe-mounted liferafts, enlarged pop-out cabin windows and automatic float deployment. Long-range cruising speed 137 kt (254 km/h; 158 mph); service ceiling, OEI 1,495 m (4,900 ft); range at long-range cruising speed, 30 min reserves 345 n miles (639 km; 397 miles). Optional five-passenger VIP interior by Keystone Helicopter Corporation and Heritage Aviation, introduced in 2005, features two forward-facing captain's leather chairs and a three-person aft-facing bench and Keystone Silencer soundproofing system.

S-76D: Further improved version, announced February 2005. Features include Pratt & Whitney PW210S engines each rated at 746 kW (1,000 shp) that will afford an increase in max T-O weight of nearly 454 kg (1,000 lb) with no range penalty when compared with the S-76C+; new main rotor with advanced technology composites blades of advanced aerofoil section that will improve hovering performance and cruise efficiency while offering greater damage tolerance; a 136 kg (300 lb) increase in maximum T-O weight in hot-and-high conditions and a 50 n mile (93 km; 57 mile) increase in maximum range compared to the current versions' main rotor; new quiet tail rotor (NQTR) affording a 2 dBA reduction in external noise at take-off and a 1.5 dBA reduction on flyover; rotorcraft icing protection system (RIPS) for main and tail rotor blades permitting despatch into known icing conditions; and Thales TopDeck integrated avionics featuring large format active matrix LCD displays. Certification to FAA/EASA requirements and first deliveries expected in late 2008.



Artist's impression of Sikorsky S-76D, with Pratt & Whitney PW210S engines 1133998



Sikorsky S-76C++ commercial transport helicopter ***(Paul Jackson)*** 1159820

Sikorsky S-76 in rescue role with Japan Coast Guard *(Mitsuhiro Kadota)* 1159804

CUSTOMERS: See table. The 600th production S-76 received its airworthiness certificate on 30 September 2005. Recent customers include The Fisheries and Maritime Affairs Department of Xunta de Galicia in Spain, which took delivery of two S-76C+s on 31 May 2005 for SAR operations; CHC Helicopter Corporation of Vancouver, British Columbia, which ordered five in February 2005; Era Aviation, which has ordered two S76C+s and three S-76C++s for delivery beginning in the first quarter of 2006 and deployment on offshore oil support duties in the Gulf of Mexico; China Eastern General Aviation Corporation, which ordered two in August 2005 to support offshore oil operations in the Bohai Bay area of Northern China; J C Bamford Excavators Ltd of the UK, which has ordered an S-76C++ for delivery in September 2006; Malaysian Helicopter Service, which ordered three S-76C++s for delivery in July 2007; Aero Med Spectrum Health of Grand Rapids, Michigan, which has ordered one S-76C++; Wynn Resorts (Macau) SA, which ordered two S-76C++s for delivery in 2007; Xavier Aviation of Palm Springs, Florida, which ordered two S-76Ds; and Premier Aviation Services Ltd, which has ordered two S-76Ds.

COSTS: Unit cost approximately USD8.5 million in offshore configuration (2004).

DESIGN FEATURES: Meets FAR Pt 29 with Category A IFR; intended for offshore support, business transport, medical evacuation and general utility use; technology and aerodynamics based on those of UH-60 Black Hawk.

Four-blade main rotor with high twist and varying section and camber based on Sikorsky SC-1095; tapered blade tip has 30° leading-edge sweep; fully articulated rotor head with single elastomeric bearings; hydraulic drag dampers; dual bifilar vibration absorber assemblies above rotor head; four-blade cross-beam tail rotor on port side; rotor brake optional. Max rotor speed, power on, 316 rpm (108 per cent). Main rotor blade life of 28,000 hours; tail rotor life unlimited. Optional manual blade folding.

Emergency medical service installation includes multiple-position pivoting primary patient litter, a second litter, and track-mounted seats for four attendants, forward and rear oxygen systems, and dual access to external power on ground; cabin volume 4.0 m^3 (141 cu ft).

FLYING CONTROLS: Dual powered hydraulic controls with autostabilisation and autopilot; releasable spring-centring trim system for both cyclic and collective controls.

STRUCTURE: Main rotor blades have formed and welded titanium oval-section tubular main spar with Nomex honeycomb aerofoil core, glass fibre composites outer skin and titanium/nickel leading-edge abrasion strips. Fuselage has bonded aluminium/honeycomb skin panels to permit flush riveting; extensive use made of carbon fibre (replacing Kevlar and glass fibre in earlier S-76s). Aerospace Industrial Development Corporation (AIDC) of Taiwan signed five-year contract in December 1998 for supply of composites crew and passenger doors.

LANDING GEAR: Hydraulically retractable tricycle type, with single wheel on each unit. Nosewheel retracts rearward, main units inward into rear fuselage; all three wheels are enclosed by doors when retracted. Mainwheel tyres size 14.5×5.5–6 (14 ply) tubeless, pressure 11.38 bar (165 lb/sq in); nosewheel tyre size 5.00–4 (12 ply) tubeless, pressure 9.31 bar (135 lb/sq in). Hydraulic brakes; hydraulic mainwheel parking brake. Non-retractable tricycle gear, with low-pressure tyres and skid landing gear both optional.

POWER PLANT: Two Turbomeca Arriel 2S1 turboshafts with FADEC, each rated at 638 kW (856 shp) for take-off, 731 kW (980 shp) OEI for 30 seconds and 592 kW (794 shp) maximum continuous; transmission rating 1,193 kW (1,600 shp) for take-off and maximum continuous. Standard fuel capacity 1,083 litres (286 US gallons; 238 Imp gallons) of which 1,064 litres (281 US gallons; 234 Imp gallons) are usable; optional auxiliary tank capacity 405 litres (107 US gallons; 89.1 Imp gallons). Self-sealing tanks optional.

ACCOMMODATION: One or two pilots and 12 to 13 passengers. Three four-abreast rows of seats, floor-mounted at a pitch of 79 cm (31 in). A number of executive layouts are available, including a four-passenger 'office in the sky' configuration. Executive versions have luxurious interior trim, full carpeting, special soundproofing, radiotelephone and co-ordinated furniture. Dual controls optional. Two large doors on each side of fuselage, hinged at forward edges; sliding doors available optionally. Baggage hold aft of cabin, with external door each side of fuselage. Cabin heated and ventilated; air conditioning optional. Windscreen demisting and dual windscreen wipers. Windscreen heating and external cargo hook optional.

SYSTEMS: Hydraulic system at pressure of 207 bar (3,000 lb/sq in) supplied by two pumps driven from main gearbox. Hydraulic system maximum flow rate 15.9 litres (4.2 US gallons; 3.5 Imp gallons)/min. Bootstrap reservoir. Pump head pressure 3.45 bar (50 lb/sq in). In VFR configuration, electrical system comprises two 200 A DC starter/generators and a 24 V 17 Ah Ni/Cd battery. In IFR configuration, system comprises gearbox-driven 7.5 kVA generator, and a 115 V 600 VA 400 Hz static inverter for AC power. 34 Ah battery optional. Engine fire detection and extinguishing system.

AVIONICS: *Comms:* Honeywell Primus II integrated radios.

Radar: Honeywell Primus 440 colour weather radar.

Flight: Honeywell SPZ-7600 dual digital AFCS. Optional Universal UNS-1D navigation management system, L-3 Com/Sextant TCAS and Argus moving map display.

Instrumentation: Four-tube Honeywell colour EFIS; Parker Hannifin Gull Electronics active colour matrix LCD three-screen integrated instrument display system (IIDS).

EQUIPMENT: Standard equipment includes cabin fire extinguishers; cockpit, cabin, instrument, navigation and anti-collision lights; landing light; external power socket; and utility

S-76 DELIVERIES

Year	S-76A	S-76A+	S-76B	S-76C	S-76C+	Total	Cum
1979	35					35	35
1980	86					86	121
1981	50					50	171
1982	29					29	200
1983	36					36	236
1984	30					30	266
1985	8		11			19	285
1986	3		13			16	301
1987	3		7			10	311
1988	2		9			11	322
1989		3	14			17	339
1990	1	13	5			19	358
1991		1	8	10		19	377
1992			4	8		12	389
1993	1		3	7		11	400
1994			6	7		13	413
1995			6	10		16	429
1996			11	1	7	19	448
1997			4		14	18	466
1998					16	16	482
1999					7	7	489
2000					7	7	496
2001					8	8	504
2002					6	6	510
2003					23	23	533
2004					29	29	562
2005					30	30	592
Totals	**284**	**17**	**101**	**43**	**148**	**592**	

Notes: Some S-76As retrofitted to A+. Excludes seven (six flying) prototypes and pre-series

soundproofing. Optional equipment includes 1,497 kg (3,000 lb) capacity cargo hook, 272 kg (600 lb) capacity rescue hoist, emergency flotation gear, engine air particle separators and litter installation.

DIMENSIONS, EXTERNAL:

Main rotor diameter	13.41 m (44 ft 0 in)
Main rotor blade chord	0.39 m (1 ft 3½ in)
Tail rotor diameter	2.44 m (8 ft 0 in)
Tail rotor blade chord	0.16 m (6½ in)
Length: overall, rotors turning	16.00 m (52 ft 6 in)
fuselage	13.21 m (43 ft 4 in)
Height overall, tail rotor turning	4.42 m (14 ft 6 in)
Tailplane span	3.05 m (10 ft 0 in)
Width of fuselage	2.13 m (7 ft 0 in)
Wheel track	2.44 m (8 ft 0 in)
Wheelbase	5.00 m (16 ft 5 in)
Tail rotor ground clearance	1.97 m (6 ft 5¾ in)

DIMENSIONS, INTERNAL:

Passenger cabin: Length	2.41 m (7 ft 11 in)
Max width	1.93 m (6 ft 4 in)
Max height	1.35 m (4 ft 5 in)
Floor area	4.18 m^2 (45.0 sq ft)
Volume	5.8 m^3 (204 cu ft)
Baggage compartment volume	1.1 m^3 (38 cu ft)

AREAS:

Main rotor disc	141.26 m^2 (1,520.5 sq ft)
Tail rotor disc	4.67 m^2 (50.27 sq ft)
Tailplane	2.00 m^2 (21.5 sq ft)

WEIGHTS AND LOADINGS:

Operating weight empty	2,545 kg (5,611 lb)
Weight empty, executive configuration	3,691 kg (8,138 lb)
Max baggage	272 kg (600 lb)
Useful load	1,616 kg (3,562 lb)
Max fuel	3,030 kg (6,680 lb)
Max T-O weight	5,307 kg (11,700 lb)
Max disc loading	37.6 kg/m^2 (7.69 lb/sq ft)
Transmission loading at max T-O weight and power	4.45 kg/kW (7.31 lb/shp)

PERFORMANCE:

Never-exceed speed (VNE) and max level speed	155 kt (287 km/h; 178 mph)
Long-range cruising speed	140 kt (259 km/h; 161 mph)
Max rate of climb at S/L	495 m (1,625 ft)/min
Service ceiling	3,871 m (12,700 ft)
Service ceiling, OEI	975 m (3,200 ft)
Hovering ceiling: IGE	1,722 m (5,650 ft)
OGE	549 m (1,800 ft)
Range at 140 kt (259 km/h; 161 mph) at FL40, standard fuel:	
no reserves	439 n miles (813 km; 505 miles)
30 min reserves	385 n miles (713 km; 443 miles)

SIKORSKY S-92 and H-92 SUPERHAWK

Canadian Forces name: CH-148 Cyclone

TYPE: Medium transport helicopter.

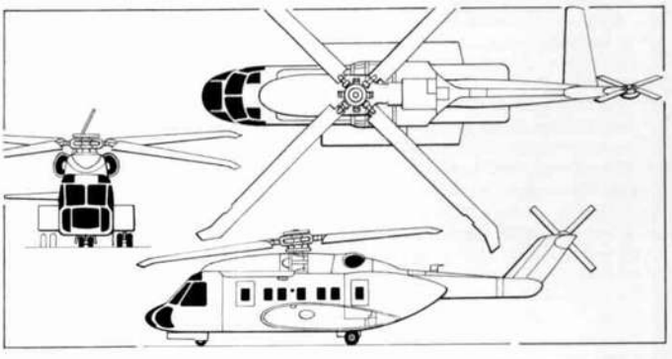
PROGRAMME:

DEVELOPMENT MILESTONES

Programme launched	Jun 95
Announced	Mar 92
First flight	23 Dec 98
First flight, production representative	5 Oct 01
First flight, production	14 Jun 04
Certification	17 Dec 02

Announced March 1992; originally envisaged as S-92C'Growth Hawk' development of S-70; market evaluation co-ordinated with Mitsubishi Corporation and Mitsubishi Heavy Industries. Launched at Paris Air Show, June 1995 as S-92A Helibus and military S-92IU (international utility). Risk-sharing partners Mitsubishi Heavy Industries (7.5 per cent), Jingdezhen Helicopter Group of China (2 per cent) and Gamesa of Spain (7 per cent), with

Turkish military Sikorsky S-92 in VIP role 1159806



Sikorsky S-92 in envisaged production configuration *(James Goulding)* 0103496

Taiwan Aerospace (6.5 per cent) and Embraer (4 per cent) as additional fixed-price supplier/partners; Russia's Mil is associated with programme, but not yet a full partner; other suppliers include Aerazur (fuel cells), Goodrich (health and usage monitoring system), Dunlop (engine inlet), Eaton (emergency flotation bag electro-optical sensors); Hamilton Sundstrand (automatic flight control system and active vibration computers), Honeywell (radar and APU), Lucas-Western (rescue hoist), Martin-Baker (crew seats), Messier-Bugatti (wheels and brakes), Moog (active vibration controls), Parker Bertea (servos), Rockwell Collins (multifunction displays and nav/com suite); Universal (FMS) and Vickers (hydraulic pumps). Programme rationalisation resulted in discontinuation of S-92IU and adoption of standard civil/military configuration with new designation S/H-92 applied in 2002; designations S-92 and H-92 Superhawk adopted in 2003 for civilian and military variants respectively.

Design changes announced in July 2000 in response to customer requests include a 0.41 m (1 ft 4 in) increase in cabin length to permit installation of a 1.27 m (4 ft 2 in) wide cabin door to improve hoisting capability and to accommodate a Stokes litter during SAR operations; reduction in height of tail rotor pylon by about 1.02 m (3 ft 4 in) to offset additional weight of cabin extension; and relocation of the horizontal stabiliser. These changes will provide additional benefits in creating an improved fold configuration for shipboard operations, increased birdstrike protection deriving from the relocation of tail rotor drive shaft and controls aft of the tail spar, and a flatter hover attitude arising from a forward shift of the helicopter's centre of gravity, improving visibility for confined space and shipboard landing, and increasing aft fuselage ground clearance. The revised configuration has been incorporated from the third prototype and on all production aircraft.

Test programme comprises one ground test vehicle (PA1/GTV; first airframe built, first ground run 4 September 1998 and completed 200-hour FAA certification endurance run in September 1999) and four flying prototypes, of which first (PA2/N292SA) completed maiden flight at Sikorsky's Development Flight Center in Florida on 23 December 1998 and was subsequently modified to the revised configuration described above. GTV and first

First Sikorsky S-92 delivered to Cougar Helicopters of Canada 1159805

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flying prototype have 1,305 kW (1,750 shp) CT7-6D engines; remaining three flying prototypes have production-standard CT7-8s and APUs. PA3/N392SA (second flying) joined the test programme in May 1999, flew in October, and is devoted principally to engine and AFCS development; subsequently upgraded to production configuration with extended main rotor shaft; new main rotor servos; redesigned electrical system to maintain rotor ice protection after a generator failure; new tail rotor pylon; and state-of-the-art cockpit displays. Flown again in this configuration on 22 March 2002. PA4/N492SA delayed during assembly to incorporate airframe changes described above and final avionics updates and first flew in definitive production configuration on 5 October 2001. PA5/N592SA, exhibited unflown at the Paris Air Show in June 1999, is in utility configuration with MIL-STD-1553 databus, rear loading ramp, folding seats for 22 troops, sliding windows, cargo hook and provision for 7.62 mm machine gun pintle mounts; was later modified to revised configuration as described above, and made its first flight on 8 February 2001.

By February 2002, PA2 had flown more than 380 hours, and PA3 221 hours, including flights at maximum take-off weight of 13,998 kg (30,860 lb), demonstrating a range of 800 n miles (1,482 km; 921 miles) with mid-mission hover; PA4 had flown 60 hours; and PA5 more than 260 hours. PA2 was withdrawn from use in May 2002.

FAA FAR Pt 29 Category A Amendment 47 certification achieved 17 December 2002 after 1,570-hour flight test programme; Category B full release awarded 7 May 2004. EASA certification achieved 8 June 2004 as the first helicopter certified by the Agency, followed by EASA approval in April 2006 for flight into known icing conditions. Transport Canada certification achieved 7 February 2005. Initial production aircraft (c/n 920006/N192PH) made its first flight on 14 June 2004.

Total fleet time exceeded 20,000 flight hours in July 2006, with two high-time airframes having logged more than 2,200 hours each.

CURRENT VERSIONS: **S-92A:** Civilian variant, *as described.*

H-92 Superhawk: Military variant. Name announced at the Paris Air Show 16 June 2003. Features uprated 2,289 kW (3,070 shp) CT7-8C engines providing some 25 per cent more power than the S-92's CT7-8As; folding main and tail rotors; BAE Systems fly-by-wire controls; self-sealing fuel tanks; armour protection for critical components; self-defence systems including chaff/flare dispensers and IR suppression; and Rockwell Collins mission avionics. Programme timetable dependent on engine development, with first flight tests of CT7-8C targeted for 2006 and certification on H-92 in 2007.

The H-92 Superhawk is also competing for the USAF combat search and rescue helicopter programme to replace HH-60G Pave Hawks, with a requirement for 100 to 150 helicopters, and in a proposed **VH-92** variant which was the unsuccessful contender for the US Marine Corps VX requirement to replace VH-3Ds for Presidential transport missions.

H-92 Cyclone: Canadian military version. Selection announced 22 July 2004 and confirmed 23 November 2004; 28 required for service in maritime role aboard Halifax-class vessels at cost of CAD1.8 billion (including ship adaptation). Sikorsky is teamed with Bombardier Aerospace Defence Services for the Cyclone, which will replace Canadian Forces Sea King helicopters. General Dynamics Canada is responsible for mission system integration, and Bombardier will perform interior completion, installation and checking of mission equipment, exterior painting and final acceptance and delivery, in addition to in-service support and fleet management. Deliveries from November 2008 at one per month.

CUSTOMERS: First four delivered in 2004, followed by 19 in 2005.

Launch customer Cougar Helicopter of Eastern Canada announced intent to order up to five for delivery in 2002; following programme delays, reaffirmed requirement for three at February 2003 Heli-Expo, Dallas, Texas of which the first entered service in June 2005 in support of PetroCanada exploration in the Terra Nova offshore fields in Newfoundland and Labrador. Other announced civil customers include Norsk Helikopter which ordered two for its Stratoil contract in February 2003, with service entry of the first on 21 February 2005, followed by the second in April 2005 and third on 2 January 2006, at which time the Norsk S-92 fleet had accumulated 3,206 flight hours; Petroleum Helicopters Inc (PHI) ordered six for offshore support operations in the Gulf of Mexico, of which the first was "handed over" in unflown condition at Heli-Expo 2004 at Dallas in March 2004, and the fourth was delivered in June 2005; CHC Helikopter Service, ordered an initial two, the first of which entered service on 23 May under contract to Norsk Hydro; Gulf Helicopters of Qatar, ordered one in VVIP configuration for delivery in 2006; Brunei Shell Petroleum, which ordered three in September 2005 for offshore oil support in the South China Sea; Eastern General Aviation Corporation of China, ordered one in September 2005 for delivery in late 2006 and subsequent operation in the Bohai Bay area on offshore oil support missions; the Government of Turkey, ordered one in December 2004 for head of state missions; the Republic of Korea, ordered three in VIP configuration for its Presidential mission, with delivery beginning in 2007 and the Turkmenistan Government, which ordered two for delivery in 2005-06 for Presidential transport. First VIP configured S-92 (c/n 920007/N908W) delivered to Harrods Aviation at London-Stansted Airport, UK, on 22 September 2004, for operation on behalf of Laws Helicopter LLC. CHC Helicopter Corporation ordered four on 13 December 2005 for operation in SAR role on behalf of the UK Maritime and Coastguard Agency, commencing 1 July 2007 from bases at Sumburgh and Stornoway, Scotland. In June 2006, the Bristow Group signed a multiyear agreement for the supply of S-92s, with first deliveries scheduled for early 2007.

COSTS: Programme USD600 million. Direct operating cost USD2,381 per hour, comprising USD1,194 fixed and USD1,175 variable costs (2003). Turkmenistani order for two valued at USD54 million (2004).

DESIGN FEATURES: Design, manufacture and assembly use CATIA database system; modular design simplifies customised configurations. Standard medium helicopter configuration, with engines above cabin; raised tailboom to permit rear loading via ramp; high-set, strut-braced tailplane to port. Prominent sponsons accommodate main landing gear and fuel.

Dynamic components based on proven Sikorsky technology to reduce development risks, including: titanium yoke-type infinite-life main rotor head with elastomeric bearings; four-blade, quick-release, all-composites main rotor with swept, tapered anhedral tips based on scaled-up version of blades tested on Black Hawk in 1995–96; blade chord increased 12 per cent, compared with Black Hawk; damping masses at mid-span of each blade; normal rotor speed 246 rpm; new transmission based on upgraded four-stage version of Black Hawk's three-stage main gearbox; rotor brake; new intermediate tail rotor gearbox; and new four-blade, fully articulated, birdstrike-tolerant tail rotor with individually removable blades to starboard, meeting FAR/JAR 29 birdstrike requirements. Manual rotor blade folding (two forward; two aft). New-style bifiliar vibration absorber, with Hamilton Sundstrand computer and Moog actuators, on top of rotor hub comprises metal drum enclosing five composites springs allowing absorber to move in opposition to in-plane forces. Service life initially set (2004) at 30,000 hours. Target TBO for rotor head is 50,000 hours. Gearbox TBO 6,000 hours.

FLYING CONTROLS: Similar, but not identical, to Black Hawk; dual digital AFCS with autopilot and dual independent, triple-axis stability augmentation features Hamilton Sundstrand primary processor based on that of RAH-66 Comanche, and is expected to have 8,000 hour MTBF. BAE Systems contracted in 2003 to design FBW control system.

STRUCTURE: Modular structure of aluminium and composites (about 40 per cent of structure is of composites, though mostly non-structural to reduce costs) designed to be highly crack-resistant, with extensive lightning/HIRF protection; composites main rotor blades (including spars); structure optimised for minimum parts count.

Sikorsky responsible for rotor and transmission systems, final assembly and flight test. Airframe largely designed and manufactured by 'Team S-92' partners, as follows: Mitsubishi (main cabin), AIDC of Taiwan (flight deck), Embraer (sponson front halves, landing gear and incorporation of Aerazur/Intertechnique fuel system), Gamesa (cabin interior, aft fuselage, tail boom and upper fuselage transmission housing), and Jingdezhen (vertical tail including horizontal stabiliser).

LANDING GEAR: Retractable tricycle; main units retract rearwards into sponsons; nosewheel retracts forwards under flight deck. Wheels and brakes supplied by Messier-Bugatti. Optional inflatable emergency flotation bags, usable up to Sea State 5, activated by Eaton electro-optical sensors.

SIKORSKY S-92 ORDERS AND DELIVERIES
(at 1 July 2006)

Customer	Date	Qty	Del	First aircraft
Bristow Group (OLOG)	14 Jun 06	2	2007	
Brunei Shell Petroleum	14 Sep 05	3		
Canadian Forces	23 Jul 04	28	2008 on	
CHC	13 Feb 04	12	2004	LN-OQA
CHC/UK Coast Guard	13 Dec 05	4	2007	G-CHCK
China, Communications Ministry	Jan 05	2		
Cleveland Browns Transportation		1[1]	2004	N88CP
Cougar Helicopters	Feb 03	1	2005	C-GSCH
	Feb 03	2[1]	2005	C-GMCH
Eastern General Aviation	9 Sep 05	1		
Gulf Helicopters	25 Jan 05	1[1]	2006	A7-HHT
Laws Helicopter	2003	1[1]	2004	N908W
Norsk Helikopter/Stratoil	Feb 03	2	2005	LN-ONN
/BP-Talisman	1 Jun 05	1	2005	LN-ONP
/Conoco	1 Jun 05	2	2006	LN-ONQ
PHI	18 Aug 03	2	2004	N192PH
	7 Feb 05	2	2005	N392PH
	14 Jun 05	4	2005	N592PH
Republic of China Air Force	Nov 05	3	2007	
Republic of Korea Air Force	6 May 05	3	2007	
Sikorsky (prototypes)	N/A	4[2]	1998	N292SA
Turkish Air Force	22 Dec 04	1[1]	2005	EM-002
Turkmenistan Government	28 Jun 04	2[2]	2005	ES-Z720
United Technologies		1[1]	2005	N92UT
Washington Times Aviation	Jan 05	5[1]	2005	HL9292
Wells Fargo Bank		2	2006	N8010S
Order status unknown:				
Aircontactgruppen		6	(2004 on)	
Copter Action		2	(2003 on)	
East Asia Airlines	Feb 02	1		
Era Aviation	Aug 01	3	(2003)	
Order cancelled:				
Helijet Airways	Jan 00	1	(2002)	
Irish Air Corps	Jan 02	3	(2004)	

[1] VIP interior
[2] Plus static test aircraft 920001 "N19SA"

POWER PLANT: Two GE CT7-8A turboshafts, each rated at 1,879 kW (2,520 shp) for T-O, 1,742 kW (2,336 shp) for 30 minutes, and 1,523 kW (2,043 shp) maximum continuous; 1,939 kW (2,600 shp) OEI 30 seconds; 1,879 kW (2,520 shp) OEI 2 minutes; 1,863 kW (2,498 shp) OEI 30 minutes; and 1,523 kW (2,043 shp) OEI continuous. Hamilton Sundstrand dual-channel FADEC with autostart, power assurance and OEI training modes. Rolls-Royce Turbomeca RTM322 will be offered as alternative engine if demand is forthcoming. Transmission via modular compound planetary gearbox with 30 minute run-dry capability and 140 per cent overtorque certification, rating 3,110 kW (4,170 shp).

Single-point pressure refuelling/defuelling. Standard fuel in sponsons, each with optional gravity fuelling port, combined capacity 2,896 litres (765 US gallons; 637 Imp gallons) of which 2,877 litres (760 US gallons; 633 Imp gallons) are usable. Standard auxiliary fuel option of 1,401 litres (370 US gallons; 308 Imp gallons, comprising two 700 litre (185 US gallon; 154 Imp gallon) tanks in cabin. Other fuel options include two external tanks, each 871 litres (230 US gallons; 192 Imp gallons); or single or dual 322 litre (85.0 US gallon; 70.8 Imp gallon) bench-type tanks in cabin. Crash-resistant fuel system standard. In-flight refuelling probe optional.

ACCOMMODATION: Two-pilot crew on separate flight deck on FAA/JAA 16 *g* crashworthy seats; provision for one flight deck observer; 19 (FAA certification limit) to 24 passengers, with baggage on rear ramp; 10 executive passengers; or up to three LD-3 cargo containers in civil version. Martin-Baker ergonomically advanced crew seats available from mid-2006. In medevac configuration cabin can accommodate 16 patients on lifters. Main door, starboard side, front in three options: (a) split horizontally in upward- and downward-hinged sections, latter including steps; (b) lower airstair section with inward/backward-sliding upper portion (allowing installation of external SAR winch) and (c) full-height sliding door incorporating Type IV emergency exit. Further three FAA/JAA Type IV cabin emergency exits, plus pop-out windows at each seat row, for rapid emergency evacuation. Total of 22 combat-ready troops on sideways seats in military version; both versions have rear-loading ramp and 366 kg/m^2 (75 lb/sq ft) minimum floor rating (optionally 976 kg/m^2; 200 lb/sq ft). Military version has sliding cabin windows and weapons mounts. Martin-Baker crew and passenger seats. Accommodation is heated and ventilated with independent cockpit and cabin zones; air conditioning optional. Active noise suppression system under consideration.

SYSTEMS: Goodrich IMD-HUMS health and usage monitoring system standard, with cockpit displays and downloading facility to enable ground crew to access system via hand-held diagnostic equipment; active noise control system reduces cabin noise by 3 to 4 dB; active vibration control may be employed in key airframe areas.

Honeywell 36-150 (S92) APU with in-flight start and continuous run capability. Electrical system comprising two 75 kVA, 115 V, 400 Hz, three-phase main gearbox-driven AC generators, two 400 A, AC/28 V DC converters and one 35 kVA APU-driven back-up generator with 100 A AC/DC backup converter. Battery 28 V, 15 Ah. Three hydraulic systems, supplied by main gearbox-driven pumps, two serving main and tail rotor and stability augmentation system, while third serves utilities and acts as back-up; all 276 bar (4,000 lb/sq in). Anti-icing system for engine inlets, windscreen and pitot head; main and tail rotor de-icing optional. Automatically deployed emergency flotation system meets or exceeds FAR/JAR stability requirements and has demonstrated Sea State 5 capability; externally mounted 14-person liferaft in forward end of each sponson, with 50 per cent overload capability.

AVIONICS: Open architecture avionics system accommodating ARINC 429 and MIL-STD-1553 interfaces with Collins Pro Line 4 as core system.

Comms: Dual VHF, radio management and audio controls. Mode S transponder. BAE Systems CVR/FDR. Optional deployable emergency beacon.

Radar: Provision for radar in nose compartment.

Flight: UNS-1C FMS; Hamilton Sundstrand automatic flight control system featuring three-axis stability augmentation system and fully coupled dual digital autopilots with automatic approach-to-hover option. Independent standby instruments. Optional UNS-1ESP with GPS; TCAS I; and EGPWS.

Instrumentation: Rockwell Collins EFIS cockpit with four 203 × 152 mm (8 × 6 in) MFD-268EP active matrix liquid crystal displays (AMLCD) for PFD, EICAS, health monitoring, navigational and weather radar functions; fifth AMLCD, 152 × 203 mm (6 × 8 in) centre-mounted, optional for displaying sensor information such as moving map or FLIR data.

All avionics housed in removable mission equipment rack behind co-pilot station with wiring routed through conduits in fuselage frames for added protection.

Mission: Optional satcom, FLIR and loudhailer.

EQUIPMENT: Optional, single or dual, hydraulically powered, electrically controlled SAR rescue hoist, maximum capacity 272 kg (600 lb), with 88 m (290 ft) of usable cable, cable viewing window and spotlight. Windscreen wiper/washer system. Optional cargo handling system, which is compatible with 1.07 × 1.22 m (3 ft 6 in × 4 ft 0 in) pallets, includes 1,814 kg (4,000 lb) capacity centreline winch with 28 V DC winch motor, easy on/off cabin rollers, and 16 *g* cargo tiedowns at all major frames.

DIMENSIONS, EXTERNAL:

Main rotor diameter	17.71 m (56 ft 4 in)
Tail rotor diameter	3.35 m (11 ft 0 in)
Length overall, rotors turning	20.88 m (68 ft 6 in)
Fuselage: Length: airframe	17.12 m (56 ft 2 in)
incl tail rotor	18.47 m (60 ft 7 in)
Max width: over sponsons	3.89 m (12 ft 9 in)
incl horizontal stabiliser	5.26 m (17 ft 3 in)
Max width, main rotor in X position	12.19 m (40 ft 0 in)
Height: overall, tail rotor turning	5.46 m (17 ft 11 in)
tail rotor in X position	5.13 m (16 ft 10 in)
to top of main rotor head	4.70 m (15 ft 5 in)
to top of fin	4.32 m (14 ft 2 in)
Wheel track (c/l shock-absorbers)	3.17 m (10 ft 5 in)
Wheelbase	6.20 m (20 ft 4 in)
Forward door (stbd): Height	1.85 m (5 ft 11 in)
Width	1.02 m (3 ft 4 in)

DIMENSIONS, INTERNAL:

Cabin: Length (incl bulkhead)	6.10 m (20 ft 0 in)
Max width	2.01 m (6 ft 7 in)
Max height	1.83 m (6 ft 0 in)
Volume	16.9 m^3 (596 cu ft)
Baggage volume (civil)	3.97 m^3 (140 cu ft)

AREAS:

Main rotor disc	231.55 m^2 (2,492.4 sq ft)
Tail rotor disc	8.83 m^2 (95.03 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: offshore oil	7,654 kg (16,875 lb)
airline	7,666 kg (16,901 lb)
SAR	7,650 kg (16,866 lb)
Operating weight empty:	
offshore oil	7,857 kg (17,322 lb)
airline	7,869 kg (17,348 lb)
SAR	8,034 kg (17,713 lb)
Max baggage weight	454 kg (1,000 lb)
Max fuel: internal	2,327 kg (5,130 lb)
with auxiliary tank	3,460 kg (7,628 lb)
Max external load	4,536 kg (10,000 lb)
Max T-O weight (civil):	
internal load	12,020 kg (26,500 lb)
external load	12,836 kg (28,300 lb)
Max disc loading:	
internal load	51.91 kg/m^2 (10.63 lb/sq ft)
external load	55.4 kg/m^2 (11.35 lb/sq ft)
Transmission loading at max T-O weight and power:	
internal load	3.87 kg/kW (6.35 lb/shp)
external load	4.13 kg/kW (6.79 lb/shp)

PERFORMANCE (at max internal load T-O weight):

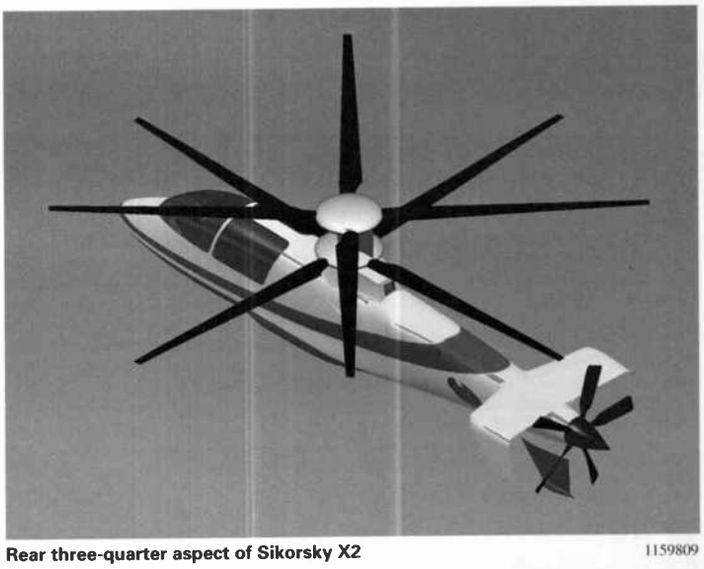
Never-exceed speed (VNE): power on	165 kt (305 km/h; 189 mph) IAS
power off	120 kt (222 km/h; 138 mph) IAS
Max cruising speed	151 kt (280 km/h; 174 mph)
Long range cruising speed	136 kt (252 km/h; 157 mph)
Service ceiling	4,425 m (14,520 ft)
Hovering ceiling: IGE	3,330 m (10,920 ft)
OGE	2,040 m (6,700 ft)
Range, offshore configuration: standard internal fuel, 19 passengers and baggage, 30 min reserves + 10%	400 n miles (740 km; 460 miles)
as above, no reserves	495 n miles (916 km; 569 miles)
with max internal fuel, 30 min reserves + 10%	712 n miles (1,318 km; 819 miles)
Range, airline configuration:	
with 19 passengers and baggage, 30 min reserves	476 n miles (881 km; 547 miles)
with 19 passengers and baggage, no reserves	543 n miles (1,005 km; 624 miles)
Max range with main fuel, 30 min reserves	532 n miles (985 km; 612 miles)
SAR mission radius of action:	
standard internal fuel + 10% reserves:	
pick up 25 survivors	147 n miles (272 km; 169 miles)
pick up 6 survivors	226 n miles (418 km; 260 miles)
max internal fuel + 10% reserves:	
pick up 25 survivors	247 n miles (457 km; 284 miles)
pick up 6 survivors	334 n miles (618 km; 384 miles)

SIKORSKY X2

TYPE: New concept rotorcraft.

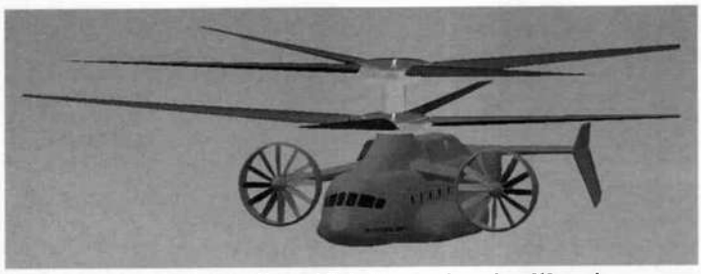
PROGRAMME: At the American Helicopter Society International Annual Technical Forum in Texas on 1 June 2005, Sikorsky announced plans to build and test fly a demonstrator for its new class of X2 Technology coaxial rotor helicopters, which are aimed at maintaining or improving all vertical flight capabilities of current helicopters while providing a high cruising speed of 250 kt (463 km/h; 288 mph). Goal is doubled performance parameters — hence 'Times Two' designation.

X2 Technology refers to a suite of technologies that Sikorsky will apply to achieve new levels of performance and speed on coaxial rotor helicopters, and is intended to describe the multiplying effects (times two) of technologies that will include new rotor blade designs,



Rear three-quarter aspect of Sikorsky X2 1159809

Artist's impression of proposed 'flying crane' employing X2 technology 1159810



Impression of possible Joint Heavy Lift helicopter, based on X2 work

1159811

rotor hub drag reduction, fly-by-wire, advanced flight control laws, transmissions with greater power-to-weight performance and the ability to transfer power seamlessly from main rotors to an aft propulsor, and active vibration control. In developing the X2, Sikorsky will draw on previous in-house research including the XH-59A Advancing Blade Concept (ABC) demonstrator prototypes flown 1973-77, Cypher UAV and RAH-66 Comanche.

The X2 Technology demonstrator, which will be built by Sikorsky subsidiary Schweizer Aircraft Corporation, is a two-seat design powered by a single LHTEC T800-801 turboshaft driving coaxial four-blade main rotors and a five-blade tail-mounted propulsor. Programme partners include Chelton Flight Systems (cockpit display), Eagle Aviation (rotor blades), Hamilton Sundstrand (modifying and providing data concentrator units), Honeywell (central processing units), LHTEC (engine). First flight is expected in late 2006. On 3 November 2005, a modified Schweizer 333 equipped with the X2 Technology fly-by-wire system made its first flight and is being used as a surrogate test vehicle.

Potential future developments of X2 technology include attack helicopters, commercial transports, 'flying crane', and UAVs.

In September 2005, the US Army Applied Aviation Technology Directorate awarded Sikorsky two Concept Design and Analysis contracts in support of preliminary design of two X2 Technology heavy lift coaxial rotorcraft with cruising speeds of 165 kt (306 km/h; 190 mph) and 245 kt (454 km/h; 282 mph) respectively.

SINO SWEARINGEN

SINO SWEARINGEN AIRCRAFT COMPANY

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CHAIRMAN AND CEO: Ching-Chiang Kuo
CHIEF FINANCIAL OFFICER AND SENIOR VICE-PRESIDENT: Kelly E Simmons
SENIOR VICE-PRESIDENT, OPERATIONS AND PRODUCT SUPPORT: Steve Crawford
VICE-PRESIDENTS:
Tom Bisges (Engineering)
Gene Comfort (Sales and Marketing)
Robert Homan (Quality Assurance)
Glenn Jensen (Human Resources)
Robert Kormer (International Sales and Marketing)
SENIOR ADVISOR: Edward J Swearingen

Ed Swearingen is well known for designing Fairchild Merlin and Metro commuter and business aircraft, and for engineering such aircraft as Piper Twin Comanche and Lockheed JetStar II. Current project is SJ30-2 business jet.

Swearingen Aircraft Inc re-formed on 1 April 1995 as joint venture company with Sino Aerospace of Taiwan, which provides financial support; will certify and produce SJ30-2 at new 8,130 m² (87,500 sq ft) facility at Martinsburg, West Virginia, where the workforce totalled 73 in May 2004, and was expected to rise to about 350 by 2006.

On 20 December 2006, company received FAA approved production inspection system (APIS) authorisation to allow acceleration of manufacturing rate.

SINO SWEARINGEN SJ30-2

TYPE: Light business jet.

PROGRAMME: Announced 30 October 1986 as SA-30 Fanjet; Gulfstream Aerospace, Williams International and Rolls-Royce announced they were joining programme in October 1988 and aircraft renamed Gulfstream SA-30 Gulfjet; Gulfstream withdrew from programme 1 September 1989; place taken by Jaffe Group of San Antonio, Texas, and aircraft renamed Swearingen/Jaffe SJ30; now a Sino Swearingen project. First flight of prototype (N30SJ) 13 February 1991 (with FJ44-1 engines).

Certification originally intended in 1995 but delayed pending development of increased performance SJ30-2, *as described*, which features fuselage stretched by 1.32 m (4 ft 4 in), wing span increased by 1.83 m (6 ft 0 in), increased wing dihedral, revised wing/fuselage fairing, increased fuel capacity and more powerful FJ44-2A engines. Prototype (N30SJ, modified from SJ30 prototype) first flown (original engines) 8 November 1996.

FJ44-2A engines installed and flown for first time on 4 September 1997; total of 270 flight hours accumulated with these engines (or 370 hours overall in SJ30-2 configuration) by late April 1999, including operation at speeds up to M0.83 and maximum altitude of 13,105 m (43,000 ft), 1.8 *g* turns at 12,495 m (41,000 ft), verification of stall and engine-out minimum control speeds, stability and control tests, engine operating tests throughout the flight envelope, simulated icing tests, yaw/damper/rudder bias system testing and handling trials with simulated flight control failures including trim runaways and asymmetric speed brake deployment. N30SJ withdrawn from use in mid-1999.

Static and fatigue tests on a representative section of primary wing joint completed February 1999, to 150 per cent of limit load in 230,000 loading cycles. Risk-sharing partner Gamesa Aeronautica of Vitoria, Spain, manufactured fuselages and wings of five certification test airframes; first of envisaged three (later four) production conforming flying prototypes (c/n 002/N138BF) rolled out at San Antonio 17 July 2000 and first flown 30 November 2000; public debut at the NBAA Convention in Orlando, Florida, 9 September 2002, but destroyed in crash near Del Rio, Texas on 26 April 2003; 003/N30SJ (second use of registration), first flown 6 March 2003 and 004/N404SJ, first flown 17 October 2003, for each scheduled 400 flight hours during the test and certification programme. No. 004 successfully completed high-speed dive tests to Mach 0.90 in August 2004, accompanied by F-100 Super Sabre chase aircraft. No. 005/N50SJ added to test programme to replace 003, having previously been earmarked as initial customer delivery aircraft; first flight early January 2005; autopilot, interior and function/reliability certification airframe; c/n TF-2 and TF-3 are static test and fatigue airframes respectively; TF-2 transferred to Sino Swearingen static test facility at San Antonio 8 March 2001 and completed tests in February 2005.

The flight test programme was scheduled to culminate in FAA certification in FAR Pt 23 Commuter category and first customer deliveries in early 2004 prior to the loss of the first conforming prototype, but certification finally achieved on 27 October 2005. Initial customer aircraft, c/n 0006 scheduled for delivery in third quarter 2006, but delayed until 2007 by manufacturing fault necessitating replacement of port wing.

On 16 July 2006 N50SJ made a record-breaking city-to-city flight in class C-1, flying from San Antonio, Texas to Farnborough, UK, via a fuel stop at Goose Bay, at an average speed of 389.3 knots (721 km/h; 448.0 mph).

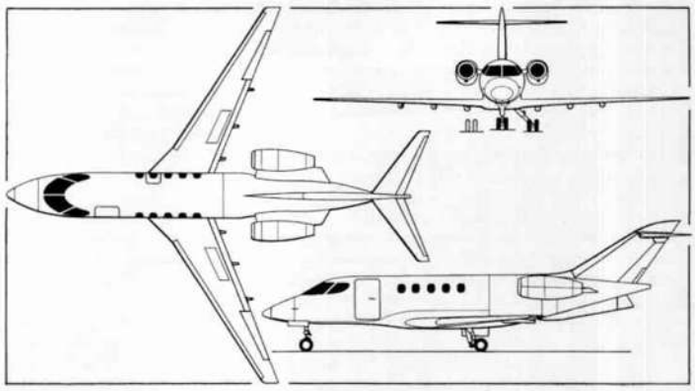
CUSTOMERS: Over 300 orders held by December 2006. Planned delivery of 13 aircraft by end of 2007, including six in first production batch.

COSTS: USD6,195 million typically equipped (2006). Estimated direct operating cost, USD740.47 per hour (2006).

DESIGN FEATURES: High-speed and high-altitude cruise with long-range capabilities, plus good slow speed handling; highly efficient swept wing planform.

Proprietary, computer-designed aerofoil sections. Wing sweep at quarter chord 32° 36', dihedral 2° 30'.

FLYING CONTROLS: Conventional and manual. Electrically actuated variable incidence tailplane, trim tab on rudder, aileron force bias spring for trimming in roll axis; single ventral fin under tail for yaw damping; slotted Fowler trailing-edge flaps actuated electrically; hydraulically actuated full-span leading-edge slats; single electrohydraulically actuated spoiler/lift dumper panel on each wing ahead of flap. Control surface movements: ailerons +15° 30'/–11° 20'; elevators +22°/–17° 10'; rudder ±27° 30'; ventral rudder ±30°; flaps have multiple settings including 10° and 20° options for T-O and positive angle for high-speed cruising.



Swearingen SJ30-2 business jet *(Paul Jackson)*

1159694

Sino Swearingen SJ30-2 N50SJ arriving at Farnborough on 16 July 2006 after its record-breaking flight *(Paul Jackson)*

1159760

STRUCTURE: All-metal with chemically milled skins on fuselage.

LANDING GEAR: Retractable tricycle type, manufactured by Integrated Aerospace of Santa Ana, California, with twin wheels on each unit. Trailing-link oleo-pneumatic suspension on main units. Hydraulic actuation, main units retracting inward and rearward into fuselage, nose unit forward. Two nosewheel doors each side; forward pair closed except when gear is cycling. Hydraulically steerable (±60°) nose unit. All wheels 41 cm (16 in) diameter. Main unit tyre pressure 10.76 bar (155 lb/sq in), nosewheel tyre pressure 2.14 bar (31 lb/sq in). Standard air-cooled power braking; dual ABS anti-skid.

POWER PLANT: Two 10.23 kN (2,300 lb st) Williams FJ44-2A turbofans flat rated to 72°C, pod-mounted on pylons on sides of rear fuselage. Six fuel tanks: one in each outer wing (total 1,055 litres; 278.8 US gallons; 232.1 Imp gallons); two wing hopper tanks (total 103 litres; 27.2 US gallons; 22.6 Imp gallons); centre wing tank (199 litres; 52.7 US gallons; 43.9 Imp gallons); and fuselage (torsion box) tank (1,440 litres; 380.3 US gallons; 316.7 Imp gallons) for total of 2,797 litres (739 US gallons; 615.3 Imp gallons) of which 389 litres (713 US gallons; 856 Imp gallons) usable. Fuel is burned sequentially to maintain aircraft centre of gravity. Single refuelling point in fuselage tank. Oil capacity 3.4 litres (0.9 US gallon; 0.75 Imp gallon) per engine.

ACCOMMODATION: Pilot and one passenger (or co-pilot) on flight deck. Main cabin separated by a bulkhead; six passengers seats comprising club four and two forward-facing seats; aft-facing seats recline and have lateral tracking capability; forward-facing seats have full berthing capability; lavatory, separated from main cabin by a half-cabin height partition with fan close-out, has belted, side-facing seat that is approved for occupation during take-off and landing. Full-height refreshment centre and foldaway tables, dual cupholders and cabin environment controls standard; recessed storage area aft of lavatory, with foldaway coat hooks, optional. Airstair passenger door with light at front on port side. Emergency exit over starboard wing. Baggage compartment aft of main cabin, with external access via port side door under engine nacelle. Two-piece birdproof electrically heated wraparound windscreen.

SYSTEMS: Cabin pressurised to 0.83 bar (12.0 lb/sq in), maintaining sea level pressure to 12,500 m (41,000 ft); cabin heated by engine bleed air; cooled by a vapour-cycle system. Hydraulic system (207 bar; 3,000 lb/sq in) for actuation of leading-edge slats, airbrake/lift dumpers and landing gear extension/retraction. Two 325 A 28 V DC engine-driven starter/generators and static inverters; 24 V lead-acid battery for engine starting and emergency power. Redundant frequency-wild alternators provide power for windscreen heating. Wing and engine inlets anti-iced by engine bleed air; tailplane has pneumatic de-icer boots, de-icing system. Oxygen system has 646 litre (22.8 cu ft) capacity.

AVIONICS: Honeywell Primus Epic CDS as core system.

Comms: Honeywell Primus II radio system; optional 8.33 kHz spacing. HF radio and Selcal optional.

Radar: Honeywell Primus 331 colour weather radar.

Flight: Dual IC-615 integrated avionics computers with combined flight director, autopilot and FMS/GPS functions; dual RVSM-compatible Honeywell AZ-850 micro air data computers; ADF, DME. Options include TCAS 2000, second FMS/GPS integrated with IC-615, second ADF, FMS data loader, second DME, CVR, FDR and lightning sensor system.

Instrumentation: EFIS cockpit comprising two Honeywell DU-180 flat panel portrait format 203 × 254 mm (8 × 10 in) active matrix colour LCDs, for PFD and MFD functions, with third optional.

DIMENSIONS, EXTERNAL:

Wing span	12.90 m (42 ft 4 in)
Wing chord: at root	2.41 m (7 ft 11 in)
at tip	0.50 m (1 ft 7½ in)
Wing aspect ratio	9.4
Length overall	14.26 m (46 ft 9½ in)
Fuselage: Length	12.79 m (41 ft 11½ in)
Max diameter	1.52 m (5 ft 0 in)
Height overall	4.34 m (14 ft 3 in)
Tailplane span	4.44 m (14 ft 7 in)
Wheel track (mean)	2.09 m (6 ft 10¼ in)
Wheelbase	5.70 m (18 ft 8½ in)
Passenger door: Height	1.42 m (4 ft 8 in)
Width	0.81 m (2 ft 8 in)
Baggage door: Height	0.65 m (2 ft 1½ in)
Width	0.47 m (1 ft 6½ in)
Emergency door: Height	0.56 m (1 ft 10 in)
Width	0.48 m (1 ft 7 in)

DIMENSIONS, INTERNAL:

Cabin: Length: between pressure bulkheads	5.36 m (17 ft 7 in)
passenger section	3.81 m (12 ft 6 in)
Max width	1.47 m (4 ft 10 in)
Max height	1.32 m (4 ft 4 in)
Floor area	5.46 m² (58.8 sq ft)
Volume	8.7 m³ (307.0 cu ft)
Baggage compartment volume	1.50 m³ (53 cu ft)

AREAS:

Wings, gross	**17.72 m² (190.7 sq ft)**
Ailerons (total)	**0.76 m² (8.20 sq ft)**
Trailing-edge flaps (total)	**3.31 m² (35.63 sq ft)**
Leading-edge flaps (total)	**2.83 m² (30.48 sq ft)**
Fin	**1.06 m² (11.40 sq ft)**
Rudder, incl tab	**0.69 m² (7.40 sq ft)**
Tailplane	**3.41 m² (36.70 sq ft)**
Elevator, incl tabs	**0.79 m² (8.53 sq ft)**

WEIGHTS AND LOADINGS:

Basic operating weight	**3,924 kg (8,650 lb)**
Max baggage weight	**227 kg (500 lb)**
Max fuel weight	**2,200 kg (4,850 lb)**
Max T-O weight	**6,327 kg (13,950 lb)**
Max ramp weight	**6,373 kg (14,050 lb)**
Max landing weight	**5,772 kg (12,725 lb)**
Max zero-fuel weight	**4,763 kg (10,500 lb)**
Max wing loading	**357.2 kg/m² (73.15 lb/sq ft)**
Max power loading	**309 kg/kN (3.03 lb/lb st)**

PERFORMANCE:

Max operating speed to FL295	320 kt (592 km/h; 368 mph)
Max operating Mach No. (MMO) above FL295	0.83
High-speed cruising speed	M0.83 (486 kt; 900 km/h; 559 mph)
Long-range cruising speed	M0.76 (436 kt; 807 km/h; 502 mph)
Stalling speed, flaps down, flight idle power	91 kt (168 km/h; 105 mph)
Max certified altitude	14,935 m (49,000 ft)
FAA T-O balanced field length	1,201 m (3,940 ft)
FAA landing distance	897 m (2,945 ft)
Range, pilot and three passengers, NBAA IFR reserves, 100 n mile (185 km; 115 mile) alternate, at M0.80:	2,363 n miles (4,376 km; 2,719 miles)
Range, pilot and three passengers, NBAA IFR reserves, 100 n mile (185 km; 115 mile) alternate at M0.78	2,500 n miles (4,630 km; 2,877 miles)

OPERATIONAL NOISE LEVELS:

T-O	**76.5 EPNdB**
Approach	**93.8 EPNdB**
Sideline	**86.5 EPNdB**

SKYCRAFT

SKYCRAFT INTERNATIONAL INC

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Rights to Super2 sold to Opus Aircraft in October 2004.

SKYCRUISER

SKYCRUISER CORPORATION

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Global Skyship Industries, then the US subsidiary of Aviation Support Group Ltd of the UK, acquired the assets of the former Westinghouse Airships Inc (WAI) in December 1996. As a result, GSI became holder of the type certificates for the UK-designed Skyship 500 HL and Skyship 600 and the WAI Sentinel 1000. In late 1997, GSI announced that it had re-opened the production line and had these airships available for immediate delivery.

Formation of Skycruiser Corporation was announced on 18 November 2002, as a joint venture between Airship Management Services Inc (AMS) of Greenwich, Connecticut, and Skyship Cruise Ltd of Lindau, Switzerland. New holder of the Type Certificates for the Skyship and Sentinel series of airships, it is part of the Skycruiser group of companies that include AMS, GSI (now co-located with AMS), Skyship Cruise Ltd and Skycruise Switzerland. The companies also operate a maintenance facility and FAA repair station at Skycruiser Corporation's base in Elizabeth City, North Carolina, where work was under way in 2006 on a Skyship 1000, based on the Sentinel 1000.

SKYCRUISER SKYSHIP 500HL

TYPE: Helium non-rigid airship.
PROGRAMME: First flight (G-SKSB) (converted Skyship 500) 30 July 1987.
CUSTOMERS: Three conversions completed in UK; one (N601LP) in service in USA with Airship Operations Inc in 1998, but destroyed by severe storm on 7 September 1998. Type

SKYSHIP 500 PRODUCTION

c/n	Registrations	Remarks
1214/01	G-BECE	AD500; first flight 3 Feb 79; destroyed Mar 79
1214/02	G-BIHN, N502LP	Now 500HL, Trans-Continental Leasing; inoperative
1214/03	G-SKSA	C of A expired 3 May 89. Deregistered 1996
1214/04	G-SKSB, N602LP, N501LP	Trans-Continental Leasing; believed inoperative
1214/05	G-SKSE, JA1003	To Japan Jul 84
1214/06	G-SKSH, N601LP	500HL; destroyed 7 Sep 98
1214/07	N503LP	Now 500HL, Trans-Continental Leasing; inoperative
1214/09	N504LP	Trans-Continental Leasing; inoperative

remains available from GSI which, in mid-2001, still had three (including 07/N503LP and 09/N504LP) ready for assembly on receipt of orders; however, no new sales reported by mid-2006.

DESIGN FEATURES: Combines modified Skyship 500 gondola with larger envelope of Skyship 600, providing ability to operate with greater payload in hotter climates and at higher altitudes than Skyship 500.

POWER PLANT: Two 153 kW (205 hp) Porsche 930/01 non-turbocharged engines; fuel capacity 545 litres (144 US gallons; 120 Imp gallons), of which 530 litres (140 US gallons; 117 Imp gallons are usable).

ACCOMMODATION: Pilot, co-pilot and up to nine passengers. Ground crew of 18.

DIMENSIONS, EXTERNAL: As for Skyship 600 except:

Length overall	59.13 m (194 ft 0 in)
Gondola: Length	9.75 m (32 ft 0 in)
Max width	2.13 m (7 ft 0 in)
Max height	1.93 m (6 ft 4 in)

DIMENSIONS, INTERNAL: As for Skyship 600 except:

Envelope volume	6,666 m^3 (235,400 cu ft)
Gondola cabin: Length	4.20 m (13 ft 9½ in)
Height	1.96 m (6 ft 5 in)

WEIGHTS AND LOADINGS:

Max usable fuel	382 kg (842 lb)
Gross disposable load	2,190 kg (4,829 lb)

PERFORMANCE:

Max level speed	53 kt (99 km/h; 62 mph)
Cruising speed	30 kt (56 km/h; 35 mph)
Pressure ceiling	2,135 m (7,000 ft)
Max range	347 n miles (643 km; 400 miles)
Endurance at 35 kt (65 km/h; 40 mph)	17 h

SKYCRUISER SKYSHIP 600

TYPE: Helium non-rigid airship.

PROGRAMME: First flight 6 March 1984; special category C of A awarded by UK CAA 1 September 1984; aerial work certification received second quarter 1986; full passenger-carrying C of A 8 January 1987, initiating Skycruise aerial sightseeing service over London, San Francisco, Munich and Sydney in 1987, and over Paris in 1988. First US FAA type certificate awarded to an airship for civil use was issued to Skyship 600 on 9 May 1989. Certificate passed to Slingsby Aviation on 24 September 1990; Westinghouse Airships Inc on 24 February 1994; Global Skyship Industries on 7 August 1997; and Skycruiser Corporation in November 2002. During 1990 Farnborough Air Show a Skyship 600 (G-SKSC) with two 227 litre (60 US gallon; 50 Imp gallon) long-endurance fuel tanks made unrefuelled flight of 50 hours 15 minutes; sufficient fuel for a further 20 hours remained at end of flight.

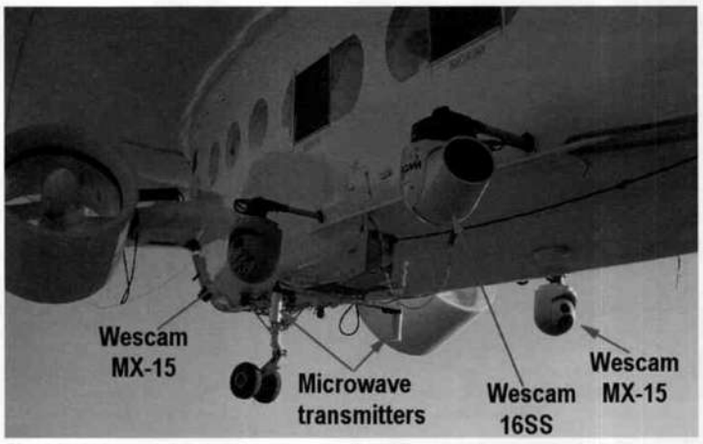
CURRENT VERSIONS: **Skyship 600**: Initial (UK-built) version (nine completed).

Description applies to Skyship 600 except where indicated.

Skyship 600B: With larger envelope, using Tedlar fabric, manufactured by TCOM LP. First example, converted from Skyship 600 c/n 07 (N602SK) and operated for Fuji Film by Airship Management Services, flew for first time 25 July 1998. Second example (c/n 10, N610SK) completed for Airship Operations Inc (Hilfiger contract) to replace destroyed Skyship 500HL.

CUSTOMERS: Total of nine built in UK, of which 01 (G-SKSC) purchased by Global Skyships from UK MoD and 07 (N602SK) converted to 600B in 1998. Two more 600Bs began construction in 1999, of which 02/B-04 (N602CL) was delivered to CargoLifter, Germany, in May 2000, certified by LBA 3 August 2001 and re-registered as D-LCLA *Charly*; for use as a crew trainer. In 2001, N606SA had its Porsche engines replaced by Lycoming IO-540s, making its maiden flight in this form on 18 January 2002 before being redelivered to Airship Management Services Europe in Paris in the second quarter of 2002. In 2003 it was operated by STI Aviation on behalf of the US Office of Naval Research.

COSTS: Skyship 600B approximately USD6 million (2000).



Skyship 600 gondola, showing sensors fitted for security patrols during Olympic Games in Athens, 2004 1040428

DESIGN FEATURES: Non-rigid envelope, with one ballonet forward and one aft (together 26 per cent of total volume); ballonet air intake aft of each propulsor unit. Cruciform tail unit.

FLYING CONTROLS: Vectored thrust propulsion (see Power Plant); differential inflation of ballonets for static fore and aft trim; cable-operated rudders and elevators, each with spring tab; ballast in box below crew seats; disposable water ballast in tanks at rear.

STRUCTURE: Envelope manufactured by TCOM LP from single ply polyester fabric, coated with titanium dioxide-loaded polyurethane to reduce ultraviolet degradation; polyvinylidene chloride film bonded on to inner coating of polyurethane on inside of envelope minimises loss of helium gas. Four parabolic arch load curtains, carrying multiple Kevlar 29 gondola suspension cables. Nose structure is domed disc, moulded from GFRP and carrying fitting by which airship is moored to its mast. Each tail surface attached to envelope at root and braced by wires on each side; all four surfaces constructed from interlocking ribs and spars of Fibrelam with GFRP skins.

One-piece moulded gondola of Kevlar-reinforced plastics, with flooring and bulkheads of Fibrelam panels; those forming engine compartment at rear are faced with titanium for fire protection.

LANDING GEAR: Single two-wheel assembly with double tyres, mounted beneath rear gondola.

POWER PLANT: Two 190 kW (255 hp) Porsche 930/67/AI/3 six-cylinder air-cooled and turbocharged piston engines mounted in rear of gondola. Each drives a ducted propulsor consisting of a Hoffmann HO-V155A-R/137 five-blade reversible-pitch propeller within an annular duct of carbon fibre-reinforced GFRP. Each propulsor can be rotated about its pylon attachment to gondola through an arc of 210°, 90° upward and 120° downward, vectored thrust thus providing both V/STOL and in-flight hovering ability.

Fuel tank, capacity 682 litres (180 US gallons; 150 Imp gallons), at rear of engine compartment; 668 litres (176.5 US gallons; 147 Imp gallons) usable. Auxiliary fuel tanks optional. Engine modifications include provision of automatic mixture control, fuel injection and electronic ignition.

ACCOMMODATION: Seats for pilot and co-pilot, with dual controls. Maximum capacity 12 passengers in addition to pilots. Ground crew of 18.

SYSTEMS: 28 V electrical system, supplied by engine-driven alternators.

AVIONICS: Include Honeywell Silver Crown series dual nav/com, ADF, Omega, VOR/ILS and weather radar.

EQUIPMENT: Night signs (30.48 m; 100 ft long and 9.14 m; 30 ft high) are full-colour aerial boards comprising 8,400 primary-coloured lamps computerised to enable the display of signs, animation and graphic logos in 16 colours.

SKYSHIP 600 PRODUCTION

c/n	Registrations	Remarks
1215/01	G-SKSC, ZH762	Sold 1998; stored at Cardington
1215/02	G-SKSD, VH-HAA, N602CL, D-CLCA, N601SK	Now 600B, Wells-Fargo (trustee)
1215/03	G-SKSG	Destroyed; cancelled 1996
1215/04	G-SKSF, N601SK, N430KK	Sentinel 1000; destroyed
1215/05	G-SKSJ, N600LP, N605SK	Wells-Fargo (trustee)
1215/06	G-SKSK, VH-HAN, JA1004, F-GLSD, N606SA	Wilmington Trust
1215/07	G-SKSL, N602SK	Now 600B, Airship Management Services
1215/08	G-SKSM, HL-	To South Korea, 1988
1215/09	G-SKSN, JA1006	To Japan, Mar 1989
1215/10	N610SK	Wells-Fargo (trustee)

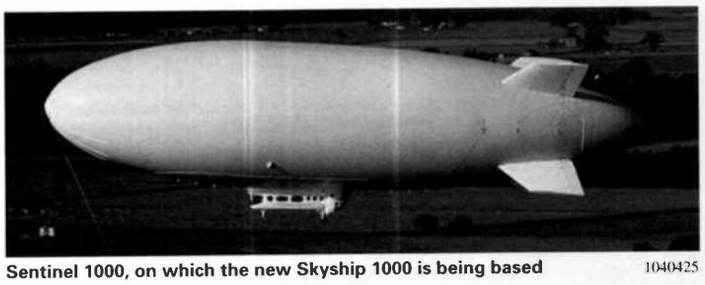
Ameriquest 'Soaring Dreams' Skyship 600, covered with artwork panels painted by disadvantaged children and adults 1040427

DIMENSIONS, EXTERNAL:
Envelope:
Length overall: 600 ..... 59.00 m (193 ft 7 in)
600B ..... 60.96 m (200 ft 0 in)
Max diameter ..... 15.20 m (49 ft 10½ in)
Fineness ratio: 600 ..... 3.88
600B 3.91
Height overall, incl gondola and landing gear ..... 20.30 m (66 ft 7¼ in)
Width over tailfins ..... 19.20 m (63 ft 0 in)
Gondola: Length overall ..... 11.67 m (38 ft 3½ in)
Max width ..... 2.56 m (8 ft 4¾ in)
Max height ..... 1.93 m (6 ft 4 in)
Propeller diameter ..... 1.37 m (4 ft 6 in)
DIMENSIONS, INTERNAL:
Envelope volume: 600 ..... 6,666 m^3 (235,400 cu ft)
600B ..... 7,192.5 m^3 (254,000 cu ft)
Ballonet volume (two, total) ..... 1,733 m^3 (61,200 cu ft)
Gondola cabin: Length ..... 6.89 m (22 ft 7¼ in)
Height ..... 1.92 m (6 ft 3½ in)
Floor area (usable) ..... 12.00 m^2 (130.0 sq ft)
WEIGHTS AND LOADINGS:
Max usable fuel ..... 484 kg (1,067 lb)
Gross disposable load ..... 2,343 kg (5,165 lb)
PERFORMANCE:
Max level speed ..... 56 kt (104 km/h; 65 mph)
Cruising speed ..... 35 kt (64 km/h; 40 mph)
Pressure ceiling ..... 2,135 m (7,000 ft)
Max range (standard fuel) ..... 347 n miles (643 km; 400 miles)

SKYCRUISER SKYSHIP 1000

TYPE: Helium non-rigid airship.
PROGRAMME: Sentinel 1000 initiated as larger derivative of Skyship 600 by Airship Industries (UK); taken over by Westinghouse Airships and first flown 26 June 1991 (largest non-rigid then flying); certified under FAR Pt 21 for single-pilot operation, 22 October 1993, but destroyed in hangar fire at Weeksville, North Carolina, 2 August 1995. Over 400 hours flown. Last described in 1999-200 *All the World's Aircraft*.

Skyship 1000 now under development based on Type Certificate of Sentinel 1000, from which it differs mainly in having enlarged gondola with greater passenger seating capacity.



Sentinel 1000, on which the new Skyship 1000 is being based 1040425

FLYING CONTROLS: Fibre optic (fly by light) control system; vectored thrust propulsion.
POWER PLANT: Two 224 kW (300 hp) Textron Lycoming IO-540 flat-six piston engines, each driving a vectoring, ducted propeller.
ACCOMMODATION: One or two pilots on flight deck. Seating for up to 24 passengers and/or cabin crew. Lavatory standard, bar or galley optional.
DIMENSIONS, EXTERNAL:
Length overall ..... 67.67 m (222 ft 0 in)
Height overall ..... 19.81 m (65 ft 0 in)
Gondola: Length ..... 12.90 m (42 ft 4 in)
Max width ..... 3.17 m (10 ft 5 in)
DIMENSIONS, INTERNAL:
Envelope volume ..... 10,000 m^3 (353,146 cu ft)
Passenger cabin: Length ..... 7.77 m (25 ft 6 in)
Max width ..... 3.05 m (10 ft 0 in)
Max height ..... 1.93 m (6 ft 4 in)
WEIGHTS AND LOADINGS:
No data released
PERFORMANCE (estimated):
Max level speed ..... 50 kt (93 km/h; 58 mph)
Cruising speed ..... 40 kt (74 km/h; 46 mph)
Endurance:
at 38 kt (71 km/h; 44 mph) ..... 13 h
at 22 kt (40 km/h; 25 mph) (max) ..... 52 h

SKY RAIDER

SKY RAIDER LLC

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e-mail: skyraiderllc@earthlink.net
Web: www.skyraiderllc.com
MANAGER: Fred Parker

Company, previously named Flying K Enterprises, was established by former SkyStar employee, the late Kenny Schrader. A version of its Sky Raider is produced in the UK as Reality Easy Raider.

In 2003, the company added a third version, the Super Sky Raider, to its range.

SKY RAIDER SKY RAIDER

TYPE: Single-seat ultralight kitbuilt; tandem-seat ultralight kitbuilt.
PROGRAMME: First flown in 1996.
CURRENT VERSIONS: **Sky Raider:** Single-seat model, available as certified aeroplane or under FAR Pt 103 ultralight regulations.

Sky Raider II: Tandem-seat version; introduced in 1999.

Super Sky Raider: Slightly larger version with dual controls, introduced 2003.

CUSTOMERS: Total of 250 SkyRaiders, 80 SkyRaider IIs and 70 Super Sky Raiders sold by August 2005.
COSTS: Sky Raider kit USD9,450; Sky Raider II kit USD10,945; Super Sky Raider kit USD13,995 (2006).
DESIGN FEATURES: High wing with tubular V-struts, and two auxiliary struts to each wing. Wire-braced fin and V-strut braced tailplane. Wings foldable for storage without disconnection of control runs. Quoted build time 300 hours for Sky Raider and 350 hours for Sky Raider II.
FLYING CONTROLS: Conventional and manual. Frise ailerons, cable actuated. Slotted flaps.
STRUCTURE: Fabric-covered steel tube. Optional wingtip extensions to Sky Raider and Sky Raider II add 55 cm (21½ in) to span; choice of rounded or square fin on Sky Raider. Heavier wing spar (6 cm; 2½ in diameter) and taller fin on Sky Raider II. Horn-balanced rudder on Sky Raider II.

Sky Raider with engine exposed ***(Paul Jackson)*** 1040496

LANDING GEAR: Tailwheel type: fixed. Two side Vs hinged to lower longerons, plus half-axles, each with bungee cord shock-absorber, attached to compression frame. Mainwheels 8.00–6. Optional floats and skis.
POWER PLANT: *Sky Raider:* One 20.1 kW (27 hp) Rotax 277 two-cylinder two-stroke driving a two-blade propeller for Pt 103; 31.0 kW (41.6 hp) Rotax 447 for normal operations. Optionally, engines up to 37.3 kW (50 hp) can be fitted. Fuel capacity 18.9 litres (5.0 US gallons; 4.2 Imp gallons).

Sky Raider II: One 44.7 kW (60 hp) HKS flat-two, four-stroke engine driving a GSC ground-adjustable three-blade or Powerfin carbon fibre propeller. Optional engines include the 41.8 kW (56.0 hp) Zanzottera MZ 202. Fuel capacity 37.9 litres (10.0 US gallons; 8.3 Imp gallons) due to extra wing fuel tank.

Super Sky Raider: One 59.7 kW (80.0 hp) Jabiru 2200 driving a GSC ground-adjustable two-blade propeller; optional engines include the 68.6 kW (92 hp) Zanzottera MZ 301. Fuel capacity 53 litres (14.0 US gallons; 11.7 Imp gallons).

ACCOMMODATION: *Sky Raider:* Pilot only, in open-sided cabin.

Sky Raider II: Two seats in tandem with single controls within fully enclosed cabin.

Super Sky Raider: Two seats in tandem with dual controls; taller and longer cabin.

DIMENSIONS, EXTERNAL (A: Sky Raider, B: Sky Raider II, C: Super Sky Raider):
Wing span: A, B ..... 7.99 m (26 ft 2½ in)
C ..... 8.53 m (28 ft 0 in)
Length overall: A, B ..... 5.18 m (17 ft 0 in)
C ..... 5.49 m (18 ft 0 in)
Height overall: A ..... 1.57 m (5 ft 2 in)
B ..... 1.73 m (5 ft 8 in)
C ..... 1.83 m (6 ft 0 in)
AREAS:
Wings, gross, A, B:
without extensions ..... 9.10 m^2 (98.0 sq ft)
with extensions; and C ..... 9.94 m^2 (107.0 sq ft)
WEIGHTS AND LOADINGS:
Weight empty: A with Rotax 447 ..... 115 kg (253 lb)
B with HKS ..... 184 kg (405 lb)
C with Jabiru ..... 204 kg (450 lb)
Max T-O weight: A ..... 249 kg (550 lb)
B ..... 431 kg (950 lb)
C ..... 476 kg (1,050 lb)
PERFORMANCE (A with Rotax 447; B with HKS, C with Jabiru 2200):
Never-exceed speed (VNE):
all ..... 86 kt (160 km/h; 100 mph)
Normal cruising speed: A ..... 56 kt (105 km/h; 65 mph)
B ..... 65 kt (121 km/h; 75 mph)
C ..... 70 kt (129 km/h; 80 mph)
Stalling speed, flaps down: A ..... 20 kt (37 km/h; 23 mph)
B ..... 26 kt (49 km/h; 30 mph)
C ..... 28 kt (52 km/h; 32 mph)
Max rate of climb at S/L: A ..... 320 m (1,050 ft)/min
B ..... 396 m (1,300 ft)/min
C ..... 427 m (1,400 ft)/min
T-O and landing run: all ..... 23 m (75 ft)
Range: A ..... 120 n miles (222 km; 138 miles)
B ..... 250 n miles (463 km; 287 miles)

SKYSTAR

SKYSTAR AIRCRAFT CORPORATION

Production rights to Kitfox transferred to Kitfox Aircraft LLC.

SLIPSTREAM

SLIPSTREAM INDUSTRIES INC

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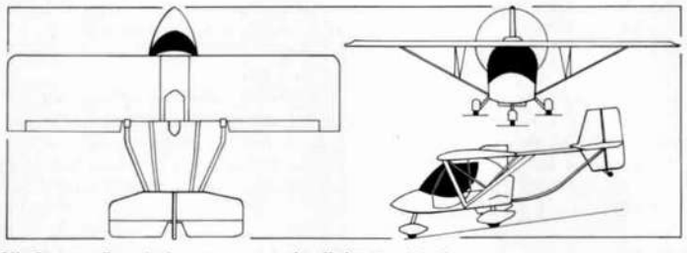
Web: www.slipstream.bz
PRESIDENT: Paul Klomhaus

Formed on 1 April 1999, SlipStream produces a range of ultralight aircraft and accessories, and distributes the Verner range of engines. Rights to the Viking Dragonfly were sold to Dart Industries of South Africa in March 2004. The Skyquest was also withdrawn from the product line at this time; from 2006 the Defiance was withdrawn. In July 2004, the aircraft manufacturing division of SlipStream was sold to Paul and Kim Klomhaus, with the Shark range of amphibious floats being transferred to Downwind Technologies. Downwind has retained the 1,394 m² (15,000 sq ft) factory in Wautona, with Slip Stream moving to Neenah. In April 2004, the workforce numbered six.

SLIPSTREAM GENESIS and REVELATION

TYPE: Side-by-side kitbuilt; side-by-side ultralight kitbuilt.
PROGRAMME: Prototype Genesis first flew 1992; Revelation developed as a lower-powered 'recreational' version.
CURRENT VERSIONS: **Genesis:** Baseline version. Experimental category.
Revelation: Lower-powered version; can be upgraded to Genesis standard by replacement only of windscreen and engine and addition of glass fibre enclosure.
CUSTOMERS: Total of 135 Genesis and 79 Revelation aircraft flying by end 2006.
COSTS: Kit including engine (2006): Genesis USD18,122 estimated complete USD33,000; Revelation USD13,295, estimated complete USD29,000-37,000.
DESIGN FEATURES: Quoted build time for Genesis 400 hours; for Revelation 300 hours (deduct 90 when opting for sailcloth-covered wing).
FLYING CONTROLS: Conventional and manual. Horn-balanced elevator.
STRUCTURE: Preformed glass fibre nose; fabric-covered strut-braced wings; tubular steel rear fuselage; main landing gear legs of 4 cm (1½ in) glass fibre.
LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring glass fibre cantilever mainwheel legs with optional composites wheel fairings. Cable brakes; hydraulic brakes optional. Optional floats.
POWER PLANT: *Genesis:* One 47.8 kW (64.1 hp) Rotax 582 driving Tennessee two-blade wooden propeller. Fuel capacity 76 litres (20.0 US gallons; 16.7 Imp gallons). Other engines including Verner 133M, Rotax 912 UL, 912 ULS and 914 can be fitted. In 2005, Slipstream fitted an 89.5 kW (120 hp) Yamaha Genesis Extreme three-cylinder liquid-cooled engine to a demonstrator; it also plans to offer the 111.9 kW (150 hp) four-cylinder fuel-injected version.



SlipStream Revelation two-seat ultralight *(Paul Jackson)* 0100466

Slipstream Genesis ultralight *(Paul Jackson)* 1040495

Revelation: One 39.3 kW (52.7 hp) Rotax 503B. Fuel capacity 38 litres (10.0 US gallons; 8.3 Imp gallons). Same engine options as Genesis.
Data apply to both versions, except where otherwise stated.

DIMENSIONS, EXTERNAL:
Wing span ..... 9.35 m (30 ft 8 in)
Length overall ..... 5.89 m (19 ft 4 in)
Height overall ..... 1.92 m (6 ft 3½ in)
AREAS:
Wings, gross ..... 16.62 m² (179.0 sq ft)
WEIGHTS AND LOADINGS (A: Genesis, B: Revelation):
Weight empty: A ..... 295 kg (650 lb)
B ..... 211 kg (465 lb)
Max T-O weight: A ..... 589 kg (1,300 lb)
B ..... 499 kg (1,100 lb)
PERFORMANCE (A and B as above):
Never-exceed speed (VNE): A ..... 104 kt (193 km/h; 120 mph)
Normal cruising speed: A ..... 70 kt (129 km/h; 80 mph)
B ..... 57 kt (106 km/h; 66 mph)
Stalling speed: A ..... 39 kt (72 km/h; 45 mph)
B ..... 38 kt (70 km/h; 43 mph)
Max rate of climb at S/L: A ..... 305 m (1,000 ft)/min
B ..... 244 m (800 ft)/min
T-O run: A, B ..... 122 m (400 ft)
Landing run: A ..... 77 m (250 ft)
B ..... 46 m (150 ft)
Range with max fuel: A ..... 252 n miles (466 km; 290 miles)
B ..... 130 n miles (241 km; 150 miles)

SLIPSTREAM SCEPTER

TYPE: Single-seat ultralight kitbuilt.
PROGRAMME: Development of Genesis, introduced in 1999.
CUSTOMERS: Total of 20 flying by end 2006.
COSTS: USD11,495 to USD13,295 (2006) including engine.
DESIGN FEATURES: Quoted build time 120 hours.
Data as Genesis, except that below.
POWER PLANT: One 39.3 kW (52.7 hp) Rotax 503B, 29.5 kW (39.6 hp) Rotax 447 UL-1V or 47.8 kW (64.1 hp) Rotax 582. Fuel capacity 19 litres (5.0 US gallons; 4.2 Imp gallons); options to increase to 37.9 litres (10.0 US gallons; 8.3 Imp gallons) and 75.7 litres (20.0 US gallons; 16.7 Imp gallons) available.
WEIGHTS AND LOADINGS (Rotax 503):
Weight empty ..... 199 kg (438 lb)
Max T-O weight ..... 544 kg (1,200 lb)
PERFORMANCE (Rotax 447):
Normal cruising speed ..... 48 kt (89 km/h; 55 mph)
Stalling speed ..... 24 kt (44 km/h; 27 mph)
Max rate of climb at S/L ..... 229 m (750 ft)/min
T-O and landing run ..... 31 m (100 ft)
Range with max fuel ..... 60 n miles (112 km; 70 miles)

SlipStream Scepter single-seat ultralight *(Paul Jackson)* 0526985

SLIPSTREAM DEFIANCE

TYPE: Two-seat kitbuilt twin.
PROGRAMME: Introduced in 2000 as the Skyblaster; based on Genesis/Revelation with 98 per cent commonality of parts; withdrawn from product line in 2003 for redesign of cowling and front-mounted engine; reintroduced in late-2004 as the Defiance. No further information received and by 2006 it had been withdrawn from the product line.

SOLARIS

SOLARIS AVIATION INC

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Web: www.solarisaviation.com
PRESIDENT: Nick Schneider
VICE-PRESIDENTS:
George Rodgers
J Cook
CHAIRMAN: David Schuldt

Solaris Aviation was established in 1999 and purchased the assets of Ruschmeyer Luftfahrttechnik GmbH of Germany including Type Certificates, moulds and tooling. Ruschmeyer had filed for bankruptcy in January 1996, having built a small number of R 90 four-seat touring aircraft. Solaris has also acquired a 10,220 m² (110,000 sq ft) manufacturing facility in Bielsko-Biala, Poland, where labour-intensive parts of the relaunched aircraft are produced before being shipped to Florida for final assembly. The Sigma, as the R 90 is now known, was first shown publicly at AirVenture, Oshkosh, in July 2001, the project having been formally announced on 5 July 2001. No new airframe production had ensued by late-2006 although promotion was then continuing and at least one airframe partially built by Ruschmeyer had been completed in 2004 by Aircraft Technology Construction of Germany, with future production reportedly planned at the SZD plant in Poland.

SOLARIS SIGMA and ALPHA

TYPE: Four-seat lightplane.

PROGRAMME: Development of original Ruschmeyer MF-85 started in Germany in 1985; first prototype MF-85P-RG (V0001) flew with Porsche engine; changed to R 90-230 RG using flat-rated Textron Lycoming IO-540 after cessation of Porsche production in March 1990; first flight of prototype V001 (D-EEHE) 8 August 1988; first flight of V002 (D-EERO) 25 September 1990; V003 (D-EERH) first flight 12 February 1992; LBA certification June 1992; FAA 24 June 1994. Main production variant was R 90-230 RG, of which 25 built; Ruschmeyer also produced prototype fixed landing gear R 90-230 FG; lower and higher-powered versions were overtaken by company's bankruptcy. Programme transferred to Solaris in USA, 1999; German-built R 90-230 RG registered N230S in June 2001 as demonstrator. Production deliveries due to begin in third quarter of 2002, but only c/n 029/D-EEHY, partially completed under Ruschmeyer, was manufactured in 2004. US demonstrator N230S was transferred back to Germany in October 2005.

CURRENT VERSIONS: **Sigma 230:** One Textron Lycoming IO-540-C4D5 flat-six, derated to 172 kW (230 hp). Retractable landing gear; intended for European market.

Alpha 230: As above. Fixed gear.

Sigma 250: IO-540-C4D5 engine, fully rated at 186 kW (250 hp). Retractable gear. Baseline US version.

Alpha 230: As immediately above. Fixed gear.

Sigma 310: Teledyne Continental IO-550N flat-six, rated at 231 kW (310 hp). Retractable gear. Uprated US version.

Alpha 310: As immediately above. Fixed gear.

COSTS: Sigma 250 USD244,900; Sigma 310 USD279,900 (2002).

DESIGN FEATURES: Objectives were FAR Pt 23 compliance; high performance by low-drag all-composites airframe, use of derated engine for European version, requiring less cooling, reduced noise by lower engine rpm, special silencer and, originally, matched four-blade constant-speed propeller. Consequently, reduced fuel consumption and emissions; noise level under German regulations demonstrated 66 dBA, 8 dBA below limit; also 10.2 dBA below ICAO Chapter 10 limit. Laminar flow aerofoil. Certified 18,000 hour life.

FLYING CONTROLS: Conventional and manual; all push/pull rod operated to minimise friction; dual controls with sticks standard; fixed tailplane; combined trim and trim tab on port elevator; stall strips on inboard wing leading-edge; three-position Fowler flaps operated by electrohydraulic system are linked to elevator to avoid trim changes; max deflection 30°. Aileron deflections +16/−11°; elevator +18/−15°; rudder starboard 240 mm (9.45 in), port 220 mm (8.66 in).

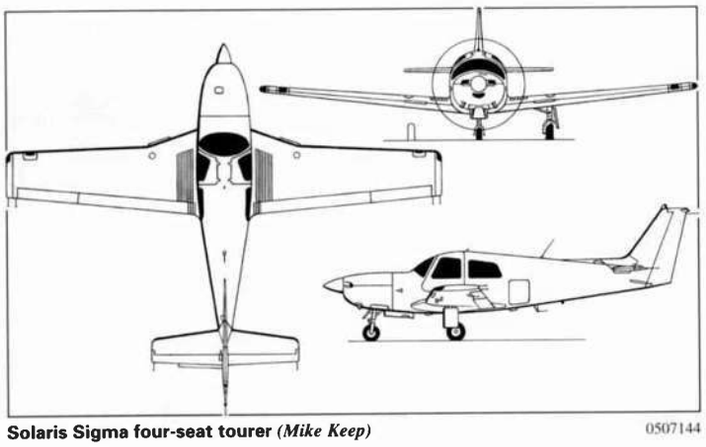
STRUCTURE: All-composites moulded airframe with 70 per cent fewer parts than equivalent metal structure. Ruschmeyer qualified BASF Palatal A430 resin fibre composites material for aviation; advantages are durability at up to 72°C ambient, improved strength, field repair without special tools, negligible allergic risks during manufacture, and material is recyclable. GFRP with Rohacell foam cores and CFRP reinforcement round doors; steel tube running from firewall, over roof and into tail, supports doors and protects against roll-over; components earth bonded to German and FAA standards. Meets 1.75 safety factor for composites airframes.

LANDING GEAR: Tricycle type; retractable. Electrohydraulic actuation; trailing-link levered mainwheel suspension retracts inward and covered by mechanically linked doors; foot-powered hydraulic disc brakes; steerable nosewheel retracts rearward, also covered by doors.

POWER PLANT: As for Current Versions. Hartzell three-blade, constant-speed propeller. Adjustable cowl flaps. Standard Sigma 250/Alpha 250 fuel 311 litres (82.0 US gallons; 68.3 Imp gallons) in integral tanks in inner wings; Sigma 310/Alpha 310 349 litres (92.0 US gallons; 76.7 Imp gallons). Oil capacity 11.4 litres (3.0 US gallons; 2.5 Imp gallons) for Sigma 250/Alpha 250; 12 litres (3.25 US gallons; 2.7 Imp gallons) for Sigma 310/Alpha 310.

ACCOMMODATION: Four-seat interior with ergonomically designed seats; three-point harness; upward-opening gull wing doors; heating and ventilation system with electric blower; baggage compartment accessible from inside and outside.

SYSTEMS: S-Tec 40 (optional 55X) single-axis autopilot. Electrohydraulic actuation for flaps; pitot heater and night lighting. Electrical system 28 V DC; 70 Ah alternator; 24 V 18 Ah battery.



Solaris Sigma four-seat tourer ***(Mike Keep)*** 0507144

Solaris Sigma demonstrator (Ruschmeyer R 90-230 RG) promoting the type at Aero '05, Friedrichshafen, in April 2005 ***(Paul Jackson)*** 1129476

AVIONICS: *Comms:* Garmin GNS-430 transceiver; GTX-327 transponder; GMA-340 audio system; ELT. Optional GNS-530 nav/com with GI-106 moving map indicator.

Flight: Garmin GNS-420 GPS. Optional second GNS-430, S-Tec ST-180 slaved compass, ST-361 flight director, ST-360 altitude selector, Goodrich WX-500 Stormscope and Shadin fuel/air data computer.

DIMENSIONS, EXTERNAL:

Wing span	9.50 m (31 ft 2 in)
Wing aspect ratio	7.0
Length overall	**7.98 m (26 ft 2 in)**
Height overall	**2.74 m (9 ft 0 in)**
Wheelbase	**1.93 m (6 ft 4 in)**
Propeller diameter	**1.88 m (6 ft 2 in)**

DIMENSIONS, INTERNAL:

Cabin: Length	2.86 m (9 ft 4½ in)
Width	1.14 m (3 ft 9 in)
Height	1.24 m (4 ft 0¼ in)
Baggage compartment volume	0.80 m^3 (28.3 cu ft)

AREAS:

Wings, gross	12.94 m^2 (139.3 sq ft)

WEIGHTS AND LOADINGS (Sigma 230, 250 and 310):

Weight empty: S230	850 kg (1,874 lb)
S250	880 kg (1,940 lb)
S310	1,051 kg (2,317 lb)
Baggage capacity: all	50 kg (110 lb)
Max T-O weight: S230	1,352 kg (2,980 lb)
S250	1,372 kg (3,025 lb)
S310	1,587 kg (3,500 lb)
Max wing loading: S230	104.4 kg/m^2 (21.39 lb/sq ft)
S250	106.0 kg/m^2 (21.72 lb/sq ft)
S310	122.7 kg/m^2 (25.13 lb/sq ft)
Max power loading: S230	7.89 kg/kW (12.96 lb/hp)
S250	7.36 kg/kW (12.10 lb/hp)
S310	6.87 kg/kW (11.29 lb/hp)

PERFORMANCE (Sigma 230, 250 and 310):

Max level speed: S230	**175 kt (324 km/h; 201 mph)**
S250	**184 kt (340 km/h; 211 mph)**
S310	215 kt (398 km/h; 247 mph)
Cruising speed: S250	173 kt (320 km/h; 199 mph)
S310	205 kt (380 km/h; 236 mph)
Econ cruising speed: S250	125 kt (232 km/h; 144 mph)
S310	150 kt (278 km/h; 173 mph)
Stalling speed:	
flaps up:	
S230, S250	67 kt (125 km/h; 78 mph)
S310	71 kt (132 km/h; 82 mph)
flaps down: S230, S250	57 kt (106 km/h; 66 mph)
S310	60 kt (112 km/h; 69 mph)
Max rate of climb at S/L: S250	399 m (1,310 ft)/min
S310	408 m (1,340 ft)/min
Service ceiling: S250, S310	6,100 m (20,000 ft)
T-O run: S230	261 m (855 ft)
S250	249 m (815 ft)
S310	250 m (820 ft)
T-O to 15 m (50 ft): S250	427 m (1,400 ft)
S310	503 m (1,650 ft)
Landing from 15 m (50 ft): S250	412 m (1,350 ft)
S310	488 m (1,600 ft)
Landing run: S230, S250	328 m (1,075 ft)
S310	406 m (1,330 ft)
Range:	
normal cruise:	
S250	840 n miles (1,555 km; 966 miles)
S310	1,150 n miles (2,129 km; 1,323 miles)
long-range cruise:	
S230	870 n miles (1,611 km; 1,001 miles)
S250	1,160 n miles (2,148 km; 1,334 miles)
S310	1,488 n miles (2,755 km; 1,712 miles)

SONEX

SONEX AIRCRAFT LLC

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Company formed by John Monnett, designer of the Sonerai, Monerai and Moni light aircraft, to produce kits of his latest design, the Sonex, its Y-tailed Waiex and motor glider Xenos derivatives. In late 2002 the company had a workforce of four in its 968 m^2 (10,424 sq ft) factory and in November 2004 added a further 520 m^2 (5,600 sq ft) hangar, by April 2006 the workforce had increased to eight.

SONEX SONEX

TYPE: Side-by-side ultralight kitbuilt.

PROGRAMME: Announced March 1996 in response to request for ultralight to meet Italian requirements; first flight of prototype (N12SX) with Jabiru 2200 engine, 28 February 1998. Five prototypes. First customer-built aircraft flown 12 June 2001.

CURRENT VERSIONS: **Sonex:** Kitbuilt, *as described.*

Sonex ST: Introduced May 2005; as Sonex but with controls located on centre console, thus intended as a transition trainer.

Waiex: Y-tailed derivative (name indicates Y-tailed experimental); meets FAA 51 per cent rule. Prototype (N12YX) first flown 19 July 2003 and made public debut at AirVenture 2003 following week. Data as per Sonex, except length 5.51 m (18 ft 1 in), empty weight 283 kg (625 lb), never-exceed speed 166 kt (309 km/h; 192 mph), stalling speed, flaps down 37 kt (68 km/h; 42 mph). First two customer kits delivered 4 June 2004; first customer-built aircraft (N612BW) flown 10 January 2006.

Xenos: Motor glider, based around Sonex front fuselage; *described separately.*

CUSTOMERS: Over 1,000 sets of plans and kits sold and 144 Sonex and five Waiex flying by November 2006.

COSTS: Sonex Airframe kit USD13,495 tailwheel, USD13,845 tricycle both excluding engine and wheels and brakes (2006). Waiex kit USD13,995 (2006). Estimated completed cost: Sonex USD24,730-USD33,735; Waiex USD25,230-USD34,235.

DESIGN FEATURES: Simple to assemble; 198 parts to easy-build kit. Wings removable for transport and storage. Quoted build time 700 hours.

NACA 64-415 aerofoil.

FLYING CONTROLS: Conventional and manual. Flaps.

STRUCTURE: Of 6061-T6 aluminium throughout.

LANDING GEAR: Fixed; nosewheel or tailwheel type. Fuselage-mounted spring titanium tube mainwheel legs with sheet metal trouser and glass fibre wheel fairings. Azusa wheels and brakes. Mainwheels 5.00x5, tailwheel (where fitted) 4x1 in. Optional Czech Aircraft Works floats; prototype first flown 18 May 2004 from land and 12 July 2004 from water.

POWER PLANT: Choice of power plants between 59.7 and 89.5 kW (80 and 120 hp), including 59.7 kW (80 hp) AeroVee 2002 conversion of Volkswagen 2180 motorcar engine and Jabiru 2200 and 3300. Two-blade, wooden, fixed-pitch Sensenich or Sterba propeller. Fuel capacity 61 litres (16.0 US gallons; 13.3 Imp gallons) in single fuel tank.

DIMENSIONS, EXTERNAL:

Wing span	6.71 m (22 ft 0 in)
Length overall	5.36 m (17 ft 7 in)
Height overall: tailwheel	1.63 m (5 ft 4 in)
nosewheel	1.93 m (6 ft 4 in)

AREAS:

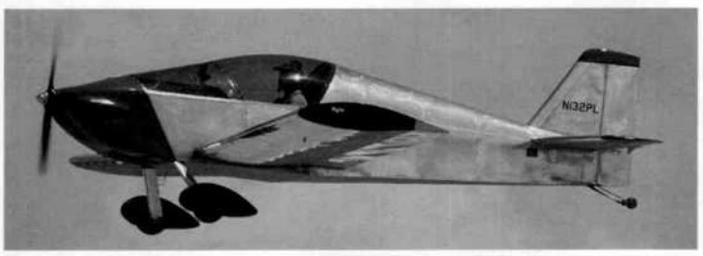
Wings, gross	9.10 m² (98.0 sq ft)

WEIGHTS AND LOADINGS (59.7 kW; 80 hp Jabiru 2200):

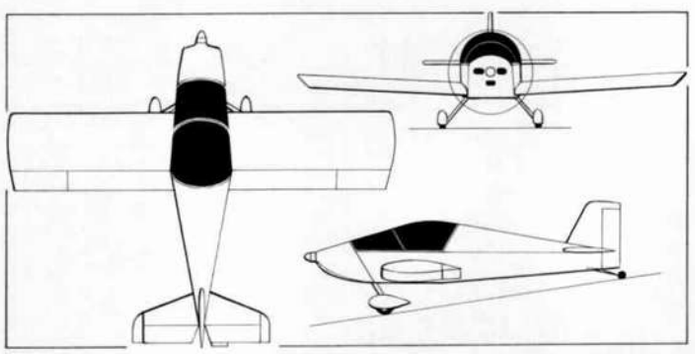
Weight empty	281 kg (620 lb)
Max baggage weight	18 kg (40 lb)
Max T-O weight: Utility	499 kg (1,100 lb)
Aerobatic	430 kg (950 lb)

PERFORMANCE (engine as above):

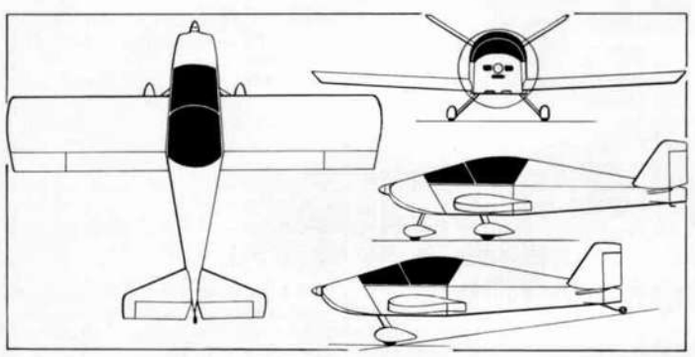
Never-exceed speed (VNE)	171 kt (317 km/h; 197 mph)
Max level speed	130 kt (241 km/h; 150 mph)
Normal cruising speed	113 kt (209 km/h; 130 mph)
Stalling speed: flaps up	40 kt (74 km/h; 46 mph)
flaps down	35 kt (65 km/h; 40 mph)
Max rate of climb at S/L	305 m (1,000 ft)/min
T-O run	91 m (300 ft)
Landing run	153 m (500 ft)
Range with max fuel	412 n miles (764 km; 475 miles)
g limits: Utility	+4.4/–2.2
Aerobatic	+6/–3



Sonex Sonex built by Samuel Pavel *(Paul Jackson)* 1040499



Production version of Sonex Sonex *(James Goulding)* 0530165



Y-tailed Sonex Waiex *(James Goulding)* 0561623

SONEX XENOS

TYPE: Side-by-side ultralight motor glider kitbuilt.

PROGRAMME: Announced in 2000 as a successor to the earlier Monnett Moni; wing static load testing completed March 2001; Jabiru 3300 prototype (N212XS) first flown 19 July 2003, followed same day by Aero-Vee 2002 VW prototype (N112XS). First three customer kits shipped 22 July 2004. Meets FAA 51 per cent rule.

CUSTOMERS: Eleven kits sold and three aircraft flying by November 2006.

COSTS: Kit USD18,995 (2006). Estimated completed cost USD30,430-USD39,435, depending on engine choice.

DESIGN FEATURES: Based on Sonex fuselage (which see). Quoted build time 1,200 hours.

FLYING CONTROLS: Conventional and manual. Speed brakes.

STRUCTURE: Primarily of 6061 aluminium. Wing has Wortmann FX-61 aerofoil. V tail similar to designer's earlier Moni motor glider.

LANDING GEAR: Tailwheel type; fixed. As Sonex.

POWER PLANT: Choice of engines including 2,180 cc Aero-Vee 2002 VW conversion and 2200 and 3300 Jabiru. Fuel capacity 61 litres (16.0 US gallons; 13.3 Imp gallons) in single fuel tank.

All data are provisional.

DIMENSIONS, EXTERNAL:

Wing span: Utility	13.91 m (45 ft 7½ in)
Aerobatic	11.99 m (39 ft 4 in)
Length overall	6.02 m (19 ft 9 in)

AREAS:

Wings, gross: Utility	14.68 m² (158.0 sq ft)
Aerobatic	13.38 m² (144.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: Utility	345 kg (760 lb)
Aerobatic	340 kg (750 lb)
Max T-O weight: Utility	578 kg (1,275 lb)
Aerobatic	476 kg (1,050 lb)

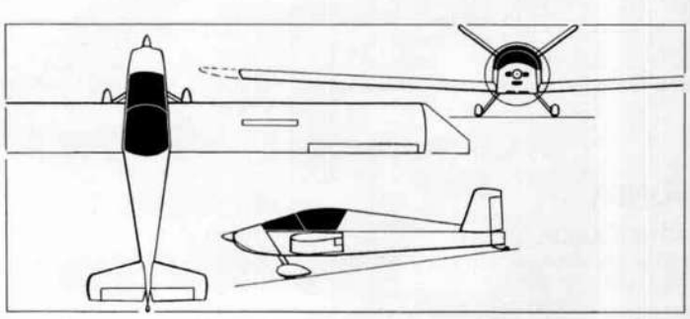
PERFORMANCE, POWERED:

Never-exceed speed (VNE)	130 kt (241 km/h; 150 mph)
Stalling speed: Utility	39 kt (71 km/h; 44 mph)
Aerobatic	36 kt (66 km/h; 41 mph)
g limits: Utility	+4.4/–2.2
Aerobatic	+6.0/–3.0

PERFORMANCE, UNPOWERED:

Best glide ratio: Utility	24
Aerobatic	21

Sonex Xenos motor glider *(Paul Jackson)* 1044943



Sonex Xenos motor glider kitplane *(James Goulding)* 0561625

SPECTRUM

SPECTRUM AERONAUTICAL LLC

120 Birmingham Avenue, Suite 110, Cardiff by the Sea, California 92007
Tel: (+1 760) 230 18 85
Fax: (+1 760) 454 46 32
Web: www.spectrum.aero
CEO AND CHAIRMAN: Linden Blue
CHIEF ENGINEER: Dan Cooney

Company founded by management experienced in design of UAVs and employment of composites in aircraft construction. Initial product was Spectrum S-33 light business jet, announced at the NBAA Convention in Orlando 8 November 2005. S-40 announced at following year's convention, October 2006.

Production of prototype and series S-33 by Rocky Mountain Composites at Spanish Fork, Utah, initially in 6,040 m² (65,000 sq ft) plant, to which further 5,575 m² (60,000 sq ft) added in 2006.

SPECTRUM S-33 INDEPENDENCE

TYPE: Business jet.

PROGRAMME: Development began 1998; detail design by Dan Cooney. Proof-of-technique airframe and prototype constructed prior to formal announcement at NBAA Convention, Orlando, Florida, in November 2005. Initial flight of prototype (N332LA—indicating lead composites engineer Larry Ashton) originally scheduled for September 2005, but did not take place until 7 January 2006 because of systems integration delays. This aircraft was destroyed in a crash on take off on 25 July 2006, apparently as a result of misrigged aileron controls following maintenance. S-33 named Independence in October 2006.

Planned four conforming prototypes and one or two fatigue and static test airframes originally due for completion by end of 2006. FAR Pt 23 certification planned for late 2007 or early 2008. However, at NBAA Convention in October 2006, Spectrum announced programme delay and rescheduling first flight of second prototype to August 2007; certification in 2009.

COSTS: USD3.65 million (2005). Ownership and operation stated to cost half as much as equivalent aircraft.

DESIGN FEATURES: High-speed, long-range design, employing latest composites material and assembly techniques for lightness and manufacturing economy. No novel aerodynamic features.

High aspect ratio wing, with winglets, mounted below and towards rear of cabin. T tail and two rear-mounted engines. Dimensions dictated, in part, by cabin size equivalent to Cessna Citation CJ2. Large cabin windows enhance interior appeal.

FLYING CONTROLS: Conventional and manual. Actuation by carbon fibre pushrods. Flaps.

STRUCTURE: Aircraft 99 per cent carbon fibre; no filler; almost all carbon-core-carbon sandwiches eliminated, reducing weight by 33 per cent. Labour-intensive and error-prone hand lay-up replaced by FibeX proprietary filament winding process, relying on computer control, permitting fuselage manufacture in five hours, not including pressure co-curing in low-temperature oven. Basic wing and fuselage structures weigh 279 kg (615 lb).

Wing constructed around five I spars. Fuselage interior walls reinforced by integral lattice of grid stiffeners in tradition of geodetic structure pioneered in aerospace applications by Sir Barnes Wallis. Bonded polycarbonate windows.

LANDING GEAR: Tricycle type; retractable. Single wheel on each unit. Hydraulic mainwheel brakes. Nosewheel retracts forward; mainwheels, on cantilever carbon fibre legs anchored at fuselage and splayed outwards, retract rearwards.

POWER PLANT: Two 7.0 kN (1,568 lb st) Williams FJ33-4 turbofans. Fuel in wing tanks, combined capacity 1,563 litres (413 US gallons; 344 Imp gallons).

ACCOMMODATION: Up to 10 persons, including pilot(s) and fully-enclosed aft lavatory; typically seven, including 'club four' in centre of cabin with single, forward-facing seat, starboard, opposite door and adjacent to emergency exit. Internal features by Infusion Design of Bonner Springs, Kansas. Sidestick controllers. Cabin equivalent pressure 1,830 m (6,000 ft) up to FL450. Externally accesses baggage compartments fore and aft of pressure bulkheads.

AVIONICS: Avidyne three-screen EFIS in prototype; other options under consideration for production aircraft.

DIMENSIONS, EXTERNAL:

Wing span	12.83 m (42 ft 1 in)
Wing aspect ratio	10.4
Length overall	14.00 m (45 ft 11 in)
Height overall	3.56 m (11 ft 8 in)

DIMENSIONS, INTERNAL:

Cabin:	
Length: between pressure bulkheads	5.49 m (18 ft 0 in)
aft of cockpit	3.96 m (13 ft 0 in)
Max width	1.47 m (4 ft 10 in)
Max height	1.47 m (4 ft 10 in)
Baggage compartment volume: front	0.28 m³ (10 cu ft)
rear	1.8 m³ (63 cu ft)

AREAS:

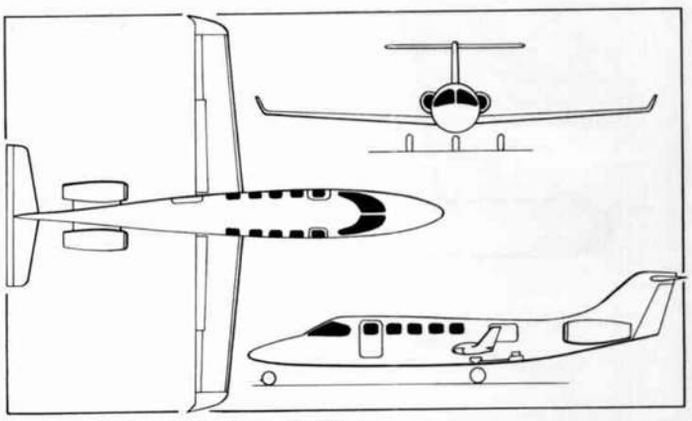
Wings, gross	15.79 m² (170.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	1,642 kg (3,620 lb)
Max payload	907 kg (2,000 lb)
Max fuel weight	1,257 kg (2,771 lb)
Max T-O weight	3,311 kg (7,300 lb)
Max wing loading	209.7 kg/m² (42.94 lb/sq ft)
Max power loading	237 kg/kN (2.33 lb/lb st)

PERFORMANCE (estimated):

Max level speed:	415 kt (768 km/h; 478 mph)
Normal cruising speed	415 kt (768 km/h; 478 mph)
Stalling speed: flaps up	92 kt (170 km/h; 106 mph)
flaps down	78 kt (145 km/h; 90 mph)
Max rate of climb at S/L	1,549 m (5,082 ft)/min
Rate of climb at S/L, OEI	455 m (1,492 ft)/min
Max certified altitude	13,715 m (45,000 ft)
Service ceiling, OEI	6,100 m (20,000 ft)
T-O balanced field length	914 m (3,000 ft)
Landing balanced field length	823 m (2,700 ft)
Range:	
with max payload	875 n miles (1,620 km; 1,006 miles)
with four passengers, NBAA reserves	1,600 n miles (2,962 km; 1,841 miles)
ferry, VFR	2,000 n miles (3,704 km; 2,301 miles)



Spectrum 33 business jet *(James Goulding)* 1151952

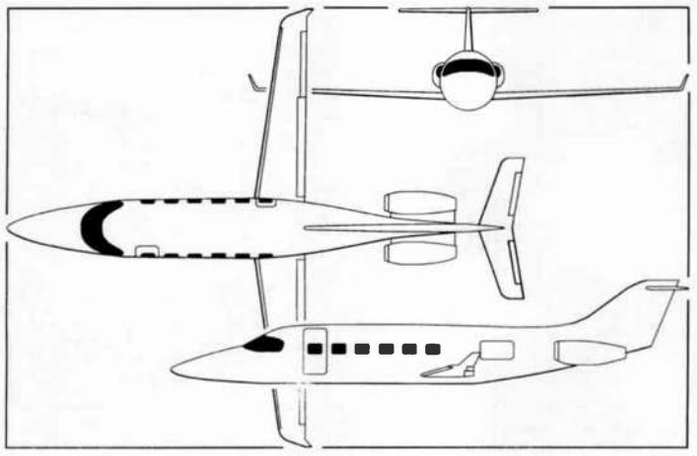
SPECTRUM SA-40 FREEDOM

TYPE: Business jet.

PROGRAMME: Announced 17 October 2006 at the NBAA Convention in Orlando. FAA certification and first customer deliveries scheduled for mid-2010.

COSTS: USD6.2 million (2006).

Spectrum S-33 prototype during its brief flying career 1159707



Spectrum SA-40 Freedom *(Paul Jackson)* 1159575

Artist's impression of the Spectrum SA-40 Freedom mid-size business jet 1159572

Description for Spectrum SA-33 Independence applies generally to the SA-40 Freedom except as follows.

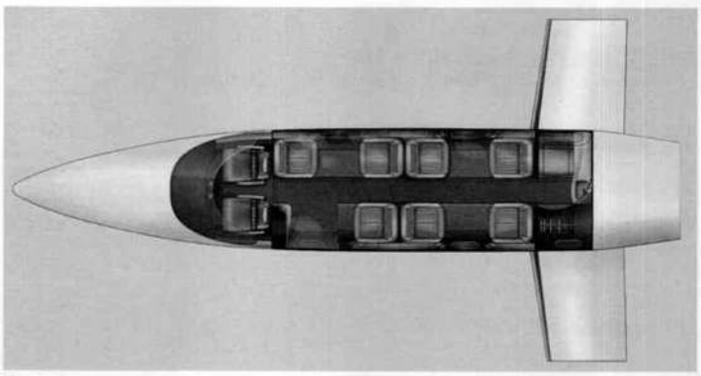
POWER PLANT: Two GE Honda HF120 turbofans, with FADEC, each rated at 9.12 kN (2,050 lb st).

ACCOMMODATION: Single pilot and up to nine passengers. Typical cabin layout for seven passengers features single forward-facing seat on port side immediately aft of entrance door, with club pair opposite, and club-four to rear, with full-enclosed aft lavatory. Alternative layouts include food/drinks cabinet and two-seat sideways-facing divan on starboard side opposite door, with 'club four' to rear. Six cabin windows per side.

AVIONICS: EFIS cockpit with sidestick controllers and keyboard avionics interface.

DIMENSIONS, EXTERNAL:

Wing span	13.90 m (45 ft 7¼ in)
Wing aspect ratio	11.1



Typical seven-seat cabin layout for Spectrum SA-40 Freedom 1159573

Length overall	16.40 m (53 ft 9½ in)
Height overall	3.96 m (13 ft 0 in)

DIMENSIONS, INTERNAL:

Cabin: Length:	
between pressure bulkheads	6.46 m (21 2½ ft in)
excl flight deck	4.88 m (16 ft 0 in)
Max width	1.83 m (6 ft 0 in)
Max height	1.83 m (6 ft 0 in)

WEIGHTS AND LOADINGS:

Weight empty	2,195 kg (4,840 lb)
Basic operating weight	2,286 kg (5,040 lb)
Payload with max fuel	503 kg (1,110 lb)
Fuel weight: max	1,633 kg (3,600 lb)
with max payload	1,048 kg (2,310 lb)
Max T-O weight	4,332 kg (9,550 lb)
Max landing weight	4,115 kg (9,072 lb)
Max zero-fuel weight	3,284 kg (7,240 lb)
Max power loading	238 kg/kN (2.33 lb/lb st)

PERFORMANCE (estimated):

Max cruising speed	M0.76 (435 kt; 806 km/h; 501 mph)
Stalling speed: flaps up	101 kt (187 km/h; 117 mph)
flaps down	85 kt (158 km/h; 98 mph)
Service ceiling	13,715 m (45,000 ft)
Service ceiling, OEI	more than 7,620 m (25,000 ft)
Max rate of climb at S/L	1,372 m (4,500 ft)/min
Max rate of climb at S/L, OEI	533 m (1,750 ft)/min
Time to FL450	20 min
T-O run	less than 914 m (3,000 ft)
Landing run	less than 823 m (2,700 ft)
Max range, IFR reserves	2,200 n miles (4,074 km; 2,531 miles)
Range with pilot and four passengers, IFR reserves	2,030 n miles (3,759 km; 2,336 miles)

SREYA

SREYA AVIATION

Santa Maria Airport, California
Tel: (+1 805) 349 74 55
Web: www.sreyaaviation.com
GENERAL MANAGER: Rienk Ayers
AERONAUTICAL ENGINEER: Andrew Kimble

Established in 1999, Sreya undertook custom-building of kit aircraft and operation of a fractional ownership Beechcraft King Air before embarking on its first newly designed aircraft programme, the Envoy. Completion of the prototype has been delayed by one year.

SREYA ENVOY

TYPE: Six-seat turboprop/kitbuilt.

PROGRAMME: Design began October 2004; partly complete prototype exhibited at AirVenture, Oshkosh, July 2005; first flight was then scheduled for October 2005, but postponed for redesign to incorporate feedback from potential customers, including revised empennage, trailing-link landing gear, Fowler flaps, increased door size, additional fuel and five-blade (replacing three-blade) Avia propeller. Changes required abandonment of original fuselage.

CURRENT VERSIONS: **Low wing:** Envisaged as principal variant for commercial and private owner/operators. Available in **LFT** (low-wing fixed tricycle landing gear) and **LRP** (low-wing, retractable gear, pressurised fuselage) versions.

High wing: Expected to be acquired by missionary organisations, to which Sreya will donate aircraft. High commonality with low-wing version, except upper, centre fuselage.

Sreya Envoy as exhibited at Sun 'n' Fun in April 2006 1037975

COSTS: LFT kit USD449,000, including reconditioned engine and propeller, plus interior and avionics (2005). Includes customer assistance under '51 per cent rule'. Extra USD50,000 for retractable gear and pressurisation.

DESIGN FEATURES: See current versions.

FLYING CONTROLS: Conventional and manual. Fowler flaps.

STRUCTURE: Composites. Carbon fibre structure, control surfaces and cabin; glass fibre wing and fuselage skins. Two-spar wing.

LANDING GEAR: Tricycle type; fixed. Trailing link suspension. Mainwheels 19.5×6.75-8; nosewheel; 6.00-6. Optional retraction.

POWER PLANT: One 490 kW (657 hp) Walter M601D turboprop driving an Avia five-blade, constant-speed propeller. Fuel capacity 1,136 litres (300 US gallons; 250 Imp gallons).

ACCOMMODATION: Two front seats for pilot(s), plus 'club four' cabin. Door port, above wing leading-edge. Baggage compartment behind cabin with external door, port. Accommodation heated and ventilated.

SYSTEMS: TruTrak autopilot. Oxygen system.

AVIONICS: *Instrumentation:* Dynon EFIS with OP Technologies three-screen integrated system.

DIMENSIONS, EXTERNAL:

Wing span	11.96 m (39 ft 3 in)
Wing aspect ratio	7.6
Length overall	10.21 m (33 ft 6 in)
Cabin door: Height	1.07 m (3 ft 6¼ in)
Width	0.68 m (2 ft 2¾ in)

DIMENSIONS, INTERNAL:

Cabin: Max width	1.32 m (4 ft 4 in)
Max height	1.24 m (4 ft 1 in)

AREAS:

Wings, gross	18.95 m^2 (204.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	1,361 kg (3,000 lb)
Baggage capacity with reduced fuel	136 kg (300 lb)
Max T-O weight	2,721 kg (6,000 lb)
Max wing loading	143.6 kg/m^2 (29.41 lb/sq ft)
Max power loading	5.56 kg/kW (9.13 lb/shp)

PERFORMANCE (estimated):

Cruising speed	217 kt (402 km/h; 250 mph)
Stalling speed, flaps down	60 kt (111 km/h; 69 mph)
Max rate of climb at S/L	610 m (2,000 ft)/min
T-O run	244 m (800 ft)
Landing run	305 m (1,000 ft)
Range with IFR reserves	1,216 n miles (2,253 km; 1,400 miles)
g limits	+4.4/–2.2

STEEN

STEEN AERO LAB LLC

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Tel: (+1 321) 725 41 60
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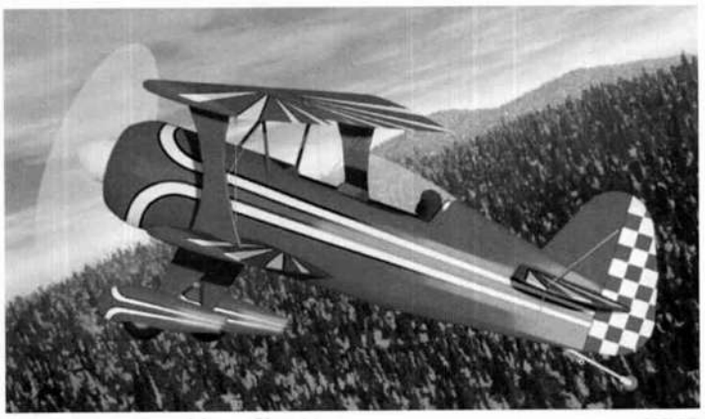
e-mail: info@steenaero.com
Web: www.steenaero.com
PRESIDENT: David Stone

Steen is a long-established company (formed in the 1970s) which provides plans, materials and components to aircraft builders; products include plans and components for the Steen Skybolt, Pitts S1 and Payne Knight Twister. Its latest product is a new design from the late Curtis Pitts. The company operates from a 1,579 m² (17,000 sq ft) facility.

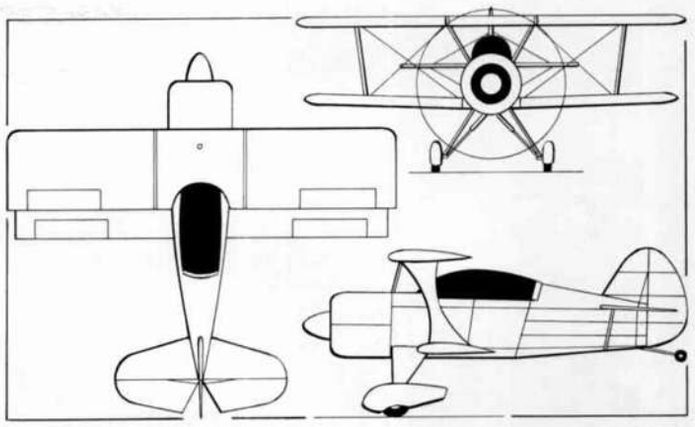
Steen Skybolt plans-built sportplane ***(Paul Jackson)*** 1044937

STEEN PITTS 14

TYPE: Tandem-seat biplane kitbuilt.
PROGRAMME: Frame of prototype revealed at AirVenture, Oshkosh, July 2003; first flight then due before July 2004, but was rescheduled for 2006; had not taken place by November 2006.
COSTS: Not priced as a complete kit, but all components available from Steen Aero Lab.



Artist's impression of Steen Pitts 14 0561653



Steen Pitts 14 aerobatic biplane ***(James Goulding)*** 0567292

DESIGN FEATURES: Continues Pitts' 60-year history of aerobatic biplane development. Differs from earlier designs in concentrating bracing wire loads in a single plane between the interplane struts. Designed for simplicity of structure, low weight, ease of construction and strength. Suitable as airshow aerobatic performer.

Choice of semi-symmetric NACA 23012 aerofoil or symmetric SS. Former on prototype. Straight or swept upper wing, to builder's choice; range of empennage shapes, including classic Samson style.

Single-bay biplane with broad-chord interplane strut each side and supporting cabane for upper wing. Wire-braced empennage.

LANDING GEAR: Tailwheel type; fixed. Two faired-in side Vs, each with half-axle and oleo shock-absorber joined at centreline. Wheel fairings.

POWER PLANT: One 294 kW (394 hp) VOKBM M-14PF nine-cylinder radial. Standard fuel capacity 132 litres (35.0 US gallons; 29.1 Imp gallons); optional 68-litre (18.0 US gallon; 15.0 Imp gallon) tank can be added.

ACCOMMODATION: Two in tandem beneath single-piece blown canopy.

EQUIPMENT: Optional 'smoke tank' in lower fuselage with external filler.

Provisional data follow:

DIMENSIONS, EXTERNAL:
- Wing span: upper ..... 6.55 m (21 ft 6 in)
- lower ..... 6.25 m (20 ft 6 in)
- Wing aspect ratio 5.7

AREAS:
- Wings, gross ..... 14.59 m² (157.0 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty ..... 680 kg (1,500 lb)
- Max baggage weight ..... 16 kg (35 lb)
- Airshow weight ..... 848 kg (1,871 lb)
- Max aerobatic weight ..... 907 kg (2,000 lb)
- Max T-O weight ..... 1,021 kg (2,250 lb)
- Wing loading: aerobatic ..... 62.2 kg/m² (12.74 lb/sq ft)
- max ..... 70.0 kg/m² (14.33 lb/sq ft)
- Power loading: aerobatic ..... 3.08 kg/kW (5.06 lb/hp)
- max ..... 3.47 kg/kW (5.70 lb/hp)

PERFORMANCE (estimated):
- Never-exceed speed (VNE) ..... 204 kt (378 km/h; 235 mph) TAS
- Max speed ..... 165 kt (306 km/h; 190 mph)
- Cruise speed at 75% power ..... 156 kt (290 km/h; 180 mph)
- Stalling speed ..... 54 kt (100 km/h; 62 mph)
- Max rate of climb ..... 1,067 m (3,500 ft)/min
- *g* limits: standard ..... +6/–4.5
- ultimate ..... +9/–6

TAYLORCRAFT

TAYLORCRAFT AVIATION INC

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Web: www.taylorcraft.com
PRESIDENT: Harry Ingram

Present Taylorcraft Aviation inherits traditions of Taylor-Young Airplane Company, formed 1935 on C G Taylor's departure from Piper. Taylor produced A, BC, BF, DC, 15, 16, 18, 19 and 20 until late 1950s; Taylorcraft Aviation Corporation established 1971 at Alliance, Ohio, to build F-19 and, from 1971, F21 until 1985, when transferred to Lock Haven, Pennsylvania, where 16 more built before bankruptcy. Taylorcraft Aircraft Company re-established in 1989 to manufacture F22, of which only 17 produced up to 1992 closure. Type Certificate passed through several hands, including Taylorcraft Aerospace and Taylorcraft 2000, none of which initiated production.

Taylorcraft Aviation established by Harry Ingram in 5,020 m² (54,000 sq ft) plant at La Grange, Texas, to deliver new F22s from 2004 onwards; total of 20 full-time staff by mid-2004. Obtained F22 Type Certificate 5 March 2003. Transferred operations to Brownsville on 1 June 2005, manufacturing being outsourced to Nova/Link Inc, with consequent delay to start of new production.

Planned to relaunch modernised (Continental O-200 engine) version of 1930s Taylor E2 Cub in 2006; cost USD69,995.

Original Taylor Cub, similar to planned production version of 2006 1159045

TAYLORCRAFT F22 and SPORT

TYPE: Two-seat lightplane.
PROGRAMME: Taylorcraft 19 awarded FAA certification 20 June 1951, followed by F19 on 3 July 1973, F21 on 2 July 1980, F21A (fuel tanks transferred to wings) 15 November 1982, F21B (793 kg; 1,750 lb MTOW) 6 September 1985 and F22 (prototype N180GT) on 1 August 1988. Production re-launch delayed from 2004 to 2005. Priority for production changed to Model 19, which returned to range in 2005 as basis of Sport, meeting US LSA requirements.
CURRENT VERSIONS: **F22 Classic:** Derived from F21B with addition of flaps, wider doors, up-hinged windows and adjustable individual seats. Lycoming O-235 engine. Tailwheel.

F22A Tracker: F22 with tricycle landing gear. Prototype N14KV; certified 20 February 1991.

F22B Ranger: F22 with Lycoming O-360 engine. Prototype N24UK; certified 14 July 1992.

F22C Trooper: F22A (tricycle gear) with O-360 engine. Prototype N223UK; certified 20 February 1992.

Sport: Taylorcraft 19 with certified Teledyne Continental O-200-A of 74.6 kW (100 hp), increased (F22) fuel capacity and hydraulic brakes. Prototype N170TX completed November 2005 and granted airworthiness certificate 9 January 2006.

CUSTOMERS: Previous series comprised four F22s; 11 F22As; one F22B; and one F22C up to 1992.

First Taylor Sport, N170TX *(R W Simpson)* 1159031

COSTS: F22 USD79,995; F22A USD84,995; F22B USD89,995; F22C USD94,995; Sport USD69,995 (all 2006).

DESIGN FEATURES: Progressive development of Taylorcraft 19 series, incorporating classic features of earlier designs. High, constant-chord wing with rounded tips and V-type braces with intermediate struts. Wire-braced empennage.

Wing section NACA 23012.

FLYING CONTROLS: Conventional and manual. Flaps, except Sport. Flight-adjustable tab in elevator. Control movements: ailerons ±23°; elevators +27/ −25°; rudder ±26°. Max flap deflection 30°.

STRUCTURE: Welded steel tube airframe with fabric covering.

LANDING GEAR: Nosewheel or tailwheel type; fixed. Split type with bent half-axles incorporating bungee shock absorbers. Mainwheels 6.00–6 (4 ply). Optional nosewheel 5.00–5. Cleveland mainwheel brakes.

POWER PLANT: F22 series has one 88.0 kW (118 hp) Textron Lycoming O-235-L2C flat-four or 134 kW (180 hp) O-360-A4M driving a Sensenich (72CK-0-50 or 76EM8S-0-60, respectively) two-blade, metal, fixed-pitch propeller. Fuel tank in each wing; total capacity 159 litres (42.0 US gallons; 35.0 Imp gallons), of which 151 litres (40.0 US gallons; 33.3 Imp gallons) are usable.

ACCOMMODATION: Two, side by side; door each side. Baggage area behind seats. Cabin heated and ventilated.

SYSTEMS: Electrical system includes 14 V 60 A alternator and 25 Ah battery.

AVIONICS: Provision for IFR avionics.

Data apply to all versions, except where otherwise stated.

DIMENSIONS, EXTERNAL:

Wing span	10.97 m (36 ft 0 in)
Length overall: except Sport	6.78 m (22 ft 2¾ in)
Sport	6.74 m (22 ft 1¼ in)
Height overall: F22, F22B	1.88 m (6 ft 2 in)
F22A, F22C	2.31 m (7 ft 7 in)
Sport	1.98 m (6 ft 6 in)
Propeller diameter: O-235	1.83 m (6 ft 0 in)
O-360	1.93 m (6 ft 4 in)

AREAS:

Wings, gross	17.07 m² (183.7 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: F22	494 kg (1,090 lb)
F22A	517 kg (1,140 lb)
F22B	538 kg (1,185 lb)
F22C	560 kg (1,235 lb)
Sport	404 kg (890 lb)
Baggage capacity	91 kg (200 lb)
Max T-O weight: except Sport	793 kg (1,750 lb)
Sport	598 kg (1,320 lb)
Max wing loading: except Sport	46.5 kg/m² (9.53 lb/sq ft)
Sport	35.1 kg/m² (7.19 lb/sq ft)
Max power loading: F22, F22A	9.03 kg/kW (14.83 lb/hp)
F22B, F22C	5.92 kg/kW (9.72 lb/hp)
Sport	8.03 kg/kW (13.20 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	128 kt (238 km/h; 148 mph)
Max level speed: F22, F22A	96 kt (177 km/h; 110 mph)
F22B, F22C	109 kt (201 km/h; 125 mph)
Sport	110 kt (204 km/h; 127 mph)
Cruising speed at 75% power:	
F22, F22A	87 kt (161 km/h; 100 mph)
F22B, F22C	104 kt (193 km/h; 120 mph)
Sport	100 kt (185 km/h; 115 mph)
Stalling speed, power off: flaps up, except Sport	42 kt (78 km/h; 48 mph)
Sport (no flaps)	38 kt (70 km/h; 43 mph)
flaps down	37 kt (68 km/h; 42 mph)
Max rate of climb at S/L: F22, F22A	229 m (750 ft)/min
F22B, F22C	457 m (1,500 ft)/min
Sport	236 m (775 ft)/min
Service ceiling	5,485 m (18,000 ft)
T-O run: F22, F22A	153 m (500 ft)
F22B, F22C	122 m (400 ft)
Sport	115 m (375 ft)
T-O to 15 m (50 ft): F22, F22A	243 m (795 ft)
F22B, F22C	199 m (650 ft)
Sport	214 m (700 ft)
Landing from 15 m (50 ft): except Sport	176 m (575 ft)
Sport	190 m (625 ft)
Landing run: except Sport	107 m (350 ft)
Sport	115 m (375 ft)
Range at 75% power, 30 min reserves:	
F22, F22A	530 n miles (981 km; 610 miles)
F22B, F22C	398 n miles (737 km; 458 miles)
Sport	564 n miles (1,046 km; 650 miles)

TBG

THUNDER BUILDERS' GROUP LLC

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Web: www.thundermustang.com
MANAGING MEMBER: John McCartney

Scale replica of the classic P-51 Mustang fighter was originally produced by Papa 51 company which ceased trading on 1 December 2000. Group of 25 kitbuilders (six of them with almost complete aircraft) then formed Thunder Builders' Group LLC and acquired company's intellectual rights and production moulds with a view to sustaining their own projects and resuming manufacture. This seemed to have been achieved on 13 September 2001, when GUT Works reached agreement with Group; however, the two partners parted on 25 July 2002 when TBG again put the assets up for sale. In mid-2006, a Canadian company was reported to be interested in purchasing the project.

Thunder Mustang completed in 2005 by Tom Gaston 1040482

There has been no production of kits since that time, although completions have continued. By November 2006, flying aircraft totalled 12.

TEAM ROCKET

TEAM ROCKET

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Web: www.teamrocketaircraft.com
PRESIDENT: Mark Frederick

Team Rocket was formed in 1998. Its F1 kitbuilt was developed by Team Rocket's subsidiary division, International High Performance Aircraft of Lobeček 732, CZ-728 01 Kralupy nad Vlatava, Czech Republic, and Venice, Florida (www.international-hpa.com).

A tapered-wing version, the F1EVO, was introduced in 2003. In June 2004, Team Rocket had a workforce of 35 in its 470 m² (5,060 sq ft) factory.

TEAM ROCKET F1

TYPE: Tandem-seat sportplane kitbuilt.

PROGRAMME: Developed from Van's RV-4 by way of Harmon Rocket. First flight (in USA) November 2000 (N121JC). Second flew in Australia, July 2001.

CURRENT VERSIONS: **Team Rocket F1:** Baseline version.

Description applies to this version, unless otherwise indicated.

Team Rocket F1 QB: Quick build version, introduced 2006. Build time reduced by up to 40 per cent.

Team Rocket F1EVO: Tapered-wing version announced as under development in 2003, first flown late 2003 (N84MF). As F1, except where otherwise indicated.

Team Rocket F2: Planned side-by-side two-seat version, announced at Oshkosh in July 2002 but discontinued; project has been moved to High Performance Aircraft of USA.

CUSTOMERS: Sales totalled 145 kits by October 2004, of which 130 had been delivered and 29 were flying in Australia, Canada and the USA. Some 46 flying by mid-2005, and 61 by November 2005, plus six F1EVOs.

COSTS: Kit, excluding engine, propeller and avionics, F1 USD39,750, F1EVO USD45,200 (2006).

DESIGN FEATURES: Intended to combine high performance and low price. Low-wing monoplane with closely cowled engine. Constant-chord wings, tapered tailplane and moderately sweptback fin.

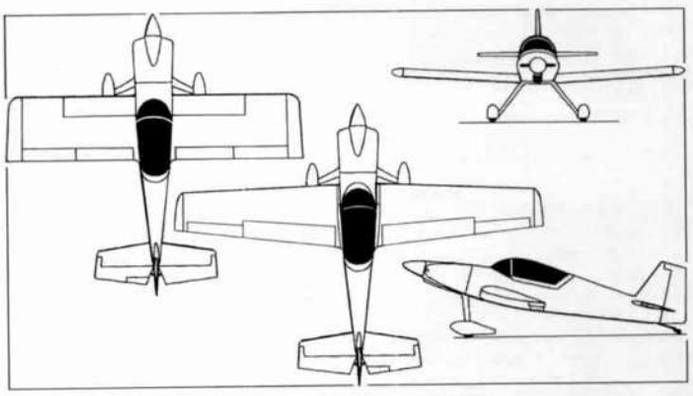
Meets '51 per cent' rule. Quoted build time 2,000 hours (1,200 for fast-build kit). Aerofoil on F1 is NACA 23013.5, that on F1EVO is MS(1)-313.

FLYING CONTROLS: Conventional and manual. Flaps. Horn-balanced rudder and elevators.

STRUCTURE: Principally of aluminium, primed with epoxy chromate for corrosion resistance. Titanium mainwheel legs; glass fibre engine cowling and wingtips.

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted, raked back spring titanium cantilever mainwheel legs with wheel fairings. Mainwheels 5.00–5.

Team Rocket F1 built by Vincent Frazier *(Paul Jackson)* 1040502



Team Rocket F1, with additional plan view (lower) of F1EVO 0567251

POWER PLANT: One flat-six piston engine rated between 175 and 224 kW (235 and 300 hp), driving a two- or three-blade propeller recommended for both versions; typically prototypes have Textron Lycoming IO-540 and three-blade, constant-speed MTV-9-B-C/C198-52 propeller. Fuel capacity 197 litres (52.0 US gallons; 43.3 Imp gallons).

ACCOMMODATION: Two persons in tandem, beneath rearwards-sliding canopy. Fixed windscreen.

DIMENSIONS, EXTERNAL:

Wing span: F1	6.56 m (22 ft 6 in)
F1EVO	7.57 m (24 ft 10 in)[1]
Wing aspect ratio: F1	4.8
F1EVO	6.0
Length overall	6.40 m (21 ft 0 in)

DIMENSIONS, INTERNAL:

Cockpit max width	0.64 m (2 ft 1 in)

AREAS:

Wings, gross: F1	9.85 m² (106.0 sq ft)
F1EVO	9.48 m² (102.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: F1	544 kg (1,200 lb)
F1EVO	568 kg (1,252 lb)
Max T-O weight: F1	907 kg (2,000 lb)
F1EVO	952 kg (2,100 lb)
Max wing loading: F1	92.1 kg/m² (18.87 lb/sq ft)
F1EVO	102.5 kg/m² (21.00 lb/sq ft)
Max power loading: F1	4.06 kg/kW (6.67 lb/hp)
F1EVO	4.26 kg/kW (7.00 lb/hp)

PERFORMANCE (224 kW; 300 hp engine):

Max level speed: F1	220 kt (407 km/h; 253 mph)
F1EVO	230 kt (426 km/h; 265 mph)
Cruising speed at 75% power:	
F1	200 kt (370 km/h; 230 mph)
F1EVO	209 kt (386 km/h; 240 mph)
Stalling speed: F1	47 kt (87 km/h; 54 mph)
F1EVO	44 kt (81 km/h; 50 mph)
Max rate of climb at S/L	1,067 m (3,500 ft)/min
T-O run	92 m (300 ft)
Landing run	214 m (700 ft)
Range at 55% power	1,000 n miles (1,850 km; 1,150 miles)

[1] *Company's scale drawings indicate span of some 8.2 m (27 ft)*

TEAM TANGO

TEAM TANGO INC

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Web: www.teamtango.com
PRESIDENT AND CEO: Tom Miller

The former DFL was purchased by a consortium of constructors of its projects in June 2002 and now a subsidiary of Revolution Aviation. A new 557 m² (6,000 sq ft) Builder's Center has been opened at Williston Municipal Airport, where the company continues to develop and market the Tango and Foxtrot.

TEAM TANGO FOXTROT

TYPE: Four-seat kitbuilt.

PROGRAMME: Development began in 1999; first engine runs of prototype (N747F) completed 27 August 2001; first flight was due before end of 2001 and achieved 23 December 2002. Two further aircraft had flown by mid-2003. By June 2003, prototype had completed 35 hours of flying. An MTOW upgrade to 1,361 kg (3,000 lb) is planned.

Team Tango Foxtrot *(Paul Jackson)* 1040503

COSTS: Basic kit USD35,995 (2006).

CUSTOMERS: Two flying and two more partially completed by November 2006.

DESIGN FEATURES: Conventional design similar in appearance to Tango. Vinylester resin used in place of epoxy to reduce cure time of composites.

FLYING CONTROLS: Conventional and manual. Flaps (electric actuation) optional.

STRUCTURE: Extensive use of composites throughout.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring cantilever mainwheel legs with wheel fairings. Steerable nosewheel with wheel fairings.

POWER PLANT: Prototype fitted with 224 kW (300 hp) Textron Lycoming IO-540; engines in the range 149 to 224 kW (200 to 300 hp) are recommended. Standard fuel capacity 379 litres (100 US gallons; 83.3 Imp gallons).

ACCOMMODATION: Pilot and three passengers in two pairs of seats. Upward-opening, centreline-hinged door each side; fixed windscreen. Baggage stowage behind seats.

DIMENSIONS, EXTERNAL:

Wing span	9.75 m (32 ft 0 in)
Wing aspect ratio	8
Length overall	7.56 m (24 ft 9½ in)
Height overall	2.21 m (7 ft 3 in)

DIMENSIONS, INTERNAL:

Cabin: Max width	1.17 m (3 ft 10 in)
Max height	1.09 m (3 ft 7 in)
Baggage volume	0.40 m³ (14.0 cu ft)

AREAS:

Wings, gross	11.89 m² (128.0 sq ft)

WEIGHTS AND LOADINGS (224 kW; 300 hp engine):

Weight empty	774 kg (1,706 lb)
Max baggage weight	68 kg (150 lb)
Max payload	250 kg (552 lb)
Max T-O weight	1,270 kg (2,800 lb)
Max wing loading	106.8 kg/m² (21.88 lb/sq ft)
Max power loading	5.68 kg/kW (9.33 lb/hp)

PERFORMANCE (224 kW; 300 hp engine):

Never-exceed speed (VNE)	212 kt (394 km/h; 245 mph)
Max operating speed	200 kt (370 km/h; 230 mph)
Normal cruising speed	189 kt (351 km/h; 218 mph)
Stalling speed, flaps down	54 kt (100 km/h; 62 mph)

Max rate of climb at S/L ..... 914 m (3,000 ft)/min
Service ceiling ..... 7,315 m (24,000 ft)
T-O run ..... 107 m (350 ft)
Landing run ..... 244 m (800 ft)
Range with max fuel ..... 1,564 n miles (2,896 km; 1,800 miles)
g limits ..... +6/–4

TEAM TANGO TANGO 2

TYPE: Side-by-side kitbuilt.

PROGRAMME: Developed from the Aero Mirage TC-2 of 1983. Prototype flew November 1996. First two production aircraft displayed at Oshkosh in July 1999; third flew March 2000. Production delayed from mid-2001 to mid-2002 whilst buyer sought for company.

CUSTOMERS: By November 2006, at least 22 kits had been sold, at which time 10 aircraft were on the US register.

COSTS: Basic kit USD27,995. Firewall forward USD50,000 (2006).

DESIGN FEATURES: Conventional design optimised for amateur assembly; low-mounted, constant-chord wings and mid-positioned tailplane. Steeply raked windscreen. Quoted build time 570 hours for quick-build kit version; company has building facility to enable purchasers to complete in 30 to 45 days. Roll rate 120°/s.

FLYING CONTROLS: Conventional and manual. Flaps deflect 10/20/35°.

STRUCTURE: Generally of composites. Two-spar wing has modified NACA64415 aerofoil and 3° dihedral.

POWER PLANT: One 134 kW (180 hp) Textron Lycoming O-360 flat-four driving a two-blade Hartzell HCC2YR-7666A constant-speed propeller. Fuel capacity 216 litres (57 US gallons; 47.5 Imp gallons) in two wing tanks; two optional extra 62 litre (16.5 US gallon; 13.7 Imp gallon) tanks can be fitted. Optionally, 149 kW (200 hp) IO-360.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring glass fibre cantilever mainwheel legs; cantilever 4130 steel tube nosewheel leg with trouser; speed fairings on all wheels. Main units have Cleveland wheels and brakes with Goodyear 5.00–5 tyres; nosewheel is steerable and has 4.50–5 Lamb tyre.

ACCOMMODATION: Two, side by side. Upward-opening, centreline hinged door each side; fixed windscreen. Baggage stowage behind seats.

AVIONICS: To customer's specification. Standard VFR option includes Honeywell KLX 135 GPS/com, KT 76A transponder and Sigtronics intercom; IFR version adds KX 155 nav/com and KI 209 VOR/LOC.

DIMENSIONS, EXTERNAL:
Wing span ..... 7.62 m (25 ft 0 in)
Wing aspect ratio 8.3
Length overall ..... 6.31 m (20 ft 8½ in)
Height overall ..... 2.06 m (6 ft 9 in)
Wheel track ..... 2.54 m (8 ft 4 in)
Propeller diameter ..... 1.93 m (6 ft 4 in)

AREAS:
Wings, gross ..... 6.97 m² (75.0 sq ft)

DIMENSIONS, INTERNAL:
Cockpit: Max width ..... 1.12 m (3 ft 8 in)
Max height ..... 0.94 m (3 ft 1 in)
Baggage compartment volume ..... 0.34 m³ (12.0 cu ft)

WEIGHTS AND LOADINGS:
Weight empty ..... 488 kg (1,075 lb)
Max baggage weight ..... 45 kg (100 lb)
Max T-O weight ..... 839 kg (1,850 lb)
Max wing loading ..... 120.4 kg/m² (24.67 lb/sq ft)
Max power loading ..... 6.26 kg/kW (10.28 lb/hp)

PERFORMANCE:
Never-exceed speed (VNE) ..... 212 kt (394 km/h; 245 mph)
Max level speed ..... 191 kt (354 km/h; 220 mph)
Max cruising speed ..... 174 kt (322 km/h; 200 mph)
Stalling speed ..... 53 kt (97 km/h; 60 mph) IAS
Max rate of climb at S/L ..... 549 m (1,800 ft)/min
Service ceiling ..... 7,315 m (24,000 ft)
T-O run ..... 107 m (350 ft)
Landing run ..... 244 m (800 ft)
Max range ..... 869 n miles (1,609 km; 1,000 miles)
g limits ..... +6/–4

Team Tango Tango 2 ***(Paul Jackson)*** 1040506

TERRAFUGIA

TERRAFUGIA

Cambridge, Massachusetts
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Web: www.Terrafugia.com

Terrafugia (Latin for 'escape from the Earth') is a group of graduates of the Department of Aeronautics at the Massachusetts Institute of Technology formed in 2006 to develop a roadable aircraft.

TERRAFUGIA TRANSITION

TYPE: Technology demonstrator.

PROGRAMME: Announced 2006. First flight planned for 2008 and initial deliveries in 2009.

COSTS: USD148,000 (estimated for 2009).

DESIGN FEATURES: 'Flying car'. Conforms aeronautically to LSA weight limits. Intended to overcome the technical compromises which have prevented previous vehicles of this type from entering quantity production. Folding wing, foreplane and twin fin design obviates requirement to detach wings and empennage before road travel.

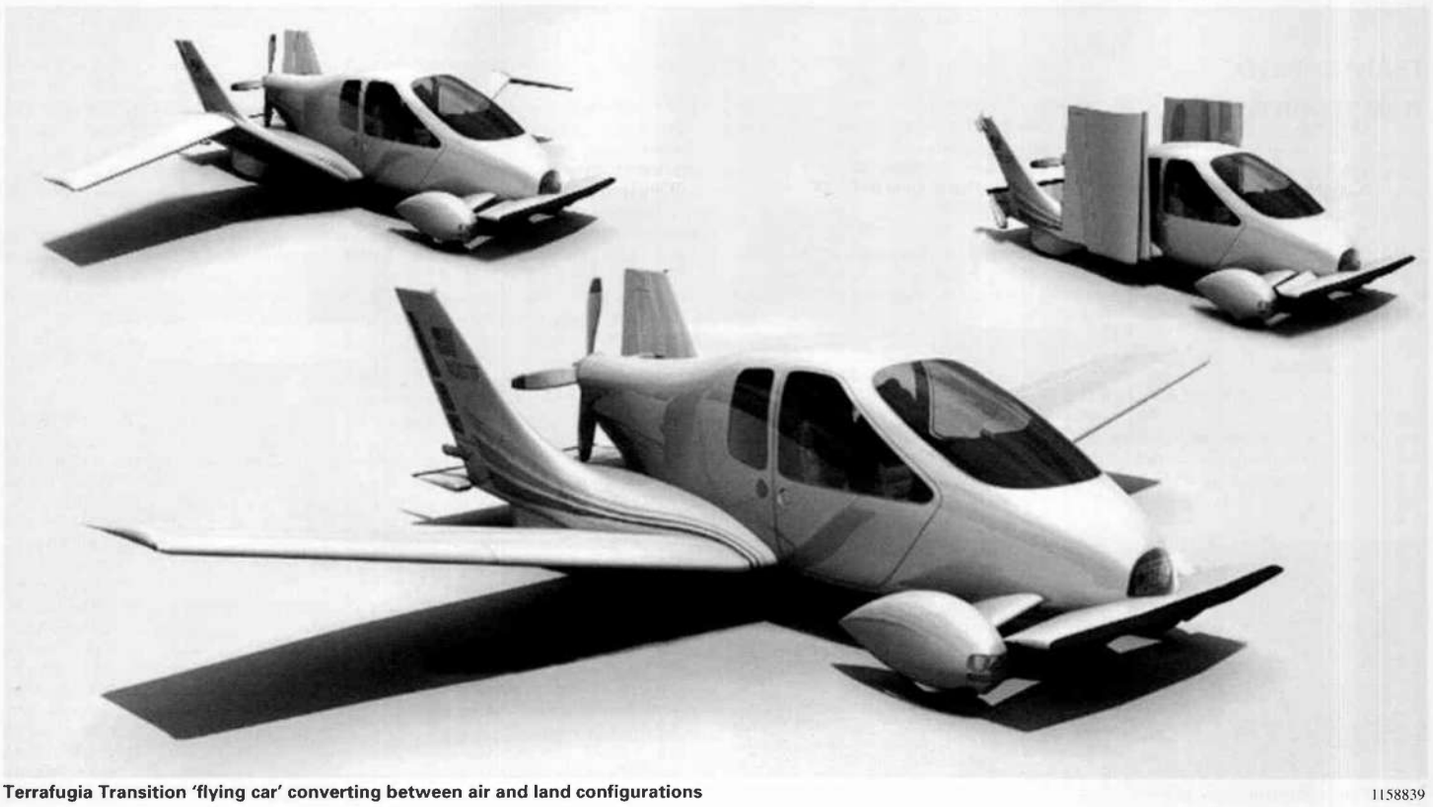
Low-mounted wings fold upwards at root and downwards at mid-span to lie vertically against the passenger pod sides when not required. Pusher propeller between twin fins which mounted in narrow V configuration. Short, fixed foreplane serves as mounting for front roadwheels.

Fuel consumption in flight and in city traffic estimated identical at 13.7 km/litre (30 miles/US gallon; 36 miles/Imp gallon); 33 per cent more for motorway driving.

FLYING CONTROLS: Manual. Pitch control by foreplane

LANDING GEAR: Four-wheel gear in rectangular layout; fixed. Wheel fairings.

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912 ULS flat-four driving a four-blade pusher propeller and, when required, road wheels. Fuel capacity 76 litres (20.0 US gallons; 16.7 Imp gallons).



Terrafugia Transition 'flying car' converting between air and land configurations 1158839

DIMENSIONS, EXTERNAL:
- Wing span ..... 8.25 m (27 ft 1 in)
- Length overall ..... 5.71 m (18 ft 9 in)
- Width folded ..... 2.03 m (6 ft 8 in)
- Height overall ..... 2.03 m (6 ft 8 in)

WEIGHTS AND LOADINGS:
- Max payload ..... 195 kg (430 lb)
- Max T-O weight ..... 598 kg (1,320 lb)

PERFORMANCE (airborne, estimated):
- Cruising speed at 75% power ..... 104 kt (193 km/h; 120 mph)
- Stalling speed ..... 45 kt (84 km/h; 52 mph)
- T-O run ..... 458 m (1,500 ft)

THRUSH

THRUSH AIRCRAFT INC

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PRESIDENT: Larry Bays
EXECUTIVE VICE-PRESIDENT: Joni Kehoe
VICE-PRESIDENT, MANUFACTURING: Gene Vaughn
PRODUCTION MANAGER: Ken Gum
DIRECTOR OF INTERNATIONAL SALES AND SERVICE: Fred Ayres

Former Ayres Corporation bought Albany factory and manufacturing and world marketing rights to Thrush Commander-600 and-800 from Rockwell International General Aviation Division in November 1977. Acquired 93 per cent shareholding in Let Kunovice of Czech Republic in 1998, but stopped providing finance in July 2000 after Czech bank cancelled a debt repayment freeze; Let declared bankrupt in October 2000.

Ayres filed for Chapter 11 bankruptcy protection in late November 2000 and was seeking further investment of US$80 million; work restarted on the Loadmaster programme after a financing agreement with GATX, as debtor-in-possession, was concluded. However, GATX foreclosed on the company on 7 August 2001, securing all assets in return for a debt reduction of US$10.3 million.

Quality Aerospace established, also on 7 August 2001, to take over almost all of Ayres's assets at 21,100 m² (227,000 sq ft) Albany plant and continues to produce aerostructures, support existing Thrush fleet and promote Turbo-Thrush. Thrush Aircraft Inc purchased Ayres assets on 30 June 2003, and began the process of restarting the production line, with intention to manufacture two new aircraft by November 2003. Employment stood at about 300 in 2004.

THRUSH TURBO-THRUSH S2R

TYPE: Agricultural sprayer.

PROGRAMME: Leland Snow designed S-1 prototype, first flown with radial engine on 17 August 1953; entered production as S-2; Type Certificate for original S2D issued 1 November 1965; SR2 followed 21 March 1968; over 1,800 built by Snow and (following 18 February 1970 transfer of Type Certificate) Rockwell. Type Certificate obtained by Ayres on 28 November 1977; Ayres introduced turboprop version, having previously specialised in turbine conversions. PT6-engined S2R-T34 certified 28 April 1977; Garrett TPE331 versions certified from 5 March 1992 (S2R-G6) onwards. Quality Aerospace obtained Type Certificate on 26 November 2001 and this transferred to Thrush Aircraft on 2 September 2003. New company standardised version designations, adopting marketing names of Model 400, 510 and 660.

CURRENT VERSIONS: **Thrush 400:** Light airframe version with 1,514 litre (400 US gallon; 333 Imp gallon) hopper. Undergoing redesign in 2006, prior to relaunch of marketing.

S2RHG Thrush 510: Baseline version with 1,931 litre (510 US gallon; 425 Imp gallon) hopper and option of PT6A (designation S2RHG-T34) or TPE331 turboprop. *As described.*

Thrush 660: Described separately.

S2R-T34: 559 kW (750 shp) P&WC PT6A-34AG turboprop; standard or optional hoppers. High Gross (4,763 kg; 10,500 lb) MTOW version certified 5 November 1997.

S2RHG-T65: Certified 8 June 1988 with PT6A-65AG engine.

CUSTOMERS: Over 2,500 of all versions delivered to 80 countries.

Production by new Thrush company began with 273rd S2R-T34 (temporarily N550AG) registered December 2003. This delivered to Christopher Carranza in Arizona, early 2005; further two to Tommy's Flying Service and Riddell Flying Service by August 2005; seven S2R-T34s built by Thrush up to early 2006. Thrush 510 continues to be registered as S2RHG-T34, of which four produced in 2004 for Thrush; Hamlin Flying Services; Valley Air Applicators; and Allen Chormant & Son; none further in following two years. Also in current production is S2RHG-T65, of which 10 built by Thrush up to mid-2006.

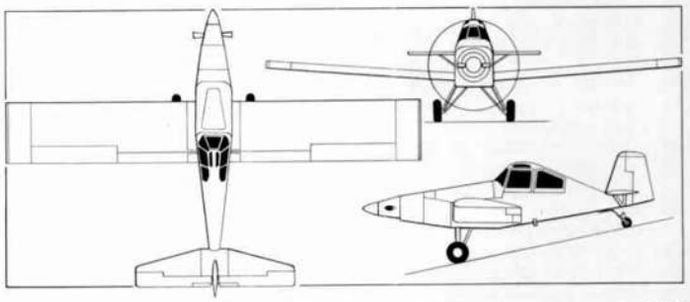
COSTS: About US$600,000, depending on engine and customer fit.

DESIGN FEATURES: Conventional crop-sprayer configuration, with hopper ahead of cockpit; cantilever low wing of constant chord; braced empennage with sweptback leading-edges; robust landing gear.

Advantages over piston-engined versions include much improved take-off and climb, 454 kg (1,000 lb) higher payload because of lower engine weight, operation on aviation turbine fuel or diesel, 3,500 hour TBO, quieter operation and ability to feather propeller without stopping engine while refuelling and reloading.

FLYING CONTROLS: Conventional and manual. Plain ailerons; servo tab in each elevator; electrically actuated flaps.

Ayres-built TPE331-engined Thrush S2R-G10 0559124



Turbo-Thrush S2R-T34 ***(James Goulding)*** 0569767

STRUCTURE: Two-spar light alloy wing with 4130 chrome molybdenum steel spar caps; welded chrome molybdenum steel tube fuselage structure covered with quickly removable light alloy skin panels; underfuselage skin of stainless steel; all-metal tail surfaces and strut-braced tailplane; metal ailerons and flaps. Extended wing, originally optional, is now standard, replacing earlier 13.54 m (44 ft 5 in), 30.34 m² (326.6 sq ft) version.

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted spring steel cantilever mainwheel legs standard from 2004. Ayres-built aircraft have narrower track (2.51 m; 8 ft 3 in) gear comprising two side Vs hinged to lower longerons, plus half-axles sprung under centreline with rubber-in-compression shock-absorbers; 8.50–10 (10 ply) tyres. Hydraulically operated Cleveland dual calliper disc brakes. Parking brakes. Wire cutters on main gear. Steerable, spring steel locking tailwheel, size 5.00-5.

POWER PLANT: One turboprop rated at 559 kW (750 shp): P&WC PT6A-34G standard, Honeywell TPE331-6 optional. Hartzell three-blade, constant-speed, feathering and reversing propeller; usable fuel capacity 515 litres (136 US gallons; 113 Imp gallons) in 400 gallon hopper version and 863 litres (228 US gallons; 190 Imp gallons) in 510 gallon hopper version.

ACCOMMODATION: Single adjustable mesh seat in 'safety pod' sealed cockpit enclosure, with steel tube overturn structure; aft fuselage pressurised to prevent chemical ingress. Tandem seating optional, with forward-facing second seat. Dual controls optional with forward-facing rear seat, for pilot training; these versions have 'DC' suffix to c/n; available since 1985. Adjustable rudder pedals. Downward-hinged door on each side. Tempered safety glass windscreen. Cockpit wire cutter. Dual inertia reel safety harness with optional second seat. Baggage compartment standard on single-seat aircraft.

SYSTEMS: Electrical system powered by a 24 V 50 A alternator. Dual lightweight 24 V 35 Ah batteries.

AVIONICS: To customer's requirements.

EQUIPMENT: GFRP 'clear view' hopper forward of cockpit can hold 2,082 litres (550 US gallons; 458 Imp gallons) of liquid, equivalent to 1.87 m³ (66.0 cu ft). Standard equipment includes Universal spray system with external 50 mm (2 in) stainless steel plumbing, 50 mm pump with wooden fan, Transland gate, 50 mm valve, quick-disconnect pump mount and strainer. Streamlined spraybooms with outlets for 68 nozzles. Micro-adjust valve control (spray) and calibrator (dry). A 51 mm (2 in) side-loading system is installed on the port side. Smoke drift detection system standard. Stainless steel rudder cables. Navigation lights, instrument lights and two strobe lights. Windscreen washer/wiper.

Optional items are a Transland high-volume spreader; agitator installation; 10-unit AU5000 Micronair installation in lieu of standard booms and nozzles; Transland gatebox with stiffener casting; quick-disconnect flange and kit; night working lights including landing light and wingtip turn lights; cockpit fire extinguisher; and water-bomber configuration.

DIMENSIONS, EXTERNAL:
- Wing span ..... 14.48 m (47 ft 6 in)
- Wing chord, constant ..... 2.29 m (7 ft 6in)
- Wing aspect ratio 6.4
- Length overall ..... 10.06 m (33 ft 0 in)
- Height overall ..... 2.79 m (9 ft 2 in)
- Tailplane span ..... 5.18 m (17 ft 0 in)
- Wheel track ..... 2.74 m (9 ft 0 in)
- Wheelbase ..... 5.88 m (19 ft 3½ in)

AREAS:
- Wings, gross ..... 32.52 m² (350.0 sq ft)

WEIGHTS AND LOADINGS (Thrush 510):
- Weight empty ..... 1,950 kg (4,300 lb)
- Typical operating weight (CAM 8) ..... 4,400 kg (9,700 lb)
- Max wing loading ..... 135.3 kg/m² (27.71 lb/sq ft)
- Max power loading ..... 7.87 kg/kW (12.93 lb/shp)

PERFORMANCE (Thrush 510):
- Never-exceed speed (VNE) ..... 138 kt (256 km/h; 159 mph)
- Max level speed with spray equipment ..... 138 kt (256 km/h; 159 mph)
- Cruising speed at 55% power ..... 130 kt (241 km/h; 150 mph)
- Working speed at 30–50% power ..... 78–130 kt (145–241 km/h; 90–150 mph)
- Stalling speed: flaps up ..... 61 kt (113 km/h; 70 mph)
  - flaps down ..... 57 kt (106 km/h; 66 mph)
- Stalling speed at normal landing weight:
  - flaps up ..... 51 kt (95 km/h; 59 mph)
  - flaps down ..... 50 kt (92 km/h; 57 mph)
- Max rate of climb at S/L ..... 267 m (875 ft)/min
- T-O run ..... 366 m (1,200 ft)
- Landing run ..... 183 m (600 ft)
- Landing run with propeller reversal ..... 122 m (400 ft)
- Ferry range at 45% power ..... 669 n miles (1,239 km; 770 miles)

THRUSH 660 TURBO-THRUSH

TYPE: Agricultural sprayer.

PROGRAMME: Prototype produced in 1997 to verify new hopper and landing gear designs, but was otherwise as S2R. Certification achieved 13 March 2000 with first delivery same day. Is also marketed as Thrush 710 to reflect gross capacity of spray system.

CUSTOMERS: Eight delivered by October 2000; ninth was first of type registered to Thrush company (c/n T660-109, N204PE), December 2003. This delivered to Farmers Aerial Seeders of Arkansas; further 14 registered by July 2006. Total 23, including 15 by Thrush.

DESIGN FEATURES: Based on S2R (which see) but with enlarged hopper, made possible by change to cantilever main landing gear. Enlarged wing centre-section extends span. Wing section NACA 4412 modified; incidence root 3.5°, tip 1.72°, twist 1.784°. Tailplane section NACA 0008 modified. Rear fuselage is pressurised.

Data as for Turbo-Thrush S2R, except as below.

FLYING CONTROLS: Aileron droop system, plus enlarged flaps. Control surface deflections: ailerons +21°, −17°; elevators +27°,−17°; rudder 19° or 20° on dual cockpit versions. flaps −15°.

LANDING GEAR: Tailwheel type; fixed. Fuselage mounted spring steel cantilever mainwheel legs with heavy-duty 29 in tyres (31 in tyres optional) and Cleveland dual calliper hydraulic disc brakes. Wire cutters on main undercarriage legs. Tailwheel 6.00x6.

POWER PLANT: One 969 kW (1,300 shp) Pratt & Whitney Canada PT6A-67AG turboprop driving a Hartzell HC-B5MA-3D/M11276NS five-blade, constant-speed, feathering and reversing propeller. Optionally, one 783 kW (1,050 shp) P&WC PT6A-60AG or -65AG turboprop with Hartzell HC-B5MP-3C/M10876 (60AG) or HC-B5MP-3F/M11276NS (65AG) propeller. Dual cockpit aircraft have -65AG engines rated at 969 kW (1,300 shp) and B5MP-3F propellers. Fuel capacity 871 litres (230 US gallons; 191.5 Imp gallons), of which 854 litres (225.6 US gallons; 187.8 Imp gallons) are usable.

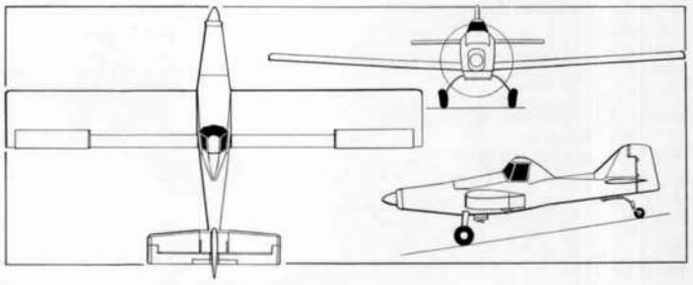
ACCOMMODATION: Generally as for S2C, including dual cockpit option. Optional air conditioning.

EQUIPMENT: GFRP hopper can hold 2,500 litres (660 US gallons; 550 Imp gallons) of liquid. Total capacity, including spray system, is 2,687 litres (710 US gallons; 591 Imp gallons); total capacity with fire-bomber equipment 2,971 litres (785 US gallons; 654 Imp gallons). Side loader size 76 mm (3 in) on port side. Standard equipment includes Universal spray system with external 76 mm (3 in) stainless steel plumbing, five-blade Weath-Aerofan, 76 mm Transland pump, 68-nozzle sprayboom extending over 70 per cent of span and smoke drift detection system. Optional equipment as per Turbo-Thrush S2R.

DIMENSIONS, EXTERNAL (PT6A engine):

Wing span	16.46 m (54 ft 0 in)
Wing aspect ratio	7.2
Wing chord, constant	2.29 m (7 ft 6 in)

Thrush 660 Turbo-Thrush of Moroccan Gendarmerie 1158637



Thrush 660 Turbo-Thrush *(James Goulding)* 0569764

Length overall	10.89 m (35 ft 8¾ in)
Height overall	3.08 m (10 ft 1¼ in)
Tailplane: span	5.18 m (17 ft 0 in)
chord: at root	1.36 m (4 ft 5½ in)
at tip	1.13 m (3 ft 8½ in)
Wheel track	2.90 m (9 ft 6 in)
Wheelbase	2.76 m (9 ft 0¾ in)
Propeller diameter: HC-B5MA-3D	2.92 m (9 ft 7 in)
HC-B5MP-3C	2.82 m (9 ft 3 in)

DIMENSIONS, INTERNAL:

Hopper volume	2.5 m^3 (88 cu ft)

AREAS:

Wings, gross	37.63 m^2 (405.0 sq ft)
Flaps, total	4.26 m^2 (45.87 sq ft)
Ailerons, total	4.34 m^2 (46.71 sq ft)
Tailplane	6.58 m^2 (70.78 sq ft)
Elevators, total	2.29 m^2 (24.61 sq ft)
Fin	3.15 m^2 (34.0 sq ft)
Rudder	1.39 m^2 (15.0 sq ft)

WEIGHTS AND LOADINGS (PT6A-65AG):

Weight empty	2,880 kg (6,350 lb)
Max T-O weight: exemption	6,418 kg (14,150 lb)
normal	5,670 kg (12,500 lb)
Max landing weight	5,670 kg (12,500 lb)
Max wing loading: exemption	170.6 kg/m^2 (34.94 lb/sq ft)
normal	150.7 kg/m^2 (30.86 lb/sq ft)
Max power loading (PT6A-67AG): exemption	6.62 kg/kW (10.88 lb/shp)
normal	5.85 kg/kW (9.62 lb/shp)

PERFORMANCE (PT6A-65AG):

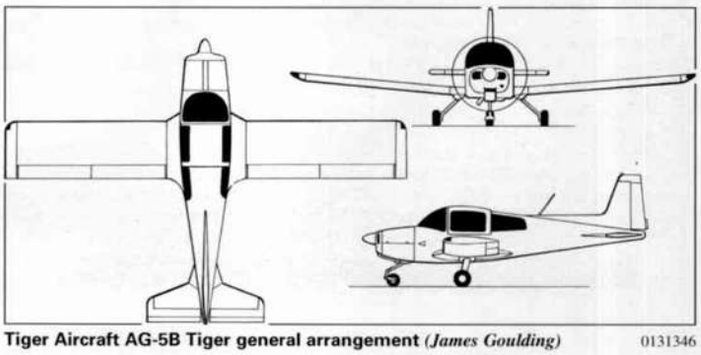
Never-exceed speed (VNE)	191 kt (354 km/h; 220 mph)
Cruising speed at 55% power	161 kt (298 km/h; 185 mph)
Working speed	86–152 kt (185–282 km/h; 100–175 mph)
Stalling speed, power off, flaps down	50 kt (92 km/h; 57 mph)
Max rate of climb at S/L:	
at 5,670 kg (12,500 lb)	312 m (1,025 ft)/min
at 6,418 kg (14,150 lb)	213 m (700 ft)/min
T-O run	335 m (1,100 ft)
Landing run	183 m (600 ft)
Ferry range at 50% power	521 n miles (966 km; 600 miles)

TIGER

TIGER AIRCRAFT LLC

226 Pilot Way, Martinsburg, West Virginia 25401

On 12 May 2000, Tiger Aircraft acquired the Type Certificate for the AG-5B Tiger, last employed by American General Aircraft Corporation. It also holds the AA-1 Type Certificate and intends to produce new designs. The company employed 63 at the end of 2001 with plans to increase workforce to 85 over following 12 months. In late 2002, it was owned jointly by Teleflex (30 per cent) and Taiwanese investors. Production certification for Tiger granted by FAA on 3 September 2002. Proposed sale of company to Florida-based Tiger Aircraft Corporation (TAC) did not materialise and was formally rejected by TAC in August 2006. Company directors approved motion to apply for bankruptcy on 31 July 2006; deliveries totalled three in first ten months of 2006 (compared with 15 in 2005) and Chapter 7 bankruptcy petition filed on 16 January 2007, citing debts in excess of USD929,000.



Tiger Aircraft AG-5B Tiger general arrangement *(James Goulding)* 0131346

TIGER AG-5B TIGER

TYPE: Four-seat lightplane.

PROGRAMME: Original two-seat BD-1 designed by Jim Bede; prototype first flown 11 July 1963; developed into AA-1 by American Aviation (later bought by Grumman and then by Gulfstream American), which built 461 AA-1s, 470 AA-1As, 680 AA-1Bs and 211 AA-1Cs. Four-seat AA-5 certified 12 November 1971 and 3,054 built before designs sold to American General Aircraft in 1989. Updated AG-5B Tiger first flown 21 April 1990; certified 21 September 1990; company sold to Teleflex in early 1992 but later filed for bankruptcy in January 1994 after building 89 examples.

Tiger Aircraft AG-5B Tiger *(Paul Jackson)* 1158588

First Tiger Aircraft AG-5B (N999TE) made maiden flight 9 July 2001. Symbolically delivered to new owner, Herb Hortman, 26 July 2001 at AirVenture 2001. Certification completed 3 December 2001, when first three aircraft handed over. In late 2002 Tiger Aircraft was negotiating with Chengdu Aircraft Industrial Corporation (CAC) of China with a view to licensed assembly of the AG-5B for Chinese commercial pilot training schools. Nothing further reported of this initiative, although Chinese type certification was obtained in July 2005.

CUSTOMERS: Production included 15 in 2005, and three in the first six months of 2006; total 51 had received airworthiness certificates by February 2006; none further in following six months.

COSTS: USD239,500 (2005).

DESIGN FEATURES: Conventional low-wing monoplane with constant-chord wings and tailplane and moderately sweptback fin with fillet. Extensive use of honeycomb and adhesive bonding throughout the structure.

FLYING CONTROLS: Conventional and manual with adjustable tab on each aileron and rudder. Electrically operated flaps, maximum deflection 45°.

STRUCTURE: Semi-monocoque fuselage of aluminium honeycomb. Cantilever low wing with tubular single spar, section NACA 64_2415 (modified), clad in aluminium skin. Dihedral 5°, incidence 1° 25'.

LANDING GEAR: Tricycle type; fixed. Mainwheels 6.00–6, tyre pressure 2.34 bar (34 lb/sq in); nosewheel 5.00–5, tyre pressure 1.72 bar (25 lb/sq in). Cleveland hydraulic brakes.

POWER PLANT: One 134 kW (180 hp) Textron Lycoming O-360-A4K flat-four, driving a two-blade fixed-pitch Sensenich 76EM8S-10-0 propeller. Fuel in two wing tanks, combined

capacity 199 litres (52.6 US gallons; 43.8 Imp gallons), of which 193 litres (51.0 US gallons; 42.5 Imp gallons) are usable. Oil capacity 7.6 litres (2.0 US gallons; 1.7 Imp gallons).

ACCOMMODATION: Pilot and three passengers in individual pairs of leather seats; baggage area behind rear seats. Fixed wraparound windscreen; entry to cockpit via sliding canopy. Amsafe Aviation inflatable restraints (AAIRS) standard on front seats and optional on rear seats from late 2005.

SYSTEMS: 24 V electrical system.

AVIONICS: Full Garmin IFR panel standard. G430 standard; G1000 certified 2005 as option.

Comms: Dual GNS 430 com/nav with VOR/LOC/GPS/GPS-LOC; GMA 340 audio panel with marker beacon and four-place intercom system; GTX 327 digital transponder, and ground clearance system

Flight: Dual Garmin 106A glideslope indicators; S-Tec 30 two-axis autopilot with altitude hold.

Instrumentation: Sigma/Tek electronic instrument cluster comprising vacuum, load amp, oil pressure, oil temperature, fuel pressure and CHT gauges; Davtron M800 chronometer and A301C digital OAT gauge, and Datcom Hobbs meter.

EQUIPMENT: Standard equipment includes leather interior; leather-wrapped control yokes, machined aluminium instrument panel with backlit instruments and panel/instrument light dimmers, cabin dome light, map light, and flush-mounted anti-collision beacons and landing lights.

DIMENSIONS, EXTERNAL:

Wing span	9.60 m (31 ft 6 in)
Wing chord, constant	1.35 m (4 ft 5¼ in)
Wing aspect ratio	7.1
Length overall	6.71 m (22 ft 0 in)
Height overall	2.44 m (8 ft 0 in)
Tailplane span	2.65 m (8 ft 8½ in)
Wheel track	2.51 m (8 ft 3 in)
Wheelbase	1.64 m (5 ft 4½ in)
Propeller diameter	1.93 m (6 ft 4 in)

DIMENSIONS, INTERNAL:

Cabin: Length	1.98 m (6 ft 6 in)
Max width	1.04 m (3 ft 5 in)
Max height	1.23 m (4 ft 0¼ in)
Floor area	2.18 m² (23.5 sq ft)
Baggage hold volume	0.34 m³ (12.0 cu ft)

AREAS:

Wings, gross	13.02 m² (140.1 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	680 kg (1,500 lb)
Baggage capacity: four-seat	54 kg (120 lb)
two-seat	154 kg (340 lb)
Max T-O weight	1,089 kg (2,400 lb)
Max wing loading	83.6 kg/m² (17.13 lb/sq ft)
Max power loading	8.12 kg/kW (13.33 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	173 kt (93 km/h; 200 mph)
Max operating speed (VMO)	148 kt (274 km/h; 170 mph)
Max cruising speed at 75% power at FL85	143 kt (265 km/h; 165 mph)
Stalling speed: flaps up	56 kt (104 km/h; 65 mph)
flaps down	53 kt (99 km/h; 61 mph)
Max rate of climb at S/L	259 m (850 ft)/min
Service ceiling	4,205 m (13,800 ft)
T-O run	260 m (854 ft)
T-O to 15 m (50 ft)	472 m (1,550 ft)
Landing from 15 m (50 ft)	341 m (1,120 ft)
Landing run	125 m (410 ft)
Range: no reserves	681 n miles (1,261 km; 783 miles)
with 45 min reserves	572 n miles (1,059 km; 658 miles)
Endurance, no reserves	4 h 42 min

TITAN

TITAN AIRCRAFT

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While continuing to produce five variants of the Tornado ultralight, Titan has expanded its range with a scaled-down representation of the Second World War North American P-51 Mustang.

TITAN T-51 MUSTANG

TYPE: Tandem-seat sportplane kitbuilt.

PROGRAMME: Construction started September 2001 and prototype (N151TD) flew 17 June 2002. By late 2003, a turbocharged version with a Rotax 914 was nearing completion.

COSTS: Standard kit USD49,900 Light Sport Aircraft version USD48,400, both less engine, propeller and instruments; estimated total cost to completion USD70,000 (2006).

Titan T-51 Mustang *(Paul Jackson)* 1040507

CUSTOMERS: More than 53 sold and four flying by mid-2006.

DESIGN FEATURES: Configuration approximates to 75% scaled-down NA P-51 of 1940s. Laminar flow wing is 72% scale. Quoted build time 600 hours.

FLYING CONTROLS: Conventional and manual. Horn-balanced elevators and rudder; flight-adjustable tab in starboard elevator; elevator airflow energised by vortex generators above and below tailplane. Fowler flaps; maximum deflection 30°.

STRUCTURE: Welded 4130 steel tube fuselage. Aluminium wing has foam-filled D section. Composites wing-, fin- and elevator tips.

LANDING GEAR: Tailwheel type; retractable; Light Sport Aircraft version has fixed landing gear. Mainwheels 120/90-10; tailwheel 2.8/2.5–4. Hydraulic retraction; hydraulic brakes.

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912S flat-four, driving a three-blade IVO, ground-adjustable pitch propeller; 84.6 kW (113.4 hp) Rotax 914 optional. Fuel capacity 91 litres (24.0 US gallons; 20.0 Imp gallons) of which 87 litres (23.0 US gallons; 19.2 Imp gallons) are usable.

ACCOMMODATION: Canopy slides rearward; baggage compartments fore and aft of cabin accessed by doors on port side of fuselage.

DIMENSIONS, EXTERNAL:

Wing span	7.32 m (24 ft 0 in)
Length overall	7.16 m (23 ft 6 in)
Height overall	2.79 m (9 ft 2 in)

DIMENSIONS, INTERNAL:

Cabin max width	0.61 m (2 ft 0 in)

AREAS:

Wings, gross	10.96 m² (118.0 sq ft)

WEIGHTS AND LOADINGS (Rotax 912S engine):

Weight empty	386 kg (850 lb)
Max T-O weight	657 kg (1,450 lb)
Max wing loading	60.0 kg/m² (12.29 lb/sq ft)
Max power loading	8.95 kg/kW (14.71 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	171 kt (317 km/h; 197 mph)
Max cruising speed	130 kt (241 km/h; 150 mph)
Stalling speed, flaps down	34 kt (63 km/h; 39 mph)
Max rate of climb at S/L	365 m (1,200 ft)/min
Service ceiling	4,875 m (16,000 ft)
T-O and landing run	92 m (300 ft)
Range	625 n miles (1,158 km; 720 miles)
g limits	+6/–4

TREK

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Company founded in 1996 to conduct research on powered-lift, ducted rotor aircraft. US Defense Advanced Research Projects Agency (DARPA) awarded a 36 month, USD4.7 million development contract in December 2000. NASA Ames assisting with development of stability augmentation system. Initial proof-of-concept vehicle, SoloTrek XFV (see *Jane's All the World's Aircraft* 2003-04), conducted first controlled, tethered flight on 18 December 2001. Proof-of-concept vehicle retired in March 2002 after 39 hours of tethered flight testing.

Pre-series vehicle (001) first tethered flight on 13 December 2002. This was seriously damaged four days later when the rotors ingested the overhead safety tether and the craft fell from a height of 1.3 m (4 ft). Additional design and safety enhancements were made throughout 2003. Activities temporarily suspended on 31 December 2002, but resumed with further funding in following year. Pre-series vehicle (002) was constructed in July/August 2003 and successfully completed the DARPA contract in February 2004.

Company's efforts in 2005 were directed principally towards development of Oviwun miniature UAV, incorporating Trek's core technology.

TREK SPRINGTAIL EFV-4

TYPE: Exoskelitor flying vehicle.

PROGRAMME: Follow-on aircraft to previously tested SoloTrek XFV. Designed in early 2003. First tethered flight (N401XV) 2 October 2003. First free (untethered) hover 20 October 2003. First transitional, forward flight 5 November 2003.

CURRENT VERSIONS: **EFV-4A:** Prototype N401XV; employed for pure research.

EFV-4B: Redesigned fans with variable pitch blades. Prototype, nicknamed 'Bluey' completed March 2005 and embarked on programme of 'non-pure research' and envelope expansion. Registrations N403FV, N404FV and N501FV reserved in 2004 for unspecified Trek Aerospace products, but allowed to lapse in following year.

COSTS: USD125,000 including operation and maintenance training (2006).

DESIGN FEATURES: Proprietary, core technology consists of twin, counter-rotating, variable-pitch ducted rotors which have the ability to generate 4.8 kg/kW (8 lb/hp) of thrust, which Trek states is superior to other designs. Use of the twin counter-rotating, variable-pitch ducted rotors also has the advantage of eliminating torque problems associated with some VTOL vehicles. EFV-4 uses an advanced fly-by-wire stability augmentation system (SAS) which allows it to be operated either manned, remotely piloted, or autonomously. SAS

TREK Springtail EFV-4A in forward flight, 16 March 2005 1129596

significantly reduces the pilot workload; reduces RPV operator-training time: and can be programmed to limit vehicle performance to operator's capabilities (low, medium or high performance).

Twin, counter-rotating, variable-pitch ducted rotors are tilted in conjunction with power variation to achieve vertical take-off, climb, forward flight and vertical landing. Maximum duct forward tilt angle 35°. Windmilling, variable-pitch rotors limit power-out descent rate to 5 m (17 ft)/s.

Airframe configuration supports pilot in standing position: engine behind pilot. Power transmitted by a short driveshaft with universal joints to self-lubricating main gearbox above and behind the pilot's head. Twin driveshafts to fans, each with satellite gearboxes. Small cooling fan for main gearbox. Projected time between overhauls 1,000 hours.

FLYING CONTROLS: No conventional aerodynamic surfaces. Ducted rotors tilted by electromechanical actuators; small vanes, electromechanically actuated, behind each fan for precise control at slow speed and hover. Three-axis trim.

STRUCTURE: Aluminium honeycomb airframe with carbon fibre, Kevlar, stainless steel and titanium components. Welded, aluminium tube landing skids. Composites ducts.

LANDING GEAR: Twin skids incorporate crush technologies that reduce damage in the event of a hard landing. Pneumatic forward mainwheels; solid, castoring rear wheels for ground handling and taxying.

POWER PLANT: One 88 kW (118 hp) Wankel-type rotary engine driving pair of three-blade, variable-pitch rotors. Fuel tank below engine; capacity 46 litres (12.3 US gallons; 10.2 Imp gallons). Other power plant options are possible.

ACCOMMODATION: One person in standing position, supported by safety harness. Two hand levers for engine and flight control; engine/vertical axis, left; longitudinal and lateral axes, plus trim, right. Small area between landing gear for a limited cargo.

SYSTEMS: Fully FBW stability control system. 24 V DC electrical system.

AVIONICS: *Instrumentation:* Production aircraft utilise a helmet-mounted display for all necessary flight data. A small touch-screen 'maintenance' panel to monitor system health.

EQUIPMENT: Ballistic recovery parachute as backup to power-out descent capability.

DIMENSIONS, EXTERNAL:

Height over rotor hub	2.53 m (8 ft 4 in)
Width over ducts	2.95 m (9 ft 8 in)
Width at landing gear	1.07 m (3 ft 6 in)
Length (front to rear)	1.63 m (5 ft 4 in)

WEIGHTS AND LOADINGS:

Weight empty	170 kg (375 lb)
Payload with max fuel	162 kg (358 lb)
T-O weight: normal	281 kg (622 lb)
max	378 kg (834 lb)

PERFORMANCE (estimated):

Max level speed	98 kt (181 km/h; 113 mph)
Cruising speed	82 kt (152 km/h; 94 mph)
Loiter speed	56 kt (104 km/h; 64 mph)
Max rate of climb at S/L	1,676 m (5,500 ft)/min
Hovering ceiling, OGE	3,475 m (11,400 ft)
Range	160 n miles (296 km; 184 miles)
Endurance	2 h 10 min

TREK DRAGONFLY UMR-1

TYPE: Lifting vehicle.

PROGRAMME: Development began in 2004. Remained in conceptual phase in 2006.

Trek Dragonfly UMR-1 enclosed lifting vehicle 1047813

TSI

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Techsphere Systems was formed in mid-2002 to manufacture, own, operate, lease and sell spherical airship platforms for manned and unmanned use in commercial, research and government applications. To this end, in November 2002 it entered an agreement giving it worldwide exclusive rights to manufacture and sell certain types of airship of this configuration designed by the Canadian company 21st Century Airships. That company's 19.05 m (62.5 ft) diameter SPAS-70-1A, redesignated AeroSphere SA-60 and registered N8041X, was acquired as a low-altitude prototype for larger new products, the first of which is a 28.65 m (94 ft) diameter AeroSphere, the SA-90, under construction in second half of 2005 and capable of flying for up to two days and reaching altitudes up to 6,100 m (20,000 ft). As of late 2006, this was not known to have made its maiden flight.

Exclusive marketing rights are delegated to Cyber Aerospace Corporation of West Palm Beach, Florida; TSI became a wholly owned subsidiary of Cyber Defense Systems on 20 September 2005. SA-60 prototype was evaluated by US Naval Air Systems Command for a surveillance role in 2004, then being sold on to Sierra Nevada Corporation (SNC) of Sparks, Nevada, for systems integration to convert it to unmanned operation. SNC holds exclusive integration contract rights for government end-users of TSI airships. Also in 2004, Cyber took delivery of a 23.2 m (76 ft) SA-76, a five-engined variant intended as an optionally piloted vehicle with the ability to operate at up to 4,880 m (16,000 ft). Georgia Tech Research Institute (GTRI) is assisting in developing some TSI platforms for unmanned (UAV) applications.

Immediate TSI production is at an initial 3,902 m^2 (42,000 sq ft) manufacturing facility on Phillips Drive, Columbus, Georgia, opened on 10 November 2004. At a second Columbus location, TSI planned to complete a 10,035 m^2 (108,000 sq ft) modern factory during 2006, as well as a hangar able to house airships of up to 91.4 m (300 ft) diameter. A payload integration production facility in Reno, Nevada, was due to open in 2005.

TSI AEROSPHERE SA-60

TYPE: Helium non-rigid special shape airship.

Demonstration by AeroSphere SA-60 1133373

PROGRAMME: Prototype (N8041X) acquired from 21st Century Airships; subsequently sold to Cyber Aerospace Corporation (early 2004), evaluated by US Navy (June 2004), then sold on to Sierra Nevada Corporation (July 2004). Subjected to successful flight tests in Nevada 21 June 2006 in which envelope treated with so-called 'paint-on' conformal antennas developed by Applied EM Inc and Unitech LLC under research contract from US Air Force

Research Laboratory at Hanscom AFB. These antennas transmitted and received voice and data links via the Iridium global satellite system. The flight also included a NASA Langley experiment to evaluate airship applications for soil moisture remote sensing missions.

CUSTOMERS: Lease of two SA-60s to an unidentified 'Fortune 100' company, at an estimated initial contract value of approx USD4.2 million, was announced on 13 June 2006.

DESIGN FEATURES: Spherical.

FLYING CONTROLS: Autonomous; 5 kW onboard power for payload.

POWER PLANT: Diesel/electric hybrid.

DIMENSIONS, EXTERNAL:

Diameter	19.05 m (62 ft 6 in)

WEIGHTS AND LOADINGS:

Max payload	227 kg (500 lb)

PERFORMANCE:

Cruising speed	30 kt (56 km/h; 35 mph)
Operating altitude	2,280-3,050 m (7,500-10,000 ft)
Ceiling (demonstrated)	6,234 m (20,453 ft)
Endurance on station	5 h

TSI AEROSPHERE SA-90

TYPE: Helium non-rigid special shape airship.

PROGRAMME: Under construction in 2005. No further news of progress by late 2006.

DESIGN FEATURES: Part-spherical, with 'deployable aerofoil', resulting in 'teardrop' overall shape.

FLYING CONTROLS: Autonomous; 4 kW onboard power for payload.

POWER PLANT: Diesel.

DIMENSIONS, EXTERNAL:

Max diameter	28.65 m (94 ft 0 in)

WEIGHTS AND LOADINGS:

Max payload	454 kg (1,000 lb)

PERFORMANCE (estimated):

Max level speed	46 kt (85 km/h; 53 mph)
Max cruising speed	35 kt (64 km/h; 40 mph)
Ceiling	6,100 m (20,000 ft)
Endurance on station	48 h

UAI

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American Utilicraft Corporation formed August 1990 to design and produce Freight Feeder cargo transport. Headquarters at Gwinnett County, Atlanta, Georgia; final assembly at that time planned in San Juan Pueblo, New Mexico, in a purpose-built 7,430 m² (80,000 sq ft) facility funded in part by USD11 million investment TSAY Native American casino and construction company.

USD50 million of financing secured during June 2001 but economic slowdown in late 2001 affected progress with construction of prototype Freight Feeder; however on 25 June 2002 AUC signed an MoU with Averitt Express for lease of capacity of first 25 aircraft, and announced a more aggressive merger and acquisition strategy. In March 2003, AUC announced the formation of a new division in conjunction with Averitt, AUC X-press, offering air cargo services with a fleet of Cessna 404 and Beechcraft 1900 aircraft, which to have been supplemented by the FF-1080 in due course; agreement since lapsed.

In July 2003, AUC signed a further MoU, this time with Alpine Air Express, for development of the FF-1080; again agreement has lapsed.

In November 2003, AUC signed an MoU with WSI Hong Kong to cover intended purchase of 300 FF-1080s, including exclusive Far East sales and support; in January 2004, WSI signed an initial firm purchase agreement for 36.

By mid-2004, AUC was in negotiations with Metalcraft of Cedar City, Utah, which planned fuselage production, plus initial assembly at AUC plant, Lawrenceville, Georgia. This rapidly overtaken on 8 December 2004, when signed agreement for formation of Utilicraft Aerospace Industries as partnership with Navajo Nation of indigenous Americans, latter obtaining 25 per cent share in exchange for USD34 million investment to bring FF-1080-300 variant to Phase 1 of FAA certification. Subassembly planned in three plants within Navajo homelands and final assembly at Double Eagle II Airport, Albuquerque, New Mexico. Partnership now AMI for design; Metalcraft for subassembly of fuselage; D3 for structures engineering; DERS for systems engineering; and wing subassembly yet to be allocated.

UAI FF-1080 FREIGHT FEEDER

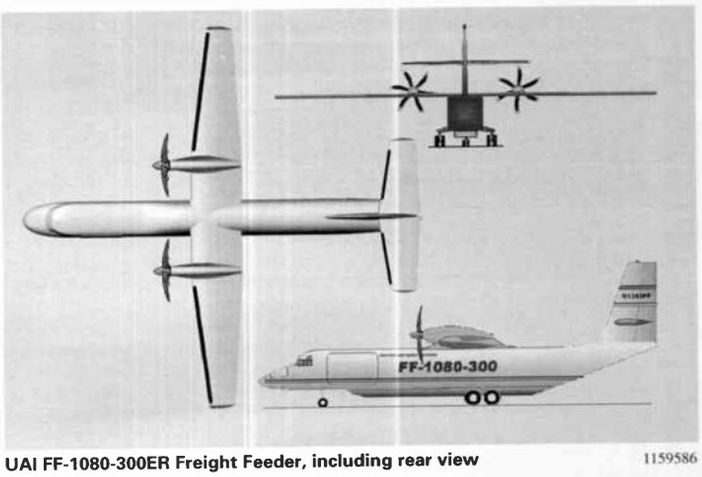
TYPE: Twin-turboprop freighter.

PROGRAMME: Design started 1990; patents filed 1991; original capacity for four LD3 containers increased to six in 1997. Two flying prototypes planned; first flight due 18 months after programme financing in place, followed by FAR Pt 25 certification. Mock up completed end 1999 at which time pre-production prototype intended for completion early 2002 and first flight was due before end 2002, with certification in 2003. FAA Pt 25 certification; this was revised following market downturn at end 2001.

In November 2003, company signed MoU with WSI Hong Kong for acquisition of 300 aircraft; purchase agreement for first 36 signed January 2004.

Manufacture of first 36 aircraft planned to run concurrently with certification programme starting six months from launch. Prototype first flight in 12th month; pre-series aircraft in 18th month; first production (c/n 001) aircraft joining test programme in final year before certification. Start of work on construction of prototype was authorised on 7 February 2005.

Artist's impression of UAI Freight Feeder 300ER 1159585



UAI FF-1080-300ER Freight Feeder, including rear view 1159586

In December 2004, Series 300 became baseline version, powered by 5,458 kW (4,637 shp) RR AE2100D turboprops and six blade propellers. This overtaken in August 2006 by Series 300ER, featuring longer fuselage, additional fuel and increased MTOW. Schedule in mid-2006 was first flight of prototype in September 2007 and of initial production machine in December 2008, followed by FAA certification in June 2009.

CURRENT VERSIONS: **FF-1080-100**: Short fuselage version; four LD3 containers; PW121 engines. Not now intended for construction.

FF-1080-200: Previously proposed standard version; six LD3 containers; wing span 27.10 m (88 ft 11 in); MTOW 17,236 kg (38,000 lb); PW127F turboprops; replaced as launch version by larger -300.

FF-1080-300ER: Announced December 2004; new standard version, *as described*.

FF-1080-500: Enlarged version.

CUSTOMERS: Company estimates market for 5,000 aircraft and aims to capture 10 per cent. Target market is Cessna 208 replacement/growth and F27 all-cargo market. Discussions in hand with several unidentified potential customers; first production batch to comprise 36 aircraft to be built during two-year certification period and available for rapid delivery thereafter. WSI Hong Kong is new launch customer. In June 2004 an LOI was signed with Global Air Group of Brisbane, Australia, for 50 Freight Feeders, plus option on further 50, to be delivered from 2007 for African services of Ghana-based CTK-CiTylinK.

COSTS: Operating cost per ton/mile USD0.48 over 500 n miles (926 km; 575 miles), increasing to USD0.62 over 2,000 n miles (3,704 km; 2,301 miles).

DESIGN FEATURES: High-mounted wings, tapered outboard of overwing engine nacelles; box-section fuselage with ventral pannier; upswept rear fuselage with rear-loading door; angular tail surfaces with large dorsal fin fairing. Onboard freight management system.

FLYING CONTROLS: Conventional and manual. Upper surface blowing (USB) via overwing engine mounting.

STRUCTURE: All-aluminium construction.

LANDING GEAR: Non-retractable tricycle type; twin nosewheels and tandem pairs of mainwheels.

POWER PLANT: Two 3,781 kW (5,071 shp) Pratt & Whitney PW150C turboprops, each driving a Hamilton Sundstrand NP 2000 six-blade propeller. Fuel capacity 14,301 litres (3,778 US gallons; 3,146 Imp gallons) in landing gear panniers.

ACCOMMODATION: Flight crew of two on IPECO seats. Designed for single-pilot operation. Main cargo hold accommodates up to 10 LD3 or five A-1 containers. Cargo roller floor from AAR Cargo Systems. Large cargo double door on port side, forward of wing; rear-loading door hinged at rear and raised to roof for access; crew airstair door on port side of flight deck. Flight deck pressurised; main cargo bay unpressurised. Additional capacity in cargo pannier and nose compartment.

SYSTEMS: Securaplane smoke detection system; HS Dynamic Controls anti-icing and de-icing systems; electrical system integration by Thales Avionics Electrical Systems. Shaw Aero Devices fuel management system.

AVIONICS: Collins Pro Line 21 five-screen EFIS.

DIMENSIONS, EXTERNAL:

Wing span	34.92 m (114 ft 7 in)
Length overall	34.32 m (112 ft 7 in)
Height overall	11.18 m (36 ft 8 in)

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jawa.janes.com

Side cargo door: Height ..... 2.44 m (8 ft 0 in)
Width ..... 2.59 m (8 ft 6 in)
Rear cargo door: Height ..... 2.44 m (8 ft 0 in)
Width ..... 2.54 m (8 ft 4 in)
DIMENSIONS, INTERNAL:
Cargo bay: Length ..... 18.29 m (60 ft 0 in)
Max width ..... 2.54 m (8 ft 4 in)
Max height ..... 2.29 m (7 ft 6 in)
Volume: cargo bay ..... 113.3 m^3 (4,000 cu ft)
pannier ..... 9.3 m^3 (330 cu ft)
nose compartment ..... 5.47 m^3 (193 cu ft)
AREAS:
Wings, gross ..... 122.2 m^2 (1,315 sq ft)
WEIGHTS AND LOADINGS (estimated):
Weight empty ..... 17,514 kg (38,612 lb)
Payload: for 200 nm (max) ..... 18,942 kg (41,761 lb)
for 500 nm ..... 17,236 kg (38,000 lb)
for 1,000 nm ..... 15,331 kg (33,800 lb)
for 1,500 nm ..... 12,927 kg (28,500 lb)
for 2,000 nm ..... 10,886 kg (24,000 lb)
for 2,500 nm ..... 8,618 kg (19,000 lb)
for 3,000 nm ..... 4,536 kg (10,000 lb)
Max fuel weight ..... 11,416 kg (25,168 lb)
Max T-O weight ..... 38,010 kg (83,800 lb)
Max landing weight ..... 37,648 kg (83,000 lb)
Max zero-fuel weight ..... 36,469 kg (80,400 lb)
Max wing loading ..... 311.1 kg/m^2 (63.73 lb/sq ft)
Max power loading ..... 5.03 kg/kW (8.26 lb/hp)
PERFORMANCE (estimated):
Max level speed ..... 280 kt (519 km/h; 322 mph)
Stalling speed, flap down ..... 91 kt (169 km/h; 105 mph)
Rate of climb at S/L, OEI ..... 366 m (1,200 ft)/min
Service ceiling ..... 9,450 m (31,000 ft)
T-O run ..... 952 m (3,125 ft)
T-O to 15 m (50 ft) ..... 1,082 m (3,550 ft)
Landing from 15 m (50 ft) ..... 992 m (3,255 ft)
Landing run ..... 900 m (2,950 ft)
Ferry range ..... 3,360 n miles (6,222 km; 3,866 miles)

USA

ULTRALIGHT SOARING AVIATION

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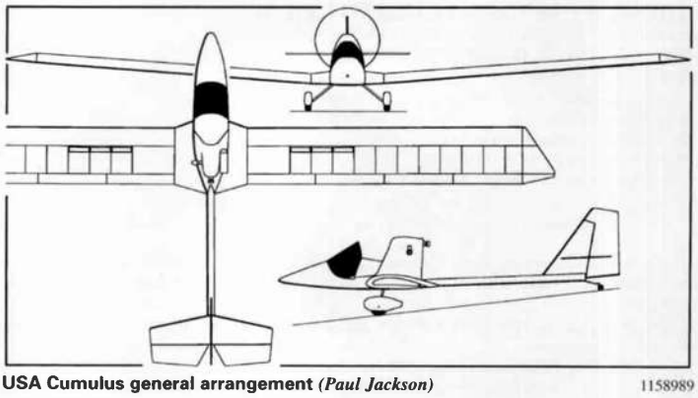
Web: www.ultralightsoaringaviation.com
PRESIDENT: Dave Ekstrom

Marketing of the third-generation Cumulus motor glider began in 2003.

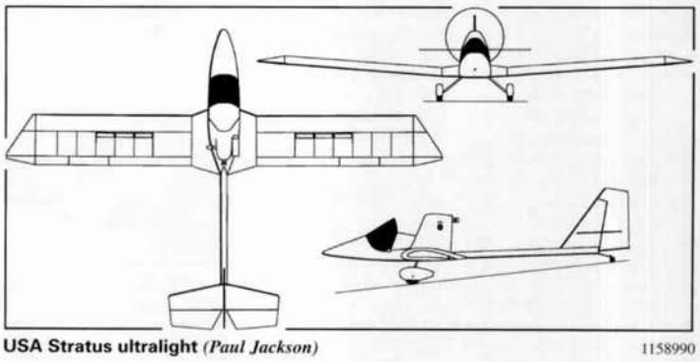
USA CUMULUS

TYPE: Single-seat ultralight motor glider/kitbuilt.
PROGRAMME: Original Cloud Dancer designed by Erwin Rodger; prototype flew mid 1980s; Cumulus development redesigned by Jim Collie; made flying debut at Sun 'n' Fun 1996 but crashed, killing Collie. Marketing in considerably modified present form began 2003 as third-generation design; exhibited at Sun 'n' Fun, Lakeland, Florida, April 2004. Will also be LSA compliant.
CURRENT VERSIONS: **Cumulus:** Standard version, *as described*.
Stratus: Proposed short-span version.
ViperJet Mk II: Production version, *as described*.
CUSTOMERS: Total 19 under construction plus eight flying by end 2005.
COSTS: Kit less instruments USD8,995; power plant USD3,939 (2006). Estimated total cost to first flight USD15,500.
DESIGN FEATURES: Low-wing, open cockpit (optionally enclosed) pusher of pod-and-boom configuration with strut-braced cruciform tailplane.
Quoted build time 150 hours.
Optional short-span wing.
FLYING CONTROLS: Conventional and manual. One-third span flaps with upward reflex for improved cruising speed. Door-type spoilers in wing upper surface. Horn-balanced rudder.
STRUCTURE: Spec 6061-T6 aluminium (optional 4130 steel) boom and cockpit frame with glass fibre skin. Tubular metal wing with single spar; aluminium skin with fabric covered ailerons and flaps.
LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted spring steel cantilever mainwheel legs with optional speed fairings. Steerable, solid tailwheel.
POWER PLANT: One 31.0 kW (41.6 hp) Rotax 447 two-cylinder piston engine driving a Tennessee Propellers Inc two-blade wooden propeller. Fuel capacity 19 litres (5.0 US gallons; 4.2 Imp gallons).
EQUIPMENT: Optional BRS-5 ballistic recovery parachute.
DIMENSIONS, EXTERNAL:
Wing span ..... 13.11 m (43 ft 0 in)

USA Cumulus kitbuilt motor glider *(Paul Jackson)* 1133281



USA Cumulus general arrangement *(Paul Jackson)* 1158989



USA Stratus ultralight *(Paul Jackson)* 1158990

Length overall ..... 6.10 m (20 ft 0 in)
Height overall ..... 1.35 m (4 ft 5 in)
AREAS:
Wings, gross ..... 13.01 m^2 (140.0 sq ft)
WEIGHTS AND LOADINGS:
Weight empty ..... 163 kg (360 lb)
Max T-O weight ..... 290 kg (640 lb)
PERFORMANCE, POWERED:
Max level speed ..... 78 kt (144 km/h; 90 mph)
Max cruising speed ..... 65 kt (121 km/h; 75 mph)
Stalling speed ..... 28 kt (52 km/h; 32 mph)
Max rate of climb at S/L ..... 304 m (1,000 ft)/min
T-O run ..... 52 m (170 ft)
Range ..... 173 n miles (321 km; 200 miles)
PERFORMANCE, UNPOWERED:
Stalling speed, flaps down ..... 28 kt (52 km/h; 32 mph)
Best glide ratio at 37 kt (69 km/h; 43 mph) 20
Min rate of sink at 30 kt (55 km/h; 34 mph) ..... 0.97 m (3.2 ft)/s

USAI

UNITED STATES AIRSHIPS INTERNATIONAL

153 Little John Road, Statesville, North Carolina 28625
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Web: www.usairships.com
WORKS (under construction):
Kerr Chapel Road, Caswell County, Matkins, North Carolina
OWNER AND PRESIDENT: Willian S Meadows

USAI founder/owner William Meadows formed Ballon Ascensions Ltd as a balloon training facility 1969; was sales director for The Balloon Works 1975 to 1980; founded National Balloon Racing Association 1980; became sales director for The Blimp Works 1990; USAI founded 1997 to manufacture one- and two-person small helium airships. Manufacturing facility at 10.1 ha (25 acre) site with 549 m (1,800 ft) grass airstrip. Main airship hangar construction scheduled for late 2004, but not reported by late 2006. Airship deliveries to start within three months of hangar completion.

USAI UL1 and UL2

TYPE: Helium non-rigid airship.
PROGRAMME: First flight March 2001. Production started 2003, but no sales or deliveries reported by late 2006.
CURRENT VERSIONS: **UL-1B:** Basic single-seater; 6.7 kW (9 hp) single-cylinder engine. Smallest in current range.
UL1-S: Standard single-seater; 8.2 kW (11 hp) single-cylinder engine; increased diameter propeller; larger gondola.
UL1-D: De luxe single-seater; 9.7 kW (13 hp) single-cylinder engine; vectored thrust propeller at rear, powered by electric motor; dual controls.
UL2-B: Basic two-seater; 13.4 kW (18 hp) two-cylinder engine; larger gondola, as in UL1-S.
UL2-S: Standard two-seater; 14.9 kW (20 hp) two-cylinder engine.
UL2-D: De luxe two-seater; 17.9 kW (24 hp) two-cylinder engine; vectored thrust, as in 1-D; dual controls.
COSTS: USD90,000 (UL1-B), USD120,000 (UL1-S), USD150,000 (UL1-D), USD180,000 (UL2-B), USD210,000 (UL2-S) and USD240,000 (UL2-D) (all 2005).

DESIGN FEATURES: All USAI airships can be dismantled by two persons in one or two hours and loaded onto a pick-up truck or into a 4.27 m (14 ft) long trailer.

FLYING CONTROLS: Rudders and elevators fly by wire. In addition, 1-D and 2-D have electric motors at rear which can be vectored left/right and up/down to provide secondary directional control.

STRUCTURE: Envelope of 9 mm polyurethane; all seams overlapped and heat-sealed. Single internal ballonet. Welded, aluminium tube open frame gondola, attached to envelope at 13 points each side; can be disconnected in less than 2 minutes by removing two rods that slide through attachments.

LANDING GEAR: Floats optional on 1-D and 2-D.

POWER PLANT: See Current Versions above. B versions have pull start, S and D versions electric starting. Standard fuel capacity 19 litres (5.0 US gallons; 4.2 Imp gallons); second tank of same capacity optional.

ACCOMMODATION: See Current Versions above. Optional lightweight gondola cover for cold-weather flying.

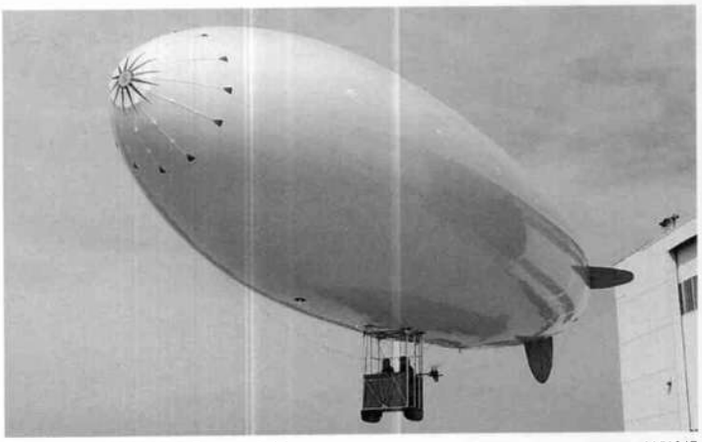
AVIONICS: Suffixes B, S and D indicate basic, standard and de luxe levels of instrumentation.

DIMENSIONS, EXTERNAL:

Envelope: Length: 1-B	18.29 m (60 ft 0 in)
1-S	19.81 m (65 ft 0 in)
1-D	21.34 m (70 ft 0 in)
2-B	22.86 m (75 ft 0 in)
2-S	24.38 m (80 ft 0 in)
2-D	25.91 m (85 ft 0 in)
Fineness ratio: 1-B	3.58
1-S	3.52
1-D	3.79
2-B	3.73
2-S	3.67
2-D	3.90

DIMENSIONS, INTERNAL:

Envelope volume: 1-B	250.4 m³ (8,843 cu ft)
1-S	328.2 m³ (11,592 cu ft)
1-D	353.5 m³ (12,484 cu ft)
2-B	450.7 m³ (15,918 cu ft)



Two-place USAI UL2-D non-rigid 1151047

2-S	564.3 m³ (19,927 cu ft)
2-D	599.5 m³ (21,172 cu ft)
Gondola max height: 1-B, 1-D	1.83 m (6 ft 0 in)
1-S, 2-B, 2-S, 2-D	1.98 m (6 ft 6 in)

PERFORMANCE:

Max cruising speed: 1-B	21 kt (39 km/h; 24 mph)
1-S	23 kt (42 km/h; 26 mph)
1-D	24 kt (44 km/h; 28 mph)
2-B	26 kt (48 km/h; 30 mph)
2-S	28 kt (52 km/h; 32 mph)
2-D	30 kt (56 km/h; 35 mph)

US LIGHT AIRCRAFT

US LIGHT AIRCRAFT CORPORATION

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PRESIDENT: James Millet

US Light Aircraft formed from partnership between Millett Engineering and Forespar Company in 1993; was purchased by Higher Class Aviation in 2005.

VAN'S

VAN'S AIRCRAFT INC

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Web: www.vansaircraft.com
PRESIDENT: Richard VanGrunsven

Founded in 1970, the company derives its name from its president's nickname and began with the sale of plans (and, later, kits) for the RV-3 sporting homebuilt. More than 14,000 Van's kits sold by October 2006, of which 4,867 were flying by 30 November 2006. The four-seat RV-10 was announced in October 2001 and made its first flight on 29 May 2003.

The company constructed a new 5,110 m² (55,000 sq ft) facility at Aurora, Oregon, to which it moved during 2000; by June 2002 the workforce numbered 60 and by December 2006, 70. All Van's kits conform to the FAA's 51 per cent rule.

The company is now working on the RV-11 motor glider; by early 2004 the forward fuselage was under construction.

The RV-12 was introduced in 2006 to meet LSA criteria.

VAN'S RV-4

TYPE: Tandem-seat kitbuilt.

PROGRAMME: First flight of prototype 21 August 1979. Plans and kits available to homebuilders.

CURRENT VERSIONS: **RV-4:** *As described.*

CUSTOMERS: Over 4,600 sets of plans and kits sold, with about 1,800 aircraft under construction and 1,197 RV-4s flying by September 2006..

COSTS: Kit: USD14,015 (2006).

DESIGN FEATURES: Cantilever low-wing monoplane with constant-chord, low aspect ratio wings, tapered horizontal tail surfaces and sweptback fin.

Wing section Van's Aircraft 135; dihedral 3° 30'; incidence 1°.

FLYING CONTROLS: Conventional and manual. Horn-balanced elevators; Frise ailerons; plain flaps. No tabs.

Vans RV-4 tandem-seat kitbuilt ***(Paul Jackson)*** 1040504

STRUCTURE: Generally of light alloy. I-beam main wing spar and pressed ribs; moulded glass fibre wingtips and engine cowling.

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted, rakedback Wittman spring tapered steel cantilever mainwheel legs with glass fibre trouser and wheel fairings; tyre size 5.00-5; steerable tailwheel, tyre size 6 in.

POWER PLANT: One 112 kW (150 hp) Textron Lycoming O-320-E1F flat-four engine; two-blade fixed-pitch propeller. Options for engine up to 134 kW (180 hp). Fuel capacity 121 litres (32.0 US gallons; 26.6 Imp gallons).

ACCOMMODATION: Two persons in tandem under starboard-hinged canopy. Baggage compartments forward of instrument panel and aft of rear seat.

DIMENSIONS, EXTERNAL:

Wing span	7.01 m (23 ft 0 in)
Wing aspect ratio	4.8
Length overall	6.20 m (20 ft 4 in)
Height overall	1.65 m (5 ft 5 in)
Wheel track	1.88 m (6 ft 2 in)
Propeller diameter	1.73 m (5 ft 8 in)

DIMENSIONS, INTERNAL:

Cabin: Length	1.91 m (6 ft 3 in)
Max width	0.72 m (2 ft 4 in)
Max height	1.02 m (3 ft 4 in)
Baggage volume	0.21 m³ (7.3 cu ft)

AREAS:

Wings, gross	10.22 m² (110.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	411 kg (905 lb)
Max baggage weight	23 kg (50 lb)
Max T-O weight	680 kg (1,500 lb)
Max wing loading	66.6 kg/m² (13.64 lb/sq ft)
Max power loading	6.09 kg/kW (10.00 lb/hp)

PERFORMANCE (112 kW; 150 hp engine; MTOW):

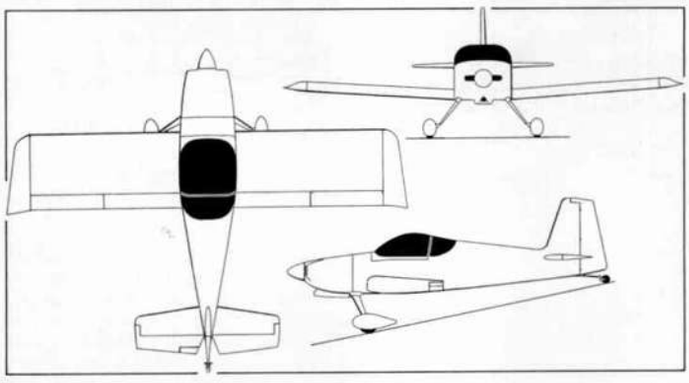
Max level speed at S/L	174 kt (322 km/h; 200 mph)
Cruising speed at FL80:	
at 75% power	163 kt (303 km/h; 188 mph)
at 55% power	148 kt (274 km/h; 170 mph)
Stalling speed	47 kt (87 km/h; 54 mph)
Max rate of climb at S/L	457 m (1,500 ft)/min
Service ceiling	5,485 m (18,000 ft)
T-O run	145 m (475 ft)
Landing run	130 m (425 ft)
Range with max fuel at 55% power	686 n miles (1,271 km; 790 miles)

VAN'S RV-7 and RV-7A

TYPE: Side-by-side kitbuilt.

PROGRAMME: Replacement for the RV-6 and RV-6A. Design work undertaken during 2000; prototype (N137RV) first flown 19 March 2001. Public debut at Sun 'n' Fun in April 2001. RV-6/6A kits currently under construction can be completed to RV-7/7A standard by using optional parts.

Van's RV-7A nosewheel version *(Paul Jackson)* 1040508



Van's RV-7 general arrangement *(Paul Jackson)* 0110689

CURRENT VERSIONS: **RV-7:** Tailwheel version.
RV-7A: Nosewheel version.

CUSTOMERS: Total of 2,850 kits sold by September 2006, of which 350 were flying by that date.

COSTS: RV-7 kit USD17,580, quick-build kit USD25,705; RV-7A kit USDD18,355, quick-build kit USD26,480 (2006).

DESIGN FEATURES: Shares commonality of parts with the RV-8/8A and RV-9A. Quoted build time reduced to 1,400 hours compared to RV-6 family due to improvements made in kit production.

FLYING CONTROLS: Conventional and manual. Horn-balanced rudder and elevators, flight-adjustable tab in port tailplane. Plain electric flaps.

STRUCTURE: Fuselage and wings of metal, with composites wingtips, tailplane tip, fintip, fin-root fairing, cowling, landing gear legs, fairings and spats.

LANDING GEAR: Fixed; tailwheel or tricycle type. Fuselage-mounted, rakedback Wittman spring tapered steel cantilever mainwheel legs with composites trouser and wheel fairings; contilever tailwheel leg with solid tyre. Optional trailing link nosewheel with trouser and wheel fairing; mainwheel legs attached further aft.

POWER PLANT: Prototype has 149 kW (200 hp) Textron Lycoming IO-360 driving a two-blade Hartzell constant-speed propeller; the design accepts engines in the 112 to 149 kW (150 to 200 hp) range. Fuel capacity 159 litres (42.0 US gallons; 35.0 Imp gallons) in two wing tanks.

ACCOMMODATION: Pilot and passenger side by side under forward-hinged one-piece canopy; optional rearward-sliding canopy with fixed windscreen. Compared to RV-6, cabin room is increased.

DIMENSIONS, EXTERNAL:

Wing span	7.62 m (25 ft 0 in)
Wing aspect ratio	5.2
Length overall	6.20 m (20 ft 4 in)
Height overall: RV-7	1.78 m (5 ft 10 in)
RV-7A	2.39 m (7 ft 10 in)

DIMENSIONS, INTERNAL:

Cabin max width	1.09 m (3 ft 7 in)
Baggage volume	0.34 m³ (12.0 cu ft)

AREAS:

Wings, gross	11.15 m² (120.0 sq ft)

WEIGHTS AND LOADINGS (149 kW; 200 hp engine):

Weight empty	505 kg (1,114 lb)
Max baggage weight	45 kg (100 lb)
Max T-O weight	816 kg (1,800 lb)
Max wing loading	73.2 kg/m² (15.00 lb/sq ft)
Max power loading	5.48 kg/kW (9.00 lb/hp)

PERFORMANCE (149 kW; 200 hp engine):

Never-exceed speed (VNE)	199 kt (370 km/h; 230 mph)
Max operating speed: RV-7	188 kt (348 km/h; 216 mph)
RV-7A	185 kt (343 km/h; 213 mph)
Cruising speed:	
at 75% power:	
RV-7	179 kt (332 km/h; 206 mph)
RV-7A	177 kt (328 km/h; 204 mph)
at 55% power: RV-7	162 kt (299 km/h; 186 mph)
RV-7A	159 kt (295 km/h; 183 mph)
Stalling speed, flaps down:	
RV-7, RV-7A	51 kt (94 km/h; 58 mph)
Max rate of climb at S/L: RV-7	579 m (1,900 ft)/min
RV-7A	564 m (1,850 ft)/min
Service ceiling: RV-7	6,860 m (22,500 ft)
RV-7A	6,555 m (21,500 ft)
T-O and landing run	152 m (500 ft)
Range with max fuel, 55% power:	
RV-7	812 n miles (1,504 km; 935 miles)
RV-7A	803 n miles (1,488 km; 925 miles)

VAN'S RV-8 and RV-8A

TYPE: Tandem-seat kitbuilt.

PROGRAMME: First flown (N118RV) 22 July 1995; launched at Oshkosh five days later. Second prototype (N58RV) flew early 1997 and accumulated 325 hours in seven months. In 2006, manufacturing was refined to offer 'matched hole' kits, intended to reduce build time by up to 20 per cent.

CURRENT VERSIONS: **RV-8:** Tailwheel version.
RV-8A: Tricycle version; first flown (N58VA) April 1998; public debut at Sun 'n' Fun, same month.

CUSTOMERS: By September 2006 over 2,600 kits had been sold and 632 were flying.

COSTS: RV-8 kit USD18,335, quick-build kit USD26,460; RV-8A kit USD18,620, quick-build kit USD26,745 (2006).

DESIGN FEATURES: Similar in appearance to the RV-4, but with wider, longer fuselage; rounded engine cowling; non-sweptback main landing gear legs; larger canopy; however, very little parts commonality with RV-4. Quoted build time 1,600 hours.
Description generally as for RV-4.

LANDING GEAR: Fixed; tailwheel or tricycle type. Fuselage-mounted, rakedback Wittman spring cantilever mainwheel legs with composites trouser and wheel fairings; cantilever tailwheel leg. Optional trailing link nosewheel with trouser and wheel fairing; mainwheel legs attached farther aft.

POWER PLANT: One 149 kW (200 hp) Textron Lycoming IO-360-A16D four-cylinder piston engine driving two-blade Hartzell HC-C2YK-BF/F7666A4 constant-speed propeller; optionally 119 kW (160 hp) Textron Lycoming O-320 driving two-blade Sensenich 70CM2 propeller. Fuel capacity 159 litres (42.0 US gallons; 35.0 Imp gallons). Oil capacity 7.6 litres (2.0 US gallons; 1.7 Imp gallons).

ACCOMMODATION: Tandem seating for pilot and passenger under sliding canopy. Separate windscreen.
Specification for RV-8/RV-8A, except where noted.

DIMENSIONS, EXTERNAL:

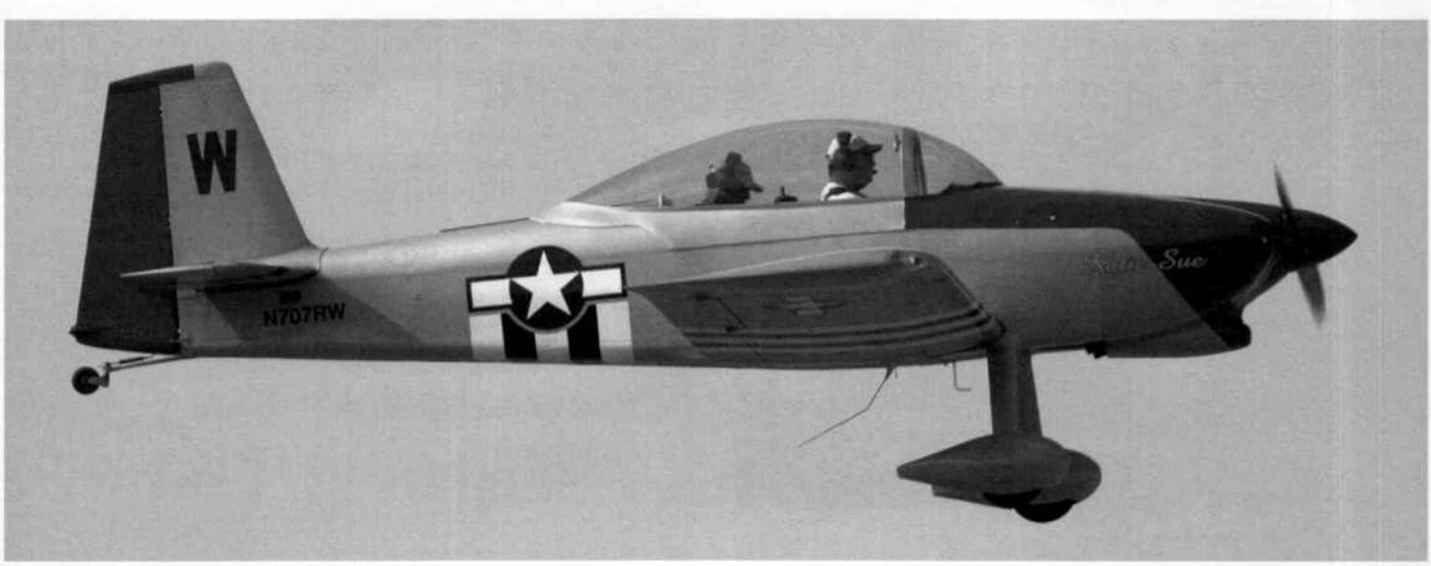
Wing span	7.32 m (24 ft 0 in)
Wing chord, constant	1.47 m (4 ft 10 in)
Wing aspect ratio	4.8
Length overall: RV-8	6.40 m (21 ft 0 in)
RV-8A	6.35 m (20 ft 10 in)
Height overall: RV-8	1.70 m (5 ft 7 in)
RV-8A	2.24 m (7 ft 4 in)
Wheel track	1.90 m (6 ft 3 in)
Propeller diameter	1.83 m (6 ft 0 in)

DIMENSIONS, INTERNAL:

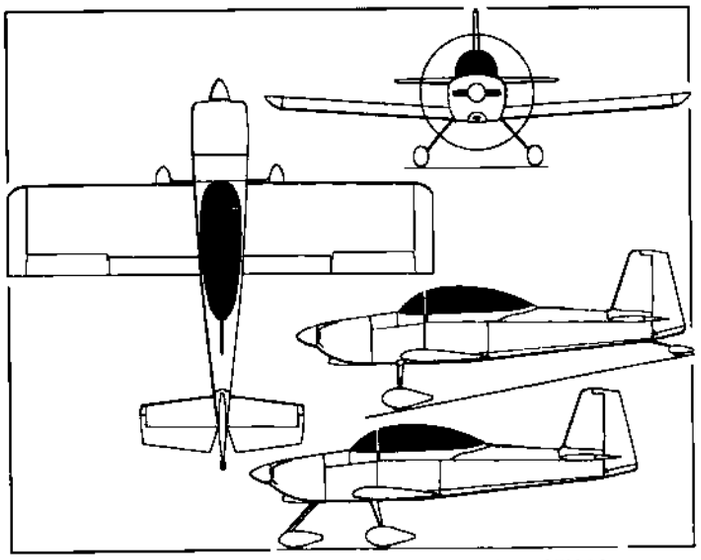
Cockpit max width	0.91 m (3 ft 0 in)
Baggage volume	0.21 m³ (7.5 cu ft)

AREAS:

Wings, gross	10.78 m² (116.0 sq ft)



Van's RV-8 in 1944-style markings *(Paul Jackson)* 1040505



Van's RV-8 two-seat light aircraft, with additional side view of RV-8A *(Paul Jackson)* 1158988

WEIGHTS AND LOADINGS:
- Weight empty ..... 508 kg (1,120 lb)
- Max baggage weight ..... 57 kg (125 lb)
- Max T-O weight ..... 816 kg (1,800 lb)
- Max wing loading ..... 79.9 kg/m² (16.36 lb/sq ft)
- Max power loading ..... 5.48 kg/kW (9.00 lb/hp)

PERFORMANCE (two persons, 149 kW; 200 hp engine):
- Max operating speed: RV-8 ..... 191 kt (354 km/h; 220 mph)
- RV-8A ..... 189 kt (351 km/h; 218 mph)
- Cruising speed at 55% power at FL80:
- RV-8 ..... 162 kt (301 km/h; 187 mph)
- RV-8A ..... 161 kt (298 km/h; 185 mph)
- Stalling speed, power off:
- one occupant: both ..... 45 kt (83 km/h; 51 mph)
- two occupants: both ..... 51 kt (94 km/h; 58 mph)
- Max rate of climb at S/L: RV-8 ..... 579 m (1,900 ft)/min
- RV-8A ..... 549 m (1,800 ft)/min
- Service ceiling: RV-8 ..... 6,860 m (22,500 ft)
- RV-8A ..... 6,550 m (21,500 ft)
- T-O and landing run: both ..... 153 m (500 ft)
- Range at 55% power:
- RV-8 ..... 816 n miles (1,512 km; 940 miles)
- RV-8A ..... 808 n miles (1,496 km; 930 miles)

VAN'S RV-9 and RV-9A

TYPE: Side-by-side kitbuilt.

PROGRAMME: Prototype RV-9A (N96VA) first flown late 1997; was hybrid proof-of-concept aircraft using unique RV-6T fuselage plus new wings; had flown more than 200 hours when lost in accident 2 April 2000; second prototype, and first 'true' RV-9A (N129RV), flown 15 June 2000. Empennage kits became available in late 1999, followed by wing and fuselage/finishing kits in mid-2000 and quick-build kits in late 2000; first customer-built aircraft flown 17 June 2001. RV-9 prototype (N179RV) first flown 4 March 2002.

CURRENT VERSIONS: **RV-9**: Tailwheel version.

RV-9A: Tricycle version.

CUSTOMERS: 1,500 kits sold by September 2006 of which 232 were flying.

COSTS: Basic kit RV-9 USD17,925, RV-9A USD18,715; quick-build RV-9 USD26,050, RV-9A USD26,840 (2006).

DESIGN FEATURES: Based upon, and similar in appearance to, RV-6/6A, but with redesigned wing (Roncz aerofoil and sheared wingtips) and enlarged, constant-chord horizontal tail surfaces.

FLYING CONTROLS: Conventional and manual. Horn-balanced rudder. Slotted electric flaps extend approximately two-thirds of wing span, compared with one-half on other RV designs.

LANDING GEAR: Fixed; tailwheel or tricycle type. Fuselage-mounted, rakedback Wittman spring tapered steel cantilever mainwheel legs with composites trouser and wheel fairings; cantilever tailwheel leg. Optional trailing link nosewheel with trouser and wheel fairings; mainwheel legs attached farther aft.

POWER PLANT: First prototype flown with 88.0 kW (118 hp) Textron Lycoming O-235-L2C flat-four driving two-blade Sensenich 72 × 66 fixed-pitch metal propeller. Second prototype has 119 kW (160 hp) Textron Lycoming O-320-D3G driving three-blade MT propeller. Engines between 80.5 and 119 kW (108 and 160 hp) can be fitted. Fuel capacity 136 litres (36.0 US gallons; 30.0 Imp gallons) in two wing tanks. Wilksch reportedly developing conversion during 2002, to enable use of its 90 kW (120 hp) WAM-120 diesel engine.

ACCOMMODATION: Pilot and passenger side by side under sliding canopy. Dual controls.

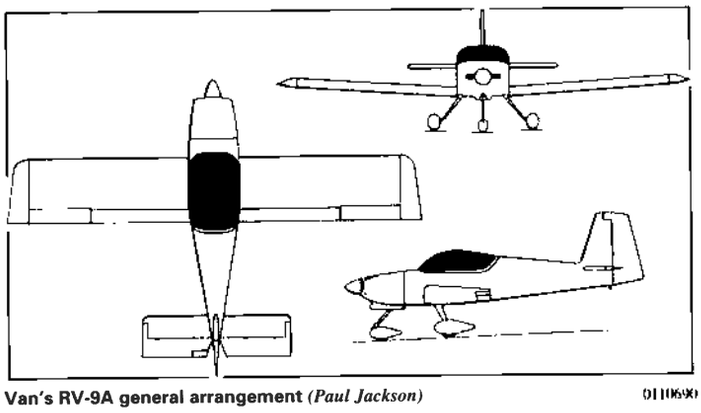
DIMENSIONS, EXTERNAL:
- Wing span: both ..... 8.53 m (28 ft 0 in)
- Length overall: both ..... 6.22 m (20 ft 5 in)
- Height overall: RV-9 ..... 1.83 m (6 ft 0 in)
- RV-9A ..... 2.39 m (7 ft 10 in)
- Propeller diameter ..... 1.83 m (6 ft 0 in)

DIMENSIONS, INTERNAL: As RV-7

AREAS:
- Wings, gross ..... 11.52 m² (124.0 sq ft)

WEIGHTS AND LOADINGS (119 kW; 160 hp engine):
- Weight empty ..... 476 kg (1,050 lb)
- Max baggage weight ..... 45 kg (100 lb)
- Max T-O weight ..... 793 kg (1,750 lb)
- Max wing loading ..... 68.9 kg/m² (14.11 lb/sq ft)
- Max power loading ..... 6.66 kg/kW (10.94 lb/hp)

PERFORMANCE (119 kW; 160 hp engine):
- Max operating speed: RV-9 ..... 170 kt (315 km/h; 196 mph)
- RV-9A ..... 169 kt (312 km/h; 194 mph)
- Cruising speed at 75% power:
- RV-9 ..... 163 kt (303 km/h; 188 mph)
- RV-9A ..... 162 kt (299 km/h; 186 mph)
- Stalling speed, flaps down: both ..... 44 kt (81 km/h; 50 mph)
- Max rate of climb at S/L: both ..... 427 m (1,400 ft)/min
- Service ceiling: RV-9 ..... 5,790 m (19,000 ft)
- RV-9A ..... 5,640 m (18,500 ft)
- T-O run: both ..... 145 m (475 ft)
- Landing run: both ..... 137 m (450 ft)
- Range at 75% power:
- RV-9 ..... 617 n miles (1,142 km; 710 miles)
- RV-9A ..... 608 n miles (1,126 km; 700 miles)



Van's RV-9A general arrangement *(Paul Jackson)* 0110690

Van's RV-9 two-seat kitbuilt *(Paul Jackson)* 1040509

VAN'S RV-10

TYPE: Four-seat kitbuilt.

PROGRAMME: Programme announced in late 2001 and wooden mockup of cabin shown when first flight expected second quarter of 2003; this achieved by prototype (N410RV) on 29 May 2003. Exhibited at AirVenture, Oshkosh, July 2003. Kit deliveries started 25 September 2003. Second prototype (N220RV) first flown 31 August 2004.

CUSTOMERS: By September 2006, 631 kits had been sold and 49 aircraft were flying.

COSTS: Standard kit USD36,180; quick-build kit USD46,230 (2006).

DESIGN FEATURES: Similar to other members of RV series; designed to carry four 1.90 m (6 ft 3 in) tall adults. Wing incidence 1°, dihedral 3.5°. Van's proprietary aerofoil.

FLYING CONTROLS: Conventional and manual. Horn-balanced rudder and elevator; actuation by cables (rudder) and pushrods. Fowler electric flaps. Tabs in both elevators.

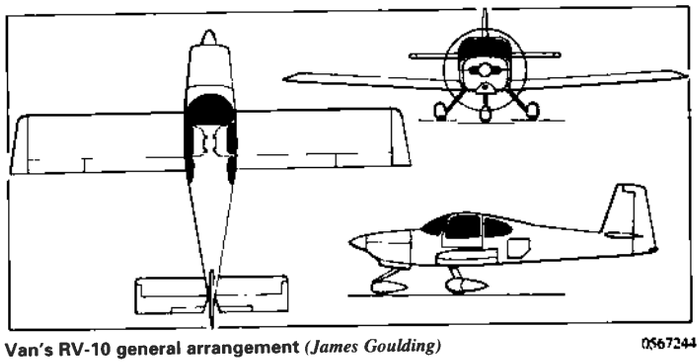
STRUCTURE: Similar to RV-7 and RV-9; monocoque with composites cabin top, wingtips and wingroot. Two-spar wing.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted, rakedback Wittman tapered steel cantilever mainwheel legs with composites trouser; cantilever trailing-link nosewheel leg with trouser and compressed rubber shock-absorber. 6.00-6 tyres on all wheels; Cleveland disc brakes on mainwheels. Optional speed fairings.

POWER PLANT: Prototype fitted with one 194 kW (260 hp) Textron Lycoming IO-540 flat-six driving a Hartzell F8477-4 two-blade, constant-speed propeller. Engines in the range 149 to 194 kW (200 to 260 hp) can be fitted. Second prototype fitted with 157 kW (210 hp) Teledyne Continental IO-360. Total fuel capacity 227 litres (60.0 US gallons; 50.0 Imp gallons) in two wing leading-edge tanks.

ACCOMMODATION: Pilot and three passengers in two pairs of seats; rear seatbacks remove to increase baggage space. Cabin has gull-wing door on each side. Baggage door on port fuselage side behind cockpit.

DIMENSIONS, EXTERNAL:
- Wing span ..... 9.68 m (31 ft 9 in)
- Wing aspect ratio 6.8
- Length overall ..... 7.44 m (24 ft 5 in)
- Height overall ..... 2.64 m (8 ft 8 in)



Van's RV-10 general arrangement *(James Goulding)* 0567244

Four-seat Van's RV-10 ***(Paul Jackson)*** 1040510

DIMENSIONS, INTERNAL:
- Cabin: Max width ..... 1.23 m (4 ft 0¼ in)
- Max height ..... 1.03 m (3 ft 4½ in)
- Baggage volume ..... 0.37 m³ (13.0 cu ft)

AREAS:
- Wings, gross ..... 13.75 m² (148.0 sq ft)

WEIGHT AND LOADINGS (194 kW; 260 hp engine):
- Weight empty ..... 726 kg (1,600 lb)
- Max baggage weight ..... 45 kg (100 lb)
- Max T-O weight ..... 1,224 kg (2,700 lb)
- Max wing loading ..... 89.1 kg/m² (18.24 lb/sq ft)
- Max power loading ..... 6.32 kg/kW (10.38 lb/hp)

PERFORMANCE (194 kW; 260 hp engine):
- Max operating speed (VMO) ..... 180 kt (334 km/h; 208 mph)
- Normal cruising speed at 75% power ..... 171 kt (317 km/h; 197 mph)
- Econ cruising speed at 55% power ..... 152 kt (282 km/h; 175 mph)
- Stalling speed, flaps down ..... 55 kt (102 km/h; 63 mph)
- Max rate of climb at S/L ..... 442 m (1,450 ft)/min
- Service ceiling ..... 6,096 m (20,000 ft)
- T-O run ..... 152 m (500 ft)
- Landing run ..... 198 m (650 ft)
- Range at 75% power at FL80 ..... 716 n miles (1,327 km; 825 miles)

VAN'S RV-11

TYPE: Motor glider.

PROGRAMME: Private, slow-moving project being built by Richard VanGrunsven, with forward fuselage under construction by 2004. Initially to be proof-of-concept aircraft; neither first flight nor decision whether it will be available as a kit or production aircraft had taken place by end 2006.

DESIGN FEATURES: Wings from Schreder HP-18 sailplane.

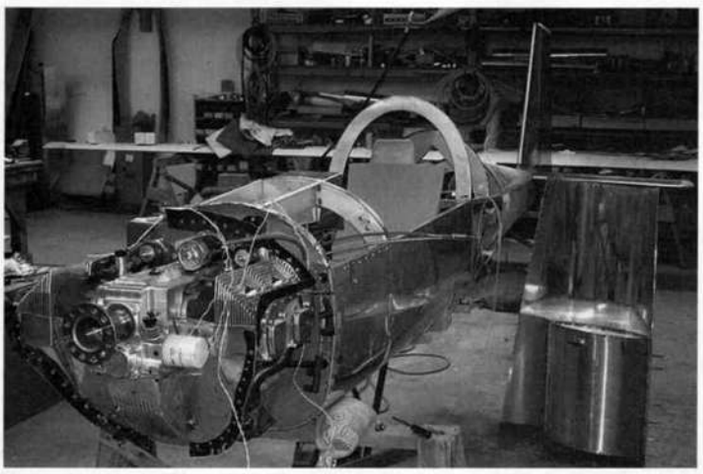
STRUCTURE: Fuselage of aluminium. Wings have metal spars and PVC ribs bonded to aluminium skins.

LANDING GEAR: Semi-retractable monowheel.

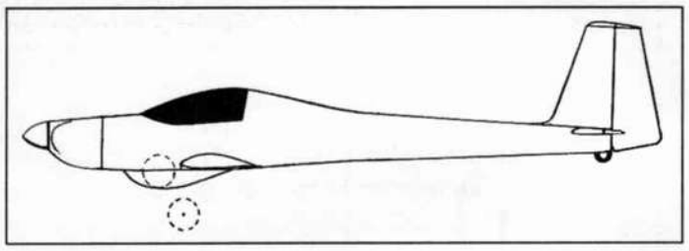
POWER PLANT: One 59.7 kW (80 hp) Jabiru 2200 engine. Fuel in single tank behind cockpit and attached to upper fuselage skin.

ACCOMMODATION: Canopy taken from RV-4 and modified.

DIMENSIONS, EXTERNAL:
- Wing span (provisional) ..... 15.00 m (49 ft 2½ in)



Incomplete Van's RV-11 airframe 1040479



Side view of Van's RV-11 1047712

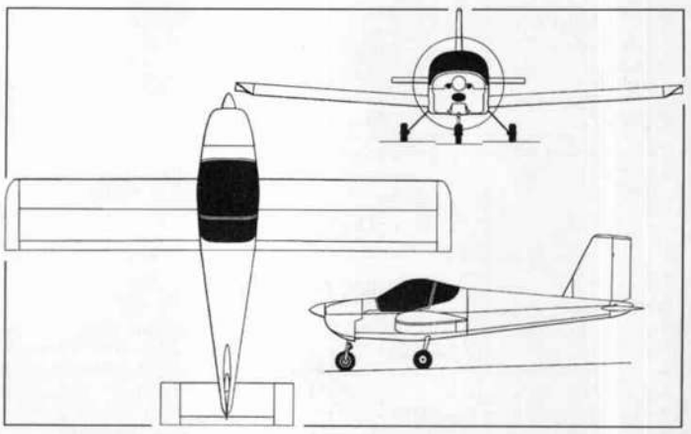
VAN'S RV-12

TYPE: Side-by-side kitbuilt.

PROGRAMME: Incomplete proof-of-concept aircraft shown at AirVenture, Oshkosh, July 2006. First flight (N912VA) 9 November 2006. Kits expected to be available by end 2007.

Van's RV-12 proof-of-concept prototype taxying for its first flight on 9 November 2006 1040484

Van's RV-12 instrument panel 1040485



Van's RV-12 general arrangement ***(Paul Jackson)*** 1158986

DESIGN FEATURES: Objectives for homebuilders include low parts count, to reduce kit costs and assembly time; systems installation at the lowest possible level of structural subassembly; minimal use of composites; maximum use of simple hand tools, possibly eliminating the need for pneumatic tools. Performance intended to meet LSA criteria.

Low, constant-chord wing with Hoerner tips; trapezoidal fin and low-mounted tailplane. Wings removable for storage: two spar stubs projecting from the inboard ends of the wings overlap inside the fuselage and are secured with two large pins, fitting into machined bushings.

FLYING CONTROLS: Manual. Full-span flaperons and all-moving tailplane.

STRUCTURE: Generally of riveted aluminium; glass fibre engine cowling.

LANDING GEAR: Fixed. Fuselage-mounted cantilever spring steel mainwheel legs; steerable nosewheel.

POWER PLANT: One 73.5 kW (98.6 hp) Rotax 912S flat-four, driving a Sensenich ground-adjustable pitch propeller. Fuel capacity 76 litres (20.0 US gallons; 16.7 Imp gallons).

ACCOMMODATION: Two persons, side by side. Forward-hinged canopy/windscreen; rear window each side.

AVIONICS: All-glass instrument panel including two-screen Dynon EFIS/engine monitor, Garmin SL40 com/nav, 196 GPS and GTX 327 transponder.

DIMENSIONS, EXTERNAL:
- Wing span ..... 8.13 m (26 ft 8 in)
- Wing aspect ratio 5.9
- Length overall ..... 6.07 m (19 ft 11 in)

DIMENSIONS, INTERNAL:
- Cabin max width ..... 1.09 m (3 ft 7 in)

AREAS:
- Wings, gross ..... 11.14 m² (120.0 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty ..... 340 kg (750 lb)
- Max baggage weight ..... 23 kg (50 lb)
- Max T-O weight ..... 598 kg (1,320 lb)
- Max wing loading ..... 53.7 kg/m² (11.00 lb/sq ft)
- Max power loading ..... 8.15 kg/kW (13.38 lb/hp)

PERFORMANCE (estimated):
- Max level speed ..... 120 kt (222 km/h; 138 mph)
- Stalling speed ..... 45 kt (83 km/h; 51 mph)

VAT

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Formed in 1989, Vertical Aviation Technologies Inc is FAA-approved repair facility for various Sikorsky helicopters. The company remanufactures Sikorsky S-55/H-19s, S-58/H-34s and S-62s. In 1984, began to modify four-seat Sikorsky S-52-3 former production helicopter (of which 95 originally produced, mainly for US Marine Corps as HO5S) into kit for assembly by individuals, corporations or military; all tooling and fixtures completed by 1988. Promotion and manufacture was interrupted by S-55 upgrade effort, but resumed at Sun 'n' Fun in April 2002, when upgraded S-52 was first shown.

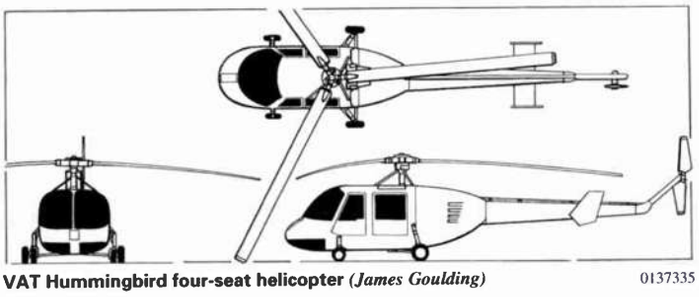
The company had 844 m² (9,090 sq ft) of manufacturing space and a workforce of 11 in 2006.

VAT HUMMINGBIRD

TYPE: Four-seat helicopter kitbuilt.

PROGRAMME: Based on previously type-certified Sikorsky S-52-3 and first flown 1990. (S-52 prototype flew 12 February 1947; total 95 built). First batch of sales between 1989 and 1993; promotion lapsed between 1993 and 2001, when VAT efforts directed towards S-55QT Whisper Jet conversion. Modified Hummingbird shown at Sun 'n' Fun in April 2002; twin anhedral tail strakes replaced by more conventional horizontal stabilisers with endplates; Lycoming engine replacing 194 kW (260 hp) Ford Taurus V-8; doors and engine cowling of composites. Lycoming version renamed **Hummingbird 260L** to reflect new engine; first flew with Lycoming on 11 November 2002.

CUSTOMERS: Nine Hummingbird kits sold in 2006 in addition to 14 earlier versions. Customers in Australia (four), China, Hungary, New Zealand, Slovak Republic, South Africa, USA and UK. Further deliveries due from second production run in 2007.



VAT Hummingbird four-seat helicopter *(James Goulding)* 0137335

COSTS: Kit USD170,520 (2006), including engine, but excluding avionics and upholstery. Quick-build fuselage USD48,300.

DESIGN FEATURES: Newly manufactured airframes and tailcones identical to S-52-3, except for nose section, which is based on Bell JetRanger. Quoted build time 800 hours; kit includes original Sikorsky components. Quick-build version introduced November 2006, reducing build time by up to 75 per cent.

FLYING CONTROLS: Conventional and manual. Two anhedral stabilisers of original S-52 replaced from 2002 by horizontal unit with endplates.

STRUCTURE: Mainly aluminium, with GFRP nose (from Bell JetRanger), doors, engine cowling, tailplane endplates and tailcone. Monocoque cabin and tailboom; metal tube centre-section.

LANDING GEAR: Four-wheel type, fixed. Rear wheels on horizontal, tubular metal hinged Vs with shock plunger braced to fuselage side. Front wheels attached to vertical shock-absorbers by scissor links, absorbers mounted outboard of fuselage on metal arms to increase track. Rear wheels 5.00-5; forward wheels 4.10/3.50. Hydraulic brakes on rear.

POWER PLANT: One 194 kW (260 hp) Textron Lycoming VO-435-A1F derated to 186 kW (250 hp) driving three-blade fully articulated main rotor and two-blade tail rotor. Unlimited transmission. Fuel capacity 216 litres (57.0 US gallons; 47.5 Imp gallons); optional 83 litre (22.0 US gallon; 18.3 Imp gallon) auxiliary fuel tank available. Oil capacity 11 litres (3.0 US gallons; 2.5 Imp gallons).

ACCOMMODATION: Four persons, including pilot(s); door each side at front; rear door port only.

DIMENSIONS, EXTERNAL:

Main rotor diameter	10.06 m (33 ft 0 in)
Tail rotor diameter	1.75 m (5 ft 9 in)
Length: overall, rotors turning	12.11 m (39 ft 9 in)
fuselage	9.30 m (30 ft 6 in)
Distance between rotor centres	6.07 m (19 ft 11 in)
Height: to top of rotor head	2.62 m (8 ft 7 in)
overall	2.95 m (9 ft 8 in)
Fuselage max width	1.52 m (5 ft 0 in)
Wheel track: forward	1.83 m (6 ft 0 in)
rear	2.49 m (8 ft 2 in)
Wheelbase	1.88 m (6 ft 2 in)

AREAS:

Main rotor disc	79.46 m² (855.3 sq ft)
Tail rotor disc	2.41 m² (25.97 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	794 kg (1,750 lb)
Max T-O weight	1,225 kg (2,700 lb)
Max disc loading	15.4 kg/m² (3.16 lb/sq ft)
Max power loading	6.57 kg/kW (10.80 lb/hp)

PERFORMANCE (three-blade rotor):

Never-exceed speed (VNE)	95 kt (177 km/h; 110 mph)
Cruising speed	78 kt (145 km/h; 90 mph)
Max rate of climb at S/L at 1,043 kg (2,300 lb)	381 m (1,250 ft)/min
Hovering ceiling: IGE	2,745 m (9,000 ft)
OGE	1,220 m (4,000 ft)
Service ceiling	3,660 m (12,000 ft)
Range: normal fuel	325 n miles (603 km; 375 miles)
max fuel	434 n miles (804 km; 500 miles)

VAT Hummingbird 260L *(Paul Jackson)* 1040514

VELOCITY

VELOCITY INC

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PRESIDENT: Scott Swing
VICE-PRESIDENT: R Scott Baker

Velocity was formed in 1984 by Danny Maher to develop a four-seat canard aircraft based on the Rutan LongEz; prototype first flew in July 1985; company was purchased by the Swing family in 1992. Latest version is the XL-5; the company also provides support for the SE model.

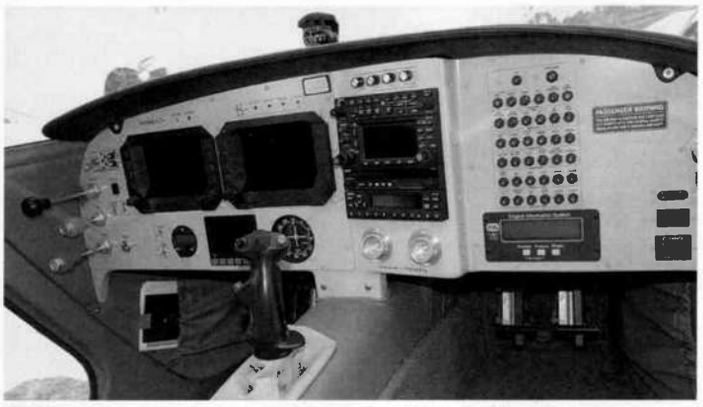
In October 2005, Velocity had a workforce of 15.

VELOCITY XL-5

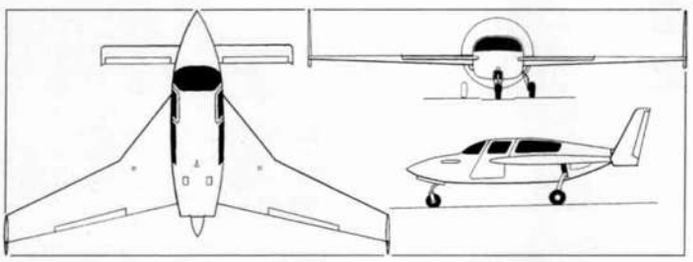
TYPE: Four-seat kitbuilt.

PROGRAMME: Design of the initial fixed-gear Velocity (N401DM), based upon the Rutan LongEz, began in December 1984 and was first flown in July 1985 after making public non-flying debut at Sun 'n' Fun that year. Retractable landing gear option introduced in 1990; LW (formerly 173) with larger wing introduced in 1992 and Elite in 1995, latter becoming SE (Standard Elite). Earlier versions, including the LW (Type 173), are no longer available.

Velocity XL-5 demonstrator 1040480



EFIS instrument panel of a recently-completed Velocity XL *(Paul Jackson)* 1040511



Velocity XL-RG canard kitbuilt *(Paul Jackson)* 1133251

CURRENT VERSIONS: **Velocity SE-FG:** Standard version with fixed landing gear, powered by engines in 119 to 149 kW (160 to 200 hp) range.

Velocity SE-RG: As SE-FG with retractable landing gear.

Velocity XL-FG: Introduced July 1997; large cabin version (14 cm; 5½ in wider, 25 cm; 10 in fuselage stretch) with fixed landing gear; engines in 194 to 231 kW (260 to 310 hp) range.

Velocity XL-RG: As XL-FG with retractable landing gear. One aircraft recently fitted with Sky Watcher surveillance system and described as optionally piloted.

Velocity TXL-RG-5: As XL-RG but with 231 kW (310 hp) Continental TSIO-550 turbocharged engine. Flight testing under way in 2006.

Velocity XL-5: Introduced in 2003; externally as XL models; internally has three-person rear bench seat.

Velocity UAV: Self-funded development by Proxy Aviation Systems; three built by 2006.

CUSTOMERS: Around 700 Velocity kits of all versions sold by September 2006. Total of 210 SE, 100 XL and 35 XL-55 flying at this time.

COSTS: SE standard kit USD31,950; XL standard kit USD42,950; fastbuild options for both include wings (USD11,500), fuselage (USD7,700); retractable landing gear (USD8,500) and -5 conversion (for XL only), USD2,800 (all 2006).

DESIGN FEATURES: Mid-wing monoplane with foreplanes. Rear-mounted wings with Eppler aerofoil section. Three Roncz vortillons under leading edge of each wing. Fin and rudder at end of each wing; constant chord foreplanes on nose. Early versions had electro-hydraulic speed brake under fuselage. Quoted build time 1,200 to 1,500 hours, which reduces to around 800 hours with fast-build kit.

FLYING CONTROLS: Manual. Top-hinged Frise ailerons on trailing edge of wing; almost full-span elevators on foreplane with Flettner fixed tab on starboard elevator; rudder on each fin hinges outwards only. No flaps. Fixed landing gear versions have drag-producing speed brake on underside of fuselage, operable by electric linear actuator; optional on RG versions.

STRUCTURE: Primarily foam composite construction using E-glass and Divyncell foam core materials of varying thicknesses. S-glass construction used on spars and main landing gear. Carbon fibre also used throughout airframe; 4130 steel tube and aluminium front landing gear, control linkages and flight control systems.

LANDING GEAR: Tricycle type; option of fixed or retractable. Mainwheel legs of glass fibre. On retractable versions, nosewheel retracts rearwards and mainwheels outwards into underside of strakes; retraction achieved with electro-hydraulic pump. Mainwheel doors attached to legs. SE and XL have Matco mainwheels and Asuza (SE) or Matco (XL) nosewheel; XL-5 has Cleveland mainwheels and Matco nosewheel. SE has 15×6.00-6 low profile mainwheel tyres and 340×5.00 nosewheel tyre; XL versions have 6.00×6 mainwheel tyres and 5.00×5 nosewheel tyre. Speed fairings on fixed-gear models.

POWER PLANT: *SE:* Typically one 149 kW (200 hp) Textron Lycoming IO-360 flat-four driving a three-blade MT Propeller MTV-9-D/LD178-102 constant-speed composites propeller; other recommended engines include 119 kW (160 hp) Textron Lycoming IO-320, 164 kW (220 hp) Franklin 6A-350-C1R and 134 kW (180 hp) Superior TNIO-360. Fuel capacity 227 litres (60.0 US gallons; 50.0 Imp gallons).

XL and XL-5: Typically one 231 kW (310 hp) Teledyne Continental IO-550 flat-six with optional FADEC driving three-blade Catto fixed-pitch propeller; other recommended engines include 194 kW (260 hp) Textron Lycoming IO-540D. Standard fuel capacity 265 litres (70.0 US gallons; 58.3 Imp gallons) on XL-RG and 322 litres (85.0 US gallons; 70.8 Imp gallons) on XL-FG; option to increase to 352 litres 93.0 US gallons; 77.4 Imp gallons) on latter.

Velocity also offers 119 kW (160 hp) DeltaHawk DH160V4 four-cylinder turbocharged Diesel engine on SE; can also be retrofitted to earlier Standard and LW (173) versions.

ACCOMMODATION: Individual seats in SE and XL; XL-5 has bench seat in rear; latter splits 60-40 to allow access to baggage compartment behind seats. Gull-wing doors each side of cockpit.

AVIONICS: Glass cockpit options include Garmin suite of GNS-430 GPS/NAV/COM; GTX327 transponder and GMA340 audio panel.

EQUIPMENT: Optional BRS ballistic recovery parachute in XL-5.

DIMENSIONS, EXTERNAL:

Wing span: SE	8.94 m (29 ft 4 in)
XL, XL-5	9.45 m (31 ft 0 in)
Foreplane span: SE	4.17 m (13 ft 8 in)
XL, XL-5	4.77 m (15 ft 8 in)
Length overall: SE	5.79 m (19 ft 0 in)
XL, XL-5	6.10 m (20 ft 0 in)
Height overall: all	2.36 m (7 ft 9 in)
Wheel track: all	2.03 m (6 ft 8 in)
Wheelbase: SE	2.54 m (8 ft 4 in)
XL, XL-5	2.79 m (9 ft 2 in)

DIMENSIONS, INTERNAL:

Cabin: Length: SE	2.13 m (7 ft 0 in)
XL, XL-5	2.39 m (7 ft 10 in)
Max width: SE	1.07 m (3 ft 6 in)
XL, XL-5	1.21 m (3 ft 11½ in)
Max height: SE	1.07 m (3 ft 6 in)
XL, XL-5	1.10 m (3 ft 7½ in)

AREAS:

Wings, gross: SE	9.48 m² (102.0 sq ft)
XL, XL-5	11.38 m² (122.5 sq ft)
Foreplanes (total): SE	1.84 m² (19.80 sq ft)
XL, XL-5	2.12 m² (22.80 sq ft)

WEIGHTS AND LOADINGS (A: SE-RG with 149 kW; 200 hp Lycoming; B: XL-FG with 194 kW; 260 hp Lycoming; C: XL-RG with 231 kW; 310 hp Continental):

Weight empty: SE	590 kg (1,300 lb)
XL	771 kg (1,700 lb)
XL-5	816 kg (1,800 lb)
Max T-O weight: SE	1,043 kg (2,300 lb)
XL	1,224 kg (2,700 lb)
XL-5	1,315 kg (2,900 lb)
Max wing loading: A	110.1 kg/m² (22.55 lb/sq ft)
B	107.6 kg/m² (22.04 lb/sq ft)
C	115.6 kg/m² (23.67 lb/sq ft)
Max power loading: A	7.00 kg/kW (11.50 lb/hp)
B	6.32 kg/kW (10.38 lb/hp)
C	5.69 kg/kW (9.35 lb/hp)

PERFORMANCE (A, B, C as above):

Never-exceed speed (VNE): all	200 kt (370 km/h; 230 mph) IAS
Normal cruising speed at 75% power: A, B	175 kt (324 km/h; 201 mph)
C	205 kt (380 km/h; 236 mph)
Stalling speed: A	60 kt (112 km/h; 69 mph)
B, C	65 kt (121 km/h; 75 mph)
Max rate of climb at S/L: A, B	366 m (1,200 ft)/min
C	457 m (1,500 ft)/min
Service ceiling: A	5,486 m (18,000 ft)
B, C	more than 6,096 m (20,000 ft)
T-O run: A, B	427 m (1,400 ft)
C	396 m (1,300 ft)
Landing run: all	457 m (1,500 ft)
Range at 65% power: A:	1,240 n miles (2,296 km; 1,427 miles)
B	875 n miles (1,620 km; 1,006 miles)
C	1,000 n miles (1,852 km; 1,150 miles)
g limits: SE	+12/–7
XL, XL-5	+9/–7

VIPER

VIPER AIRCRAFT CORPORATION

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PRESIDENT: Scott Hanchette
VICE-PRESIDENT: Dan Hanchette

Viper Aircraft's first product is the ViperJet. Series production is now under way.

VIPER VIPERJET

TYPE: Two-seat jet sportplane kitbuilt.

PROGRAMME: Development began in 1988; engineering by AirBoss Aerospace; tooling began in 1996; prototype was initially designed around a Teledyne Continental TSIO-520 and named ViperFan; in early 1999 a switch to jet propulsion was revealed and aircraft renamed ViperJet; development of ViperFan will continue as a lower priority. Prototype (N520VF), officially registered as Hanchette ViperJet) first flown 22 October 1999 and displayed publicly at Oshkosh in July 2000; underwent further modifications; seriously damaged in crash at St George, Utah, on 13 March 2002, but repaired and rolled out October 2004. Demonstrated at AirVenture, Oshkosh, in July 2005 following return to airworthy standard (certificate issue) 11 May 2005 and first flight (as Viperjet II) on 12 June 2005.

Middle East marketing begun in late 2005 by Jordan Aerospace Industries as JAI **Shibel**.

Viper ViperJet demonstrator in Mk II form *(Paul Jackson)* 1040515

CURRENT VERSIONS: **ViperFan:** Initial piston-engined version.
ViperJet: Jet-powered prototype.
ViperJet Mk II: Production version, *as described.*

CUSTOMERS: Total 18 sold and one flown by mid-2005; three aircraft registered by 2003, including No.3 (N999VJ) to Russell Skinner of Dana Point, California, although not declared complete by late 2006.

COSTS: Kit US$183,400; engine extra. Pressurisation upgrade US$39,000; builder-assistance programme US$75,000 (2006).

DESIGN FEATURES: High-performance personal jet at self-build price. Low wing with sweptback leading-edge and initially with winglets; sweptback tail surfaces with fin fillet and twin ventral strakes.

Wing aerofoil section NACA 65-215 at root, NACA 65-212 at tip; horizontal tail NACA 66-212; vertical tail NACA 63-015. Wing incidence at root 1.84°, twist 2.86°.

Quoted build time 2,000 hours using builder-assistance programme.

FLYING CONTROLS: Conventional and manual. Ailerons have inboard horn balance and trim tab, port; horn-balanced rudder; mass- and horn-balanced elevators with anti-balance tab starboard and trim tab port. Electric double-slotted flaps, span 1.65 m (5 ft 5 in) deflecting between 0 and 45°; aileron span 1.22 m (4 ft 0 in), deflection 27° up and 18° down; rudder deflection ±25°; elevator deflection ±30°. Perforated airbrake below each wingroot.

STRUCTURE: Extensive use of composites; much of this provided by Unlimited Composites of Scappoose, Oregon. Preformed skins and wing spars. 'Glue and bolt' assembly.

LANDING GEAR: Tricycle type; retractable. Nosewheel retracts rearwards, mainwheels inwards. Mainwheels 4.5×5.5-6, hydraulic brakes; nosewheel 5.00-5, steerable. Oleo on each leg. Mainwheels partly visible when retracted; production aircraft will not have landing gear doors.

POWER PLANT: Prototype initially powered by one refurbished Turbomeca Marboré 2 turbojet rated at 3.91 kN (880 lb st); later changed to converted General Electric T58-8F rated at 4.44 kN (1,000 lb st). Other engine options include versions of Marboré up to 4.89 kN (1,100 lb st). Performance data based on 13.12 kN (2,950 lb st) General Electric J85/CJ-610 derated to 12.0 kN (2,700 lb st). Fuel capacity 511 litres (135 US gallons; 112 Imp gallons) in prototype; 1,022 litres (270 US gallons; 225 Imp gallons) of which 1,004 litres (265 US gallons; 221 Imp gallons usable) in wingroot tanks on production models.

ACCOMMODATION: One or two pilots in tandem in unpressurised cockpit; cockpit pressurisation upgrade is available. Single-piece windscreen; separate, rear-hinged, single-piece canopy also holds rear instrument panel.

AVIONICS: *Comms:* Garmin GMA 340 nav/com and Bendix/King KY 96A transponder in prototype.

Instrumentation: Op Technologies Flight Op 200 MFD.

DIMENSIONS, EXTERNAL:

Wing span	9.14 m (30 ft 0 in)
Wing chord: at root	1.78 m (5 ft 10 in)
at tip	0.61 m (2 ft 0 in)
Wing aspect ratio	6.9
Length overall	7.75 m (25 ft 5 in)
Height overall	3.25 m (10 ft 8 in)
Tailplane span	4.06 m (13 ft 4 in)

DIMENSIONS, INTERNAL:

Cockpit: Length	2.92 m (9 ft 7 in)
Max width	0.76 m (2 ft 6 in)
Max height	1.24 m (4 ft 1 in)

AREAS:

Wings, gross	12.08 m² (130.0 sq ft)
Horizontal tail	3.77 m² (40.56 sq ft)
Vertical tail	1.92 m² (20.63 sq ft)

WEIGHTS AND LOADINGS (J85 engine):

Weight empty	1,292 kg (2,850 lb)
Max T-O weight: normal	2,268 kg (5,000 lb)
max	2,494 kg (5,500 lb)
Max baggage weight	45 kg (100 lb)
Max wing loading	206.6 kg/m² (42.31 lb/sq ft)
Max power loading	208 kg/kN (2.04 lb/lb st)

PERFORMANCE (estimated):

Never-exceed speed (VNE)	456 kt (844 km/h; 525 mph)
Max level speed at FL180	380 kt (703 km/h; 437 mph)
Stalling speed, flaps down	77 kt (143 km/h; 89 mph)
Max rate of climb at S/L	3,050 m (10,000 ft)/min
Service ceiling	10,665 m (35,000 ft)
T-O run	366 m (1,200 ft)
Landing run	762 m (2,500 ft)
Range with max fuel, 45 min reserve	800 n miles (1,481 km/h; 920 miles)
Endurance	2 h 0 min
g limits	±12

VSTOL

VSTOL AIRCRAFT CORPORATION

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CEO: Dick Turner

VSTOL is responsible for marketing the SST 2000 Pairadigm and SS 2000 Super Solution series of kitbuilt aircraft, notably for crop spraying. Mr Turner has been designing ultralight aircraft since 1983. Kits are produced in Venezuela.

VSTOL SST 2000 PAIRADIGM

TYPE: Agricultural sprayer twin.

PROGRAMME: Designed by Dick Turner and developed from the Star Flight XC 280 Stiletto, which first flew January 1997. A previous single-engined version is known as the **Super Solution 2000**, hence, PAIRadigm for twin version.

CUSTOMERS: Over 400 of both single- and twin-engined versions are flying. Some used for crop-spraying.

COSTS: USD85,000 with full spray equipment (2006). Estimated total cost to completion USD105,000.

VSTOL Pairadigm agricultural sprayer with exposed rear fuselage and cruciform empennage 1044876

DESIGN FEATURES: Designed for slow speed and high AOAs; engines close to centreline for optimum control in the event of failure of one. Two pusher engines mounted side by side at rear of fuselage; propellers partly overlap and rotate in same direction. Wings have full length leading-edge slats and are removable for storage. Versions exist with exposed and covered fuselage structure and low and medium tailplane positions.

FLYING CONTROLS: Conventional and manual. Actuation by stainless steel cables. Leading-edge slats. Frise ailerons, slotted three position flaps and horn-balanced rudder.

STRUCTURE: 4130 steel and aluminium tubing throughout; fabric-covered V-braced wings and composites fuselage skin; braced tailplane. Extended wings are optional. Cabin enclosure removable.

LANDING GEAR: Fixed; choice of nose- or tailwheel versions; Fuselage mounted spring metal tube cantilever mainwheel legs with wire cross-bracing to fuselage centreline. Hydraulic disk brakes; wheel size 152 mm (6 in). Steerable nosewheel on tricycle model.

POWER PLANT: Two engines, each between 37.3 and 74.6 kW (50 and 100 hp); 48.5 kW (65 hp) Hirth 2706 engines are recommended. Fuel capacity 75.7 litres (20.0 US gallons; 16.7 Imp gallons) in two wing tanks.

EQUIPMENT: Crop-spraying kit includes 189 litre (50.0 US gallon; 41.6 Imp gallon) chemical tank and 8.23 m (27 ft) sprayboom with 16 nozzles. Swath width 16.76 m (55 ft).

DIMENSIONS, EXTERNAL:

Wing span	10.52 m (34 ft 6 in)
Wing aspect ratio	6.3
Length overall	7.16 m (23 ft 6 in)
Height overall	2.59 m (8 ft 6 in)

AREAS:

Wings, gross	17.65 m² (190.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	408 kg (900 lb)
Max T-O weight	771 kg (1,700 lb)
Max wing loading	43.7 kg/m² (8.95 lb/sq ft)

PERFORMANCE:

Never-exceed speed (VNE)	108 kt (201 km/h; 125 mph)
Max level speed	78 kt (145 km/h; 90 mph)
Normal cruising speed	61 kt (113 km/h; 70 mph)
Stalling speed	26 kt (47 km/h; 29 mph)
Max rate of climb at S/L	244 m (800 ft)/min
Rate of climb at S/L, OEI	61 m (200 ft)/min
Service ceiling	3,660 m (12,000 ft)
T-O run	46 m (150 ft)
Landing run	31 m (100 ft)
Range at cruising speed	250 n miles (463 km; 287 miles)
g limits	+4.4/−2.2

WACO

WACO AIRCRAFT COMPANY OHIO INC

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Web: www.wacokit.com
DIRECTORS:
Mike Fisher
John Kennard
Ben Bagnall

Founded 1 June 2001, Waco produced kit replicas of the UMF design built in the early 1930s by the US company of the same name and certified under ATC 546 on 11 July 1934. Mike Fisher is founder of Fisher Flying Products. The company had a workforce of four at its 297 m² (3,200 sq ft) factory but all the company's stock of jigs, patterns and materials was auctioned on 17 October 2006.

(Weaver Aircraft Company formed 1920 and traded as WACO; renamed Waco Aircraft Company at Troy, Ohio, in 1928 and ceased aircraft production in 1947.)

WACO UMF

TYPE: Three-seat biplane/kitbuilt.

PROGRAMME: UMF indicates Continental R-670 or W-670 engine; 1934 open cockpit; tandem cockpits. Originals built 1934 and 1935; production totalled 77. Prototype of recent series (N2021N) built 1999 and first flown 4 June 2000. Demonstrator N30056, built 2002 and first public display at AirVenture '02, July 2002; registered as Waco YMF, having Jacobs R755-B2 engine (for which ZMF more accurate designation).

Production terminated and company liquidated in 2006.

WACO CLASSIC

WACO CLASSIC AIRCRAFT CORPORATION

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PRESIDENT: Mitchell Lampert
GENERAL MANAGER: Patrick Horgan

Waco Classic (known until 1997 as Classic Aircraft) delivers some five or six aircraft per year. It originated in 1983 at Lansing, Michigan, and acquired the Waco YMF-5 type certificate from the FAA; manufacturing authority was assigned in February 1984. The company moved into a purpose-built, 2,800 m² (30,000 sq ft) factory at W K Kellogg Airport, Battle Creek, in April 2000; 90th aircraft handed over at official opening of factory on 20 May 2000; 100th followed in 2002, with 112th delivered in April 2006, to a customer in Massachusetts. By November 2006, the 118th airframe had been completed and was awaiting a customer.

WACO CLASSIC YMF SUPER

TYPE: Three-seat biplane.

PROGRAMME: Construction began March 1984 under type certificate of original, pre-Second World War Waco YMF-5; first flight of prototype (N1935B) 20 November 1985; FAA certification 10 March 1986; marketed initially as F-5, differing from original in having 300 modifications, including new throttle control, wheels, brakes, electrical system, starting system, engine and propeller, plus steerable tailwheel; modern constructional materials and methods; MTOW 1,202 kg (2,650 lb). Recertified 28 January 1988 at 1,256 kg (2,770 lb) from 10th aircraft onwards, and Supplemental Type Certificate issued 24 June 1991 incorporating changes to throttle control, wheels and brakes, electrical and starting system, engine, propeller and tailwheel.

YMF Super certified 24 June 1991 with stretched fuselage and further increase in MTOW; balanced rudder; designation F5C; introduced at 40th aircraft.

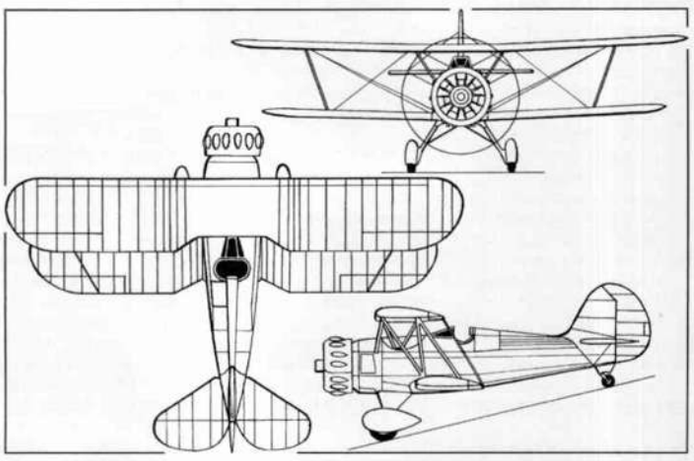
CURRENT VERSIONS: **YMF Super:** Fuselage stretched 15 cm (6 in); larger front cockpit than previous standard F-5 version for commercial pleasure flying; enlarged forward door; front and rear cockpits 10 cm (4 in) longer; front cockpit 6.3 cm (2½ in) wider.

CUSTOMERS: Total 116 (including F-5s) sold by November 2006. Exported to Australia, Canada, Germany, Japan, Kenya, Mexico, South Africa, Switzerland and the Caribbean. One delivered to Germany in February 2005, and one to the UK in April 2005.

COSTS: Standard equipped aircraft USD349,000 (2005).

DESIGN FEATURES: Single-bay biplane of 1930s vintage. Wings braced with N-type interplane struts, plus flying and landing wires, with double-N cabane. Elliptical wingtips. Cross-braced landing gear. Helmeted engine cowling.

Wing section Clark Y; dihedral 2°, incidence 0° on upper and lower wings.



Waco Classic YMF Super three-seat biplane *(James Goulding)* 1158557

G-WOCO, the United Kingdom's first Waco Classic YMF Super *(Paul Jackson)* 1129524

FLYING CONTROLS: Conventional and manual. Interconnected ailerons on upper and lower wings; no tabs. Horn-balanced tail surfaces. Tailplane trim by screw-jack actuator; ground-adjustable trim tab on rudder. Control surface movements; ailerons ±25°; elevator +33°/–27°; rudder ±30°.

Waco Classic YMF Super built in 2006 *(Paul Jackson)* 1158599

STRUCTURE: Modern construction techniques, tolerances and materials applied to original design. Steel interplane struts; streamlined stainless steel flying and landing wires; all-wood wing with Dacron covering; aluminium ailerons with external chordwise stiffening. Fuselage of 4130 welded steel tubes with internal oiling for corrosion protection; wooden bulkheads; Dacron covering. Braced welded steel tube tail surfaces with Dacron covering. Helmeted aluminium engine cowling.

LANDING GEAR: Tailwheel type; fixed. Shock-absorption by oil and spring shock-struts with radius rod bracing. Steerable tailwheel. Cleveland 30-67F hydraulic brakes on mainwheels only. Cleveland 40-101A mainwheels, tyre size 7.50–10; Cleveland 40-199A tailwheel, tyre size 3.50–10. Fairings standard on main legs and wheels; tailwheel fairing optional. DeVore Aviation PK3000 floats optional.

POWER PLANT: One 205 kW (275 hp) Jacobs R-755-B2M or –B2 air-cooled radial engine (remanufactured), driving a Sensenich W90T6J- or W96J-series two-blade, fixed-pitch, wooden propeller. Hamilton Standard 2B20 constant-speed propeller with spinner optional. Fuel in two aluminium tanks in upper wing centre-section, usable capacity 182 litres (48.0 US gallons; 40.0 Imp gallons). Refuelling point for each tank in upper wing surface. Auxiliary tanks, usable capacity 45.4 litres (12.0 US gallons; 10.0 Imp gallons) each, optional in either or both inboard upper wing panels. Oil capacity 15 litres (4.0 US gallons; 3.3 Imp gallons) standard;18.9 litres (5.0 US gallons; 4.2 Imp gallons) when additional fuel tanks installed. Fuel injection system optional.

ACCOMMODATION: Three seats in tandem open cockpits, two side by side in front position, single seat at rear. Controls in both cockpits; toe brakes in rear only. Seat belts with shoulder harness, and pilot's adjustable seat, standard. Lockable front and rear baggage compartments. Front windscreen removable.

SYSTEMS: 24 V electrical system with two batteries, alternator and starter for electrical supply to navigation, strobe and rear cockpit lights. Hydraulic system for brakes only.

AVIONICS: Customer specified. Bendix/King and Garmin VFR and IFR packages available. S-Tec 30 autopilot optional.

Instrumentation: Compass, airspeed indicator, turn and bank indicator, rate of climb indicator, sensitive altimeter, recording tachometer, cylinder head temperature gauge and oil pressure and oil temperature gauges standard in rear cockpit. Front cockpit instruments optional. Other options include exhaust gas temperature gauge, carburettor temperature gauge, *g* meter, vacuum or electrically driven gyro system, Hobbs meter (engine-time recorder), outside air temperature gauge and manifold gauge.

EQUIPMENT: Instrument post lighting, heated pitot, three-colour paint scheme with choice of two designs, landing and taxying lights, front and rear cockpit heaters, also standard. Optional equipment includes ground service plug, flight-approved metal front cockpit cover, glider tow hook, deluxe interior with carpet, leather sidewalls and interior trim, and special exterior paint designs.

DIMENSIONS, EXTERNAL:

Wing span: upper	9.14 m (30 ft 0 in)
lower	8.18 m (26 ft 10 in)
Length overall	7.26 m (23 ft 10 in)
Height overall	2.59 m (8 ft 6 in)
Wheelbase	1.95 m (6 ft 5 in)
Propeller diameter	2.44 m (7 ft 8 in)

DIMENSIONS, INTERNAL:

Rear baggage compartment volume	0.21 m^3 (7.5 cu ft)

AREAS:

Wings, gross	21.69 m^2 (233.5 sq ft)

WEIGHTS AND LOADINGS:

Basic weight empty	900 kg (1,985 lb)
Baggage capacity: front	11 kg (25 lb)
rear	34 kg (75 lb)
Max T-O and landing weight	1,338 kg (2,950 lb)
Max wing loading	61.7 kg/m^2 (12.63 lb/sq ft)
Max power loading	6.53 kg/kW (10.73 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	186 kt (344 km/h; 214 mph)
Max level speed at S/L	117 kt (217 km/h; 135 mph)
Max cruising speed at S/L	104 kt (193 km/h; 120 mph)
Econ cruising speed at FL80	95 kt (177 km/h; 110 mph)
Stalling speed, power off	51 kt (95 km/h; 59 mph)
Max rate of climb at S/L	235 m (770 ft)/min
T-O run	152 m (500 ft)
Range, standard fuel, 30 min reserves	286 n miles (531 km; 330 miles)
g limits	+5.5/–2.2

WAG-AERO

WAG-AERO INC

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DIRECTOR, TECHNICAL: Tom O'Neill
MARKETING SUPERVISOR: Mary Pat Henningfield

Company founded in early 1960s, initially to supply light aircraft spares. Three aircraft types currently offered, based on Piper designs. Founders Dick and Bobbie Wagner sold Wag-Aero to Bill Read and Mary Myers on 1 September 1995. Some 7,000 kits or sets of plans have been sold; kit sales represent approximately 15 per cent of company revenue.

Recent additions to the company product line include replacement wing spars for a wide range of Aeroncas.

WAG-AERO SPORT TRAINER

TYPE: Tandem-seat kitbuilt.

PROGRAMME: Modernised kitbuilt version of 1937 Piper J3. Sport Trainer first flew 12 March 1975.

CURRENT VERSIONS: **Sport Trainer:** Basic two-seat design. Quoted build time of 1,200 hours; conforms to FAA 51 per cent rule.

Description applies to Sport Trainer.

Acro Trainer: Differs from standard version by having strengthened fuselage, shortened wings (8.23 m; 27 ft 0 in), modified lift struts, improved wing fittings and rib spacing, and new leading-edge.

Observer: Replica of Piper L-4 military liaison aircraft.

Super Sport: Structural modifications to accept engines of up to 112 kW (150 hp), making it suitable for glider towing, bush operations, or as floatplane.

CUSTOMERS: 4,193 sets of plans and kits sold by mid-2001; more than 200 flying by December 2006.

COSTS: Plans: USD125; kit USD31,849 with Continental engine finishing kit, USD33,501 with Lycoming finishing kit (2006).

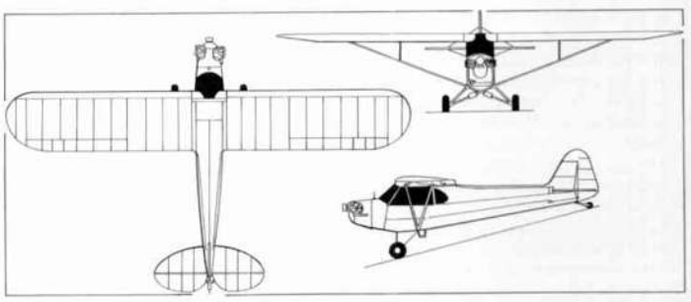
DESIGN FEATURES: High-wing cabin monoplane with braced wings and tailplane.

FLYING CONTROLS: Conventional and manual. Horn-balanced rudder.

STRUCTURE: Fuselage and empennage of welded 4130 chrome molybdenum steel tube with fabric covering; wooden wing with light alloy leading-edge and fabric covering.

LANDING GEAR: Tailwheel type; fixed. Two faired-in welded steel tube side Vs hinged to lower longerons, plus half axles, each with bungee cord shock-absorber, attached to compression frame. Optional wheel fairings.

Wag-Aero Sport Trainer *(Paul Jackson)* 1040512



General arrangement of the Wag-Aero Sport Trainer *(Paul Jackson)* 0526902

POWER PLANT: Can be powered by any flat-four Teledyne Continental, Franklin or Textron Lycoming engine between 48.5 and 93 kW (65 and 125 hp). Standard fuel capacity 45.4 litres (12.0 US gallons; 10.0 Imp gallons); auxiliary fuel capacity 98.4 litres (26.0 US gallons; 21.7 Imp gallons).

ACCOMMODATION: Two persons in tandem. Horizontally split door on starboard side.

DIMENSIONS, EXTERNAL:

Wing span	10.73 m (35 ft 2½ in)
Wing chord, constant	1.60 m (5 ft 3 in)
Wing aspect ratio	6.9
Length overall	6.82 m (22 ft 4½ in)
Height overall	2.03 m (6 ft 8 in)
Wheel track	1.80 m (5 ft 11 in)

AREAS:

Wings, gross	16.58 m^2 (178.5 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	327 kg (720 lb)
Max T-O weight	635 kg (1,400 lb)
Max wing loading	38.3 kg/m^2 (7.84 lb/sq ft)
Max power loading	6.82 kg/kW (11.20 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	104 kt (193 km/h; 120 mph)
Max level speed at S/L	89 kt (164 km/h; 102 mph)
Cruising speed	82 kt (151 km/h; 94 mph)
Stalling speed	34 kt (63 km/h; 39 mph)
Max rate of climb at S/L	149 m (490 ft)/min
Service ceiling	3,660 m (12,000 ft)
T-O run	122 m (400 ft)
Landing run	130 m (425 ft)
Range:	
at cruising speed with standard fuel	270 n miles (500 km; 310 miles)
with auxiliary fuel	395 n miles (732 km; 455 miles)

WAG-AERO WAG-A-BOND

TYPE: Side-by-side kitbuilt.

PROGRAMME: Replica of 1948 Piper PA-17 Vagabond. Prototype Wag-A-Bond completed May 1978; plans and kits available. Conforms to FAA 51 per cent rule.

Alternative engine installation tested late 2005 when NX707SV flown with 74.6 kW (100 hp) Corvair O-164 converted motorcar engine and Ware Drive two-blade composites propeller (later replaced by Sensenich wooden unit).

CUSTOMERS: 1,519 plans and kits sold by mid-2001; more than 70 flying by December 2006.

COSTS: Plans USD125 (2006). Kit USD18,000 (2003).

DESIGN FEATURES: Two versions (**Classic** and **Traveler**); Traveler is modified and updated version of Vagabond with port and starboard doors, overhead skylight window, extended sleeping deck (conversion from aircraft to camper interior taking about 2 minutes and

Wag-Aero Wag-A-Bond with Corvair O-164 engine *(Paul Jackson)* 1040513

accommodating two persons), extended baggage area, engine of up to 85.7 kW (115 hp), and provision for full electrical system.
Wing section USA 35B.

FLYING CONTROLS: Conventional and manual; all controls cable-actuated. Frise ailerons. Horn-balanced rudder. Tab on port elevator. Pitch trim by variable incidence tailplane.

STRUCTURE: All-wood wing and aluminium alloy aileron structures. Welded 4130 steel tube and flat plate fuselage structure, and steel tube tail unit. Single streamlined wing bracing strut. Complete airframe is fabric covered.

LANDING GEAR: Tailwheel type; fixed; faired-in side V main gear with compressed rubber suspension and half axle. Mainwheel tyres 7.00–6; Cleveland hydraulic brakes. Optional skis.

POWER PLANT: Traveler can be powered by a Textron Lycoming engine of 80.5 to 85.7 kW (108 to 115 hp). Classic can be powered by a Teledyne Continental engine of 48.5 to 74.5 kW (65 to 100 hp). Fuel capacity: Traveler 98.4 litres (26.0 US gallons; 21.6 Imp gallons), Classic 45.4 litres (12.0 US gallons; 10.0 Imp gallons).

ACCOMMODATION: Two persons side by side on adjustable bench seat; cabin includes baggage stowage. Forward-opening cabin door on each side of fuselage.

SYSTEMS: Optional electrical system in Traveler.

DIMENSIONS, EXTERNAL:

Wing span	8.32 m (29 ft 3½ in)
Wing chord, constant	1.60 m (5 ft 3 in)
Wing aspect ratio	5.0
Length overall	5.70 m (18 ft 8½ in)
Height overall	1.83 m (6 ft 0 in)
Wheel track	1.83 m (6 ft 0 in)

DIMENSIONS, INTERNAL:

Cabin max width	1.02 m (3 ft 4 in)

AREAS:

Wings, gross	13.70 m² (147.5 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: Classic	318 kg (700 lb)
Traveler	363 kg (800 lb)
Max baggage weight: Classic	18 kg (40 lb)
Traveler	27 kg (60 lb)
Max T-O weight: Classic	567 kg (1,250 lb)
Traveler	658 kg (1,450 lb)
Max wing loading: Classic	41.4 kg/m² (8.47 lb/sq ft)
Traveler	48.0 kg/m² (9.83 lb/sq ft)
Max power loading: Classic	7.61 kg/kW (12.50 lb/hp)
Traveler	7.67 kg/kW (12.61 lb/hp)

PERFORMANCE:

Max level speed: Classic	91 kt (169 km/h; 105 mph)
Traveler	118 kt (219 km/h; 136 mph)
Cruising speed: Classic	83 kt (153 km/h; 95 mph)
Traveler	104 kt (193 km/h; 120 mph)
Stalling speed: Classic, Traveler	39 kt (71 km/h; 44 mph)
Max rate of climb at S/L: Classic	190 m (625 ft)/min
Traveler	259 m (850 ft)/min
Service ceiling: both	4,260 m (14,000 ft)
T-O run: both	119 m (390 ft)
Landing run: both	232 m (760 ft)
Range: both	620 n miles (1,148 km; 713 miles)

WAG-AERO 2+2 SPORTSMAN

TYPE: Four-seat kitbuilt.

PROGRAMME: Version of the Piper PA-14 Family Cruiser. Plans and material kits available. Conforms to FAA 51 per cent rule.

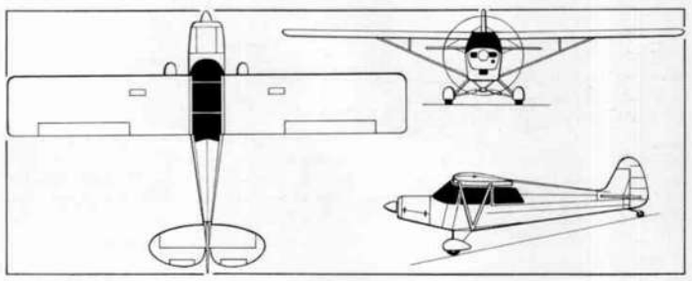
CUSTOMERS: 1,971 sets of plans and kits sold by May 2001; more than 30 flying by December 2006.

COSTS: Plans: USD125; kit USD18,000 (2006).

DESIGN FEATURES: True four-seater, with option of hinged rear fuselage decking to provide access to baggage and rear seat areas. Conventional, high-wing configuration with V-type bracing struts, wire-braced empennage, mid-mounted tailplane and classic fin and rudder.
Wing section USA 35B.

FLYING CONTROLS: Conventional and manual. Horn-balanced rudder. Upper and lower spoilers; trim tabs on both elevators. Aileron limits ±17°; elevator limits 34° up, 29° down.

Wag-Aero 2+2 Sportsman *(Paul Jackson)* 1040516



Wag-Aero 2+2 Sportsman *(James Goulding)* 0526903

STRUCTURE: Similar construction to Wag-A-Bond, with glass fibre wingtips. Alternatively, drawings and materials provided to modify standard PA-12, PA-14 or PA-18 wings. Prewelded fuselage structure also available.

LANDING GEAR: Tailwheel type; fixed; as Sport Trainer; main units use 8.00-6 or 7.00-6 tyres. Optional floats.

POWER PLANT: Engine of 93 to 149 kW (125 to 200 hp). Usable fuel capacity 148 litres (39.0 US gallons; 32.5 Imp gallons).

ACCOMMODATION: Four persons; two separate front seats, plus rear bench seat which is removable for stretcher or cargo carrying. Baggage area to rear of bench seat. Forward-opening cabin door on each side.

DIMENSIONS, EXTERNAL:

Wing span	10.90 m (35 ft 9 in)
Wing chord, constant	1.60 m (5 ft 3 in)
Wing aspect ratio	7.3
Length overall	7.12 m (23 ft 4½ in)
Height overall	2.02 m (6 ft 7½ in)
Wheel track	1.98 m (6 ft 6 in)

DIMENSIONS, INTERNAL:

Cabin max width	0.99 m (3 ft 3 in)

AREAS:

Wings, gross	16.18 m² (174.1 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	490 kg (1,080 lb)
Max T-O weight	998 kg (2,200 lb)
Max wing loading	61.7 kg/m² (12.63 lb/sq ft)
Max power loading	6.70 kg/kW (11.00 lb/hp)

PERFORMANCE (typical; actual data depend on engine fitted):

Max level speed	112 kt (207 km/h; 129 mph)
Cruising speed	108 kt (200 km/h; 124 mph)
Stalling speed	33 kt (62 km/h; 38 mph)
Max rate of climb at S/L	244 m (800 ft)/min
Service ceiling	4,510 m (14,800 ft)
T-O run	70 m (230 ft)
Landing run	104 m (340 ft)
Range at cruising speed	670 n miles (1,240 km; 771 miles)

WARNER

WARNER AEROCRAFT COMPANY

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PRESIDENT: Dana Axelrod
SALES MANAGER: Mike Dwyer

Warner Aerocraft markets the Warner Sportster. Its earlier Spacewalker and Revolution have been sold to Serenity Aviation of Singapore.

WARNER SPORTSTER

TYPE: Tandem-seat sportplane kitbuilt.

PROGRAMME: Development of Country Air (later Warner and now Serenity) Space Walker, of which 46 built. Two-seat versions of Space Walker developed as Revolution I (48.5 kW; 65 hp Teledyne Continental) and Revolution II (74.6 kW; 100 hp Textron Lycoming); further power increase produced Sportster; prototype (N269U) first flown 18 April 1998. New version with revised canopy introduced 2002 and has replaced original model aircraft; length reduced to 6.20 m (20 ft 4 in). Prototype registered N69DA. An LSA compliant example was under construction and was expected to appear at Sun 'n' Fun, April 2007; original Sportster has been withdrawn in anticipation.

CUSTOMERS: 125 Space Walkers and Revolutions built, plus 11 Sportsters by 2006.

COSTS: Basic kit USD16,495; fast-build kit USD19,995 (2006). Cost of LSA compliant version estimated at USD69,900.

DESIGN FEATURES: Quoted build time 700 hours. Roll rate 45°/s.

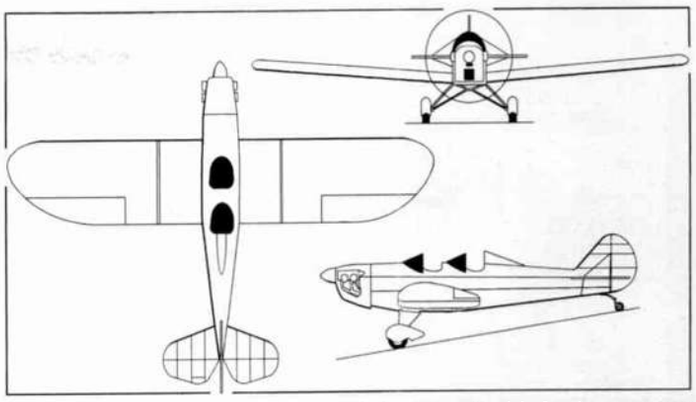
FLYING CONTROLS: Conventional and manual. Horn-balanced rudder and elevators; trim tab in port elevator. Dual controls.

STRUCTURE: 4130 steel tube and fabric fuselage with wooden turtle deck; fabric-covered two-spar metal wings. Glass fibre cowling and wingtips. Tail unit identical to Revolution/Space Walker. Compared to early version, new Sportster has lower bottom longeron and lowered bulkheads forward of cockpit.

LANDING GEAR: Tailwheel type; fixed. Two faired-in side Vs hinged to lower longerons with crossover half-axles and spring shock-absorbers. 6.00-6 tyres, Cleveland wheels with disc brakes. Steerable 15 cm (6 in) Maule tailwheel. Speed fairings on mainwheels.

POWER PLANT: Engines from 63.4 to 119 kW (85 to 160 hp) can be fitted; LSA version has 74.6 kW (100 hp) Teledyne Continental O-200. Fuel capacity 76 litres (20.0 US gallons; 16.7 Imp gallons).

Warner Sportster with covered rear cockpit *(Paul Jackson)* 1040517



Warner Sportster tandem-seat, open-cockpit version *(Paul Jackson)* 1158980

ACCOMMODATION: Pilot and passenger in tandem in individual open cockpits; choice of three styles of windscreen; alternatively, rear cockpit can be covered with a bubble canopy and front canopy temporarily faired over. Compared to early Sportster, new version has slightly more curved lips to accommodate canopy curvature, and instrument panel moved forward.

DIMENSIONS, EXTERNAL:

Wing span	8.53 m (28 ft 0 in)
Wing chord, constant	1.37 m (4 ft 6 in)
Wing aspect ratio	7.0
Length overall	6.20 m (20 ft 4 in)
Max diameter of fuselage	0.76 m (2 ft 6 in)
Height overall	1.68 m (5 ft 7 in)
Propeller ground clearance	0.46 m (1 ft 6 in)
Tailplane span	2.41 m (7 ft 11 in)
Wheel track	1.83 m (6 ft 0 in)
Wheelbase	4.41 m (14 ft 5½ in)

DIMENSIONS, INTERNAL:

Cockpit max width	0.76 m (2 ft 6 in)

AREAS:

Wings, gross	10.41 m² (115.0 sq ft)

WEIGHTS AND LOADINGS (O-290 engine):

Weight empty	386 kg (850 lb)
Max baggage weight	11 kg (25 lb)
Max T-O weight	680 kg (1,400 lb)
Max wing loading	65.4 kg/m² (13.39 lb/sq ft)
Max power loading	7.94 kg/kW (13.04 lb/hp)

PERFORMANCE (O-290 engine):

Never-exceed speed (VNE)	130 kt (241 km/h; 140 mph)
Max level speed	115 kt (212 km/h; 132 mph)
Normal cruising speed	104 kt (193 km/h; 120 mph)
Stalling speed	40 kt (73 km/h; 43 mph)
Max rate of climb at S/L	358 m (1,200 ft)/min
Service ceiling	3,660 m (12,000 ft)
T-O and landing run	130 m (350 ft)
Range with max fuel	356 n miles (659 km; 410 miles)
g limits	+6/–4

WEATHERLY

WEATHERLY AIRCRAFT COMPANY

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Web: www.weatherlyaircraft.com
PRESIDENT AND CEO: Gary Beck
MANUFACTURING MANAGER: Carl Lange

Formed in 1961 by John C Weatherly; developed conversions of Fairchild M-62 for agricultural role, and in 1966 designed the Model 201 of which 97 were built. Further refinement resulted in the Weatherly 620 of 1991, production of which continued at a low rate. Weatherly Aviation Company was declared bankrupt and purchased by GBECK Inc in September 2000, becoming Weatherly Aircraft. The company, with eight employees, moved to a 6,782 m² (73,000 sq ft) facility at McClellan Park, California, the former McClellan AFB, which closed in July 2001. Trading officially began on 13 June 2005. Transfer of the Weatherly 620 Type Certificate was effected on 20 October 2000.

WEATHERLY 620

TYPE: Agricultural sprayer.

PROGRAMME: Developed from Weatherly 201; prototype (N9256W) first flown 1979. Final Weatherly Aviation aircraft was c/n 1655 (N9045Z) in December 1999. Production by Weatherly Aircraft began with c/n 1656, delivered in October 2002 to Banana Fruit Growers, Belize.

CURRENT VERSIONS: **620:** Initial version; no longer available.

620-B: Current piston-engined version, powered by Pratt & Whitney radial engine. Length 8.15 m (26 ft 9 in); height 2.44 m (8 ft 0 in). Slightly different spray equipment but same sized hopper. Total 73 current on US civil register in 2006.

620-TP: Initial turboprop version, with P&WC PT6A-11AG; no longer available. One (N9259W) currently on US register.

620-BTG: Current turboprop version; engine can be retrofitted to earlier versions. None current in US.

Description applies to Weatherly 620-BTG.

CUSTOMERS: By 1999, 155 Weatherly 620s of all versions had been built. Deliveries by Weatherly Aviation included one 620-B for Belize; a 620-BTG for Argentina in 2003; and one to Mid-Continent Aircraft in 2005 and one further in 2006. An order was concluded with Golden Fly on behalf of a North African customer for 20 aircraft on 14 October 2005, valued at USD6.1 million.

Weatherly 620-B (one Pratt & Whitney R-985) 1044831

COSTS: 620-B USD245,000; 620-BTG USD392,000 (2004).

DESIGN FEATURES: High lift:drag ratio wings, with tip vanes for vortex diffusion and increase of swath width; vanes fold downwards for ground handling. Hinged wing leading-edges aid inspection.

FLYING CONTROLS: Conventional and manual. Stainless steel rudder cables.

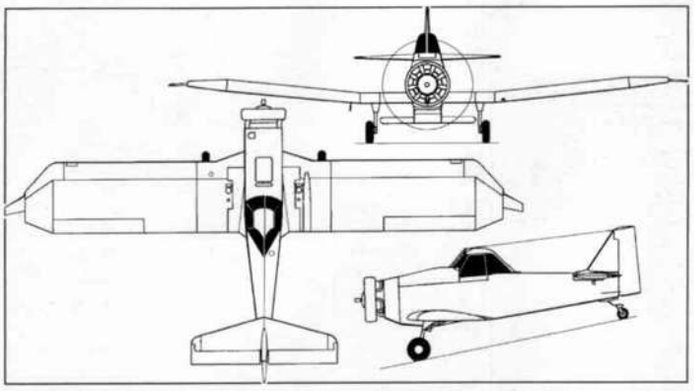
STRUCTURE: All-metal monocoque fuselage; metal wings and control surfaces; glass fibre tail fairings. Rudder deflects ±20°: elevator 27° up and 15° down; ailerons 29° up and 11° 30' down.

Wing incidence 3° at centre-section and 1°12' at tip; dihedral 6°.

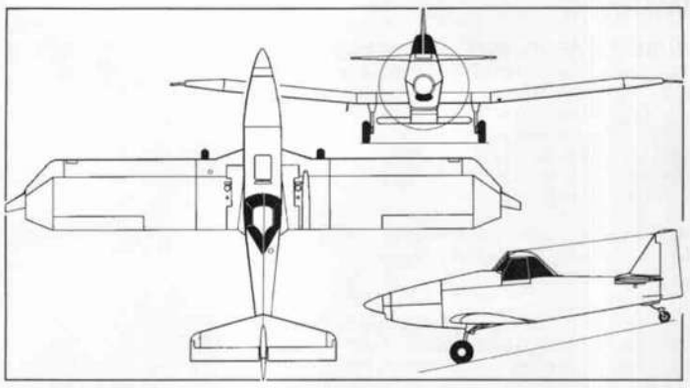
LANDING GEAR: Tailwheel type; fixed. Wing-mounted cantilever mainwheel legs with oleo-pneumatic shock-absorbers attached to main Spar. Cantilever tailwheel assembly with fully castoring and locking wheel. Three-piston Cleveland brakes. Mainwheel tyre size 8.5–10; tailwheel 12.5-4.5.

POWER PLANT: *620-B:* One Pratt & Whitney 336 kW (450 hp) R-985-AN radial engine driving a Hartzell HC-B3R30-4 or -4B three-blade propeller. Fuel capacity 369 litres (97.5 US gallons; 81.1 Imp gallons), of which 341 litres (90.1 US gallons; 75.1 Imp gallons) is usable. Oil capacity 25.3 litres (6.7 US gallons; 5.6 Imp gallons).

620-BTG: One Honeywell TPE331-1 turboprop, derated to 373 kW (500 shp), driving a McCauley 3GFR34C602/100LA-2 three-blade propeller. Fuel capacity 492 litres (131 US gallons; 108 Imp gallons) in seven tanks (two in each wing and three in wing centre-section) of which 439 litres (116 US gallons; 96.5 Imp gallons) usable. Oil capacity 0.6 litre (1.6 US gallons; 1.3 Imp gallons).



Weatherly 620-B (Pratt & Whitney R-985 radial) *(Paul Jackson)* 1158985



Weatherly 620-BTG (Honeywell TPE331 turboprop) 1158984

ACCOMMODATION: Pilot only. Four-way adjustable mesh seat. Baggage compartment behind seat.

SYSTEMS: 24 V electrical system; 50 A Jasco starter/generator in 620-B, 250A Jasco model in 620-BTG. Optional air conditioning and windshield washer/wiper.

EQUIPMENT: Agricultural dispersal system comprises a 1,268 litre (335 US gallon; 279 Imp gallon) hopper in forward fuselage, size 1.35 m³ (47.5 cu ft); Weath-Aero fan; 5 cm (2 in) SS bottom load pump; 5 cm (2 in) Agrinautics spray pump with three-way valve; 6.10 m (20 ft) pylon-mounted drop boom with nozzles every 15 cm (6 in); 63.5 cm (2 ft 1 in) Transland gate box. Main gear and cockpit wire deflectors, plus deflector cable from cabin to fin. Rinse-out system optional, as are stainless steel spray system and flow meters.

DIMENSIONS, EXTERNAL:

Wing span (with vanes extended)	14.22 m (46 ft 8 in)
Wing aspect ratio	7.9
Wing chord	1.98 m (6 ft 6 in)
Length overall	8.15 m (26 ft 9 in)
Height overall	2.90 m (9 ft 6 in)
Wheel track	3.20 m (10 ft 6 in)
Propeller diameter: 620-B	2.43 m (7 ft 11½ in)
620-BTG	2.49 m (8 ft 2 in)

AREAS:

Wings, gross	25.73 m² (277.0 sq ft)
Ailerons	1.21 m² (12.99 sq ft)
Horizontal tail	4.02 m² (43.30 sq ft)
Vertical tail	1.60 m² (17.21 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	1,374 kg (3,030 lb)
Max T-O weight under CAM 8	2,721 kg (6,000 lb)
Baggage shelf	11 kg (25 lb)
Max wing loading	105.8 kg/m² (21.66 lb/sq ft)
Max power loading	8.12 kg/kW (13.33 lb/shp)

PERFORMANCE:

Never-exceed speed (VNE)	153 kt (283 km/h; 176 mph)
Normal operating speed	122 kt (226 km/h; 140 mph)
Stalling speed	62 kt (115 km/h; 72 mph)
Max rate of climb at S/L	427 m (1,400 ft)/min
Service ceiling	4,572 m (15,000 ft)
T-O run	287 m (940 ft)

WINDCRAFTER

WINDCRAFTER INC

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Web: www.windcrafter.com
OWNERS/FOUNDERS: Steve Swearingen
Therin Laney
PILOT: Aaron Shell
SECRETARY/TREASURER: Rick Marecle

Windcrafter manufactures a range of airships of unorthodox design, both manned (ultralight) and unmanned. Basic manned version is the CA 108.

In July 2005, company reduced size of premises leased from Port of Shelton free trade zone at South Puget Sound from 232 m² (2,500 sq ft) to 70 m² (756 sq ft). In September 2006 it reported that it was "in the process of new lighter than air discoveries", and was "exploring flight dynamics that have previously eluded airship designers". No details were given.

WINDCRAFTER CA 108

TYPE: Helium non-rigid airship.

PROGRAMME: No programme history known. A larger model, the CA 2010 (6.10 × 3.05 m; 20 × 10 ft advertising area) is also available. Nothing further reported by late 2006.

COSTS: From USD16,000 including training and accessories (2004).

DESIGN FEATURES: Upright rectangular envelope, of carangifoil (fish-shaped) aerofoil section, with low or negative internal pressure. Engine at base.

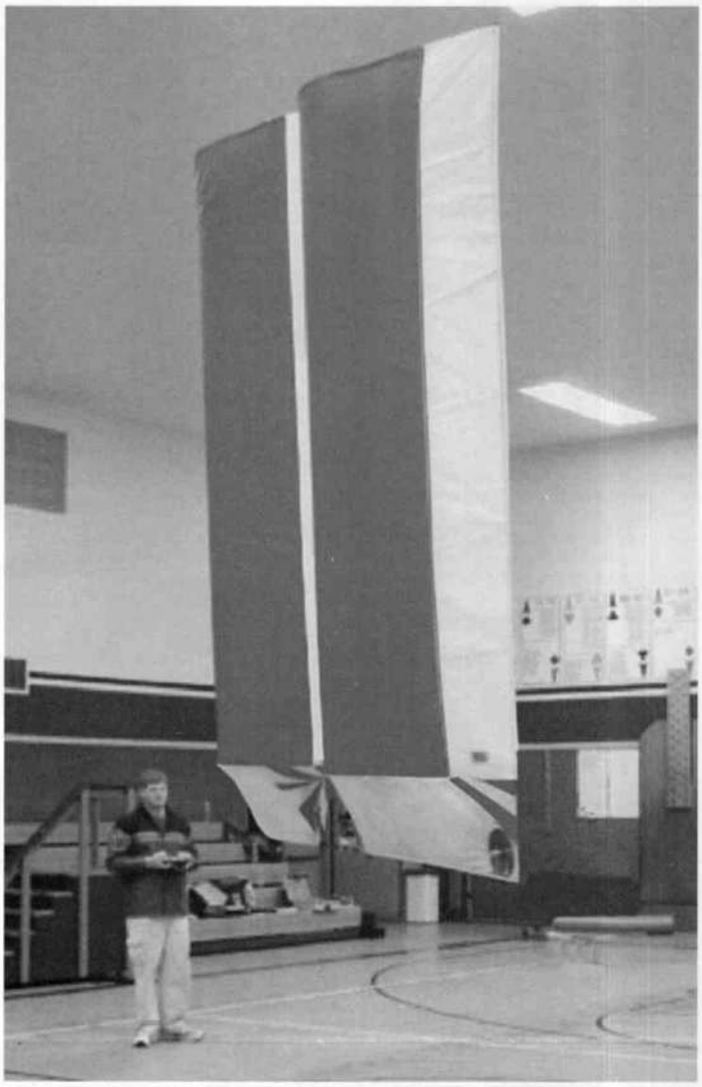
POWER PLANT: Electric brushless motor, powered by lithium polymer battery.

DIMENSIONS, EXTERNAL:

Height	3.53 m (11 ft 7 in)
Advertising banner area (each side):	
Height	3.05 m (10 ft 0 in)
Width	2.44 m (8 ft 0 in)

DIMENSIONS, INTERNAL:

Volume	more than 2.83 m³ (100 cu ft)



One of Windcrafter's radio-controlled unmanned carangifoil airships 1047199

WINGTIP TO WINGTIP

WINGTIP TO WINGTIP LLC

7453 M-50, Onsted, Michigan 49265
Tel: (+1 517) 467 74 20
email: wingtiptowingtip@aol.com
PRESIDENT: Greg Panzl

Since 1990, total of 37 aerobatic aircraft in the S-300 family have been built and have gained high placings in competitions in the US and abroad. The Staudacher company was purchased in 1999 by Greg Panzl, brother of S-300 aerobatic pilot Chris Panzl, and has launched an improved version under the new name of Wingtip to Wingtip. The company has its own private airstrip at Onsted. Staudachers have proved popular subjects for aeromodellers/building scale radio-controlled examples.

WINGTIP TO WINGTIP PANZL S-330

TYPE: Aerobatic two-seat sportplane.

PROGRAMME: Designed by Jon A Staudacher. First Staudacher S-300 built for Mike Goulian in 1990; design progressively refined throughout 1990s. Seven Staudachers participated in 1993 US national championships.

CURRENT VERSIONS: **S-300:** Baseline version; *as described*. Several subvariants, up to S-300E.

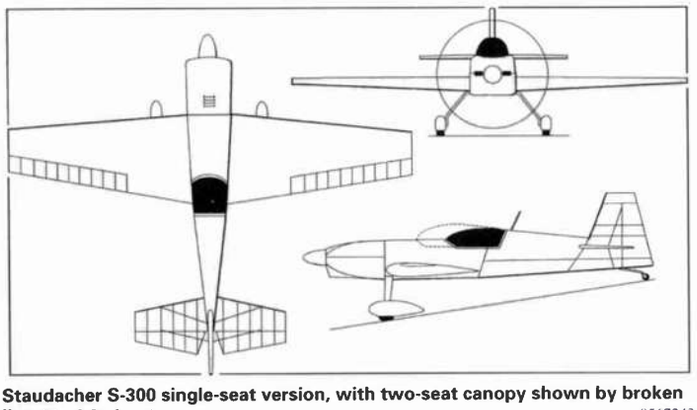
S-300RG: Retractable landing gear; cantilever tailplane; IO-540-K engine and two-blade Hartzell propeller. One only (N126RG), first flown 22 February 1998.

S-600: Tandem two-seat version; cockpit enlarged forward. Four S-600/S-600N built.

S-600F: Tandem two-seat derivative of S-300 and S-600 intended for cross-country and aerobatic training. Full dual controls and second baggage space between firewall and cockpit; composites shell over tubular fuselage. Prototype (N603SA) under construction during 2003 and completed in 2004; second aircraft, N252CW, then under construction; third and fourth built in 2005 and 2006.

Panzl S-330 P: Prototype (N330LS) delivered to Loren Smith 24 July 2000; second built 2001; third registered in July 2002; fourth in July 2003; fifth (N541FC) in July 2004. Derived from S-300, but with improved canopy and carbon fibre panels throughout, resulting in weight saving. Empty weight, equipped, 585 kg (1,289 lb); 246 kW (330 hp) Textron Lycoming IO-540-G1D5 and MTV-9-B-C propeller. Aerobatic fuel 87 litres (23.0 US gallons; 19.2 Imp gallons); ferry tank in each wingroot, combined capacity 159 litres (42.0 US gallons; 35.0 Imp gallons).

Additionally, several custom versions of Staudacher, comprising **S-341** (N341SA), built 1992 with Textron Lycoming GO-480; **S-1000** (N6195V), built 1996 for Jon Staudacher; **DC 11** (N327MS), with Textron Lycoming O-320 built 1992; and **GU 11** (N11GU), with Teledyne Continental O-200 built for Jon Staudacher in 2000.



Staudacher S-300 single-seat version, with two-seat canopy shown by broken line *(Paul Jackson)* 0567243

Latest (fifth) Wingtip-to-Wingtip Panzl S-330, owned by Frank Chenevert *(Paul Jackson)* 1040518

CUSTOMERS: Total 37 aircraft of Staudacher design built by end of 2006, including five Panzl S-330s and four S-600Fs.

DESIGN FEATURES: Created to rival Sukhoi and Extra Unlimited class aerobatic aircraft; roll rate in excess of 420°/s. Low-wing monoplane with wire-braced tail surfaces. Moderately tapered wing; ailerons occupy two-thirds of trailing-edges; all subvariants have same aerofoil.

FLYING CONTROLS: Conventional and manual. Spade-type aileron servos. Trim tab in each elevator. Twin arrowhead-shape horn balance at fin tip.

STRUCTURE: Sitka spruce (wooden) wing built on box spar reinforced with carbon fibre and covered with 3 mm (⅛ in) plywood. Metal (4130 steel) tube fuselage and fabric-covered empennage; carbon fibre front panels, cowling and turtledeck. Fabric-covered ailerons.

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted, spring aluminium cantilever mainwheel legs with wheel fairing. Cantilever tailwheel leg.

POWER PLANT: One 186 kW (250 hp) Textron Lycoming IO-540-B1A5 or 224 kW (300 hp) IO-540-K1B5 flat-six driving an MTV-9-B-C/C200-15 three-blade, constant-speed propeller. Fuel tank ahead of pilot, capacity 129 litres (34.0 US gallons; 28.3 Imp gallons).

ACCOMMODATION: One or two (in tandem) pilots, according to version.

DIMENSIONS, EXTERNAL:

Wing span	7.72 m (25 ft 4 in)
Length overall	6.64 m (21 ft 9½ in)
Height overall	1.80 m (5 ft 11 in)

AREAS:

Wings, gross	10.29 m² (110.8 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	567 kg (1,250 lb)
Max T-O weight (Aerobatic)	725 kg (1,600 lb)
Max wing loading	70.3 kg/m² (14.44 lb/sq ft)
Max power loading (IO-540-K)	3.25 kg/kW (5.33 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	217 kt (402 km/h; 250 mph)
Stalling speed	52 kt (95 km/h; 59 mph)
Max rate of climb at S/L:	
S-330	more than 1,219 m (4,000 ft)/min

YESTERYEAR

BIPLANES OF YESTERYEAR LLC

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Web: www.biplanesofyesteryear.com
DIRECTOR AND DESIGNER: Rod Cowgill

Having won several awards and mentions for his evocation of a First World War German biplane fighter, Mr Cowgill founded Biplanes of Yesteryear in late 2001 and launched a production kit version in 2003.

YESTERYEAR MIFYTER

TYPE: Single-seat ultralight biplane kitbuilt; side-by-side ultralight biplane kitbuilt.

PROGRAMME: Prototype (N666RC) first flown 12 August 1996. Nominated Champion at Arlington 1997 and Grand Champion two years later; further awards at AirVenture, Oshkosh, in 1997 and 2002. Kit available to order from July 2003 and was due to ship early 2004, but no evidence of this. Pronounced 'my fighter'.

CURRENT VERSIONS: **Mifyter:** *As described.*

Biplanes of Yesteryear Mifyter *(Paul Jackson)* 1040522

Bifyter: Side-by-side two-seat version; prototype (N66BY) completed mid-2004. Also marketed as Mifyter II.

COSTS: Kit USD14,995, excluding engine, propeller and instruments (2006). Spoked wheels, dummy bombs, flowing white scarf and machine guns optional.

DESIGN FEATURES: Based on Fokker biplane, with third 'aerofoil' surface between wheels but with same main wing aerofoil as Avid series. Two-bay wings with N-type interplane struts. Quoted build time 650 to 850 hours. Cross-axle lifting surface has Clark 23012 airfoil and is free-floating to accommodate landing gear movement during take-off and landing. Fuselage breaks immediately behind cockpit for transport and storage.

FLYING CONTROLS: Conventional and manual. Large, horn-balanced rudder. Ailerons on both mainplanes.

STRUCTURE: Fuselage of 4130 welded steel tube; wood and 6061-T6 steel wing. Both covered in Stits Polyfiber. Glass fibre nose cowling and wingtips.

POWER PLANT: One piston engine of between 48.5 and 55.9 kW (65 and 75 hp); prototype has inverted 47.0 kW (63.1 hp) Rotax 532 with radiator installed vertically under louvered top cowling. Fuel capacity 57 litres (15.0 US gallons; 12.5 Imp gallons) in upper wing tank.

LANDING GEAR: Tailwheel type; fixed. Two side Vs of metal tube with added streamline fairings hinged to lower longerons, plus half axles spring under centreline. False axle with auxiliary 'aerofoil' between wheels. Main wheels are 35 cm (14 in) with heavy-duty spokes and 51 cm (20 in) Cheng Shin tyres; 17 cm (7 in) Matro tailwheel on prototype; kit aircraft will have 13 cm (5 in) version.

EQUIPMENT: Options include two fake 7.92 mm Spandau machine guns mounted forward of cockpit and bomb beneath fuselage.

DIMENSIONS, EXTERNAL:

Wing span: upper	6.25 m (20 ft 6 in)
lower	5.64 m (18 ft 6 in)
Length overall	5.03 m (16 ft 6 in)
Height overall	2.01 m (6 ft 7 in)

AREAS:

Wings, gross	13.56 m² (146.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	195 kg (430 lb)
Max T-O weight	342 kg (755 lb)

PERFORMANCE:

Max level speed	83 kt (153 km/h; 95 mph)
Cruising speed	65 kt (121 km/h; 75 mph)
Stalling speed	33 kt (60 km/h; 37 mph)
Max rate of climb at S/L	411 m (1,350 ft)/min
T-O run	31 m (100 ft)
Landing run	61 m (200 ft)
Range	304 n miles (563 km; 350 miles)

ZENITH

ZENITH AIRCRAFT COMPANY

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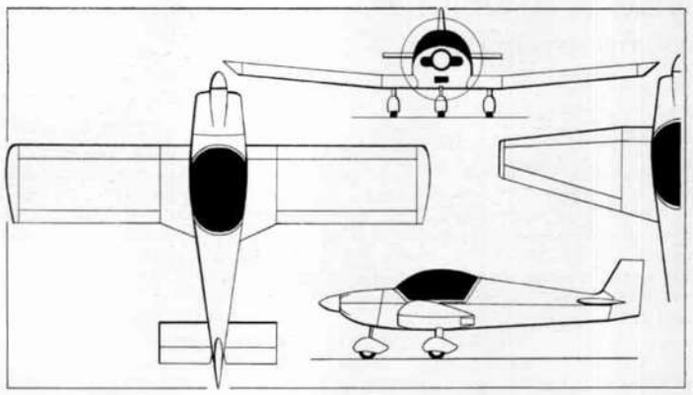
Web: www.zenithair.com
PRESIDENT: Sebastien C Heintz
CHIEF DESIGNER: Christophe Heintz
MANAGER, OFFICE: Joyce Fort
MANAGER, PRODUCTION: Nicholas M Heintz

Zenith Aircraft Company has acquired all rights to manufacture and sell the Canadian Zenair range of light aircraft kits, detailed below. For details of the CH 2000, see AMD in this section. By the end of 2002, over 2,700 kits had been produced.

In 1997, Zenith announced a joint venture with Czech Aircraft Works (CZAW, which see) to assemble the CH 601 and CH 701 for the European market; the agreement was amicably dissolved on 31 December 2006. Additionally these Zenith aircraft are marketed both as complete aircraft and in kit form in Germany and Austria by Roland Aircraft; they are distinguished by the suffix 'D' in model numbers.



Zenith Zodiac CH 601HD, with half-plan view of tapered CH 601HDS wing *(James Goulding)* 1158983

ZENITH ZODIAC CH 601HD

TYPE: Side-by-side ultralight kitbuilt.

PROGRAMME: First flight of CH 600 prototype June 1984. Plans and kits of parts (45 per cent premanufactured) for improved model followed. New **CH 601UL** developed to meet TP 10141 advanced ultralight (AULA) category in Canada. Construction of prototype CH 601 (59.7 kW; 80 hp Rotax 912) began September 1990 (first flight October that year). Kit production started January 1991. UL version (2001 cost USD12,380) remains available.

CURRENT VERSIONS: **CH 601HD:** Offers wider cockpit and extra power for increased performance and true cross-country capability.

CH 601HDS: First flown August 1991. Has shorter, tapered 'speed' wing of 7.01 m (23 ft 0 in) span. HD and UL are available as kits and as 85 per cent pre-assembled kits requiring only quoted 120 working hours to complete, compared to quoted 400 hours for unassembled kits.

Description applies to CH 601HD.

CUSTOMERS: Over 800 of all versions flying by end 2005.

COSTS: Plans: USD315. Kit: USD12,620. Information pack with DVD: USD35 (2006). Materials and component parts are available.

DESIGN FEATURES: Conventional low-wing monoplane with all-moving vertical tail. Conforms to Canadian TP 10141 airworthiness standards. Quoted build time 500 hours.

Wing section NACA 65018 (modified); dihedral 6°, incidence 8°.

FLYING CONTROLS: Manual; push-rod operated. Long-span ailerons; elevators; and Zenith all-moving vertical fin.

STRUCTURE: All-metal semi-monocoque. Single-piece, starboard-hinged canopy.

LANDING GEAR: Fixed; tricycle or tailwheel type. Wing-mounted cantilever main and nose legs with integral shock-absorbers; optional wheel fairings.

POWER PLANT: One engine of 47.7 to 85.75 kW (64 to 115 hp), including 59.6 kW (79.9 hp) Rotax 912 UL, with reduction gear, driving three-blade ground adjustable propeller, 47.8 kW (64.1 hp) Rotax 582 UL, 48.5 to 74.5 kW (65 to 100 hp) Teledyne Continental or 52 kW (70 hp) Volkswagen. 74.6 kW (100 hp) four-cylinder four-stroke liquid-cooled Subaru EA81 is available from Stratos for the CH 601HD. Fuel capacity 60 litres (16.0 US gallons; 13.3 Imp gallons); wing baggage lockers may be fitted with two 26.5 litre (7.0 US gallon; 5.8 Imp gallon) auxiliary tanks.

DIMENSIONS, EXTERNAL:

Wing span	8.23 m (27 ft 0 in)
Wing chord (constant)	1.24 m (4 ft 1 in)
Wing aspect ratio	5.6
Length overall	5.79 m (19 ft 0 in)
Height overall: tailwheel	1.90 m (6 ft 2¾ in)
nosewheel	1.98 m (6 ft 6 in)
Tailplane span	2.31 m (7 ft 7 in)
Wheel track	1.88 m (6 ft 2 in)
Wheelbase	1.30 m (4 ft 3¼ in)
Propeller diameter	1.73 m (5 ft 8 in)

DIMENSIONS, INTERNAL:

Cockpit max width	1.12 m (3 ft 8 in)

AREAS:

Wings, gross	12.08 m² (130.0 sq ft)

WEIGHTS AND LOADINGS (Rotax 912 for power loading):

Weight empty	290 kg (640 lb)
Max baggage weight	36 kg (80 lb)
Max T-O weight	544 kg (1,200 lb)
Max wing loading	45.1 kg/m² (9.23 lb/sq ft)
Max power loading	9.11 kg/kW (15.00 lb/hp)

PERFORMANCE (Rotax 912):

Never-exceed speed (VNE)	130 kt (241 km/h; 150 mph)
Max level speed at S/L	117 kt (217 km/h; 135 mph)
Econ cruising speed	104 kt (193 km/h; 120 mph)
Stalling speed	41 kt (76 km/h; 47 mph)
Max rate of climb at S/L	351 m (1,150 ft)/min
Service ceiling	4,875 m (16,000 ft)
T-O run	131 m (430 ft)
Landing run	159 m (520 ft)
Range with max fuel	677 n miles (1,255 km; 780 miles)
Endurance	4 h
g limits	±6

ZENITH ZODIAC CH 601XL

TYPE: Side-by-side kitbuilt; two-seat lightplane.

PROGRAMME: Certifiable version of CH 601 (which see), with new wing planform and 589 kg (1,300 lb) MTOW. Introduced at Oshkosh in July 1998. A Zodiac CH601XL (N1777W) was displayed at Sun 'n' Fun 2004 fitted with a 2,700 cc (164 cu in) Corvair 0-164 automobile engine; first flight 12 May 2004. A quick-build kit was introduced in 2005; quoted build time 250 hours.

Description generally as for CH 601, except that below.

CURRENT VERSIONS: **CH 601XL:** US kitbuilt version.

CH 601DX: German kitbuilt designation.

Zodiac 601XL SLSA: Factory-built version; see entry under Aircraft Manufacturing and Development (AMD).

Zodiac 601XLi SLSA: As 601XL SLSA, but with full IFR panel; described separately in Aircraft Manufacturing and Development (AMD) section.

COSTS: Plans USD395; Kit USD15,890; quick-build kit USD23,975; factory-built LSA compliant USD75,900; IFR USD89,900 (2006).

DESIGN FEATURES: Wing section NACA 23018 at root, NACA 23015 at tip.

FLYING CONTROLS: Flaps added, maximum deflection 24°. Control surface deflections: ailerons ±12.5/12.5°, elevators +32/–30°, rudder ±22°.

LANDING GEAR: Nosewheel type; fixed. Fuselage-mounted spring cantilever mainwheel legs.

POWER PLANT: One 89 kW (120 hp) Jabiru 3300 flat-six or 86.5 kW (116 hp) Textron Lycoming O-235. Options include 73.5 kW (98.6 hp) Rotax 912 ULS (standard in LSA-compliant models) and conversions of Subaru motorcar engines. Fuel capacity 91 litres (24.0 US gallons; 20.0 Imp gallons) in two wing tanks in 601XL; 114 litres (30.0 US gallons; 25.0 Imp gallons) in 601XLi.

Zenith Zodiac CH 601UL *(Paul Jackson)* 1040519

Zenith Zodiac CH 601XL flown in France as an ultralight *(Paul Jackson)*

1040520

DIMENSIONS, EXTERNAL:
- Wing span ..... 8.23 m (27 ft 0 in)
- Wing chord: at main panel root ..... 1.60 m (5 ft 3 in)
- at tip ..... 1.33 m (4 ft 4¼ in)
- Wing aspect ratio 5.5

DIMENSIONS, INTERNAL:
- Cabin max width ..... 1.12 m (3 ft 8 in)

AREAS:
- Wings, gross ..... 12.26 m² (132.0 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty ..... 363 kg (800 lb)
- Max baggage weight ..... 18 kg (40 lb)
- Max T-O weight ..... 589 kg (1,300 lb)
- Max wing loading ..... 47.5 kg/m² (9.85 lb/sq ft)
- Max power loading ..... 6.82 kg/kW (11.21 lb/hp)

PERFORMANCE (O-235):
- Never-exceed speed (VNE) ..... 156 kt (289 km/h; 180 mph)
- Max level speed ..... 129 kt (238 km/h; 148 mph)
- Normal cruising speed ..... 120 kt (222 km/h; 138 mph)
- Stalling speed, flaps down ..... 39 kt (71 km/h; 44 mph)
- Max rate of climb at S/L ..... 283 m (930 ft)/min
- Service ceiling ..... 4,267 m (14,000 ft)
- T-O and landing run ..... 152 m (500 ft)
- Max range ..... 521 n miles (965 km; 600 miles)
- Endurance, no reserves ..... 4 h 30 min
- *g* limits ..... ±6

ZENITH ZODIAC CH 640

TYPE: Four-seat kitbuilt.

PROGRAMME: Design work started 2 January 2001; prototype (N640Z) first flown 1 March 2001. Public debut at Sun 'n' Fun, April 2001.

CUSTOMERS: Four completed by October 2006, at which time 52 kits had been sold..

COSTS: Standard kit USD24,800; quick-build kit introductory price USD35,190, both without engine, propeller, instruments, electrics and upholstery (2006). Can be purchased in smaller kit packages.

DESIGN FEATURES: Fuselage based on AMD CH 2000 with cabin rear wall moved to allow extra seating; 90 per cent commonality of parts. Influenced by other Zenith designs: area forward of firewall is based on similarly engined Zenith CH 801. However, wings are of new design, incorporating high-lift aerofoil. Quick-build kit includes almost-complete fuselage, wings, ailerons, flaps and tailplane; quoted build time 1,500 hours. Standard kit build time quoted as 1,500 hours. Meets FAA 51 per cent rule.

Wing section LS(1)0417 (mod).

FLYING CONTROLS: Manual. Single-piece all-flying tailplane and rudder. Electrically operated split flaps with maximum deflection of 30°. Anti-balance tab on both ailerons.

STRUCTURE: Stressed-skin semi-monocoque all-metal fuselage of 6061-T6 aluminium sheet riveted to aluminium extrusions. All-metal stressed-skin wings consist of two panels bolted to fuselage spar-box assembly; Hoerner wingtips.

LANDING GEAR: Tricycle type; fixed. Cantilever main legs comprise single piece of 19 mm (¾ in) aluminium. Steerable nosewheel with heavy-duty bungee shock absorption. Cleveland 5.00x5 wheels standard throughout, with option to fit 6.00x6. Cleveland hydraulic single-disc brakes on mainwheels. Optional wheel fairings. Tailskid protects empennage in hard landings.

POWER PLANT: One 134 kW (180 hp) Lycoming IO-360-A1A driving a Sensenich 76-EM8-0-63 two-blade, fixed-pitch propeller; engines between 112 and 149 kW (150 and 200 hp) can be fitted. Standard fuel capacity 144 litres (38.0 US gallons; 31.6 Imp gallons) in two wing tanks forward of wing spar; optional capacity 174 litres (46.0 US gallons; 38.3 Imp gallons).

ACCOMMODATION: Two pairs of seats, designed to withstand loads of 27 *g* . Dual controls. Gull-wing cabin door on each side of fuselage. Roll-over protection bar of 4130N tubing between two forward seat backs is bolted to top of wing main spar.

SYSTEMS: 12 V battery and 14 V 70 A alternator standard. Auxiliary electric fuel pump.

AVIONICS: To customer's choice.

DIMENSIONS, EXTERNAL:
- Wing span ..... 9.60 m (31 ft 6 in)
- Wing chord at root ..... 1.46 m (4 ft 9½ in)
- Wing aspect ratio 6.6
- Length overall ..... 7.01 m (23 ft 0 in)
- Height overall ..... 2.24 m (7 ft 4 in)
- Tailplane span ..... 3.00 m (9 ft 10 in)

DIMENSIONS, INTERNAL:
- Cabin: Length ..... 1.88 m (6 ft 2 in)
- Max width ..... 1.17 m (3 ft 10 in)
- Height, front seat to roof ..... 0.96 m (3 ft 2 in)

AREAS:
- Wings, gross ..... 13.94 m² (150.0 sq ft)
- Tailplane ..... 2.79 m² (30.0 sq ft)

WEIGHTS AND LOADINGS:
- Weight empty ..... 520 kg (1,147 lb)
- Max T-O weight ..... 998 kg (2,200 lb)
- Max wing loading ..... 71.6 kg/m² (14.66 lb/sq ft)
- Max power loading ..... 7.44 kg/kW (12.22 lb/hp)

PERFORMANCE:
- Never-exceed speed (VNE) ..... 139 kt (257 km/h; 160 mph)
- Max operating speed ..... 136 kt (253 km/h; 157 mph)
- Normal cruising speed at 75% power at FL70 ..... 130 kt (241 km/h; 150 mph)
- Stalling speed: flaps up ..... 51 kt (94 km/h; 58 mph)
- flaps down ..... 41 kt (76 km/h; 47 mph)
- Max rate of climb at S/L ..... 290 m (950 ft)/min
- Service ceiling ..... 3,900 m (12,800 ft)
- T-O run ..... 302 m (990 ft)
- Landing run ..... 351 m (1,150 ft)
- Range with standard fuel ..... 443 n miles (820 km; 510 miles)
- Endurance ..... 3 h 45 min

ZENITH SUPER STOL CH 801

TYPE: Four-seat kitbuilt.

PROGRAMME: Based on STOL CH 701 design; work started in 1988 for an undisclosed customer, but was suspended when order cancelled. Subsequently revived; prototype built by Flypass Ltd in Ontario, Canada, and first flown March 1998. Launched at Oshkosh, July 1998, with kit deliveries following.

In 2003, Jordan Aerospace Industries of Amman announced the Hawk-I CH801, a locally marketed and assembled CH 801.

CUSTOMERS: 250 kits sold and at least 20 flying by end 2005. Marketing by CZAW (Czech Republic), which offers builder's assistance programme.

COSTS: Kit excluding engine USD20,950 (2006).

DESIGN FEATURES: High-wing, strut-braced monoplane. Although visually similar to the CH 701, no commonality of parts. Quoted build time 750 hours.

Wing aerofoil NACA65015.

FLYING CONTROLS: Manual. Full-span Junkers flaperons with outboard section offset 2° higher; deflection to 35° elevator; all-moving, horn-balanced fin. Fixed full-span leading-edge wing slats.

STRUCTURE: All-metal semi-monocoque construction, making extensive use of blind rivets. Single-spar 6061-T6 aluminium wing. Fuselage welded 4130 tubular steel frame.

LANDING GEAR: Tricycle type; fixed. Fuselage-mounted spring cantilever mainwheel legs optimised for rough-field operations with Matco or Cleveland wheels and brakes. Nosewheel steerable ±15°. Tundra tyres on all wheels. Optional flotation gear.

POWER PLANT: One 134 kW (180 hp) Textron Lycoming O-360-A driving two-blade, fixed-pitch Sensenich 76-EMB-O-54 metal propeller in production prototype; engines in the range 112 to 179 kW (150 to 240 hp) can be fitted, including four-stroke LOM M337B of 173 kW (232 hp). Standard fuel capacity 151 litres (40.0 US gallons; 33.3 Imp gallons); optional fuel capacity 303 litres (80.0 US gallons; 66.6 Imp gallons).

ACCOMMODATION: Pilot and three passengers in enclosed cabin. Single door on port side. Underfuselage cargo pod optional.

DIMENSIONS, EXTERNAL:
- Wing span ..... 9.45 m (31 ft 0 in)
- Wing chord, constant ..... 1. 60 m (5 ft 3 in)
- Wing aspect ratio 5.8
- Length overall ..... 7.47 m (24 ft 6 in)
- Height overall ..... 2.67 m (8 ft 9 in)
- Tailplane span ..... 2.54 m (8 ft 4 in)
- Tailplane chord ..... 0.91 m (3 ft 0 in)
- Wheel track ..... 2.03 m (6 ft 8 in)
- Wheelbase ..... 1.65 m (5 ft 5 in)
- Passenger door: Height ..... 0.97 m (3 ft 2 in)
- Width ..... 0.91 m (3 ft 0 in)

DIMENSIONS, INTERNAL:
- Cabin: Length ..... 1.98 m (6 ft 6 in)
- Max width ..... 1.12 m (3 ft 8 in)
- Max height ..... 1.17 m (3 ft 10 in)

AREAS:
- Wings, gross ..... 15.51 m² (167.0 sq ft)
- Tailplane ..... 2.32 m² (25.00 sq ft)

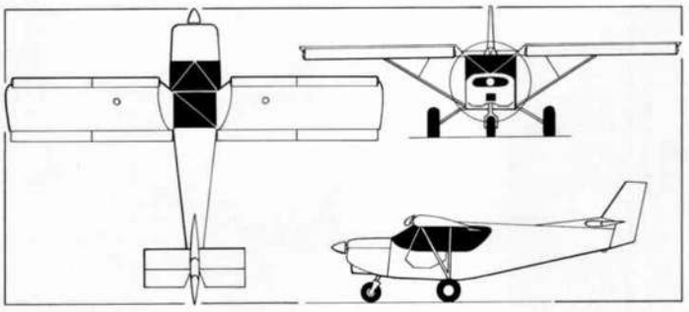
WEIGHTS AND LOADINGS:
- Weight empty ..... 522 kg (1,150 lb)
- Max T-O weight ..... 975 kg (2,150 lb)
- Max wing loading ..... 62.9 kg/m² (12.87 lb/sq ft)
- Max power loading ..... 7.27 kg/kW (11.94 lb/hp)

Zenith Zodiac CH 640 *(Paul Jackson)*

1133370

Zenith Super STOL CH 801 *(Paul Jackson)*

1040521



Zenith STOL CH 801 *(James Goulding)* 0051861

PERFORMANCE:

Never-exceed speed (VNE)	130 kt (241 km/h; 150 mph)
Max level speed	96 kt (177 km/h; 110 mph)
Max cruising speed at 75% power	91 kt (169 km/h; 105 mph)
Stalling speed: flaps up	48 kt (89 km/h; 56 mph)
flaps down	34 kt (63 km/h; 39 mph)
Max rate of climb at S/L	219 m (720 ft)/min
Service ceiling	4,267 m (14,000 ft)
T-O run	119 m (390 ft)
T-O to 15 m (50 ft)	122 m (400 ft)
Landing from 15 m (50 ft)	91 m (300 ft)
Landing run	46 m (150 ft)
Range:	
with standard fuel	273 n miles (507 km; 315 miles)
with optional fuel	547 n miles (1,013 km; 630 miles)
Endurance: with standard fuel	3 h 0 min
with optional fuel	6 h 0 min
g limits	+6/–3

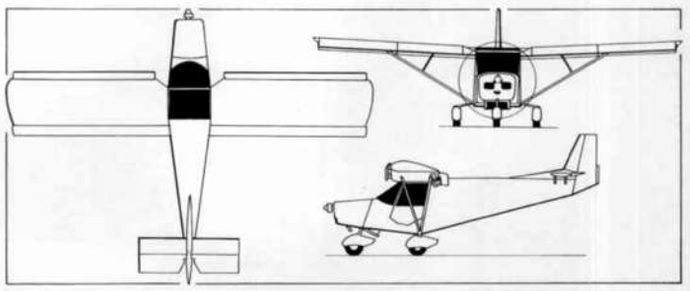
ZENITH STOL CH 701

TYPE: Side-by-side ultralight kitbuilt.

PROGRAMME: Experimental category prototype made first flight mid-1986. Plans, 49 or 85 per cent kits available. Meets Canadian TP 10141 standards for advanced ultralight trainers. German promotion as **CH-701D**. Unauthorised copies are available in Czech Republic as **Kappa-1**, with slight performance differences. Ekoflug of Slovak Republic builds version designated MXP-740. CH-701-AG agricultural version ceased US production after 55 completed, but revived by Czech Aircraft Works (CZAW). Marketed in Italy as **ICP Savannah** and previously in France as **Aerotrophy TT 2000**; several other look-alikes exist.

In July 2001 design was upgraded with redesigned wing spar to accommodate increased MTOW, increased fuel capacity, top-hinged cabin doors and redesigned windscreen. Aircraft from serial number 7–4512 are affected.

Zenith STOL CH 701 ultralight *(Paul Jackson)* 1040524



Zenith STOL CH 701 light aircraft *(Paul Jackson)* 0051860

CUSTOMERS: Over 700 flying by end 2002 (latest data supplied). Indian National Cadet Corps, part of the Indian Air Force, ordered 85 plus 48 options in 2000; these assembled by CZAW.

COSTS: Plans: USD380. Kit: USD12,980. Information pack: USD35 (2006). Materials and component parts available.

DESIGN FEATURES: Strut-braced, high-wing, STOL cabin monoplane with foldable wings and fixed leading-edge slats. In most countries, CH 701 can be registered either as advanced ultralight (AUL) or as experimental homebuilt. Quoted build time of standard CH 701 400 hours.

FLYING CONTROLS: Manual. Junkers-type flaperons deflect maximum 24°; elevators; and Zenith all-moving fin. Full-span leading-edge slats for STOL performance. Control surface deflections: Ailerons ±15°, elevators +32/–28°, rudder ±23°.

STRUCTURE: All-metal semi-monocoque.

LANDING GEAR: Fixed; tricycle or tailwheel type. Fuselage-mounted spring cantilever mainwheel legs with optional wheel fairings. Steerable nosewheel; optional floats, amphibious or ski gears.

POWER PLANT: One 37.0 kW (49.6 hp) Rotax 503 UL-2V engine in prototype, but 59.6 kW (79.9 hp) Rotax 912 UL, 47.8 kW (64.1 hp) Rotax 582 UL, 44.7 to 52.2 kW (60 to 70 hp) VW or 48.5 to 67.1 kW (65 to 90 hp) Teledyne Continental engine optional. Two- or three-blade propeller. Standard fuel capacity 75.7 litres (20.0 US gallons; 16.7 Imp gallons) in two wing tanks.

DIMENSIONS, EXTERNAL:

Wing span	8.23 m (27 ft 0 in)
Length overall	6.38 m (20 ft 11 in)
Width, wings folded	2.06 m (6 ft 9 in)
Height overall	2.62 m (8 ft 7 in)

DIMENSIONS, INTERNAL:

Cabin max width	1.07 m (3 ft 6 in)

AREAS:

Wings, gross	11.33 m² (122.0 sq ft)

WEIGHTS AND LOADINGS:

Weight empty	218 kg (480 lb)
Max T-O weight	499 kg (1,100 lb)

PERFORMANCE (47.8 kW; 64.1 hp engine):

Max level speed at S/L	82 kt (152 km/h; 95 mph)
Max cruising speed	70 kt (129 km/h; 80 mph)
Stalling speed	27 kt (49 km/h; 30 mph)
Max rate of climb at S/L	427 m (1,400 ft)/min
T-O run	28 m (90 ft)
Landing run	24 m (80 ft)
Range: standard fuel	182 n miles (338 km; 210 miles)
with wing tanks	360 n miles (667 km; 415 miles)

ZIVKO

ZIVKO AERONAUTICS INC

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PRESIDENT: Bill Zivko
VICE PRESIDENT: Eric Zivko

Founded in 1987, Zivko manufactures the Edge 540 series of aerobatic monoplanes from a 1,858 m² (20,000 sq ft) factory on the airport at Guthrie. In August 2000, it received FAA certification under Pt 21.191(g). The improved Edge 540A was introduced in April 2001. In mid-2002 the workforce numbered 20.

In addition to the Edge, Zivko also supplies custom-built components to other engineering organisations, including NASA, Hartzell and the University of California at Berkeley.

ZIVKO EDGE 540

TYPE: Single-seat sportplane kitbuilt; tandem-seat sportplane kitbuilt.

PROGRAMME: Initial version was Zivko Edge 360. Design work on 540 began in 1992 with first flight in 1993; 540T followed in 1999 with first flight 2000. Kit built aircraft are denoted by a 'K' suffix to model number.

CURRENT VERSIONS: **540:** Single-seat version.

540A: Improved version introduced at Sun 'n' Fun, April 2001 (N24KC); has larger rudder and elevator for improved handling.

540T: Two-seat model introduced March 2000; two are TK versions.

CUSTOMERS: Totals of 28 540s and nine 540Ts built by end of 2006, including examples to Mexico, South Africa, Switzerland and Australia.

COSTS: Programme cost USD1.1 million by 2003. Edge 540 USD231,655; Edge 540T USD245,632 (2004).

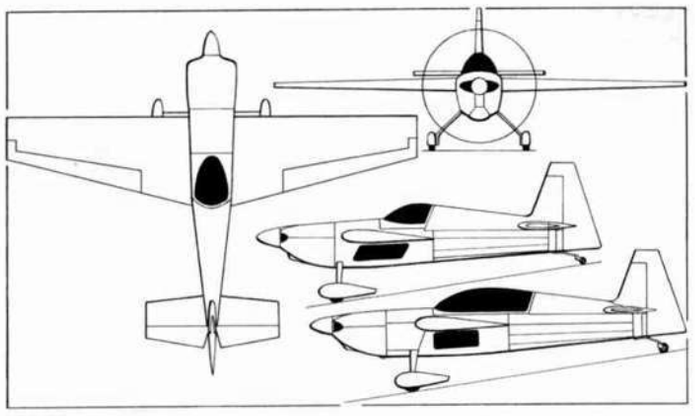
DESIGN FEATURES: Optimised for aerobatics; customised John Roncz aerodynamic design; rate of roll 420°/s. Mid-positioned, tapered wing with straight leading-edge and large, horn-balanced ailerons and unique aerofoil. Transparencies in lower sides and floor of cockpit.

Zivko Edge 540A displayed by Pip Borrman *(Paul Jackson)* 1040525

FLYING CONTROLS: Conventional and manual. Ailerons and elevator actuated by pushrods; horn-balanced rudder by cables. Flight adjustable tabs in port elevator. Suspended, spade-type tab on each aileron; electric trim.

STRUCTURE: 4130 Steel tube fuselage; upper fuselage and fairings of composites; lower aft fuselage fabric covered, stressed to ultimate ±15 *g*; all-composites fully cantilevered two-spar wing. Fully composites empennage with no wire bracing.

LANDING GEAR: Tailwheel type; fixed. Fuselage-mounted spring steel aluminium cantilever mainwheel legs; cantilever tailwheel leg. Cleveland 5.00–5 wheels and hydraulic brakes;



Zivko Edge 540, with additional profile of two-seat 540T *(James Goulding)* 1158982

optional speed fairings. Tyre pressure 3.45 bar (50.0 lb/sq in). Spring steel tail gear, with chrome-plated, solid 4.00–4 tailwheel, choice of fixed or steerable.

POWER PLANT: One Textron Lycoming IO-540 modified to produce 254 kW (340 hp), driving Hartzell HC-C3YR-4AX or optional Hartzell HC-C3YR-1AX1 three-blade, composites propeller. Edge 540 has single 72 litre (19.0 US gallon; 15.8 Imp gallon) forward fuselage fuel tank, plus optional total of 159 litres (42.0 US gallons; 35.0 Imp gallons) in wing tanks; Edge 540T has single 76 litre (20.0 US gallon; 16.6 Imp gallon) fuselage tank and two optional 83 litre (22.0 US gallon; 18.3 Imp gallon) wing tanks. Oil capacity 11.4 litres (3.0 US gallons; 2.5 Imp gallons). Inverted oil (Christen) and fuel (ZAI) systems.

ACCOMMODATION: Pilot (pilot and passenger in tandem in 540T) under one-piece perspex canopy hinged on starboard side; carbon fibre contoured seats. Baggage compartment forward of front seat.

SYSTEMS: 12 V DC system with light weight B&C 8 A alternator and regulator. Bendix fuel injection system.

AVIONICS: *Comms:* Becker com and Mode C transponder.
Flight: Optional Sierra Flight Systems EFIS.

DIMENSIONS, EXTERNAL:

Wing span: 540	7.42 m (24 ft 4 in)
540T	7.67 m (25 ft 2 in)
Wing chord:	
at root: 540	1.57 m (5 ft 2 in)
540T	1.68 m (5 ft 6 in)
at tip: 540	0.74 m (2 ft 5 in)
540T	0.84 m (2 ft 9 in)
Length overall: 540	6.27 m (20 ft 7 in)
540T	6.91 m (22 ft 8 in)
Height overall	2.36 m (7 ft 9 in)
Tailplane span	2.46 m (8 ft 1 in)

AREAS:

Wings, gross: 540	9.10 m² (98.0 sq ft)
540T	9.87 m² (106.2 sq ft)

WEIGHTS AND LOADINGS:

Weight empty: 540	531 kg (1,170 lb)
540T	562 kg (1,240 lb)
Max baggage weight	5 kg (10 lb)
Max T-O weight:	
540: Aerobatic	703 kg (1,550 lb)
Utility	816 kg (1,800 lb)
540T: Aerobatic	726 kg (1,600 lb)
Utility	885 kg (1,950 lb)
Max wing loading:	
540: Aerobatic	77.2 kg/m² (15.82 lb/sq ft)
Utility	89.7 kg/m² (18.37 lb/sq ft)
540T: Aerobatic	73.6 kg/m² (15.07 lb/sq ft)
Utility	89.6 kg/m² (18.36 lb/sq ft)
Max power loading: 540	3.22 kg/kW (5.29 lb/hp)
540T: Aerobatic	2.86 kg/kW (4.71 lb/hp)
Utility	3.49 kg/kW (5.74 lb/hp)

PERFORMANCE:

Never-exceed speed (VNE)	230 kt (426 km/h; 265 mph)
Max cruising speed at 75% power:	
540	180 kt (333 km/h; 207 mph)
540T	185 kt (343 km/h; 213 mph)
Stalling speed:	
540: Aerobatic	51 kt (95 km/h; 57 mph)
Utility	61 kt (113 km/h; 71 mph)
540T: Aerobatic	53 kt (99 km/h; 61 mph)
Utility	61 kt (113 km/h; 71 mph)
Max rate of climb at S/L: 540	1,128 m (3,700 ft)/min
540T	1,189 m (3,900 ft)/min
Service ceiling	3,810 m (12,500 ft)
T-O run	61 m (199 ft)
T-O to 15 m (50 ft)	90 m (293 ft)
Landing from 15 m (50 ft)	300 m (982 ft)
Range with max fuel	456 n miles (844 km; 525 miles)
g limits: Aerobatic	±10
Utility	±8

Uzbekistan

TAPO

TASHKENTSKOYE AVIATSIONNOYE PROIZDSTVENNOYE OBEDINENIE IMENI V P CHKALOVA (TASHKENT AIRCRAFT PRODUCTION ENTERPRISE NAMED FOR VALERY P CHKALOV)

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TECHNICAL DIRECTOR: Nikolai A Kuznetsov
MARKETING DIRECTOR: Zafar M Islamov

Tashkent plant established 20 November 1941 on arrival of first elements of GAZ 84 (formed 1932 and incorporating Polikarpov from 1936) evacuated from Khimki, Moscow. Enterprise, dating from 1972 in current form, is said to be the largest aircraft manufacturing centre on the Asian continent. It comprises five plants at Tashkent, Andizhan and Fergana. Total of over 7,000 aircraft built, including I-15s, I-16s, I-153s, Li-2s (total 2,258), Il-14s, An-8s, Ka-22s, An-12s, An-22s and Il-76s. It has manufactured wing centre-sections for the An-124 and An-225 transports and two An-70 prototypes, and has repaired MiG and Sukhoi fighters and Tu-22M bombers. It developed the Il-78 tanker version and collaborated with Beriev on the A-50 AEW derivative of the Il-76. Low-rate production is under way of the Ilyushin Il-114 twin-turboprop transport and Il-76, for which TAPO is the sole source, although airframes are stored partly complete until orders are received. After decade of stagnation, manufacture of new Il-76s resumed in 2005 with launch of Batch 97. Final report of State Tests of Il-76MF stretched version issued 24 April 2003, paving way for manufacture. Russia plans own assembly line, although costs of establishment have thrown project into doubt. Offers Il-114s retrofitted with US engines.

TAPO was registered as a joint stock company in May 1996; the state holds 82.7 per cent, National Bank of Foreign Economic Activity 6.7 per cent and employees 10.6 per cent. An attempt in 1997 to sell 14 per cent of the company was unsuccessful; by mid-1998, offers were being invited for a 25.6 per cent share, but no acceptances have been reported. Company began airbrake manufacture for Avro RJ in 1997; this now discontinued. Following April 2000 foundation of Ilyushin International company, TAPO expected to join forces with design bureau responsible for its current production aircraft. Gained ISO 9002 certification in 1998 and Boeing D1-9000 subcontractor approval in 2000.

Subsidiary, TAPO-Avia operates commercial freight charter flights with fleet of three An-12s and three Il-76MDs. TAPO aircraft are marketed via Uzavialeasing, established December 1997 in collaboration with local government and Russian and Uzbek banks.

One of several uncompleted Ilyushin Il-76s at TAPO plant 1159176

Vietnam

A-41

CONG TY SU'A CHU'A MAY BAY A-41 (AIRCRAFT REPAIR COMPANY A-41)

Sô Bis Đuòng Thăng Long, Phuòng 4, Quân Tân Bình-TP, Hô Chí Minh
Tel: (+84 8) 844 11 42
Fax: (+84 8) 811 06 47
Web: www.doemod.gov.vn/a41
DIRECTOR Vo Ta Que

ARC-41 of the Vietnamese Air Force Technology Department is manufacturing Russian-designed lightplanes under licence, with 70 per cent indigenous content. Formed in 1993, ARC-41 also overhauls and repairs Antonov An-2, An-26, Aero L-39 and Yak-52 aircraft, with a maximum capacity of six of each type per year. Additionally repairs and produces avionics and refurbishes ground servicing vehicles and airfield fire engines.

A-41 VNS-41

TYPE: Three-seat amphibion.

PROGRAMME: Original Che-22 design by Boris Chernov in Russian Federation; more recently marketed by Gidroplan OOO of Samara as Che-22 Korvet, under which heading in *Jane's All the World's Aircraft* a full description will be found.

A-41 VNS-41 prototype (left) and pre-production aircraft 1158165

Manufacturing in Vietnam begun June 2003 to meet requirements for forestry patrol and SAR. First known flight by prototype on 9 December 2004; official demonstration, including water landing, on 24 December 2004, aircraft wearing military markings and serial number '401'. Further demonstrations by initial production aircraft '502' and '503' between 3 and 5 August 2005 at Lake Tri An and Bien Hoa Airport, southern Dong Nai Province, marking completion of flight development and launch of marketing. Two latter differ from prototype in having wingtip hydroplanes.

CUSTOMERS: Three built, including prototype, by September 2005; plans in hand at that time for further four.

COSTS: VND2 billion (USD125,000) (2005).

POWER PLANT: Two 47.8 kW (64.1 hp) Rotax 582 two-cylinder, liquid-cooled piston engines.

VMA

VIETNAM MECHANICS ASSOCIATION

Ho Chi Minh City
www.cohocvietnam.org.vn
PROJECT MANAGER: Nguyen Xuân Hùng

At a press conference on 23 August 2003, Professor Nguyen Van Dao revealed a model of an ultralight aeroplane then under construction by the VAM. Reports published in the West initially described the aircraft as a helicopter. A prototype eventually flew in December 2005.

A four-seat aircraft, believed designated VAM-3, is planned to have 90 per cent local content.

VAM VAM-1 and VAM 2

TYPE: Tandem-seat ultralight.

PROGRAMME: Vietnamese adaptation of Beaver RX550, marketed in Canada by Aircraft Sales and Parts (www.ultralight.ca). Construction of prototype began April 2003, following granting of government approval on 18 April and donation of private financial resources. Announced August 2003, when first flight predicted in following month; however maiden sortie delayed. Aircraft made first fast taxying runs at Phuoc Long Airport, Binh Phuoc province, on 28 March 2004, following which an application for permission to fly was lodged. This appears to have been considerably delayed; first flight (pilot Pham Duy Long) not achieved until 8 December 2005 at Nuoc Trong Airport, Long Thanh, Dong Nai province.

VAM-2 variant, with local content increased from 20 to 70 per cent, was due for completion in 2006.

CUSTOMERS: Requirement for 120 to be imported into the USA by expatriate Vietnamese partners Ngyuen Sang and Tim Trung Tran, who are investing US$5 million in the project.

COSTS: USD45,000 (2004).

DESIGN FEATURES: Pod-and-boom configuration with high-mounted, V strut-braced, constant-chord, slightly sweptback wings.

FLYING CONTROLS: Conventional and manual. Full-span ailerons. No aerodynamic balances on tail surfaces. Boom-mounted empennage with sweptback leading-edges.

VAM-1 ultralight flying in December 2005 1159193

STRUCTURE: Aluminium 6061-T6 tube with fabric covering.

POWER PLANT: Unspecified piston engine, believed 48.0 kW (64.4 hp) Rotax 582, driving a two-blade, pusher propeller.

LANDING GEAR: Tricycle type; fixed. Mainwheels mounted on hinged horizontal, metal tube Vs with damped compression arm attached at wing strut junction with central boom.

DIMENSIONS, EXTERNAL:

Wing span	9.75 m (32 ft 0 in)
Length overall	6.30 m (20 ft 8 in)
Height overall	2.03 m (6 ft 8 in)

WEIGHTS AND LOADINGS:

Weight empty	150 kg (330 lb)
Max T-O weight	470 kg (1,035 lb)

PERFORMANCE (estimated):

Max level speed	71 kt (132 km/h; 82 mph)
T-O run	70 m (230 ft)
Service ceiling	2,500 m (8,200 ft)

AIR-LAUNCHED MISSILES

The following pages support the Armament paragraphs of aircraft descriptions by explaining in brief how the potential of an individual aircraft is enhanced by its missile armament. Coverage is restricted to missiles carried by, or applicable to, aircraft in the current edition; for this reason, some older missiles are excluded, as are future projects still in the early stages of definition. Contents do include certain anti-tank and shoulder-launched anti-aircraft missiles which have airborne applications, mostly on helicopters.
To expedite retrieval of data, missiles are listed in alphabetical order of name or designation, with full cross-references to alternative epithets. In many instances, the 'manufacturer' of Chinese and Russian missiles is actually the export sales agency. More detailed information is contained in *Jane's Air-Launched Weapons*.

Key

Roles

- **AAM** Air-to-air missile
- **ARM** Anti-radiation missile
- **ASM** Air-to-surface missile
- **ASHM** Anti-ship missile
- **ATM** Anti-tank missile
- **LGB** Laser-guided bomb
- **SOM** Standoff missile

Guidance

- **AL** Active laser
- **AP** Autopilot
- **A/P** Active/passive radar
- **ARH** Active radar homing
- **GPS** Global Positioning System
- **I** Inertial
- **IM** Imaging
- **IR** Infra-red
- **L** Laser
- **LR** Laser radar
- **MMW** Millimetric-wave
- **PR** Passive radar
- **RC** Radio command
- **RF** Radio frequency
- **SAL** Semi-active laser
- **SARH** Semi-active radar homing
- **T** Terrain reference
- **TV** Television

Missile Designator and Name	Country	Manufacturer	Role	Length (metres)	Diameter (mm)	Weight (kilograms)	Guidance	Range (km)	Remarks
3M55									see 'Yakhont'
3M60									see 'Kayak'
3M80									see Moskit
9M14									see 'Sagger'
9M17									see 'Swatter'
9M32									see 'Grail'
9M36									see 'Gremlin'
9M39									see 'Grouse'
9M114									see 'Spiral'
9M120									see 'Spiral' and AT-X-16
9M121									see AT-X-16
9M313									see 'Gimlet'
AA-8									see 'Aphid'
AA-9									see 'Amos'
AA-10									see 'Alamo'
AA-11									see 'Archer'
AA-12									see 'Adder'
AA-X-13									see R-37
AAM-3, Type 90	Japan	Mitsubishi	AAM	3.00	130	91	IR	8	
AAM-4	Japan	Mitsubishi	AAM				ARH	medium	
AAM-5	Japan	not assigned	AAM				ImIR		
AAM-L, KS-172	Russia	Novator	AAM	7.40		750	I/ARH	400	
AARGM	USA	SAT & NAWC	ARM				GPS/MMW	185	
ACM, AGM-129	USA	Raytheon	ASM	6.35	700	1,250	I/LR	3,000	
A-Darter, V3E	South Africa	Denel	AAM	2.98	170	89	AL	20	
'Adder', AA-12/R-77	Russia	Vympel	AAM	3.60	2000	175	I/ARH	75	
'Adder', R-77M-PD	Russia	Vympel	AAM	3.60	2000	225	I/ARH	150	
AFDS (unpowered)	Germany	LFK	SOM	3.47	630	660	GPS/I		
AGM-65									see Maverick
AGM-78									see Standard
AGM-84									see Harpoon/SLAM
AGM-88									see HARM
AGM-114									see Hellfire
AGM-119									see Penguin
AGM-122									see Sidearm
AGM-123									see Skipper
AGM-129									see ACM
AGM-130A	USA	Boeing	LGB	3.94	460	1,323	TV, ImIR	45	
AGM-130C	USA	Boeing	LGB	3.95	460	1,353	TV/IIR	45	
AGM-142									see Popeye
AGM-154C JSOW	USA	Raytheon	SOM	4.26		475 680	I/GPS	60	
AGM-158									see JASSM
AIM-7									see Sparrow
AIM-9									see Sidewinder
AIM-120									see AMRAAM
AIM-132									see ASRAAM
'Alamo', AA-10/R-27AE	Russia	Vympel	AAM	4.78	260	350	I/ARH	80	
'Alamo', AA-10/R-27EM	Russia	Vympel	AAM	4.78	260	350	I/SARH	110	
'Alamo', AA-10/R-27ER	Russia	Vympel	AAM	4.70	260	350	I/SARH	75	
'Alamo', AA-10/R-27ET	Russia	Vympel	AAM	4.50	260	343	I/IR	70	
'Alamo', AA-10/R-27R	Russia	Vympel	AAM	4.00	230	253	I/SARH	50	
'Alamo', AA-10/R-27T	Russia	Vympel	AAM	3.70	230	254	I/IR	40	
ALARM	International	MBDA	ARM	4.30	220	265	PR	45	
AM 39									see Exocet
'Amos' AA-9/R-33	Russia	Vympel	AAM	4.15	380	490	I/SARH	120	
AMRAAM, AIM-120A/B/C	USA	Raytheon	AAM	3.65	180	157	I/ARH	50	
APACHE AP	International	MBDA	SOM	5.10	630	1,230	I/ARH	140	
'Apex', AA-7/R-24T	Russia	Vympel	AAM	4.16	200	235	IR	50	
'Aphid', AA-8/R-60	Russia	Vympel	AAM	2.08	130	65	IR	3	
'Aphid', AA-8/R-60M	Russia	Vympel	AAM	2.08	130	65	AL	5	
'Archer', AA-11/R-73M1	Russia	Vympel	AAM	2.90	170	105	I/IR	20	
'Archer', AA-11/R-73M2	Russia	Vympel	AAM	2.90	170	110	I/IR	30	
ARMAT	International	MBDA	ARM	4.15	400	550	I/PR	90	

Missile Designator and Name	Country	Manufacturer	Role	Length (metres)	Diameter (mm)	Weight (kilograms)	Guidance	Range (km)	Remarks
Armiger	Germany	BGT	ARM	3.90	200	230	PR/ImIR	200	
AS-11									see 'Kilter'
AS-13									see 'Kingbolt'
AS-14									see 'Kedge'
AS-15									see 'Kent'
AS 15TT	International	MBDA	AShM	2.30	180	96	Radio	15	
AS-17									see 'Krypton'
AS-18									see 'Kazoo'
AS-19									see 'Koala'
AS-20									see 'Kayak'
AS-30L	International	MBDA	ASM	3.65	340	520	I/SAL	10	
ASM-1, Type 80	Japan	Mitsubishi	AShM	4.00	340	600	I/ARH	50	
ASM-1C, Type 91	Japan	Mitsubishi	AShM	4.00	350	510	I/ARH	65	
ASM-2, Type 93	Japan	Mitsubishi	AShM	4.10	350	520	I/ImIR	100	
ASMP	International	MBDA	SOM	5.38	380	860	I/T	250	
ASMP Plus (ASMP-A)	International	MBDA	SOM					500	
Aspide 1	International	MBDA	AAS	3.70	200	220	SARH	35	
ASRAAM (AIM-132)	International	MBDA	AAM	2.90	170	87	ImIR	20	
AT-2									see 'Swatter'
AT-3									see 'Sagger'
AT-6									see 'Spiral'
AT-9									see 'Spiral 2'
AT-12									see 'Swinger'
AT-16, 9M120M/9M121 Vikhr M	Russia	Shipunov	ATM	2.80	130	45	SAL	10	
Ataka									see 'Swinger'
ATAM									see Mistral
ATASK									see Helstreak
BGM-71									see TOW
Black Shaheen									see SCALP EG
Brimstone	International	MBDA	ASM	1.63	180	50	MMW/I	8	
Burya									see 'Kitchen'
C-101, YJ-16	China	CPMIEC	AShM	7.50	540	1,850	I/ARH	45	
C-201, HY-4	China	CPMIEC	AShM	7.36	760	1,740	AP/ARH	135	
C-601, CAS-1 'Kraken'/YJ-6	China	CPMIEC	AShM	7.36	760	2,440	AP/ARH	100	
C-701	China	CPMIEC	AShM	2.51	540	100	I/TV	15	
C-801, YJ-1	China	CPMIEC	AShM	4.65	360	655	I/ARH	50	
C-802, YJ-2	China	CPMIEC	AShM	6.40	360	715	I/ARH	130	
CAS-1									see C-601
Dandy									see NT-D
Darter, V-3C	South Africa	Denel	AAM	2.75	160	90	IR	5	(see U-Darter)
Derby	Israel	Rafael	AAM	3.62	160	118	ARH	34	
DWS24/DWS39 (unpowered)	Germany	LFK	SOM	3.50		600	I	10	
Exocet, AM 39	International	MBDA	AShM	4.70	350	670	I/ARH	50	
FIM-92									see Stinger
Gabriel 3AS	Israel	IAI	AShM	3.85	340	560	I/ARH	35	
Gabriel 4LR	Israel	IAI	AShM	4.70	440	960	I/ARH	200	
'Gimlet', SA-16/9M313 Igla 1	Russia	Kolomna	AAM	1.69	70	11	IR	5	
'Grail' SA-7/9M32 Strela 2	Russia	Turopov	AAM	1.22	70	10	IR	5	
'Gremlin', SA-14/9M36 Strela 3	Russia	Turopov	AAM	1.47	70	11	IR	5	
'Grouse', SA-18/9M39 Igla	Russia	Kolomna	AAM	1.69	70	11	IR	5	
Hakeem									see PGM
HARM, AGM-88A/B/B+/C/D	USA	Raytheon	ARM	4.17	250	361	PR	80	
Harpoon, AGM-84A	USA	Boeing	AShM	3.90	340	530	I/ARH	120	
Have Lite									see Popeye 2
Have Nap									see Popeye 1
Hellfire, AGM-114A	USA	Hellfire Systems LLC	ATM	1.63	180	46	SAL	8	
Hellfire, AGM-114B/C	USA	Hellfire Systems LLC	ATM	1.73	180	48	SAL, ImIR or RF+IR	8	
Hellfire, AGM-114F	USA	Hellfire Systems LLC	ATM	1.80	180	49	SAL	8	
Hellfire 2, AGM-114K	USA	Hellfire Systems LLC	ATM	1.63	180	46	SAL	9	
Hellfire 2, AGM-114 Longbow	USA	Hellfire Systems LLC	ATM	1.78	180	50	MMW/I	8	
Helstreak/ATASK (Starstreak)	UK	Shorts	AAM	1.40	130	16	RC	6	
HJ-8A	China	Norinco	ATM	0.88	120	11	Wire	3	
HJ-8B	China	Norinco	ATM	1.00	120	13	Wire	4	
HOT 1	International	MBDA	ATM	1.27	140	24	Wire	4	
HOT 2	International	MBDA	ATM	1.30	150	24	Wire	4	
HOT 3	International	MBDA	ATM	1.30	150	33	Wire	4	
Hsiung Feng 2	Taiwan	Chung Shan	AShM	3.90	340	520	I/ARH+ImIR	80	
HY-4									see C-201
Igla									see 'Grouse' and 'Gimlet'
Ingwe, ZT35	South Africa	Denel	ATM	1.75	400	29	L	5	
IRIS-T	Germany	BGT	AAM	3.00	130	87	ImIR	12	
JASSM, AGM-158	USA	Lockheed Martin	ASM	4.26	550	1,024	ImIR/GPS/INS	370	
JSOW									see AGM-154
'Kayak', AS-20/Kh-35/3M60 Uran	Russia	Zvezda	AShM	3.75	420	480	I/ARH	130	
'Kazoo', AS-18/Kh-59M Ovod M	Russia	Raduga	ASM	5.37	380	930	I/TV	115	
'Kedge', AS-14/Kh-29L	Russia	Vympel	ASM	3.87	380	657	SAL	10	
'Kedge', AS-14/Kh-29T	Russia	Vympel	ASM	3.87	380	670	TV	12	
'Kedge', AS-14/Kh-29TE	Russia	Vympel	ASM	3.87	380	700	TV	30	

Missile Designator and Name	Country	Manufacturer	Role	Length (metres)	Diameter (mm)	Weight (kilograms)	Guidance	Range (km)	Remarks
'Kent', AS-15A/Kh-55/RKV-500	Russia	Raduga	SOM	6.04	510	1,400	I/T	2,400	
'Kent', AS-15B/Kh-55SM/RKV-500M	Russia	Raduga	SOM	7.10	770	1,700	I/T	3,000	
KEPD 150 (PDWS 200)	International	Taurus Systems	SOM	4.50		1,060	I/GPS/T/ImIR	150	
KEPD 350 (Taurus)	International	Taurus Systems	SOM	5.00		1,400	I/GPS/T/ImIR	350	
Kh-29									see 'Kedge'
Kh-31									see 'Krypton'
Kh-35									see 'Kayak'
Kh-41									see Moskit
Kh-55/65									see 'Kent'
Kh-58									see 'Kilter'
Kh-59									see 'Kingbolt'
Kh-101	Russia	Raduga	SOM	7.45		2,400	I/Im	5,000	
'Kilter' AS-11/Kh-58E	Russia	Raduga	ARM	5.00	380	650	I/PR	160	
'Kingbolt', AS-13/Kh-59 Ovod	Russia	Raduga	ASM	5.40	380	850	TV	160	
Kokon									see 'Spiral'
'Kraken'									see C-601
Krypton', AS-17/Kh-31A-1	Russia	Zvezda	ASM	4.70	360	600	I/ARH	50	
'Krypton', AS-17/Kh-31A-2	Russia	Zvezda	ASM	5.23	360	600	I/ARH	70	
'Krypton', AS-17/Kh-31P-1	Russia	Zvezda	ASM	4.70	360	600	I/PR	100	
'Krypton', AS-17/Kh-31P-2	Russia	Zvezda	ASM	5.23	360	600	I/PR	200	
Kukri, V-3B	South Africa	Denel	AAM	2.94	130	73	IR	4	
LY-60									see PL-11
MAA-1 Piranha/Mol	Brazil	Orbita	AAM	2.82	150	90	IR	5	
Magic 1, R 550	International	MBDA	AAM	2.72	160	89	IR	3	
Magic 2, R 550	International	MBDA	AAM	2.75	160	89	IR	20	
Marte 2	International	MBDA	AShM	4.80	320	340	I/ARH	20	
Marte 2A	International	MBDA	AShM	3.90	320	269	I/AR	30	
Marte 2B	International	MBDA	ARM	3.90	320	269	PR	60	
Maverick, AGM-65A	USA	Raytheon	ASM	2.49	310	210	TV	3	
Maverick, AGM-65B	USA	Raytheon	ASM	2.49	310	210	TV	8	
Maverick, AGM-65D	USA	Raytheon	ASM	2.49	310	220	ImIR	20	
Maverick, AGM-65E	USA	Raytheon	ASM	2.49	310	293	SAL	20	
Maverick, AGM-65F/G/J/K	USA	Raytheon	ASM	2.49	310	307	ImIR	25	
Maverick, AGM-65H	USA	Raytheon	ASM	2.60	310	305	ARH	25	
Meteor	International	MBDA	AAM	3.65		185	ARH	100	
MICA	International	MBDA	AAM	3.10	160	110	I/ARH or IR	50	
Mistral, ATAM	International	MBDA	AAM	1.80	90	18	IR	5	
Mokopa, ZT6	South Africa	Denel	ATM	1.80	180	52	MMW or SAL	8	
Moskit, Kh-41/3M80	Russia	Raduga	ASM	9.74	760	4,500	I/ARH or I/PR	250	
Nag	India	DRDO	ATM			43	RC + ImIR or MMW	4	
Nimrod	Israel	IAI	ASM	2.84	210	100	I/SAL	25	
NTD Dandy	Israel	Rafael	ATM	1.20	140	11	I/TV/IR	4	
NT-S Spike	Israel	Rafael	ATM	1.90	140	27	I//TV/IR	10	
Ovod									see 'Kazoo' and 'Kingbolt'
Penguin 2, AGM-119B	Norway	Kongsberg	AShM	2.96	280	385	I/IR	35	
Penguin 3, AGM-119A	Norway	Kongsberg	AShM	3.18	280	370	I/IR	55	
PGM-A (1A, 2A, 3A) Hakeem	International	MBDA	ASM	3.60	350	300	I+SAL/IR/TV	20	
PGM-B (1B, 2B, 3B) Hakeem	International	MBDA	ASM	4.00	430	1,115	I+SAL/IR/TV	20	
Piranha									see MAA-1
PL-2/PL-3	China	CATIC	AAM	2.99	130	76	IR	3	
PL-5	China	CATIC	AAM	2.89	130	85	IR	3	
PL-7	China	CATIC	AAM	2.75	160	90	IR	3	
PL-8	China	CATIC	AAM	3.00	160	120	IR	5	
PL-9	China	Luoyang	AAM	2.99	160	115	IR	5	
PL-10	China	CATIC	AAM	3.99	290	300	SARH	15	
PL-11, LY-60	China	CATIC	AAM	3.89	200	220	SARH	25	
PL-12	China	CATIC	AAM	3.85	200	180	I/ARH	70	
Popeye 1, AGM-142A Have Nap	Israel	Rafael	ASM	4.82	530	1,360	I/TV or ImIR	80	
Popeye 2, AGM-142B Have Lite	Israel	Rafael	ASM	4.00	530	1,115	I/TV or ImIR	75	
Popeye, AGM-142C	Israel	Rafael	ASM		530		I/TV		
Popeye, AGM-142D	Israel	Rafael	ASM		530		I/ImIR		
Python 3	Israel	Rafael	AAM	3.00	160	120	IR	15	
Python 4	Israel	Rafael	AAM	3.00	160	105	IR	15	
QW-1 Vanguard	China	CPMIEC	AAM	1.53	70	16.5	IR	5	
QW-2 Vanguard	China	CPMIEC	AAM	1.59	70	11.3	AL	6	
R-24									see 'Apex'
R-27									see 'Alamo'
R-33									see 'Amos'
R-37, AA-X-13	Russia	Vympel	AAM	4.20	380	600	I/ARH	150	
R-46									see 'Acrid'
R-60									see 'Aphid'
R-73									see 'Archer'
R-77									see 'Adder'
R 530									see Super 530
R 550									see Magic
RB 04	Sweden	Saab	AShM	4.25	500	600	I/AR	30	
RB 05	Sweden	Saab	ASM	3.60	300	305	RC	8	
RB 15F Mk 1	Sweden	Saab	AShM	4.35	500	598	I/AR	90	
RB 15F Mk 2/3	Sweden	Saab	AShM	4.33	500	630	I/AR	150 200	
RB 71 Swedish Sky Flash									
RB 74 Swedish AIM-9L									
RB 75 Swedish Maverick									
R-Darter, V4	South Arfica	Denel	AAM	2.87	130	90	IR/AL	8	
S-25LD	Russia	PMED	ATM	4.10	340	400	SAL	10	
SA-7									see 'Grail'

Missile Designator and Name	Country	Manufacturer	Role	Length (metres)	Diameter (mm)	Weight (kilograms)	Guidance	Range (km)	Remarks
SA-14									see 'Gremlin'
SA-16									see 'Gimlet'
SA-18									see 'Grouse'
'Sagger', AT-3/9M14 Malyutka	Russia	Kolomna	ATM	0.86	130	113	Wire	3	
SCALP EG (Storm Shadow)	International	MBDA	SOM	5.10	630	1,300	I/MMW/ImIR	250	
Sea Eagle	International	MBDA	AShM	4.14	400	600	I/ARH	110	
Sea Skua	International	MBDA	AShM	2.50	250	147	SARH	15	
Shafrir 2	Israel	Rafael	AAM	2.60	160	95	IR	3	
Shturm									see 'Spiral 2'
Sidearm, AGM-122	USA	Motorola	ARM	3.00	130	91	PR	8	
Sidewinder, AIM-9L/M/S	USA and Europe	several	AAM	2.87	130	87	IR	8	
Sidewinder, AIM-9P	USA	several	AAM	3.07	130	87	IR	8	
Sidewinder, AIM-9R	USA	several	AAM	2.87	130	87	Visual band CCD	8	
Sidewinder, AIM-9S	USA	Raytheon	AAM	2.87	130	86	IR	8	
Sidewinder, AIM-9X	USA	Raytheon	AAM	2.90	130	85	ImIR	10	
Skipper, AGM-123	USA	ESC	LGB	4.33	360	582	SAL	7	
Sky Flash	International	MBDA	AAM	3.66	200	195	SARH	40	
Sky Sword (Tien Chien) 1	Taiwan	Chung Shan	AAM	2.87	130	90	IR	5	
Sky Sword (Tien Chien) 2	Taiwan	Chung Shan	AAM	3.60	200	190	SARH	40	
SLAM, AGM-84E	USA	Boeing	ASM	4.50	340	630	I/GPS/ImIR	95	
SLAM-ER, AGM-84H	USA	Boeing	ASM	4.37	340	726	I/GPS/ImIR	280	
Sparrow, AIM-7F	USA	Raytheon	AAM	3.66	200	227	SARH	40	
Sparrow, AIM-7M	USA	Raytheon	AAM	3.66	200	230	SARH	45	
Sparrow, AIM-7P	USA	Raytheon	AAM	3.66	200	230	RC/SARH	45	
Sparrow, AIM-7R	USA	Raytheon	AAM	3.66	200	230	RC/SARH/IR	45	
Spike									see NT-S
'Spiral', AT-6/9M114 Kokon	Russia	Kolomna	ATM	1.83	130	34	RC	6	
'Spiral 2', AT-9/9M/14 Shturm	Russia	Kolomna	ATM	1.83	130	40	RC	8	
Standard, AGM-78	USA	Raytheon	ARM	4.57	340	615	PR	55	
Starstreak									see Helstreak
Stinger, FIM-92	USA	Raytheon	AAM	1.52	70	16	IR	3	
Storm Shadow									see SCALP EG
Strela									see 'Grail' and 'Gremlin'
Super 530D	International	MBDA	AAM	3.80	260	270	SARH	40	
Super 530F1	International	MBDA	AAM	3.54	260	245	SARH	25	
'Swatter', AT-2C/9M17 Skorpion	Russia	Nudelman	ATM	1.16	130	30	RC	4	
Swift, ZT3	South Africa	Denel	ASM	1.35	130	19	L	4	
'Swinger', AT-12/9M120 Vikhr/Ataka	Russia	Shipunov	ATM	1.70	130	43	RC	8	
Taurus									see KEPD 350
Tien Chien									see Sky Sword
Torgos	South Africa	Denel	SOM	4.86		980	I/GPS/ImIR	300	
TOW, BGM-71A/B	USA	Raytheon	ATM	1.17	150	19	Wire	4	
TOW, BGM-71C I-TOW	USA	Raytheon	ATM	1.45	150	19	Wire	4	
TOW, BGM-71D/E TOW 2/2A	USA	Raytheon	ATM	1.55	150	22	Wire	4	
TOW, BGM-71F TOW 2B	USA	Raytheon	ATM	1.17	150	23	Wire	4	
TRIGAT, ATGW-3LR	Europe	consortium	ATM	1.57	150	49	ImIR	5	
TY-90	China	Luoyang	AAM	1.9	90	20	IR	7	
Type 80									see ASM-1
Type 88									see ASM-2
Type 90									see AAM-3
U-Darter	South Africa	Denel	AAM	2.75	160	96	IR	8	(see Darter)
Uran									see 'Kayak'
V3B									see Kukri
V3C									see Darter
V3E									see A-Darter
V4									see R-Darter
Vikhr									see 'Swinger' and AT-16
X-									see Kh-
Yakhont (3M55)	Russia	Strela	AShM	8.30	670	2,550			
YJ-1									see C-801
YJ-2									see C-802
YJ-6									see C-601
YJ-16									see C-101
ZT3									see Swift
ZT35									see Ingwe
ZT6									see Mokopa

AERO-ENGINES

Introduction

The following pages summarise the vital statistics of power plants mentioned in the main body of this book. They are divided into piston engines, turboprops/turboshafts and jet engines, and listed in alphabetical order of the manufacturer's name. Readers requiring further data on the two last-mentioned categories are referred to *Jane's Aero-Engines*. Some very small engines, employed by UAVs (and ultralights), are described in *Jane's Unmanned Aerial Vehicles and Targets*; those for large missiles and spacecraft, in *Jane's Space Directory*; and turboshafts, in *Jane's Helicopter Markets and Systems*. Space precludes an entry on each subvariant of more widely produced power plants, and therefore the aero-engine or helicopter publications should be consulted for these data.

Note that engine power ratings given below have been supplied, principally, by their manufacturers and are usually uninstalled output; data may thus vary from that quoted in the Aircraft section of this book, in which information is mainly supplied by the producer of the airframe. In most cases, the engine manufacturer's data reflect take-off power, generally under ISA sea-level conditions. Many gas-turbine engines, especially those for helicopters, are cleared to higher powers for brief periods in an emergency. Conversely, piston (and rotary) engine outputs are normally the maximum possible, which may be time-limited.

Piston Engines

Arrangement: 4-O (2) means an engine with four cylinders, horizontally opposed, two-stroke; 8-IV (4) means eight cylinders in inverted-vee form, four-stroke; 4-X (2D) means four cylinders in X configuration, two-stroke diesel; 9-R is a nine-cylinder radial; L indicates in line. Wankel-type engines (W) are alternatively known as rotary (or, more accurately, rotating-piston) engines; 2 × 2-O is two horizontally opposed pistons within single cylinder. Cooling: A = air cooling, L = liquid. In many cases the engines exist in numerous variants, for example with a geared drive or a supercharger (mechanically driven or turbo). Horsepower ratings to one place of decimals are based on metric (CV/PS) original data.

Manufacturer	Country	Designation/ name	Arrangement	Cooling	Bore mm (in)	Cylinder Stroke mm (in)	Cylinder capacity cc (cu in)	Dry weight kg (lb)	Max power kW (hp)
Aero-Conversions	US	Aero-Vee 2002	4-O (4)	A	92.0 (3.62)	82.0 (3.23)	2,180 (133.0)	73.0 (161)	59.7 (80)
AlfaPrag	Czech Republic	TP-422	4-O (4)	A	95.0 (3.74)	77.0 (3.03)	2,193 (133.2)	79.0 (174)	63 (84.5)
Alturair	US	A-650	1-rotor (W)	L	—	—	650 (39.54)	62.1 (137)	74.6 (100)
American Eagle	US	540	8-V (4)	L	114.3 (4.5)	—	8,827 (540)	316 (697)	484.9 (650)
Arrow	Italy	AE 530AC	2-O (2)	A	74.6 (2.94)	61.0 (2.40)	533 (32.53)	50.0 (110)	50.7 (68)
Arrow	Italy	AE 1070AC	4-O (2)	A	74.6 (2.94)	61.0 (2.40)	1,066 (65.1)	65.0 (143)	90 (120)
Arrow	Italy	GP 1000	4-O (2)	A	74.6 (2.94)	57.0 (2.24)	996 (60.78)	65.0 (143)	90 (120)
Arrow	Italy	GP 1500	6-O (2)	A	74.6 (2.94)	57.0 (2.24)	1,495 (91.2)	87.5 (87.5)	134 (180)
BMW	Germany	R1100RS	2-O (4)	A+oil	—	—	1,085 (66.2)	69.3 (152.8)	66 (88.5)
BMW	Germany	R1100S	2-O (4)	A+oil	—	—	1,085 (66.2)	73.2 (161.4)	70 (93.9)
BMW	Germany	R115ORS	2-O (4)	A+oil	—	—	1,130 (68.96)	76.3 (168.2)	72 (96.6)
Bombardier (Rotax)	Canada	V220	6-V (4)	L	97.0 (3.82)	70.0 (2.76)	3,104 (189)	190 (419)	164 (220)
Bombardier (Rotax)	Canada	V300	6-V (4)	L	97.0 (3.82)	70.0 (2.76)	3,104 (189)	210 (463)	223 (300)
CAM	Canada	100	4-L (4)	L	74.0 (2.91)	86.5 (3.41)	1,488 (90.7)	92.1 (203)	74.6 (100)
Centurion (TAE)	Germany	1.7	4-L (4D)	L	80.0 (3.15)	84.0 (3.31)	1,639 (103.07)	134 (295.4)	99 (135)
Centurion (TAE)	Germany	2.0	4-L (4D)	L					99 (135)
Centurion (TAE)	Germany	4.0	8-V (4D)	L	86.0 (3.386)	86.0 (3.386)	3,996 (243.85)	225.8 (606.3)	257 (350)
Continental	US	W-670	7-R (4)	A	130.175 (5.125)	117.5 (4.625)	10,947 (668)	211 (465)	164 (220)
Corvette	US	LS1	8-V (4)	L	99.0 (3.90)	92.0 (3.62)	5,665 (345.69)	208 (458.6)	257 (345)
CRM	Italy	18D/SS	18-W (4D)	L	150.0 (5.91)	180.0 (7.09)	57,260 (3,495)	1,700 (3,745)	1,380 (1,850)
DaimlerChrysler	Germany	Suprex ('Smart')	3-L(4)	L	66.5 (2.62)	66 (2.638)—	698 (42.59)	66 (146)	60.0 (80.5)
DeltaHawk	US	DH180A4	4-IV(2D)	L	101.6 (4.00)	101.6 (4.00)	3,310 (202)	149.7 (330)	134.2 (180)
Diamond	Austria	IAE 50R	1-rotor (W)	L	—	—	294 (17.94)	33.0 (72.75)	40.4 (54.2)
Diamond	Austria	IAE75R	1-rotor (W)	L	—	—	404 (24.65)	28.0 (61.7)	55.0 (73.8)
Diamond	Austria	GIAE 110R	2-rotor (W)	L	—	—	588 (35.89)	54.0 (119.05)	78.0 (104.6)
Diesel Air GmbH	Germany	D 280	2 × 2-O (2D)	A	74.0 (2.91)	2 × 78.0 (3.07)	1,400 (85.43)	85 (187.4)	58.8 (78.85)
Eagle	US	540	8-V (4)	L			8,849 (540)	316 (697)	373 (500)
FAM	France	200	6-V (4)	L	—	—	3,000 (183.0)	179 (395)	136 (182)
FDM	Germany	100c	4-L (4)	L	76.0 (2.99)	71.4 (2.81)	1,206 (73.59)	84.0 (185)	73.6 (98.7)
FDM	Germany	125C	4-L (4)	L	76.0 (2.99)	87.6 (3.45)	1,590 (97.03)	90.0 (198.4)	91.9 (123.3)
FDM	Germany	140i	4-L (4)	L	76.0 (2.99)	87.6 (3.45)	1,590 (97.03)	92.0 (202.8)	103.0 (138.1)
FDM	Germany	160Ti	4-L (4)	L	76.0 (2.99)	87.6 (3.45)	1,590 (97.03)	104.0 (229.3)	117.7 (157.8)
HCI	US	R180	5-R (4)	A	85.5 (3.365)	87.5 (3.445)	2,520 (154)	55.3 (122)	55.9 (75)
Hirth	Germany	F23A	2-O (2)	A	72.0 (2.835)	64.0 (2.52)	521 (31.79)	24.0 (52.9)	29.8 (29.8)
Hirth	Germany	F30	4-O (2)	A	72.0 (2.835)	64.0 (2.52)	1,042 (63.6)	36.0 (79.4)	70.8 (95)
Hirth	Germany	F30A	4-O (2)	A	72.0 (2.835)	64.0 (2.52)	1,042 (63.6)	39.0 (86.0)	77.2 (104)
Hirth	Germany	F30A36	4-O (2)	A	72.0 (2.835)	64.0 (2.52)	1,042 (63.6)	39.0 (85.98)	88.0 (118)
Hirth	Germany	F30E	4-O (2)	A	72.0 (2.835)	64.0 (2.52)	1,042 (63.6)	42.0 (92.6)	61.0 (82)
Hirth	Germany	F30ES	4-O (2)	A	72.0 (2.835)	64.0 (2.52)	1,042 (63.6)	42.0 (92.6)	75.0 (101)
Hirth	Germany	F31	2-L (2)	A	76.0 (3.99)	69.0 (2.72)	625 (38.13)	26.5 (5834)	29.1 (39)
Hirth	Germany	F33A	1 (2)	A	76.0 (3.99)	69.0 (2.72)	313 (19.1)	12.7 (28.0)	18.1 (24)
Hirth	Germany	F33B	1 (2)	A	76.0 (3.99)	69.0 (2.72)	313 (19.1)	13.0 (28.7)	18.1 (24)
Hirth	Germany	2701	2-L (2)	A	70.0 (2.755)	64.0 (2.52)	493 (30.08)	32.8 (72.5)	32.1 (43)
Hirth	Germany	2703	2-L (2)	A	72.0 (2.835)	64.0 (2.52)	521 (31.79)	32.8 (72.5)	40.4 (55)
Hirth	Germany	2704	2-L (2)	A	76.0 (2.99)	69.0 (2.72)	625 (38.13)	31.0 (68.3)	39.0 (52.3)
Hirth	Germany	2706	2-L (2)	A	76.0 (2.99)	69.0 (2.72)	625 (38.13)	31 (68.3)	48.5 (64.1)
Hirth	Germany	3503E	2-L (2)	L	76.0 (2.99)	69.0 (2.72)	625 (38.13)	36.0 (79.4)	51.5 (69.1)
Hirth	Germany	3701	3-L (2)	A	76.0 (2.99)	69.0 (2.72)	939 (57.3)	45.0 (99.2)	59.0 (79)
Hirth	Germany	3701ES	3-L (2)	A	76.0 (2.99)	69.0 (2.72)	939 (57.3)	45.0 (99.2)	74.0 (99)
HKS	Japan	700E	2-O (4)	A	85.0 (3.346)	60.0 (2.36)	680 (41.5)	55.0 (121.25)	44.0 (60.0)
Honda	Japan		4-O (4)	L	—	—	—	—	—
Howells	UK	HAE-100	4-O (2D)	L	80 (3.15)	90 (3.54)	1,810 (110.45)	92.7 (204.4)	74.6 (100)
HPower	US	HKS 700E	(4)		—	—	—	—	44.7 (60)
Jabiru	Australia	1600	4-O (4)	A	88.0 (3.346)	66.0 (2.60)	1,606 (98.0)	54.0 (119)	44.7 (60)
Jabiru	Australia	2200	4-O (4)	A	97.5 (3.84)	74.0 (2.91)	2,200 (134.3)	55.8 (123)	59.7 (80)
Jabiru	Australia	3300	6-O (4)	A	97.5 (3.84)	74.0 (2.91)	3,300 (201.4)	73.0 (161)	89 (120)
Jabiru	Australia	5100	8-O (4)	A	97.5 (3.84)	85.0 (3.35)	5,077 (309.8)	117.0 (258)	241 (180)
Jabiru	Australia	6000	8-O (4)	A	97.5 (3.84)	100.0 (3.94)	5,973 (364.5)	108.4 (239.0)	149 (200)
Jacobs	US	R-755-9	7-R (4)	A	133.35 (5.25)	127.0 (5.00)	12,405 (757)	231 (510)	168 (225)
JPX	France	4T60/A	4-O (4)	A	93.0 (3.66)	75.4 (2.97)	2,050 (125.0)	73.0 (161)	47.8 (65)
JPX	France	4TX75/A	4-O (4)	A	95.0 (3.74)	82.0 (3.23)	2,325 (141.9)	78.0 (172)	59.5 (79.8)
JPX	France	4TX75/M	4-O (4)	A	95.0 (3.74)	82.0 (3.23)	2,325 (141.9)	71.0 (156.5)	59.5 (79.8)
KMPO	Russia	P-800	4-O (2)	A	62.0 (2.44)	66.0 (2.60)	797 (46.6)	48.0 (105.8)	48.5 (65)
KMPO	Russia	P-1000	4-O (2)	A	72.0 (2.83)	66.0 (2.60)	925 (56.48)	55.0 (121.3)	59.7 (80)
König	Germany	SD 750	4-R (2)	A	66.0 (2.60)	42.0 (1.655)	570 (34.78)	18.5 (41.0)	20.8 (28)
König	Germany	SF 930	4-R (2)	A	70.0 (2.755)	60.0 (2.36)	930 (56.75)	36.0 (79.4)	35.8 (48)
Limbach	Germany	L 550	4-O (2)	A	66.0 (2.60)	40.0 (1.57)	548 (33.44)	15.5 (34.0)	32.0–33.6 (43–45)
Limbach	Germany	L 550E	4-O (2)	A	66.0 (2.60)	40.0 (1.57)	548 (33.44)	16.0 (35.3)	37.06 (49.6)
Limbach	Germany	L 1700EC	4-O (4)	A	88.0 (3.46)	69.0 (2.72)	1,680 (102.5)	73.0 (161)	50.7 (68)
Limbach	Germany	L 1700EA	4-O (4)	A	88.0 (3.46)	69.0 (2.72)	1,680 (102.5)	69.0 (152.1)	44.0 (59.0)
Limbach	Germany	L 2000	4-O (4)	A	90.0 (3.54)	78.4 (3.09)	1,994 (121.7)	70.0 (154)	59.0 (79.1)
Limbach	Germany	L 2000EO	4-O (4)	A	90.0 (3.54)	78.4 (3.09)	1,994 (120.3)	74.0 (163.1)	59.0 (79.1)
Limbach	Germany	L 2000EB	4-O (4)	A	90.0 (3.54)	78.4 (3.09)	1,994 (120.3)	76.5 (168.7)	59.0 (79.1)

Manufacturer	Country	Designation/ name	Arrangement	Cooling	Bore mm (in)	Cylinder Stroke mm (in)	Cylinder capacity cc (cu in)	Dry weight kg (lb)	Max power kW (hp)
Limbach	Germany	L 2400EB	4-O (4)	A	97.0 (3.82)	82.0 (3.23)	2,424 (147.9)	82.0 (181)	64.9 (87)
Limbach	Germany	L 2400EF	4-O (4)	A	97.0 (3.82)	82.0 (3.23)	2,424 (147.9)	82.0 (181)	73.5 (99)
Limbach	Germany	L 2400DFi/EFi	4-O (4)	A+L	97.0 (3.82)	82.0 (3.23)	2,424 (147.9)	76.0 (167.6)	74.0 (100)
Limbach	Germany	L 2400DWFIG	4-O (4)	A	97.0 (3.82)	82.0 (3.23)	2,424 (147.9)	100 (220)	96 (128.7)
Limbach	Germany	L 2400DT/ET	4-O (4)	A+L	97.0 (3.82)	82.0 (3.23)	2,424 (147.9)	86.0 (189.6)	96.0 (128.7)
Limbach	Germany	L 2400DT.X	4-O (4)	A+L	97.0 (3.82)	82.0 (3.23)	2,424 (147.9)	86 (189.6)	118 (158)
LOM	Czech Republic	M132A, AK, AR	4-L (4)	A	105.0 (4.13)	115.0 (4.53)	3,980 (242.9)	102 (225)	90 (121)
LOM	Czech Republic	M132B	4-L (4)	A	105.0 (4.13)	115.0 (4.53)	3,980 (242.9)	105 (231.5)	97.0 (130)
LOM	Czech Republic	M137A, AZ, AR	6-L (4)	A	105.0 (4.13)	115.0 (4.53)	5,970 (364.3)	141 (311)	134 (180)
LOM	Czech Republic	M137B	6-L (4)	A	105.0 (4.13)	115.0 (4.53)	5,970 (364.3)	141 (311)	143 (192)
LOM	Czech Republic	M332A	4-L (4)	A	105.0 (4.13)	115.0 (4.53)	3,980 (242.9)	102 (225)	103 (138)
LOM	Czech Republic	M332B	4-L (4)	A	105.0 (4.13)	115.0 (4.53)	3,980 (242.9)	113 (249)	118 (158)
LOM	Czech Republic	M332C	4-L (4)	A	105.0 (4.13)	115.0 (4.53)	3,980 (242.9)	113 (249)	124 (166)
LOM	Czech Republic	M337A	6-L (4)	A	105.0 (4.13)	115.0 (4.53)	5,970 (364.3)	153 (337)	154 (207)
LOM	Czech Republic	M337B	6-L (4)	A	105.0 (4.13)	115.0 (4.53)	5,970 (364.3)	153 (337)	173 (232)
LOM	Czech Republic	M337C	6-L (4)	A	105.0 (4.13)	115.0 (4.53)	5,970 (364.3)	153 (337)	185 (248)
LPE	US	IVG-600	8-IV (4)	L	—	—	9,832 (600.0)	255 (562)	448 (600)
Masschi	France	105	4-O (4)	L	105.4 (4.15)	74.0 (2.91)	2,582 (157.6)	45.0 (99.21)	71.6 (96)
Modena Avio	Italy	323	3-R (4)	L	100.0 (394)	95.0 (3.74)	2,238 (136.6)	82.0 (180.8)	96.9 (130)
Motorstar	Romania	R-263	5-R (4)	A	107 (4.21)	94.0 (3.70)	4,310 (263.0)	100 (220.5)	93.2 (125)
Nelson	US	H-63CP	4-O (2)	A	68.3 (2.69)	70.0 (2.75)	1,030 (63.00)	30.8 (68)	35.8 (48)
Novikov (RKBM)	Russia	DN-200	3 × 2-O (2D)	L	72.0 (2.835)	72.0 (2.835)	4,440 (270.9)	105 (231)	110 (148)
Orenda	Canada	OE600	8-V(4)	L	112.6 (4.433)	101.6 (4.00)	8,112 (495)	340 (750)	447 (600)
Orenda	Canada	OE600 Turbo	8-V (4)	L	112.6 (4.433)	101.6 (4.00)	8,112 (495)		559 (750)
Parma	Czech Republic	Mikron IIIAE	4-L (4)	A	90.0 (3.54)	96.0 (3.78)	2,440 (149.0)	70.0 (154)	48.5 (65)
Parma	Czech Republic	Mikron IIIB	4-L (4)	A	90.0 (3.54)	96.0 (3.78)	2,440 (149.0)	69.0 (152.1)	55.0 (55.0)
Porsche	Germany	3200	6-O (A)	A	95.0 (3.74)	74.4 (2.93)	3,164 (193)	181 (399)	162 (217)
Pulsar Aircraft	US	Aeromaxx	4-O (4)	A	—		1,998 (121.9)	74.8 (165)	88.0 (118)
PZL	Poland	PZL-3S	7-R (4)	A	155.5 (6.12)	155.0 (6.10)	20,600 (1,265)	411 (906)	442 (592)
PZL	Poland	PZL AI-14RA	9-R (4)	A	105.0 (4.125)	130.0 (5.118)	10,160 (620)	200 (441)	191 (256)
PZL	Poland	PZL ASz-62	9-R (4)	A	155.0 (6.10)	174.0 (6.85)	29,870 (1,823)	580 (1,279)	735 (985)
PZL	Poland	PZL K-9	9-R (4)	A	155.0 (6.10)	174.0 (6.85)	29,870 (1,823)	580 (1,279)	860 (1,170)
PZL	Poland	PZL-F 2A-120-C1	2-O (4)	A	117.48 (4.625)	88.9 (3.50)	1,916 (117.0)	58.5 (129)	44.7 (60)
PZL	Poland	PZL-F 4A-235-B31	4-O (4)	A	117.48 (4.625)	88.9 (3.50)	3,850 (235.0)	103 (226)	86.5 (116)
PZL	Poland	PZL-F 6A6350-C1	6-O (4)	A	117.48 (4.625)	88.9 (3.50)	5,735 (350.0)	150 (330)	153 (205)
Q-Drive	Czech Republic	QD-1400	4-O (4)	A	94.0 (3.70)	100.0 (3.94)	1,387 (84.64)	75.0 (165.3)	59.0 (79)
Rotax	Austria	447 UL-1V	2-L (2)	A	67.5 (2.66)	61.0 (2.40)	436.5 (26.64)	26.8 (59.1)	29.5 (39.6)
Rotax	Austria	447 UL-2V	2-L (2)	A	67.5 (2.66)	61.0 (2.40)	436.5 (26.64)	26.8 (59.1)	31.0 (41.6)
Rotax	Austria	462	2-L (2)		—	—			38.8 (52)
Rotax	Austria	503 UL-1V	2-L (2)	A	72.0 (2.835)	61.0 (2.40)	496.7 (30.31)	31.4 (69.2)	34.0 (45.6)
Rotax	Austria	503 UL-2V	2-L (2)	A	72.0 (2.835)	61.0 (2.40)	496.7 (30.31)	31.4 (69.2)	37.0 (49.6)
Rotax	Austria	582 UL	2-L (2)	L	76.0 (2.99)	64.0 (2.52)	580.7 (35.44)	27.4 (60.5)	48.0 (64.4)
Rotax	Austria	618 UL-2V	2-L (2)	L	76.0 (2.99)	68.0 (2.68)	617.0 (37.65)	31.0 (68.3)	55.0 (73.8)
Rotax	Austria	912 UL, 912A, 912F	4-O (4)	A+L	79.5 (3.13)	61.0 (2.40)	1,211.2 (73.9)	59.0 (130)	59.6 (79.9)
Rotax	Austria	912 UL DCDI	4-O (4)	A+L	84.0 (3.31)	61.0 (2.40)	1,352 (82.50)	56.6 (125)	73.5 (98.6)
Rotax	Austria	912 ULS, 912S	4-O (4)	A+L	84.0 (3.31)	61.0 (2.40)	1,352 (82.50)	56.6 (125)	73.5 (98.6)
Rotax	Austria	914 UL DCDI, 914F	4-O (4)	A+L	79.5 (3.13)	61.0 (2.40)	1,211.2 (73.9)	64.0 (141)	84.5 (113.3)
Rotax	Austria	936	6-V	—	–	–	—	—	162 (217)
Rotec	Australia	R2800 Fireball 7	7-R (4)	A	—	—	2,800 (170.87)	95 (209.4)	82.0 (110)
RotorWay	US	RI 162	4-O (4)	L	—	—	2,660 (162.0)	77.1 (170)	113 (152)
SAEC	China	HS5			ASh-62IR made under licence. See PZL ASz-62 (Poland)				
Samara MKB	Russia	P-032	2-O (2)	A	72.0 (2.835)	54.0 (2.13)	440 (26.85)	12.5 (27.6)	24.6 (33)
Samara MKB	Russia	P-033	2-O (2)	A	72.0 (2.835)	54.0 (2.13)	440 (26.85)	—	28.3 (38)
Sauer	Germany	UL 1800	4-O (4)	A	90.0 (3.54)	69.0 (2.72)	1,745 (106.49)	56.5 (124.56)	35.0 (46.9)
Sauer	Germany	UL 2100	4-O (4)	A	90.0 (3.54)	84.0 (3.31)	2,135 (130.3)	60.5 (133.4)	62.0 (83.1)
Sauer	Germany	SE 1800	4-O (4)	A	90.0 (3.54)	69.0 (2.72)	1,745 (106.49)	63.3 (139.55)	40.0 (53.6)
Sauer	Germany	SA 2100	4-O (4)	A	90.0 (3.54)	84.0 (3.31)	2,135 (130.3)	69.0 (152.1)	59.0 (79.1)
Sauer	Germany	SD 2500	4-O (4)	A	97.0 (3.82)	84.0 (3.31)	2,481 (151.4)	79.0 (174.2)	68.0 (91.2)
Sauer	Germany	SM 2700	4-O (4)	A	97.0 (3.82)	90 (3.54)	2,660 (162.3)	82.0 (180.8)	75.0 (100.6)
SMA	France	SR305	4-O (4D)	A		undisclosed	4,988 (305.0)	192 (423.3)	169 (227)
Stol Techno	Japan	HKS 700E	2-O (4)	A+L	85.0 (3.35)	60.0 (2.36)	680 (41.5)	47.0 (103.6)	44.7 (60.0)
Subaru	Japan	EJ22	4-L (4)	L	96.9 (3.81)	75.0 (2.95)	2,212 (136.0)	119 (264)	119 (160)
Subaru	Japan	EA81–100	4-O (4)	L	92.0 (3.62)	67.0 (2.64)	1,781 (108.7)	97.1 (214)	74.6 (100)
Subaru	Japan	EA81–140	4-O (4)	L	92.0 (3.62)	67.0 (2.64)	1,781 (108.7)	100 (222)	104 (140)
Superior	US	Vantage SV-360	4-O (4)	A	130.175 (5.125)	111.125 (4.375)	5,916 (361)	130.6 (287.9)	134 (180)
TCM	US	O-200-A & B	4-O (4)	A	103.1 (4.059)	98.4 (3.875)	3,280 (200.16)	77.2 (170.2)	74.6 (100)
TCM	US	IO-240-A & B	4-O (4)	A	112.7 (4.44)	98.4 (3.875)	3,940 (240.0)	93 (205.00)	93.0 (125)
TCM	US	IOF-240	4-O (4)	A	112.7 (4.44)	98.4 (3.875)	3,940 (240.0)		
TCM	US	O-300-A, C & D	6-O (4)	A	103.1 (4.06)	98.4 (3.875)	4,916 (300)	112.8 (248.70)	108.0 (145)
TCM	US	IO-300-CCB, D.DB, G.GB, H, HB	6-O (4)	A	103.1 (4.06)	98.4 (3.875)	4,916 (300)	148.4 (327.25)	156.7 (210)
TCM	US	IO-300-ES	6-O (4)	A	103.1 (4.06)	98.4 (3.875)	4,916 (300)	138.3 (305.00)	156.7 (210)
TCM	US	IO-300-J, JB, K, KB	6-O (4)	A	103.1 (4.06)	98.4 (3.875)	4,916 (300)	148.4 (327.25)	145.5 (195)
TCM	US	TSIO-300-A, AB	6-O (4)	A	103.1 (4.06)	98.4 (3.875)	4,916 (300)	128.7 (283.81)	156.7 (210)
TCM	US	TSIO-300-C, CB	6-O (4)	A	103.1 (4.06)	98.4 (3.875)	4,916 (300)	136.5 (301.00)	167.8 (225)
TCM	US	TSIO-300-D, DB	6-O (4)	A	103.1 (4.06)	98.4 (3.875)	4,916 (300)	128.7 (283.81)	167.8 (225)
TCM	US	L/TSIO-360-E, EB, F, -FB	6-O (4)	A	112.7 (4.44)	98.4 (3.875)	5,900 (360.0)	145.8 (321.35)	149.1 (200)
TCM	US	TSIO-360-H, -HB	6-O (4)	A	112.7 (4.44)	98.4 (3.875)	5,900 (360.0)	134.6 (295.75)	156.7 (210)
TCM	US	TSIO-360-JB	6-O (4)	A	112.7 (4.44)	98.4 (3.875)	5,900 (360.0)	134.6 (295.75)	167.8 (225)
TCM	US	L/TSIO-360-KB	6-O (4)	A	112.7 (4.44)	98.4 (3.875)	5,900 (360.0)	148.9 (328.35)	164.1 (220)
TCM	US	TSIO-360-LB	6-O (4)	A	112.7 (4.44)	98.4 (3.875)	5,900 (360.0)	155.7 (343.35)	156.7 (210)
TCM	US	TSIO-360-MB	6-O (4)	A	112.7 (4.44)	98.4 (3.875)	5,900 (360.0)	148.6 (237.50)	156.7 (210)
TCM	US	L/TSIO-360-RB	6-O (4)	A	112.7 (4.44)	98.4 (3.875)	5,900 (360.0)	148.6 (237.50)	164.1 (220)
TCM	US	TSIO-360-SB	6-O (4)	A	112.7 (4.44)	98.4 (3.875)	5,900 (360.0)	148.9 (328.35)	164.1 (220)
TCM	US	O-470-GCI	6-O (4)	A	127.0 (5.0)	101.6 (4.0)	7,702 (470)	195.9 (431.60)	179.0 (240)
TCM	US	O-470-J	6-O (4)	A	127.0 (5.0)	101.6 (4.0)	7,702 (470)	160.6 (354.15)	167.8 (225)
TCM	US	O-470-K, L & M	6-O (4)	A	127.0 (5.0)	101.6 (4.0)	7,702 (470)	172.4 (380.00)	171.5 (230)
TCM	US	O-470-R & S	6-O (4)	A	127.0 (5.0)	101.6 (4.0)	7,702 (470)	172.2 (379.66)	171.5 (230)
TCM	US	O-470-U	6-O (4)	A	127.0 (5.0)	101.6 (4.0)	7,702 (470)	176.4 (380.00)	171.5 (230)
TCM	US	IO-470-C	6-O (4)	A	127.0 (5.0)	101.6 (4.0)	7,702 (470)	182.6 (402.48)	186.4 (250)
TCM	US	IO-470-D & E	6-O (4)	A	127.0 (5.0)	101.6 (4.0)	7,702 (470)	193.3 (426.06)	193.9 (260)
TCM	US	IO-470-F	6-O (4)	A	127.0 (5.0)	101.6 (4.0)	7,702 (470)	181.0 (399.06)	193.9 (260)
TCM	US	IO-470-H	6-O (4)	A	127.0 (5.0)	101.6 (4.0)	7,702 (470)	182.6 (402.48)	193.9 (260)
TCM	US	IO-470-J & K	6-O (4)	A	127.0 (5.0)	101.6 (4.0)	7,702 (470)	182.3 (401.90)	167.8 (225)
TCM	US	IO-470-L & M	6-O (4)	A	127.0 (5.0)	101.6 (4.0)	7,702 (470)	186.6 (411.28)	193.9 (260)

Manufacturer	Country	Designation/ name	Arrangement	Cooling	Bore mm (in)	Cylinder Stroke mm (in)	Cylinder capacity cc (cu in)	Dry weight kg (lb)	Max power kW (hp)
TCM	US	IO-470-N	6-O (4)	A	127.0 (5.0)	101.6 (4.0)	7,702 (470)	188.0 (414.44)	193.9 (260)
TCM	US	IO-470-S	6-O (4)	A	127.0 (5.0)	101.6 (4.0)	7,702 (470)	185.7 (409.37)	193.9 (260)
TCM	US	IO-470-U, V & VO	6-O (4)	A	127.0 (5.0)	101.6 (4.0)	7,702 (470)	184.2 (406.00)	193.9 (260)
TCM	US	IO-520-A & J	6-O (4)	A	133.0 (5.25)	101.6 (4.0)	8,500 (520.0)	187.1 (412.43)	212.5 (285)
TCM	US	IO-520-B, BA, BB	6-O (4)	A	133.0 (5.25)	101.6 (4.0)	8,500 (520.0)	184.5 (406.65)	212.5 (285)
TCM	US	IO-520-C, CB	6-O (4)	A	133.0 (5.25)	101.6 (4.0)	8,500 (520.0)	180.9 (398.72)	212.5 (285)
TCM	US	IO-520-D & E	6-O (4)	A	133.0 (5.25)	101.6 (4.0)	8,500 (520.0)	186.7 (411.43)	212.5 (285)
TCM	US	IO-520-F	6-O (4)	A	133.0 (5.25)	101.6 (4.0)	8,500 (520.0)	186.7 (411.43)	212.5 (285)
TCM	US	IO-520-K	6-O (4)	A	133.0 (5.25)	101.6 (4.0)	8,500 (520.0)	186.7 (411.43)	212.5 (285)
TCM	US	IO-520-L	6-O (4)	A	133.0 (5.25)	101.6 (4.0)	8,500 (520.0)	187.2 (412.8)	212.5 (285)
TCM	US	IO-520-M, MB	6-O (4)	A	133.0 (5.25)	101.6 (4.0)	8,500 (520.0)	186.5 (411.20)	212.5 (285)
TCM	US	L/IO-520-P	6-O (4)	A	133.0 (5.25)	101.6 (4.0)	8,500 (520.0)	174.4 (384.44)	186.4 (250)
TCM	US	L/TSIO-520-AE	6-O (4)	A	133.0 (5.25)	101.6 (4.0)	8,500 (520.0)	165.5 (364.80)	186.4 (250)
TCM	US	TSIO-520-AF	6-O (4)	A	133.0 (5.25)	101.6 (4.0)	8,500 (520.0)	197.5 (435.47)	212.5 (285)
TCM	US	TSIO-520-B, BB	6-O (4)	A	133.0 (5.25)	101.6 (4.0)	8,500 (520.0)	184.7 (407.17)	212.5 (285)
TCM	US	TSIO-520-BE	6-O (4)	A	133.0 (5.25)	101.6 (4.0)	8,500 (520.0)	200.5 (442.10)	231.2 (310)
TCM	US	TSIO-520-C & H	6-O (4)	A	133.0 (5.25)	101.6 (4.0)	8,500 (520.0)	193.4 (426.30)	212.5 (285)
TCM	US	TSIO-520-CE	6-O (4)	A	133.0 (5.25)	101.6 (4.0)	8,500 (520.0)	197.5 (435.47)	242.4 (325)
TCM	US	TSIO-520-D, DB	6-O (4)	A	133.0 (5.25)	101.6 (4.0)	8,500 (520.0)	184.5 (406.72)	212.5 (285)
TCM	US	TSIO-520-E, EB	6-O (4)	A	133.0 (5.25)	101.6 (4.0)	8,500 (520.0)	184.0 (405.57)	223.7 (300)
TCM	US	TSIO-520-G	6-O (4)	A	133.0 (5.25)	101.6 (4.0)	8,500 (520.0)	188.2 (415.00)	212.5 (285)
TCM	US	TSIO-520-J, JB, N, NB	6-O (4)	A	133.0 (5.25)	101.6 (4.0)	8,500 (520.0)	179.8 (395.35)	231.2 (310)
TCM	US	TSIO-520-K, KB	6-O (4)	A	133.0 (5.25)	101.6 (4.0)	8,500 (520.0)	179.8 (395.35)	212.5 (285)
TCM	US	TSIO-520-L, LB	6-O (4)	A	133.0 (5.25)	101.6 (4.0)	8,500 (520.0)	188.7 (416.10)	231.2 (310)
TCM	US	TSIO-520-(M) P & R	6-O (4)	A	133.0 (5.25)	101.6 (4.0)	8,500 (520.0)	189.4 (417.52)	212.5 (285)
TCM	US	TSIO-520-T	6-O (4)	A	133.0 (5.25)	101.6 (4.0)	8,500 (520.0)	193.4 (426.30)	231.2 (310)
TCM	US	TSIO-520-U & UB	6-O (4)	A	133.0 (5.25)	101.6 (4.0)	8,500 (520.0)	191.5 (422.27)	223.7 (300)
TCM	US	TSIO-520-VB	6-O (4)	A	133.0 (5.25)	101.6 (4.0)	8,500 (520.0)	184.4 (406.50)	242.4 (325)
TCM	US	TSIO-520-WB	6-O (4)	A	133.0 (5.25)	101.6 (4.0)	8,500 (520.0)	216.0 (416.10)	242.4 (325)
TCM	US	GTSIO-520-D & H	6-O (4)	A	133.0 (5.25)	101.6 (4.0)	8,500 (520.0)	219.5 (484.00)	275.9 (375)
TCM	US	GTSIO-520-L	6-O (4)	A	133.0 (5.25)	101.6 (4.0)	8,500 (520.0)	220.0 (485.00)	275.9 (375)
TCM	US	GTSIO-520-M	6-O (4)	A	133.0 (5.25)	101.6 (4.0)	8,500 (520.0)	219.1 (483.00)	275.9 (375)
TCM	US	GTSIO-520-N	6-O (4)	A	133.0 (5.25)	101.6 (4.0)	8,500 (520.0)	220.4 (486.00)	275.9 (375)
TCM	US	IO-550-A	6–0 (4)	A	133.0 (5.25)	108.0 (4.25)	9,000 (520.0)	188.0 (414.40)	223.7 (300)
TCM	US	IO-550-B	6–0 (4)	A	133.0 (5.25)	108.0 (4.25)	9,000 (520.0)	184.5 (406.65)	223.7 (300)
TCM	US	IO-550-C	6–0 (4)	A	133.0 (5.25)	108.0 (4.25)	9,000 (520.0)	188.3 (415.10)	223.7 (300)
TCM	US	IO-550-D, E, F & (L)	6–0 (4)	A	133.0 (5.25)	108.0 (4.25)	9,000 (520.0)	192.8 (425.00)	223.7 (300)
TCM	US	IO-550-G	6–0 (4)	A	133.0 (5.25)	108.0 (4.25)	9,000 (520.0)	186.9 (412.00)	208.8 (280)
TCM	US	IO-550-N	6–0 (4)	A	133.0 (5.25)	108.0 (4.25)	9,000 (520.0)	186.9 (412.00)	231.2 (310)
TCM	US	TSIO-550-B & E	6–0 (4)	A	133.0 (5.25)	108.0 (4.25)	9,000 (520.0)	200.5 (442.00)	261.0 (350)
TCM	US	TSIO-550-C	6–0 (4)	A	133.0 (5.25)	108.0 (4.25)	9,000 (520.0)	200.5 (442.00)	231.2 (310)
TCM	US	TSIOL-550-A	6–0 (4)	L	133.0 (5.25)	108.0 (4.25)	9,000 (520.0)	182.1 (401.50)	261.0 (350)
TCM	US	TSIOL-550-B	6–0 (4)	L	133.0 (5.25)	108.0 (4.25)	9,000 (520.0)	188.4 (415.40)	242.4 (325)
TCM	US	TSIOL-550-C	6–0 (4)	L	133.0 (5.25)	108.0 (4.25)	9,000 (520.0)	188.4 (415.40)	261.0 (350)
Textron Lycoming	US	O-235-C	4-O (4)	A	111.0 (4.375)	98.4 (3.875)	3,850 (235.0)	96.6 (213)	85.8 (115)
Textron Lycoming	US	O-235-I, M	4-O (4)	A	111.0 (4.375)	98.4 (3.875)	3,850 (235.0)	98.0 (218)	88.0 (118)
Textron Lycoming	US	O-235N, P	4-O (4)	A	111.0 (4.375)	98.4 (3.875)	3,850 (235.0)	98.0 (218)	86.5 (116)
Textron Lycoming	US	O-320-A, E	4-O (4)	A	130.0 (5.118)	98.4 (3.875)	5,200 (319.8)	110.7 (244)	112 (150)
Textron Lycoming	US	(H)O-320-B2C	4-O (4)	A	130.0 (5.118)	98.4 (3.875)	5,200 (319.8)	112 (246)	119 (160)
Textron Lycoming	US	O-320-D	4-O (4)	A	130.0 (5.118)	98.4 (3.875)	5,200 (319.8)	114 (253)	119 (160)
Textron Lycoming	US	AEIO-320-D	4-O (4)	A	130.0 (5.118)	98.4 (3.875)	5,200 (319.8)	123 (271)	119 (160)
Textron Lycoming	US	AEIO-320-E	4-O (4)	A	130.0 (5.118)	98.4 (3.875)	5,200 (319.8)	117 (258)	112 (150)
Textron Lycoming	US	(L)IO-320-B, C	4-O (4)	A	130.0 (5.118)	98.4 (3.875)	5,200 (319.8)	117.5 (259)	119 (160)
Textron Lycoming	US	(L)O-360-A	4-O (4)	A	130.0 (5.118)	111.0 (4.375)	5,920 (361.0)	120 (265)	134 (180)
Textron Lycoming	US	O-360-F	4-O (4)	A	130.0 (5.118)	111.0 (4.375)	5,920 (361.0)	122 (269)	134 (180)
Textron Lycoming	US	TO-360-C, F	4-O (4)	A	130.0 (5.118)	111.0 (4.375)	5,920 (361.0)	154 (343)	157 (293)
Textron Lycoming	US	IO-360-A, C	4-O (4)	A	130.0 (5.118)	111.0 (4.375)	5,920 (361.0)	133 (293)	149 (200)
Textron Lycoming	US	IO-360-B	4-O (4)	A	130.0 (5.118)	111.0 (4.375)	5,920 (361.0)	122.5 (270)	134 (180)
Textron Lycoming	US	LIO-360-C	4-O (4)	A	130.0 (5.118)	111.0 (4.375)	5,920 (361.0)	139 (306)	149 (200)
Textron Lycoming	US	TIO-360-C	4-O (4)	A	130.0 (5.118)	111.0 (4.375)	5,920 (361.0)	158 (348)	157 (210)
Textron Lycoming	US	HIO-360-B1A	4-O (4)	A	130.0 (5.118)	111.0 (4.375)	5,920 (361.0)	118.4 (261)	134.3 (180)
Textron Lycoming	US	HO-360-C1A	4-O (4)	A	130.0 (5.118)	111.0 (4.375)	5,920 (361.0)	116.6 (257)	134.3 (180)
Textron Lycoming	US	HIO-360-D1A	4-O (4)	A	130.0 (5.118)	111.0 (4.375)	5,920 (361.0)	132 (290)	142 (190)
Textron Lycoming	US	(L)HIO-360-F1AD	4-O (4)	A	130.0 (5.118)	111.0 (4.375)	5,920 (361.0)	133 (293)	142 (190)
Textron Lycoming	US	AEIO-360-A	4-O (4)	A	130.0 (5.118)	111.0 (4.375)	5,920 (361.0)	139 (307)	149 (200)
Textron Lycoming	US	AEIO-360-B	4-O (4)	A	130.0 (5.118)	111.0 (4.375)	5,920 (361.0)	125 (277)	134 (180)
Textron Lycoming	US	O-540-A	6-O (4)	A	130.0 (5.118)	111.0 (4.375)	8,860 (541.5)	170 (374)	186 (250)
Textron Lycoming	US	IO-540-A1A5	6-O (4)	A	130.0 (5.118)	111.0 (4.375)	8,860 (541.5)	203 (448)	201 (270)
Textron Lycoming	US	O-540-B	6-O (4)	A	130.0 (5.118)	111.0 (4.375)	8,860 (541.5)	166 (366)	175 (235)
Textron Lycoming	US	IO-540-C	6-O (4)	A	130.0 (5.118)	111.0 (4.375)	8,860 (541.5)	170 (375)	186 (250)
Textron Lycoming	US	IO-540-D	6-O (4)	A	130.0 (5.118)	111.0 (4.375)	8,860 (541.5)	173 (381)	194 (260)
Textron Lycoming	US	O-540-E	6-O (4)	A	130.0 (5.118)	111.0 (4.375)	8,860 (541.5)	167 (368)	194 (260)
Textron Lycoming	US	O-540-F1B5	6-O (4)	A	130.0 (5.118)	111.0 (4.375)	8,860 (541.5)	167 (368)	194 (260)
Textron Lycoming	US	O-540-J	6-O (4)	A	130.0 (5.118)	111.0 (4.375)	8,860 (541.5)	165 (364)	175 (235)
Textron Lycoming	US	IO-540-K	6-O (4)	A	130.0 (5.118)	111.0 (4.375)	8,860 (541.5)	199 (438)	224 (300)
Textron Lycoming	US	IO-540-S	6-O (4)	A	130.0 (5.118)	111.0 (4.375)	8,860 (541.5)	200 (441)	224 (300)
Textron Lycoming	US	IO-540-T4B5	6-O (4)	A	130.0 (5.118)	111.0 (4.375)	8,860 (541.5)	176 (387)	1969 (260)
Textron Lycoming	US	IO-540-W1A5	6-O (4)	A	130.0 (5.118)	111.0 (4.375)	8,860 (541.5)	167 (369)	175 (235)
Textron Lycoming	US	AEIO-540-D	6-O (4)	A	130.0 (5.118)	111.0 (4.375)	8,860 (541.5)	174 (386)	194 (260)
Textron Lycoming	US	AEIO-540-L	6-O (4)	A	130.0 (5.118)	111.0 (4.375)	8,860 (541.5)	204 (449)	224 (300)
Textron Lycoming	US	TIO-540-A	6-O (4)	A	130.0 (5.118)	111.0 (4.375)	8,860 (541.5)	231.8 (511.0)	231.2 (310)
Textron Lycoming	US	TIO-540-AB1AD	6-O (4)	A	130.0 (5.118)	111.0 (4.375)	8,860 (541.5)	205 (456)	186 (250)
Textron Lycoming	US	TIO-540-AF1A, AF1B	6-O (4)	A	130.0 (5.118)	111.0 (4.375)	8,860 (541.5)	211 (466)	201 (270)
Textron Lycoming	US	TIO-540-AE2A	6-O (4)	A	130.0 (5.118)	111.0 (4.375)	8,860 (541.5)	246 (542)	261 (350)
Textron Lycoming	US	TIO-540-C	6-O (4)	A	130.0 (5.118)	111.0 (4.375)	8,860 (541.5)	205 (456)	186 (250)
Textron Lycoming	US	(L)TIO-540-F	6-O (4)	A	130.0 (5.118)	111.0 (4.375)	8,860 (541.5)	233 (514)	242 (325)
Textron Lycoming	US	(L)TIO-540-J	6-O (4)	A	130.0 (5.118)	111.0 (4.375)	8,860 (541.5)	239 (527)	261 (350)
Textron Lycoming	US	TIO-540-S	6-O (4)	A	130.0 (5.118)	111.0 (4.375)	8,860 (541.5)	228 (502)	224 (300)
Textron Lycoming	US	(L)TIO-540-U	6-O (4)	A	130.0 (5.118)	111.0 (4.375)	8,860 (541.5)	248 (547)	261 (350)
Textron Lycoming	US	(L)TIO-540-V	6-O (4)	A	130.0 (5.118)	111.0 (4.375)	8,860 (541.5)	248 (547)	269 (360)
Textron Lycoming	US	(L)TIO-540-W	6-O (4)	A	130.0 (5.118)	111.0 (4.375)	8,860 (541.5)	243 (536)	261 (350)
Textron Lycoming	US	TIO-541-E	6-O (4)	A	130.0 (5.118)	111.0 (4.375)	8,860 (541.5)	270 (596)	283 (380)
Textron Lycoming	US	TIGO-541-E	6-O (4)	A	130.0 (5.118)	111.0 (4.375)	8,860 (541.5)	319 (704)	317 (425)
Textron Lycoming	US	AEIO-580-L	6-O (4)	A	135.1 (5.319)	111.0 (4.375)	9,554 (583.0)	203.67 (449)	238.6 (320)
Textron Lycoming	US	IO-720-A, B, D	8-O (4)	A	130.0 (5.118)	111.0 (4.375)	11,840 (722.0)	258 (568)	298 (400)

Manufacturer	Country	Designation/ name	Arrangement	Cooling	Bore mm (in)	Cylinder Stroke mm (in)	Cylinder capacity cc (cu in)	Dry weight kg (lb)	Max power kW (hp)
Thielert	Germany	Centurion 1.7	4-L (4D)	L	80.0 (3.15)	84.0 (3.31)	1,689 (103.07)	134 (295.4)	99 (132.8)
Thielert	Germany	Centurion 4.0	8-V (4D)	L	80.0 (3.15)	84.0 (3.31)	3,378 (206.1)	c188 (414)	194.6 (261.0)
UFA	Russia	Turbo-Diesel							331 (443.9)
VAZ	Russia	VAZ-416	2-rotor (W)	L			1,308 (79.8)	125 (275.6)	134 (180)
VAZ	Russia	VAZ-4161	2-rotor (W)	L	-		1,308 (79.8)	125 (275.6)	132 (178)
VAZ	Russia	VAZ-4162	2-rotor (W)	L	—	—	1,308 (79.8)	125 (275.6)	147 (197)
VAZ	Russia	VAZ-426	3-rotor (W)	L	—	—	1,962 (119.7)	155 (341.7)	201 (270)
VAZ	Russia	VAZ-4261	3-rotor (W)	L	—	—	1,962 (119.7)	155 (341.7)	177 (237)
VAZ	Russia	VAZ-4262	3-rotor (W)	L	- -	—	1,962 (119.7)	155 (341.7)	198 (266)
VAZ	Russia	VAZ-4263	3-rotor (W)	L		—	1,962 (119.7)	145 (319.7)	221 (296)
VAZ	Russia	VAZ-4265	3-rotor (W)	L	-	--	1,962 (119.7)	130 (287)	201 (270)
VAZ	Russia	VAZ-526	4-rotor (W)	L			2,616 (159.6)	175 (386)	298 (400)
Verner	Czech Republic	SVS 1400	2-O (4)	A	94.0 (3.70)	100.0 (3.94)	1,400 (85.4)	62.0 (137)	58.8 (78.9)
Verner	Czech Republic	VM 133 M	2-O (4)	A	97.0 (3.82)	90.0 (3.54)	1,329 (81.0)	62.0 (136.7)	58.2 (78.0)
VM	Italy	1304HF	4-O (4D)	A	130.0 (5.118)	110.0 (4.33)	5,840 (356.4)	185 (408)	154 (154)
VM	Italy	1306HF	6-O (4D)	A	130.0 (5.118)	110.0 (4.33)	8,760 (534.6)	243 (536)	235 (315)
VM	Italy	1308HF	8-O (4D)	A	130.0 (5.118)	110.0 (4.33)	11,680 (713)	298 (657)	316 (424)
VOKBM	Russia	M-3	3-R (4)	A	105.0 (4.13)	130.0 (5.118)	3,387 (206.5)	119 (262)	77.2 (104)
VOKBM	Russia	M-5	5-R (4)	A	105.0 (4.13)	130.0 (5.118)	5,644 (344.4)	115 (254)	118 (158)
VOKBM	Russia	M-6	6-O (4)	L	105.0 (4.13)	82.0 (3.23)	4,260 (260)	270 (595)	254 (340)
VOKBM	Russia	M-7	7-R (4)	A	105.0 (4.13)	130.0 (5.118)	7,902 (482.2)	156 (343.9)	191 (256)
VOKBM	Russia	M-9F	9-R (4)	A	105.0 (4.13)	130.0 (5.118)	10,160 (620)	214 (472)	294 (294)
VOKBM	Russia	M-14NTK	9-R (4)	A	105.0 (4.13)	130.0 (5.118)	10,160 (620)		316 (424)
VOKBM	Russia	M-14PF	9-R (4)	A	105.0 (4.13)	130.0 (5.118)	10,160 (620)	214 (472)	294 (394)
VOKBM	Russia	M-14PT	9-R (4)	A	105.0 (4.13)	130.0 (5.118)	10,160 (620)	217 (478)	265 (355)
VOKBM	Russia	M-16	8-X (4)	A	-	-		150 (331)	224 (224)
VOKBM	Russia	M-17	4-O (4)	A	- -	—	-	118 (260)	130.5 (175)
Walter	Czech Republic	M202	2-O (2)	A	82.0 (3.23)	64.0 (2.52)	676 (41.25)	36.0 (79.4)	48.5 (65)
Wankel	Germany	LCR-407 SGti	1-rotor (W, D)	L	—	—	407 (24.8)	25.055.1	27.2 (36.4)
Wankel	Germany	LOCR-407 SD	1-rotor (W, D)	L	—	—	407 (24.8)	38.0 (83.8)	33.1 (44.4)
Wankel	Germany	LCR-814 TG ti	2-rotor (W, D)	L	—	—	814 (49.7)	35.0 (77.2)	55.1 (73.9)
Wankel	Germany	LOCR-814 TD	2-rotor (W, D)	L	—	—	814 (49.7)	50.0 (110)	66.2 (88.8)
Wankel	Germany	Twinpack	4-rotor (W, D)	L	—	—	- -	119 (262)	110 (148)
Wilksch	UK	WAM 120	3-L(2D)	L	—		- -	100 (220.5)	89.5 (89.5)
Wilksch	UK	WAM 160	4-L(2D)	L	—		- -	120 (264.6)	119.3 (160)
Zanzottera	Italy	MZ202	2-L (2)	A	76.0 (2.99)	69.0 (2.72)	626 (38.2)	39.0 (86.0)	48.5 (65)
Zanzottera	Italy	498ia	2-O (2)	A	75.0 (2.95)	56.0 (2.20)	498 (30.39)	17.0 (37.5)	28.3 (38)
Zanzottera	Italy	B1000I	4-O (2)	A	75.0 (2.95)	56.0 (2.20)	996 (60.78)	29.0 (29.0)	59.7 (80)
Zanzottera	Italy	B2000I	6-O (2)	A	76.0 (2.99)	69.0 (2.72)	1,880 (114.7)	51.0 (112.4)	112 (150)
Zoche	Germany	ZO 01A	4-X (2D)	A	95.0 (3.74)	94.0 (3.70)	2,665 (162.6)	84.0 (185)	110 (110)
Zoche	Germany	ZO 02A	8-X (2D)	A	95.0 (3.74)	94.0 (3.70)	5,330 (325.3)	118 (259)	220 (295)
Zoche	Germany	ZO 03A	2-IV (2D)	A	95.0 (3.74)	94.0 (3.70)	1,332.5 (81.3)	55.0 (121)	51.0 (68.4)
Zöllner	Germany	DZ	4-O (4)	A		—	1,998 (121.9)	74.0 (163)	86.8 (116)

Turboprop Engines

Arrangement: A = axial stages, C = centrifugal stages, C+C= two centrifugal stages on the same shaft, C, C two stages on different shafts.Prop drive: FT = free turbine, SS = single shaft, 2S = two-shaft engine but nodependent power turbineFor turboshaft engines, T-O rating is the maximum except contingency, usually a 30 minute, or maximum continuous power.

Manufacturer	Country	Designation/ name	Arrangement	Air flow kg/s (lb/s)	Prop drive	Length mm (in)	Width mm (in)	Weight, dry kg (lb)	T-O rating kW (shp)	Remarks
AlliedSignal										see Honeywell
Allison										see Rolls-Royce (US)
DEMC	China	WJ5							2,080 (2,790)	WJ5A I: AI-24A made under licence, details as AI-24T under Progress (ZMKB) (Ukraine)
DEMC	China	WJ5E	10A	14.6 (32.2)	SS	2,381 (93.7)	770 (30.3)	720 (1,587)	2,130 (2,856) 720 (1,587)[1]	
EPI (Europrop International)	International	TP400-D6	5A, 6A	26.31 (58.0)	FT	3,500 (137.8)	924.5 (36.4)	1,795 (3,957)	8,203 (11,000)	
General Electric	US	CT7–5A	5A+C	4.41 (10.0)	FT	2,438 (96)	737 (29)	355 (783)	1,294 (1,735)	
General Electric	US	CT7–9	5A+C	5.20 (11.5)	FT	2,438 (96)	737 (29)	365 (805)	<1,447 (1,940)	
General Electric	US	T64-P4D	14A	12.2 (27.0)	FT	2,793 (110)	683 (26.9)	538 (1,188)	2,535 (3,400)	
Honeywell	US	TPE331–3	C+C	3.54 (7.80)	SS	1,092 (43)	533 (21)	161 (355)	626 (840)	
Honeywell	US	TPE331–12	C+C	3.49 (7.7)	SS	1,168 (46)	533 (21)	181 (400)	834 (1,100)	
Honeywell	US	TPE331–14GR	C+C	5.26 (11.60)	SS	1,333 (52.5)	533 (21)	281 (620)	1,462 (1,960)	
Honeywell	US	LTP 101–700	A+C	2.31 (5.10)	FT	949 (37.4)	592 (23.3)	147 (325)	522 (700)	
Innodyn	US	165TE	C	—	SS	762 (30.0)	355.6 (14.0)	85.3 (188)	123 (165)	
Innodyn	US	255TE	C	—	SS	762 (30.0)	360 (14.2)	85.3 (188)	190 (255)	
Ivchenko	See Progress									
KKBM	Russia	NK-12MV	14A	65.0 (143)	FT	4,785 (188)	1,150 (45.3)	2,900 (6,393)	11,033 (14,795)	
Klimov	Russia	TV3–117VMA-SB2	12A	9.0 (19.84)	FT	2,860 (112.6)	880 (34.65)	570 (1,257)	1,864 (2,500)	
Klimov	Russia	TV7–117S	5A+C	7.95 (17.53)	FT	2,136 (34.88)	886 (34.88)	520 (1,146)	1,839 (2,466)	
LHTEC	US	CTP800–4T Twin	2×(C+C)	2×3.27 (7.20)	2×FT	1,769 (69.6)	1,252 (49.28)	517 (1,140)	2,013 (2,700)	
OMKB	Russia	TVD-20	7A+C	5.40 (11.9)	FT	1,770 (69.7)	850 (33.5)	240 (529)	1,081 (1,450)	
P&WC	Canada	PT6A-27	3A+C	3.08 (6.80)	FT	1,575 (62)	483 (19)	149 (328)	507 (680)	
P&WC	Canada	PT6A-41	3A+C	3.40 (7.50)	FT	1,701 (67)	483 (19)	183 (403)	634 (850)	
P&WC	Canada	PT6A-65R	4A+C	4.31 (9.50)	FT	1,905 (75)	483 (19)	218 (481)	1,026 (1,376)	
P&WC	Canada	PT6A-68	4A+C	4.5 (9.9)	FT	1,930 (76)	483 (19)	259.5 (572)	1,193 (1,600)	
P&WC	Canada	PW120	C, C	not disclosed	FT	2,134 (84)	635 (25)	418 (921)	1,491 (2,100)	
P&WC	Canada	PW121	C, C	not disclosed	FT	2,134 (84)	635 (25)	425 (936)	1,603 (2,150)	
P&WC	Canada	PW123 C/D	C, C	not disclosed	FT	2,134 (84)	635 (25)	450 (992)	1,603 (2,150)	
P&WC	Canada	PW127	C, C	not disclosed	FT	2,134 (84)	660 (26)	481 (1,060)	2,051 (2,750)	
P&WC	Canada	PW150A	3A+C	not disclosed	FT	2,423 (95.4)	767 (30.2)	690 (1,522)	3,781 (5,071)	
Progress (ZMKB)	Ukraine	AI-20M	10A	20.7 (45.6)	SS	3,096 (121.9)	842 (33.15)	1,040 (2,293)	2,940 (3,943)	
Progress (ZMKB)	Ukraine	AI-24T	10A	14.4 (31.7)	SS	2,346 (92.4)	677 (26.65)	600 (1,323)	1,880 (2,520)	
Progress (ZMKB)	Ukraine	D-27	See under Jet Engines							
PZL	Poland	TWD-10B	6A+C	4.58 (10.1)	FT	2,060 (81.1)	555 (21.9)	230 (507)	754 (1,011)	
RKBM	Russia	TVD-1500S	3A+C	4.0 (8.8)	FT	1,965 (77.4)	620 (24.4)	240 (529)	1,044 (1,400)	
Rolls-Royce	UK	Dart Mk 536	C+C	10.7 (23.5)	SS	2,480 (97.6)	963 (37.9)	569 (1,257)	1,700 (2,280)	
Rolls-Royce	UK	Tyne 21	6A, 9A	21.1 (46.5)	2S	2,762 (108.7)	1,400 (55)	1,085 (2,391)	4,226 (5,665)	
Rolls-Royce	US	250-B17	6A+C	1.56 (3.45)	FT	1,143 (45)	483 (19)	88.4 (195)	313 (420)	
Rolls-Royce	US	T56–15	14A	14.7 (32.4)	SS	3,708 (146)	686 (27)	828 (1,825)	3,424 (4,591)	
Rolls-Royce	US	T56–427	14A	15.2 (33.5)	SS	3,711 (146.1)	686 (27.0)	880 (1,940)	3,910 (5,250)	
Rolls-Royce	US	AE 2100A	14A	16.96 (37.4)	FT	2,743 (108)	1,151 (45.3)	715.8 (1,578)	3,095 (4,150)	
Rolls-Royce	US	AE 2100C	14A	16.33 (36.0)	FT	2,743 (108)	1,151 (45.3)	715.8 (1,578)	2,685 (3,600)	
Rolls-Royce	US	AE 2100D2, D3	14A	17.2 (37.9)	FT	2,743 (108)	1,151 (45.3)	745.7 (1,644)	3,424 (4,591)	
Rybinsk	Russia	TVD-1500V (RD-600V)	3A+C	4.0 (8.8)	FT	1,250 (49.2)	620 (24.4)	220 (485)	1,156 (1,550)	
SAEC	China	WJ6	Licensed AI-20M	See above under Progres (ZMBK)	—	—	—	—	—	
Saturn	Russia	AL-34–1	C	—	FT	1,700 (66.9)	640 (25.2)	178 (392)	809 (1,085)	
Turbomeca	France	Arrius 1D	C	not disclosed	FT	826 (32.5)	476 (18.74)	111 (245)	313 (420)	
Turbomeca	France	Arrius 2F	C	not disclosed	FT	945 (37.5)	459 (18.07)	103 (227)	376 (504)	
Walter	Czech Republic	M 601E	2A+C	3.60 (7.94)	FT	1,675 (65.9)	590 (23.23)	200 (441)	560 (751)	
Walter	Czech Republic	M 601F	2A+C	3.60 (7.94)	FT	1,675 (65.9)	590 (23.23)	202 (445)	580 (778)	
Walter	Czech Republic	M 602A	C+C	7.33 (16.2)	FT	2,565 (101.0)	753 (29.65)	570 (1,257)	1,360 (1,824)	
Walter	Czech Republic	M 602B	C+C	7.5 (16.53)	FT	2,285 (89.96)	753 (29.65)	480 (1,080)	1,500 (2,012)	

[1] Residual thrust

Turboshaft Engines

See Turboprop engines

Manufacturer	Country	Designation/ name	Arrangement	Air flow kg/s (lb/s)	Drive	Length mm (in)	Width mm (in)	Weight, dry kg (lb)	T-O rating kW (shp)	Remarks
AlliedSignal										see Honeywell
Allison										see Rolls-Royce
Aviadvigatel	Russia	D-25V	9A	26.2 (57.8)	FT	2,737 (107.75)	1,086 (42.8)	1,325 (2,921)	4,050 (5,430)	
CLXMW	China	WZ6							1,104 (1,480)	See Turmo IIIC
General Electric	US	CT7–2	5A+C	4.5 (10.0)	FT	1,194 (47.0)	635 (25.0)	212 (466)	1,212 (1,625)	
General Electric	US	CT7–6	5A+C	5.9 (13.0)	FT	1,194 (47.0)	660 (26.0)	220 (485)	1,491 (2,000)	
General Electric	US	CT7–6D	5A+C	6.1 (13.5)	FT	1,194 (47.0)	660 (26.0)	229 (504)	1,514 (2,030)	
General Electric	US	CT7–8A	5A+C	5.9 (13.0)	FT	1,194 (47.0)	660 (26.0)	246 (542)	1,879 (2,520)	
General Electric	US	T64–419	14A	13.3 (29.4)	FT	2,006 (79.0)	660 (26.0)	343 (755)	3,542 (4,750)	
General Electric	US	T700–401	5A+C	4.5 (10.0)	FT	1,168 (46.0)	635 (25.0)	197 (434)	1,260 (1,690)	
General Electric	US	T700–700	5A+C	4.5 (10.0)	FT	1,168 (46.0)	635 (25.0)	198 (437)	1,210 (1,622)	
General Electric	US	T700/T6	5A+C	5.9 (13.0)	FT	1,205 (47.4)	660 (26.0)	220 (485)	1,652 (2,215)	
Granit	Russia	TVD-400	A+C	2.15 (4.74)	FT	820 (32.28)	380 (14.96)	96.0 (211.6)	298 (400)	
Honeywell	US	HTS900	2C	n.a.	FT	914 (36.0)	508 (20.0)	142.9 (315)	723.3 (970)	
Honeywell	US	LTS 101–600A	1A+C	2.31 (5.10)	FT	785 (30.9)	599 (23.6)	115 (253)	459 (615)	
Honeywell	US	LTS 101–750B	1A+C	2.30 (5.10)	FT	795 (31.3)	470 (18.5)	123 (271)	515 (690)	
Honeywell	US	T53–703	5A+C	5.90 (13.0)	FT	1,209 (47.6)	584 (23.0)	247 (545)	1,343 (1,800)	
Honeywell	US	T5317A	5A+C	5.53 (12.2)	FT	1,209 (47.6)	584 (23.0)	256 (564)	1,119 (1,500)	
Honeywell	US	T55–714	7A+C	13.19 (29.1)	FT	1,181 (46.5)	610 (24.0)	377 (832)	3,630 (4,868)	
Klimov	Russia	GTD-350								see under PZL
Klimov	Russia	TV2–117	10A	8.4 (18.5)	FT	2,842 (111.9)	547 (21.7)	338 (745)	1,118 (1,500)	
Klimov	Russia	TV3–117V	12A	8.7 (19.18)	FT	2,085 (82.1)	640 (25.2)	285 (628)	<1,633 (2,190)	
Klimov	Russia	TV3–117VMA-SB3	12A	9.0 (19.84)	FT	2,055 (80.9)	650 (25.6)	310 (683)	1,864 (2,500)	
Klimov	Russia	TV7–117V	5A+C	9.2 (20.28)	FT	1,780 (70.08)	635 (25.0)	360 (794)	2,796 (3,750)	
Klimov	Russia	VK-1500	12A	7.3 (16.09)	FT	1,714 (67.48)	708 (27.87)	340 (750)	1,118 (1,500)	
Klimov	Russia	VK-2500	12A	9.3 (20.5)	FT	2,055 (80.91)	660 (26.0)	295 (650)	1,790 (2,400)	
LHTEC	US	T800–800	C+C	3.27 (7.20)	FT	843.3 (33.2)	550.1 (21.7)	143 (315)	995 (1,334)	
LHTEC	US	T800–801	C+C	4.43 (9.8)	FT	843.3 (33.2)	550.1 (21.7)	149.7 (330)	1,165 (1,563)	
LHTEC	US	CTS800–1G	C+C	4.01 (8.84)	FT	856.0 (33.7)	550 (21.66)	149.7 (330)	1,312 (1,760)	
LHTEC	US	CTS800–4	C+C	3.54 (7.8)	FT	1,047.2 (41.23)	561.6 (22.11)	173.7 (383)	1,016 (1,362)	
Mitsubishi	Japan	MG5–110	C	—	FT	1,184 (46.6)	737 (29.0)	154.2 (340)	653.2 (876)	
Mitsubishi	Japan	TS1–M-10	C	—	FT	1,499 (59.0)	609.6 (24.0)	151.5 (334)	701 (940)	
MTR	International	390	C+C	3.20 (7.05)	FT	1,078 (42.4)	442 (17.4)	154.2 (340)	958 (1,285)	
Omsk (OMKB)	Russia	TVD-20V	C+C	5.7 (12.57)	FT	1,850 (72.83)	855 (33.66)	210 (463)	1,119 (1,500)	
Omsk (OMKB)	Russia	TV-O-100	2A+C	2.66 (5.86)	FT	1,275 (50.2)	780 (30.7)	125 (275.5)	537 (720)	
P&WC	Canada	PT6B-36	3A+C	3.08 (6.80)	FT	1,504 (59.2)	495 (19.5)	169 (373)	732 (981)	
P&WC	Canada	PT6T-3B Twin-Pac	2×(3A+C)	2×3.08 (6.80)	2×FT	1,702 (67.0)	1,118 (44.0)	299 (660)	1,342 (1,800)	
P&WC	Canada	PT6C-67A	4A+C	4.3 (9.5)	FT	1,506 (59.3)	571.5 (22.5)	—	1,252 (1,679)	
P&WC	Canada	PW206A	C	—	FT	912 (35.9)	500 (19.7)	108 (237)	477 (640)	
P&WC	Canada	PW207D	C	—	FT	912 (35.9)	500 (19.7)	110	426 (572)	
Progress (ZMKB)	Ukraine	AI-450	C	1.72 (3.79)	FT	1,085 (42.72)	515 (20.28)	110 (242.5)	345 (462)	
Progress (ZMKB)	Ukraine	D-136	6A, 7A	35.6 (78.4)	FT	3,964 (156.06)	1,382 (4.4)	1,050 (2,315)	7,457 (10,000)	
Progress (ZMKB)	Ukraine	D-127	5A, 2A+C	27.4 (60.4)	FT	3,950 (155.5)	1,400 (55.1)	—	10,700 (14,350)	
PZL	Poland	PZL-10W	6A+C	4.6 (10.1)	FT	1,875 (73.8)	740 (29.0)	141 (310)	662 (888)	
PZL	Poland	GTD-350	7A+C	2.19 (4.83)	FT	1,385 (54.53)	626 (24.9)	140 (307)	294 (394)	
RKBM	Russia	(RD-600V)	3A+C	4.0 (8.8)	FT	1,250 (49.2)	620 (24.4)	220 (485)	969 (1,300)	
Rolls-Royce	UK	Gem 42	4A, C	3.41 (7.50)	FT	1,099 (43.2)	575 (22.6)	183 (404)	746 (1,000)	
Rolls-Royce	UK	Gnome	10A	6.3 (13.8)	FT	1,392 (54.8)	577 (22.7)	148 (326)	1,145 (1,535)	
Rolls-Royce	US	250-C20B	6A+C	1.56 (3.45)	FT	985 (38.8)	483 (19.0)	71.5 (158)	313 (420)	(ex/Allison)
Rolls-Royce	US	250-C28	C	2.02 (4.45)	FT	1,021 (40.2)	557 (21.9)	106 (233)	373 (500)	
Rolls-Royce	US	250-C30	C	2.54 (5.60)	FT	1,041 (41.0)	557 (21.9)	114 (251)	485 (650)	
Rolls-Royce	US	250-C40B	C	2.77 (6.10)	FT	1,041 (41)	557 (21.9)	127 (280)	533 (715)	
Rolls-Royce	US	T406	14A	16.1 (35.5)	FT	1,958 (77.0)	671 (26.4)	440 (971)	4,586 (6,150)	
RRTI	International	RTM 322–01/8	3A+C	5.75 (12.68)	FT	1,171 (46.1)	604 (23.8)	240 (538)	1,566 (2,100)	
RRTI	International	RTM 322–01/9	3A+C	5.9 (13.0)	FT	1,171 (46.1)	659 (25.9)	233 (512)	1,785 (2,393)	
RRTI	International	RTM322–01/12	3A+C	5.75 (12.68)	FT	1,171 (46.1)	736 (28.98)	249 (549.0)	1,566 (2,101)	
RRTI	International	RTM322–02/8	3A+C	5.8 (12.79)	FT	1,171 (46.1)	736 (28.98)	248 (546.7)	1,670 (2,241)	
Rybinsk	Russia	RD-600V (TVD-1500V)	3A+C	4.0 (8.8)	FT	1,250 (49.2)	620 (24.4)	220 (485)	1,156 (1,550)	
Soyuz	Russia	TV-O-100	2A+C	2.66 (5.86)	FT	1,275 (50.2)	780 (30.7)	125 (276)	537 (720)	
Turbomeca	France	Ardiden 1	C+C	not disclosed	FT		—	198 (436.5)	1,067 (1,430)	
Turbomeca	France	Ardiden 2K	C+C	not disclosed	FT		—	190 (419)	1,165 (1,562)	
Turbomeca	France	Arriel 1B	1A+C	not disclosed	SS	1,090 (42.9)	430 (16.9)	120 (265)	478 (641)	
Turbomeca	France	Arriel 2B	1A+C	not disclosed	SS	1,181 (46.5)	617.2 (24.3)	127.9 (282)	632 (848)	
Turbomeca	France	Arrius 1A	C	not disclosed	FT	782 (30.8)	360 (14.2)	87.0 (192)	380 (509)	
Turbomeca	France	Arrius 1A/1M	C	not disclosed	FT	793 (31.2)	367 (14.45)	101 (223)	357 (479)	
Turbomeca	France	Arrius 2B	C	not disclosed	FT	782 (30.8)	360 (14.2)	87.0 (192)	519 (696)	
Turbomeca	France	Arrius 2B1	C	not disclosed	FT	1,158 (45.6)	518 (20.4)	114 (251)	559 (750)	
Turbomeca	France	Arrius 2K1	C	not disclosed	FT	968 (38.1)	470 (18.5)	115 (253.5)	500 (670)	
Turbomeca	France	Artouste III	A+C	4.31 (9.50)	SS	1,815 (71.5)	507 (20.0)	178 (392)	440 (590)	
Turbomeca	France	Astazou XIVM	2A+C	2.49 (5.50)	SS	1,470 (57.9)	460 (18.1)	160 (353)	640 (858)	
Turbomeca	France	Makila 1A1	3A+C	5.5 (12.1)	FT	2,103 (82.8)	528 (20.8)	241 (531)	1,357 (1,820)	
Turbomeca	France	Makila 1A2	3A+C	5.5 (12.1)	FT	2,117 (83.8)	498 (19.6)	247 (545)	1,376 (1,845)	
Turbomeca	France	Makila 1A4	3A+C	5.7 (12.6)	FT	1,836 (71.6)	498 (19.4)	247 (545)	1,567 (2,101)	
Turbomeca	France	TM 333	2A+C		FT	1,045 (41.1)	454 (17.9)	156 (345)	747 (1,001)	
Turbomeca	France	Turmo IIIC	1A+C	5.9 (13.0)	FT	2,184 (85.5)	637 (25.1)	225 (496)	1,104 (1,480)	
ZEF	China	WZ8							522 (700)	Arriel 1C made under licence

Jet Engines

Arrangement: A = number of axial stages, C = centrifugal stages, F = fan stages, a/b = afterburner or augmentor
Air flow: Flow is through fan, where applicable, not core; BPR = bypass ratio; PF = propfan
<: Various ratings up to this maximum

without reverser (other NK-8 family include it)
measured over propfan blades
has vectored nozzle(s)

Manufacturer	Country	Designation/ name	Arrangement	Airflow kg/s (lb/s)	BPR	Length mm (in)	Diameter mm (in)	Weight, dry kg (lb)	T-O rating kN (lbst)
Aerosud-Marvol	South Africa/Russia	SMR-95	4F, 9A, a/b	75.5 (166)	0.49	4,229 (166.5)	1,080 (42.52)	1,235 (2,701)	81.4 (18,300)
									49.4 (11,110)
Agilis	US	TF1000	1F, 1A	n/a	5.0	1,420 (55.9)	580 (22.83)	129.3 (285)	4.45 (1,000)
Aviadvigatel	Russia	D-20P	3F, 8A	113 (249)	1.0	3,304 (130.0)	976 (38.3)	1,468 (3,236)	53.0 (11,90)
Aviadvigatel	Russia	D-21A1	5F, 10A	153 (337)	0.83	4,837 (190.4)	1,020 (40.2)	2,100 (4,630)	52.3 (11,750)
Aviadvigatel	Russia	D-30 III	5F, 10A	127 (280)	1.0	3,983 (156.8)	1,050 (41.3)	1,550 (3,417)	66.7 (14,990)
Aviadvigatel	Russia	D-30F6	5F, 10A, a/b	150 (331)	0.57	7,040 (277.2)	1,020 (40.2)	2,416 (5,326)	186.1 (41,843)
									93.2 (20,944)
Aviadvigatel	Russia	D-30KU	3F, 11A	269 (593)	2.42	5,700 (224.0)	1,560 (61.4)	2,668 (5,882)	107.9 (24,250)
Aviadvigatel	Russia	D-30KU-90	3F, 13A	265 (584)	2.44	5,700 (224.4)	1,560 (61.4)	2,400 (5,291)	117.7 (26,455)
Aviadvigatel	Russia	PS-7	1F+2A, 5A	n/a	n/a	n/a	n/a	n/a	68.7 (15,432)
Aviadvigatel	Russia	PS-9	1F+3A, 5A	n/a	n/a	n/a	n/a	n/a	100.0 (22,487)
Aviadvigatel	Russia	PS-14	1F+3A, 5A	n/a	n/a	n/a	n/a	n/a	137.3 (30,864)
Aviadvigatel	Russia	PS-18R	1F+4A, 5A	n/a	n/a	n/a	n/a	n/a	176.5 (30,683)
Aviadvigatel	Russia	PS-90A	2F+2A, 13A	470 (1,036)	4.6	4,964 (195.4)	1,900 (74.8)	2,950 (6,503)	156.9 (35,275)
Aviadvigatel	Russia	PS-90A10	1F, 12A	264 (582)	3.76	4,280 (168.5)	1,400 (55.1)	1,900 (4,180)	90.2 (20,283)
Aviadvigatel	Russia	PS-90A12	1F, 13A	370 (816)	5.05	4,795 (188.8)	1,670 (65.8)	2,300 (5,071)	117.7 (26,455)
CFE	US	CFE-738	1F, 5A+C	95.3 (210)	5.3	2,514 (99.0)	1,092 (43.0)	601 (1,325)	26.5 (5,957)
CFM	International	CFM56-2B	1F+3A, 9A	370 (817)	6.0	2,430 (95.7)	1,735 (68.3)	2,119 (4,671)	97.9 (22,000)
CFM	International	CFM56-3C	1F+3A, 9A	312 (688)	5.0	2,360 (93.0)	1,524 (60.0)	1,951 (4,301)	<104.5 (23,500)
CFM	International	CFM56-5A	1F+3A, 9A	386 (852)	6.0	2,422 (95.4)	1,735 (68.3)	2,257 (4,975)	<117.9 (26,500)
CFM	International	CFM56-5C	1F+4A, 9A	466 (1,027)	6.6	2,616 (103.0)	1,836 (72.3)	2,644 (5,830)	<151.3 (34,000)
CFM	International	CFM56-7B	1F+4A, 9A	<355 (783)	5.1	2,507 (98.7)	1,549 (61.0)	2,384 (5,256)	<117.4 (26,400)
CFM	International	CFM56-9	1F+2A, 9A	<282 (621)	5.08	2,329 (91.7)	1,422 (56.0)	not finalised	>82.3 (18,500)
Engine Alliance	US	GP7270	1F+5A, 9A	1,361 (3,000)	8.7	4,750 (187)	3,150 (124)	6,085 (13,416)	311.23 (70,000 lb)
Eurojet	International	EJ200	3F, 5A, a/b	<77.1 (170)	0.4	3,988 (157.0)	740 (29.0)	1,034 (2,280)	c90 (20,250)
									c60 (13,500)
General Electric	US	GE90-76B	1F+3A, 10A	1,361 (3,000)	9.0	5,182 (204.0)	3,404 (134.0)	7,559 (16,664)	340 (76,400)
General Electric	US	GE90-85B	1F+3A, 10A	1,415 (3,120)	8.7	5,182 (204.0)	3,404 (134.0)	7,559 (16,664)	377 (84,700)
General Electric	US	GE90-90B	1F+3A, 10A	1,449 (3,195)	8.4	5,182 (204.0)	3,404 (134.0)	7,559 (16,664)	401 (90,000)
General Electric	US	GE90-92B	1F+3A, 9A	1,461 (3,221)	8.3	5,182 (204.0)	3,404 (134.0)	7,559 (16,664)	409 (92,000)
General Electric	US	GE90-115B	1F+4A, 9A	1,641 (3,641)	8.9	7,290 (287)	3,442 (135.5)	8,761 (19,315)	511.6 (115,000)
General Electric	US	GEnx-1OA	1F+4A, 10A	C700 (1,543)	9.2	4,699 (185)	2,827 (111.3)	5,642 (12,439)	236.6 (53,200))
General Electric	US	CF6-50C2/E2	1F+3A, 14A	658 (1,450)	4.3	4,394 (173.0)	2,195 (86.4)	3,956 (8,721)	234 (52,500)
General Electric	US	CF6-80A2/A3	1F+3A, 14A	663 (1,460)	4.6	3,998 (157.4)	2,195 (86.4)	3,819 (8,420)	222.4 (50,000)
General Electric	US	CF6-80C2	1F+3A, 14A	802 (1,769)	5.05	4,267 (168.0)	2,692 (106.0)	4,309 (9,499)	<270 (60,690)
General Electric	US	CF6-80E1	1F+3A, 14A	874 (1,926)	5.3	4,405 (173.5)	2,794 (110.0)	5,075 (11,189)	<298 (66,870)
General Electric	US	CF34-3A	1F, 14A	151 (332)	6.3	2,616 (103.0)	1,245 (49.0)	739 (1,625)	<41.0 (9,220)
General Electric	US	CF34-8C1	1F, 10A	200 (440.9)	4.8	3,264 (128.5)	1,321 (52.0)	1,090 (2,403)	61.36 (13,790)
General Electric	US	CF34-8D3	1F, 10A	206 (454)	5.1	3,264 (128.5)	1,321 (52.0)	1,120 (2,470)	59.17 (13,300)
General Electric	US	CF34-8D3	1F, 10A	206 (454)	5.1	3,264 (128.5)	1,321 (52.0)	1,120 (2,470)	59.17 (13,300)
General Electric	US	CF34-8E	1F, 10A	211 (465)	5.1	3,251 (128.0)	1,321 (52.0)	1,120 (2,470)	64.56 (14,510)
General Electric	US	CF34-10E	1F, 10A	270 (595)	5.3	2,294 (90.29)	1,448 (57.0)	1,724 (3,800)	82.31 (18,500)
General Electric	US	F101-102	2F, 9A, a/b	159.7 (352)	2.01	4,590 (180.7)	1,402 (55.2)	2,023 (4,460)	136.9 (30,780)
General Electric	US	F110-100	3F, 9A, a/b	122.4 (269.8)	0.76	4,630 (182.3)	1,181 (46.5)	1,778 (3,920)	124.6 (28,000)
									78.0 (17,530)
General Electric	US	F110-129	3F, 9A, a/b	122 (270)	0.68	4,620 (181.9)	1,181 (46.5)	1,805 (3,980)	129.0 (29,000)
									75.7 (17,000)
General Electric	US	F110-400	3F, 9A, a/b	120.2 (265)	0.76	5,900 (232.3)	1,181 (46.5)	1,996 (4,400)	119.2 (26,080)
									71.6 (16,800)
General Electric	US	F118-100	3F, 9A	130+ (287)		2,553 (100.5)	1,181 (46.5)	1,452 (3,200)	84.6 (19,000)
General Electric	US	F404-400	3F, 7A, a/b	64.4 (142)	0.34	3,912 (154.0)	880 (34.8)	995.6 (2,195)	71.2 (16,000)
									48.9 (11,000)
General Electric	US	F404-402	3F, 7A, a/b	66.2 (146)	0.27	4,030 (158.8)	880 (34.8)	1,035 (2,282)	78.7 (17,700)
									53.2 (11,950)
General Electric	US	F404-F1D2	3F, 7A	65 (143)	n/a	2,108 (83.0)	880 (34.8)	784.7 (1,730)	46.8 (10,540)
General Electric	US	F414-400	3F, 7A, a/b	77.1 (169)	n/a	3,912 (154.0)	889 (35.0)	1,120 (2,470)	97.9 (22,000)
									55.6 (12,500)
General Electric/Rolls-Royce	International	F136	1F+3A, 5A	n/a	0.8	5,613 (221)	1,168 (46.0)	c1,950 (4,300)	181.4 (40,600)
GTRE	India	Kaveri	3F, 6A, a/b	n/a	n/a	n/a	n/a	1,100 (2,425)	80.5 (18,100)
									52.0 (11,687)
Honda	Japan	F118-2	1A+1A+1A	n/a	4.43	n/a	1,224 (48.19)	n/a	7.555 (1,700)
Honeywell	US	ALF502R-6	1F, 7A+C	87.0 (192)	5.6	1,487 (58.6)	1,059 (41.7)	624 (1,375)	33.4 (7,500)
Honeywell	US	AS907	1F, 4A+C	n/a	4.2	2,347 (92.4)	1,176 (46.3)	619 (1,364)	28.91 (6,500)
Honeywell	US	ATF3-6A	1F, 5A, C	73.5 (162)	2.8	2,591 (102.0)	853 (33.6)	510 (1,125)	24.2 (5,440)

Manufacturer	Country	Designation/ name	Arrangement	Airflow kg/s (lb/s)	BPR	Length mm (in)	Diameter mm (in)	Weight, dry kg (lb)	T-O rating kN (lbst)
Honeywell	US	LF507	1F, 7A+C	87.0 (192)	5.7	1,487 (58.6)	1,059 (41.7)	624 (1,375)	31.1 (7,000)
Honeywell	US	TFE731–2	1F, 4A+C	51.3 (113)	2.66	1,520 (59.8)	716 (28.2)	337 (743)	15.57 (3,500)
Honeywell	US	TFE731–3	1F, 4A+C	53.7 (118)	2.8	1,520 (59.8)	716 (28.2)	342 (754)	16.46 (3,700)
Honeywell	US	TFE731–5B	1F, 4A+C	64.9 (143)	3.48	1,665 (65.5)	754 (29.7)	408 (899)	21.13 (4,750)
Honeywell	US	TFE731–20	1F, 4A+C	66.2 (146)	3.1	1,547 (60.9)	716 (28.2)	406 (895)	15.57 (3,500)
Honeywell	US	TFE731–40	1F, 4A+C	65.8 (145)	2.9	1,547 (60.9)	716 (28.2)	406 (895)	18.91 (4,250)
Honeywell	US	TFE731–60	1F, 4A+C	84.8 (187)	3.9	2.083 (82.0)	781 (30.7)	448 (988)	22.24 (5,000)
Honeywell	US	TFE1042(F124)	3F, 4A+C	42.7 (94.1)	0.4	1,925 (75.8)	591 (23.25)	499 (1,100)	28.0 (6,300)
Honeywell	US	TFE1042–70(F125)	3F, 4A+C, a/b	43.3 (95.4)	0.4	3,561 (140.2)	591 (23.25)	617 (1,360)	41.1 (9,250) 26.8 (6,025)
IAE	International	V2522-A5	1F+4A, 10A	384 (848)	4.9	3,200 (126.0)	1,600 (63.0)	2,359 (5,200)	97.9 (22,000)
IAE	International	V2527-A5	1F+4A, 10A	384 (848)	4.75	3,200 (126.0)	1,600 (63.0)	2,500 (5,511)	117.9 (26,500)
IAE	International	V2528-D5	1F+4A, 10A	384 kg (848 lb)/s	4.8	3,200 (126.0)	1,600 (63.0)	2,540 (5,600)	124.6 (28,000)
IAE	International	V2533-A5	1F+4A, 10A	384 (848)	4.4	3,200 (126.0)	1,600 (63.0)	2,500 (5,511)	146.8 (33,000)
IHI	Japan	F3–30	2F, 5A	34.0 (75.0)	0.9	1,340 (52.76)	560 (22.0)	340 (750)	16.37 (3,680)
IL	Poland	D-18A	2F, 5A	38.4 (84.66)	0.7	1,940 (76.37)	750 (29.5)	380 (837.7)	17.65 (3,968)
IL	Poland	K-15	6A	23.5 (51.8)	0	1,560 (61.42)	725 (28.5)	320 (705.5)	14.71 (3,307)
IL	Poland	SO-3	7A	n/a	0	2,151 (84.7)	707 (27.8)	321 (708)	10.79 (2,425)
KKBM	Russia	NK-8–2U	2F+2A, 6A	228 (503)	1.049	5,288 (206.2)	1,442 (56.8)	2,350 (5,180)	103.0 (23,150)
KKBM	Russia	NK-8–4	2F+2A, 6A	222 (489)	1.042	5,101 (201.0)	1,442 (56.8)	2,440 (5,379)	103.0 (23,150)
KKBM	Russia	NK-86	2F+2A, 6A	292 (644)	1.6	3,638 (143.0)[1]	1,600 (63.0)	2,450 (5,401)	127.5 (28,660)
Klimov	Russia	RD-33	4F, 9A, a/b	75.5 (166)	0.49	4,229 (166.5)	1,040 (40.95)	1,055 (2,326)	81.4 (18,300) 49.4 (11,110)
Klimov	Russia	RD-133	4F, 9A	77 (170)	0.49	4,230 (166.5)	1,040 (40.94)	1,145 (2,524)	88.25 (19,841)
Klimov	Russia	RD-43	4F, 9A	85 (187.4)	n/a	4,230 (166.5)	n/a	c1,000 (2,205)	98.01 (22,057)
LM	China	WP6	9A, a/b	46.3 (102)	0	5,483 (215.9)	668 (26.3)	725 (1,598)	39.72 (8,929) 29.42 (6,614)
LM	China	WP6A	9A, a/b	46.3 (102)	0	5,483 (215.9)	668 (26.3)	725 (1,598)	36.78 (8,267)
LM	China	WS6	3F, 11A, a/b	155 (342)	1.0	4,654 (183.2)	1,370 (53.94)	2,100 (4,630)	122.1 (27,445) 71.1 (15,991)
LM	China	WS10A Taichang	3F, 9A	124.7 (275.0)	0.78	n/a	n/a	1,795 (3,957)	132 (29,675)
LMC	China	WP7	3A+5A, a/b	65.0 (143)	0	4,600 (181.1)	825 (32.5)	1,053 (2,321)	59.8 (13,448) 43.2 (9,700)
LMC	China	WP7F	3A+5A, a/b	n/a	0	n/a	n/a	n/a	63.7 (14,330) 44.1 (9,921)
LMC	China	WP13	3A+5A, a/b	65.6 (145)	0	4,600 (181.1)	907 (35.7)	1,211 (2,670)	64.7 (14,550) 40.2 (9,039)
LMC	China	WP13A II	3A+5A, a/b	65.6 (145)	0	5,150 (202.8)	907 (35.7)	1,201 (2,648)	65.9 (14,815) 47.1 (10,582)
LMC	China	WP13B	3A+5A, a/b	n/a	0	n/a	n/a	n/a	68.7 (15,432) 47.1 (10,582)
LMC	China	WP13F	3A+5A, a/b	n/a	0	n/a	n/a	n/a	64.7 (14,550) 44.1 (9,921)
Powerjet	International, France/Russia	SM146	1F, 6A	n/a	4.43	2,070 (81.5)	1,224 (48.19)	n/a	82.0 (15,920)
Pratt & Whitney	US	F100–220	3F, 10A, a/b	n/a	0.7	5,280 (208.0)	1,181 (46.5)	1,451 (3,200)	106.0 (23,830) 65.3 (14,670)
Pratt & Whitney	US	F100–220P	3F, 10A, a/b	n/a	0.6	5,280 (208.2)	1,181 (46.5)	1,526 (3,365)	120.1 (27,00) 74.3 (16,70)
Pratt & Whitney	US	F100–229	3F, 10A, a/b	n/a	0.36	4,855 (191.15)	1,181 (46.5)	1,681 (3,705)	129.5 (29,100) 79.2 (17,800)
Pratt & Whitney	US	F117–100	1F+4A, 12A	608 (1,340)	6.0	3,729 (146.8)	2,154 (84.8)	3,220 (7,100)	181.0 (40,700)
Pratt & Whitney	US	F119–100	3F, 6A, a/b	n/a	0.45	n/a	n/a	n/a	c155.6 (35,000)
Pratt & Whitney	US	F135	3F, 6A, a/b	n/a	0.57	5,588 (229)	1,295 (51)	n/a	c177.9 (40,000)
Pratt & Whitney	US	J52–408	5A, 7A	64.9 (143)	0	3,020 (118.9)	814 (32.1)	1,052 (2,318)	49.8 (11,200)
Pratt & Whitney	US	JT8D-219	1F+6A, 7A	221 (488)	1.77	3,911 (154.0)	1,250 (49.2)	2,092 (4,612)	93.4 (21,000)
Pratt & Whitney	US	JT9D-7R4H	1F+4A, 11A	769 (1,695)	4.8	3,371 (132.7)	2,463 (97.0)	4,029 (8,885)	249 (56,000)
Pratt & Whitney	US	PW2040	1F+4A, 12A	608 (1,340)	6.0	3,729 (146.8)	2,154 (84.8)	3,311 (7,300)	185.5 (41,700)
Pratt & Whitney	US	PW4050	1F+4A, 11A	798 (1,759)	5.1	3,371 (132.7)	2,463 (97.0)	4,179 (9,213)	222 (50,000)
Pratt & Whitney	US	PW4060	1F+4A, 11A	816 (1,800)	4.8	3,371 (132.7)	2,463 (97.0)	4,179 (9,213)	267 (60,000)
Pratt & Whitney	US	PW4168	1F+5A, 11A	903 (1,990)	5.1	4,143 (163.1)	2,715 (106.9)	6,396 (14,100)	305 (68,600)
Pratt & Whitney	US	PW4084	1F+6A, 11A	1,089 (2,400)	6.4	4,869 (191.7)	3,010 (118.5)	6,768 (14,920)	386 (86,760)
Pratt & Whitney	US	PW4098	1F+7A, 11A	1,293 (2,850)	5.8	4,945 (194.7)	3,035 (119.5)	7,484 (16,500)	436 (98,000)
Pratt & Whitney	US	PW6122A	1F+4A, 6A	n/a	5.1	2,748 (108.2)	1,435 (56.5)	2,291 (5,050)	100.24 (22,100)
Pratt & Whitney	US	PW8000	1F+3A, 5A	n/a	10.0	3,150 (124)	1,930 (76.0)	3,629 (8,000)	<155.7 (35,000)
Pratt & Whitney	US	PW7000 (XTE-66)	n/a	n/a	n/a	n/a	n/a	n/a	<155.7 (35,000)
P&WC	Canada	JT15D-1B	1F+C	34.0 (75.0)	3.3	1,506 (59.3)	691 (27.2)	235 (519)	9.79 (2,200)
P&WC	Canada	JT15D-5	1F+1A, C	42.0 (92.6)	n/a	1,549 (61.0)	711 (28.0)	288 (635)	12.9 (2,900)
P&WC	Canada	PW305	1F, 4A+C	n/a	4.3	2,070 (81.5)	970 (38.2)	450 (993)	23.4 (5,266)
P&WC	Canada	PW306	1F, 4A+C	n/a	4.5	1,920 (75.6)	970 (38.2)	473 (1,043)	25.35 (5,700)
P&WC	Canada	PW308A	1F, 4A+C	n/a	4.5	2,362 (93.0)	991 (39.0)	609.6 (1,344)	30.7 (6,904)
P&WC	Canada	PW308C	1F, 4A+C	n/a	3.8	2,362 (93.0)	991 (39.0)	614.2 (1,354)	31.13 (7,002)
P&WC	Canada	PW530A	1F, 2A+C	n/a	3.9	1,524 (60.0)	701 (27.6)	280 (617)	12.84 (2,887)
P&WC	Canada	PW535A	1F, 2A+C	n/a	3.9	1,524 (60.0)	701 (27.6)	317.1 (699)	15.12 (3,400)
		PW545B	1F, 2A+C	n/a	4.1	1,727 (68.0)	813 (32.0)	374 (824.5)	17.75 (3,991)
P&WC	Canada	PW610	1F, 1A+C	n/a	n/a	1,059 (41.7)	475 (18.7)	c150 (331)	4.0 (900)
		PW615F	1F, A+C	n/a	n/a	1,252 (49.3)	556 (21.9)	n/a	6.0 (1,350)
P&WC	Canada	PW800	1F, 6A	n/a	n/a	n/a	n/a	n/a	44.5+ (10,000+)
Progress (ZMKB)		AI-22	1F+5A, 7A	45.6 (100.5)	4.57	3,020 (118.9)		750 (1,653)	36.82 (8,278)

Manufacturer	Country	Designation/ name	Arrangement	Airflow kg/s (lb/s)	BPR	Length mm (in)	Diameter mm (in)	Weight, dry kg (lb)	T-O rating kN (lbst)
Progress (ZMKB)	Ukraine	AI-222–25F	2F, 8A	50.3 (110.9)	1.19	3,010 (118.5)	810 (31.89)	540 (1,190.5)	41.1 (9,259) 24.5 (5,511)
Progress (ZMKB)	Ukraine	AI-222–25KFK	2F, 8A	50.3 (110.9)	1.19	2,460 (96.85)	810 (31.89)	520 (1,146)	30.07 (6,768) 24.5 (5,511)
Progress (ZMKB)	Ukraine	AI-222-28	2A, 8A	49.4 (108.9)	1.18	1,960 (77.2)	2,020 (79.53)	520 (1,146.4)	27.46 (6,173)
Progress (ZMKB)	Ukraine	AI-25TL	3F, 7A	46.8 (103.2)	2.0	1,993 (78.46)	820 (32.3)	350 (772)	16.87 (3,792)
Progress (ZMKB)	Ukraine	AI-25TLSH	3A, 8A	46.8 (103.2)	1.98	2,322 (91.42)	861.5 (23.92)	349 (769.4)	16.87 (3,792)
Progress (ZMKB)	Ukraine	D-18T	1F, 7A, 7A	765 (1,687)	5.6	5,400 (212.6)	2,330 (91.7)	4,100 (9,039)	230 (51,660)
Progress (ZMKB)	Ukraine	D-18TM	1F, 7A, 7A	770 (1,698)	5.5	5,700 (224.5)	2,330 (91.7)	4,750 (10,472)	248 (55,777)
Progress (ZMKB)	Ukraine	D-27 propfan	2PF, 5A, 2A+C	27.4 (60.4)	29.25	4,198 (165.28)	1,260 (53.94)	1,650 (3,638)	109.8 (24,690)
Progress (ZMKB)	Ukraine	D-36	1F, 6A, 7A	255 (562)	5.6	3,470 (136.6)	1,373 (54.1)	1,109 (2,445)	63.7 (14,330)
Progress (ZMKB)	Ukraine	D-436T	1F, 6A, 7A	265 (584)	4.98	3,470 (136.6)	1,373 (54.1)	1,250 (2,756)	73.5 (16,535)
Progress (ZMKB)	Ukraine	D-436T2	1F+A, 6A, 7A	265 (584)	4.9	4,157 (163.7)	1,655 (65.2)	1,450 (3,197)	80.4 (18,078)
PS/ZMK	International	DV-2	1F+2A, 7A	49.5 (109)	1.46	1,721 (67.75)	994 (39.1)	440 (970)	21.58 (4,852)
RKBM	Russia	RD-41	7A	53.5 (118)	0	1,594 (62.75)	635 (25.0)	290 (639)	40.2 (9,040)
Rolls-Royce	Germany	BR710	1F, 10A	197 (435)	4.2	3,409 (134.0)	1,321 (52.0)	1,633 (3,600)	<69.0 (15,500)
Rolls-Royce	Germany	BR715	1F+2A, 10A	283.5 (625)	4.5	3,734 (147)	1,575 (62.0)	2,085 (4,597)	<102.3 (23,000)
Rolls-Royce	UK	535C	1F, 6A, 6A	518 (1,142)	4.4	3,010 (118.5)	1,877 (73.9)	3,309 (7,294)	166.4 (37,400)
Rolls-Royce	UK	535E4B	1F, 6A, 6A	522 (1,150)	4.3	2,995 (117.9)	1,892 (74.5)	3,261 (7,189)	<191.7 (43,100)
Rolls-Royce	UK	Pegasus 11–61	3F, 8A[3]	208 (459)	1.2	3,485 (137.2)	1,222 (48.1)	1,932 (4,260)	105.9 (23,800)
Rolls-Royce	UK	RB211–22B	1F, 7A, 6A	626 (1,380)	5.0	3,033 (119.4)	2,154 (84.8)	4,171 (9,195)	186.8 (42,000)
Rolls-Royce	UK	RB211–524B	1F, 7A, 6A	671 (1,480)	4.4	3,106 (122.3)	2,180 (85.8)	4,452 (9,814)	222 (50,000)
Rolls-Royce	UK	RB211–524G/H	1F, 7A, 6A	728 (1,604)	4.3	3,175 (125.0)	2,192 (86.3)	4,387 (9,671)	273 (60,600)
Rolls-Royce	UK	Spey 512	5A, 12A	94.3 (208)	0.71	2,911 (114.6)	942 (37.1)	1,168 (2,574)	55.8 (12,550)
Rolls-Royce	UK	Spey 807	5A, 12A	91.6 (202)	0.96	2,456 (96.7)	825 (32.5)	1,096 (2,417)	49.1 (11,030)
Rolls-Royce	UK	Tay 611, 620	1F+3A, 12A	176 (388)	3.18	2,405 (94.7)	1,118 (44.0)	1,422 (3,135)	61.6 (13,850)
Rolls-Royce	UK	Tay 651	1F+3A, 12A	193 (425.5)	3.10	2,405 (94.7)	1,138 (44.8)	1,533 (3,380)	68.5 (15,400)
Rolls-Royce	UK	Trent 556	1F, 8A, 6A	858 (1,892)	8.5	3,912 (154.0)	2,474 (97.4)	4,719 (10,400)	252 (56,000)
Rolls-Royce	UK	Trent 600	1F, 8A, 6A	922 (2,032)	8.0	3,912 (154.0)	2,474 (97.4)	4,719 (10,400)	306 (68,000)
Rolls-Royce	UK	Trent 772	1F, 8A, 6A	897 (1,978)	4.9	3,912 (154.0)	2,474 (97.4)	4,785 (10,550)	320 (71,100)
Rolls-Royce	UK	Trent 892	1F, 8A, 6A	1,200 (2,645)	5.7	4,369 (172.0)	2,794 (110.0)	5,957 (13,133)	411 (91,300)
Rolls-Royce	UK	Trent 895	1F, 8A, 6A	1,217 (2,684)	5.79	4,369 (172)	2,794 (110.0)	5,981 (13,186)	425 (95,500)
Rolls-Royce	UK	Trent 977	1F, 8A, 6A	1,225 (2,700)	8.7	4,547 (179)	2,946 (116)	6,421 (14,155)	340.3 (76,500)
Rolls-Royce	UK	Trent 1000C1	1F, 8A, 6A	1,247 (2,749)	11	4,064 (160.0)	2,845 (112)	5,409 (11,924)	310.5 (69,800)
Rolls-Royce	UK	Viper 535	8A	23.9 (52.7)	0	1,806 (71.1)	740 (29.1)	358 (790)	14.94 (3,970)
Rolls-Royce	UK	Viper 632	8A	26.5 (58.4)	0	1,806 (71.1)	740 (29.1)	376.5 (830)	17.66 (3,970)
Rolls-Royce	UK	Viper 680	8A	27.2 (60.0)	0	1,806 (71.1)	740 (29.1)	379 (836)	19.39 (4,360)
Rolls-Royce	US	AE 3007A	1F, 14A	96.6 (213)	5.0	2,705 (106.5)	1,105 (43.5)	717.1 (1,581)	33.7 (7,580)
Rolls-Royce	US	AE 3007H	1F, 14A	118 (260)	5.0	2,705 (106.5)	1,105 (43.5)	717.1 (1,581)	36.9 (8,290)
RRTI	International	Adour 811/815	2F, 5A, a/b	43.1 (95.0)	0.75	2,970 (116.9)	559 (22.0)	738 (1,627)	37.4 (8,400) 24.6 (5,520)
RRTI	International	Adour 871	2F, 5A	44.0 (97.0)	0.80	1,956 (77.0)	559 (22.0)	603 (1,330)	26.6 (5,990)
Samara	Russia	NK-25	3F, 9A	339 (747)	0.9	5,200 (205)	1,348 (53.1)	2,850 (6,283)	245 (55,155)
Samara	Russia	NK-44	n/a	n/a	6.0	n/a	3,100 (122.0)	n/a	392 (88,180)
Samara	Russia	NK-93	2PF, 7A, 8A	1,000 (2,205)	17.0	5,972 (235.1)	2,900 (114.2)[2]	3,650 (8,047)	176.5 (39,683)
Samara	Russia	NK-321	3F, 5A, 7A, a/b	365 (805)	1.4	c6,000 (236.0)	1,460 (57.5)	3,442 (7,588)	245 (55,077) 137.2 (30,843)
SARI	China	Kunlun	3A, 5A	n/a	n/a	907 (35.7)	n/a	1,200 (2,645)	76.53 (17,025)
Saturn	Russia	AL-21F3	14A, a/b	104 (229)	n/a	5,340 (210.0)	1,030 (40.6)	1,800 (3,968)	110.5 (24,800) 76.5 (17,200)
Saturn	Russia	AL-31FM	4F, 9A, a/b	112 (247)	0.57	4,950 (195.0)	1,277 (50.3)	1,488 (3,280)	122.6 (27,560) 79.3 (17,857)
Saturn	Russia	AL-37FU	4F, 9A, a/b	n/a	0.65	c5,000 (c197)	1,277 (50.3)	1,660 (3,660)	142.2 (31,967) 83.4 (18,740)
Saturn	Russia	AL-41 (SAT-41)	2F, 6A, a/b	c150 (331)	n/a	n/a	n/a	c1,850 (c4,078)	c175 (39,336) c113.8 (25,600)
Saturn	Russia	AL-55	4F, 6A	29.8 (65.7)	0.6	1,210 (47.6)	590 (23.2)	315 (694)	21.78 (4,894)
Saturn	Russia	AL-55F	4F, 6A, a/b	29.8 (65.7)	0.6	2,520 (99.2)	590 (23.2)	385 (849)	34.34 (7,716)
SNECMA	France	Atar 9K50	9A, a/b	73.0 (161)	0	5,944 (234.0)	1,020 (40.2)	1,582 (3,487)	70.6 (15,870) 49.2 (11,055)
SNECMA	France	M53 P2	3F, 5A, a/b	86.0 (190)	0.35	5,070 (199.6)	1,055 (41.5)	1,500 (3,307)	95.0 (21,355) 64.3 (14,455)
SNECMA	France	M88–2	3F, 6A, a/b	67.0 (148)	0.25	3,540 (139.0)	660 (26.0)	909 (2,004)	75.0 (16,872) 50.0 (11,250)
Soyuz	Russia	R-195	3A	67.0 (148)	0	3,300 (130.0)	914 (36.0)	990 (2,183)	44.13 (9,921)
Soyuz	Russia	R-29–300	5A, 6A, a/b	110 (243)	0	4,960 (195.0)	912 (35.9)	1,880 (4,145)	122.3 (27,500) 78.5 (17,635)
Soyuz	Russia	R-35–300	5A, 6A, a/b	110 (243)	0	4,950 (194.9)	912 (35.9)	1,765 (3,891)	127.5 (28,660) 83.9 (18,850)
Soyuz	Russia	R-79	5F, 6A, a/b[3]	120 (265)	1.0	5,229 (205.9)	1,100 (43.3)	2,750 (6,063)	152.0 (34,170) 107.6 (24,200)
Soyuz	Russia	RD-1700	2F, 4A	30 (66.1)	0.78	n/a	n/a	297.58 (656)	19.61 (4,409) 16.67 (3,748)
Turbomeca-SNECMA	France	Larzac 04–20	2F, 4A	28.6 (63.0)	1.04	1,179 (46.4)	602 (23.7)	302 (666)	14.12 (3,175)
Turbo-Union	International	RB199 Mk 105	3F, 3A, 6A, a/b	74.6 (164)	c1	3,302 (130.0)	752 (29.6)	980 (2,160)	74.7 (16,800) 42.5 (9,550)
Volvo/GE	Sweden	RM12	3F, 7A, a/b	68.0 (150)	0.28	4,100 (161.4)	880 (34.8)	1,050 (2,315)	80.5 (18,100) 54.0 (12,140)
Williams	US	FJ33–4A	1F+2A, C	n/a	n/a	978 (38.5)	444.5 (17.5)	<136 (300)	<6.7 (1,500)
Williams	US	FJ44–1A	1F+1A, C	29.575 (65.2)	3.28	1,356 (53.4)	530.9 (20.9)	205 (452)	8.45 (1,900)
Williams	US	FJ44–1C	1F+1A, C	26.49 (58.4)	3.4	1,356 (53.4)	530.9 (20.9)	208 (459)	6.67 (1,500)
Williams	US	FJ44–2A	1F+3A, C	35.8 (79.0)	4.1	1,507 (59.4)	553.7 (21.8)	n/a	10.23 (2,300)
Williams	US	FJ44–2C	1F+3A, C	n/a	n/a	1,507 (59.4)	553.7 (21.8)	n/a	10.68 (2,400)
Williams	US	FJ44-3A	1F+3A, C			1,582(62.32)	583 (22.96)	238 (525)	13.35 (3,000)
Williams	US	FJ44-3AP	1F+3A, C						10.68 (2,400)
Williams	US	FJ44-4A	1F+3A, C						15.12 (3,400)
XAE	China	WS9		Rolls-Royce Spey Mk 202 made under licence; data presumed identical					
XAE	China	WP8	8A	150 (331)	n/a	5,380 (211.8)	1,400 (55.1)	3,133 (6,906)	93.2 (20,944)

Auxiliary Power Units (APUs)

Manufacturer	Country	Designation/name	Start up ceiling m (ft)	Weight, dry kg (lb)	S/L compression bar (lb/sq in)	Ground power kVA	Rating kW
Aerosila	Russia	TA-4FE	<2,500 (8,200)	180 (397)	2.4 (35)	18	124
Aerosila	Russia	TA-6A	<3,000 (9,840)	245 (540)	4.4 (64)	40	235
Aerosila	Russia	TA-6V	<3,000 (9,840)	255 (562)	4.4 (64)	40	235
Aerosila	Russia	TA-8	<3,000 (9,840)	165 (364)	3.2 (46)	—	107
Aerosila	Russia	TA-8V	<5,000 (16,400)	185 (408)	3.2 (46)	40	107
Aerosila	Russia	TA-8K	<3,500 (11,480)	178 (392)	3.1 (45)	60	55
Aerosila	Russia	TA-12	<7,000 (22,960)	290 (639)	4.8 (70)	40	287
Aerosila	Russia	TA-12–60	<7,000 (22,960)	335 (739)	4.8 (70)	60	287
Aerosila	Russia	TA-14	<8,000 (26,250)	50 (110)	3.6 (52)	20	79
Aerosila	Russia	TA-18–100	<11,000 (36,090)	140 (309)	4.4 (64)	60	214
Honeywell	US	36–100	6,095 (20,000)	53 (117)	3.52 (51)	30	127
Honeywell	USA	36–150W	6,095 (20,000)	52–55 (115-121)	3.24 (47)	10	142
Honeywell	US	36–150CX/IAI	6,095 (20,000)	57 (126)	3.38 (49)	10	142
Honeywell	US	36–150F2	6,095 (20,000)	55 (121)	3.17 (46)	10	142
Honeywell	US	36–150F	6,095 (20,000)	53 (117)	3.24 (47)	10	142
Honeywell	US	36–150DD	6,095 (20,000)	53 (117)	3.24 (47)	10	145
Honeywell	US	36–150 M	6,095 (20,000)	65 (143)	3.59 (52)	23	145
Honeywell	US	36–150RJ	11,280 (37,000)	73 (160)	3.11 (45)	30	179
Honeywell	US	RE50		25 (55)			
Honeywell	US	RE100	6,095 (20,000)	40 (88)	3.45 (50)	10	101
Honeywell	US	RE220	13,105 (43,000)	109 (240)	3.86 (56)	45	261
Honeywell	US	36–280	10,670 (35,000)	159 (350)	3.24 (47)	90	291
Honeywell	US	36-300	10,670 (35,000)	136 (300)	3.24 (47)	90	291
Honeywell	US	131–9A	12,495 (41,000)	159 (350)	3.52 (51)	90	343
Honeywell	US	131–9B	12,495 (41,000)	186 (410)	3.52 (51)	96	90
Honeywell	US	331–200	13,105 (43,000)	227 (500)	3.45 (50)	90	432
Honeywell	US	331–250	13,105 (43,000)	227 (500)	3.04 (44)	90	447
Honeywell	US	331–350	12,495 (41,000)	254 (560)	3.45 (50)	115	618
Honeywell	US	331–500	13,105 (43,000)	331 (730)	3.65 (53)	120	969
Honeywell	US	700	7,620 (25,000)	295 (650)	3.05 (44)	100	648
Microturbo	France	Rubis 3	7,600 (24.900)	56 (123)	5.00 (73)	6	125
Microturbo	France	Saphir 20	6,000 (19,700)	38 (84)		10	70
Microturbo	France	Saphir 100	4,000 (13,100)	74 (163)	4.5 (65)		135
Omsk	Russia	VSU-10					
Pratt & Whitney	Canada	PW901	7,620 (25,000)	379 (835)	3.72 (54)	180	1,145
ZMKB Progress (design)	Ukraine	AI-8	7,620 (25,000)	145 (320)	—	60	60
ZMKB Progress (design)	Ukraine	AI-9V	—	70 (155)	2.89 (41)		
ZMKB Progress (design)	Ukraine	AI-9–3B	6,000 (19,700)	128 (282)	3.25 (47)	—	16
Stupino	Russia	TA-6					
Stupino	Russia	TA-12					
Stupino	Russia	TA-14					
Sundstrand	US	APS500	<9,145 (30,000)	46–52 (100-115)	c3.6 (c52)	19	200
Sundstrand	US	APS1000	<7,620 (25,000)	70–82 (155-180)	4.14 (60)	45	261
Sundstrand	US	APS2000	11,280 (37,000)	132 (290)	3.65 (53)	60	376
Sundstrand	US	APS2100	11,280 (37,000)	122 (270)	3.65 (53)	60	376
Sundstrand	US	APS3200	11,885 (39,000)	138 (305)	4.14 (60)	90	450
Ufa	Russia	VD-100					

PROPELLERS

Propellers

In the table will be found explanations of various manufacturers' designation systems, to be read in conjunction with data supplied in the 'Engines' paragraph of aircraft descriptions.

First and simplest of the propeller types is **fixed-pitch**, constructed of carved wood (normally glued multiple-ply for warp resistance), wood with composites skin, or aluminium. Pitch is blade angle in respect to a flat plane; proportional to the distance the propeller will advance through the air on each rotation. Fine pitch — a small angle — allows a low-power engine to develop a high rotational speed, but delivers low forward airspeed. Coarse pitch is optimised for higher speeds, but requires proportional engine power.

While diameter and blade area are related factors in performance, as is the subtle change of pitch along the blade's length, fixed-pitch is, by definition, a compromise made at the time of manufacture. Light aircraft options are normally restricted to the operator's choice of a fine-pitch 'climb propeller' or coarse-pitch'cruise propeller', according to operating environment and preference.

Increasingly, light aircraft have a **ground-adjustable pitch** propeller. Blades are mounted in sockets in the hub and clamped in place by a bolt. In theory, the pitch can be re-set to meet the specifics of each flight, but it is more normal for the owner to experiment with blade angles until the optimum for the aircraft is reached. Wood and wood/composites are used in construction, as is carbon fibre.

For special applications, such as motor gliders, a fixed-pitch, but **folding propeller** offers the simplest means of eliminating propeller drag in engine-off models. The propeller is at rest in a folded position (blades either parallel to the axis of motion or at right-angles to it, held in place by spring or bungee rubber) and extends when engine torque is applied

Variable pitch enables fine pitch to be used to enhance take-off and initial climb performance (maximum engine power at low airspeed), before a change to coarse pitch for fastest cruising speed without overspeeding the engine. Before and during landing, fine pitch and a low throttle setting will have the effect of increasing drag. Several methods of variable pitch are available:

TWO-POSITIONThe propeller is pre-set in fine pitch for take-off and the pilot provided with a once-only means of reverting to coarse pitch. Rare in current usage.

AUTOMATIC PITCHAutomatic alteration of pitch angle according to airspeed, often indicated by a vaned spinner ahead of the propeller. Rare in current usage.

FLIGHT-ADJUSTABLE PITCHChange controlled manually by the pilot and constantly monitored for each stage of flight, in concert with selected engine power. Electric or hydraulic actuation. The term 'variable pitch' is often used, loosely, to describe flight-adjustable pitch.

CONSTANT-SPEEDA governor (constant-speed unit) is set by the pilot to the desired engine (and propeller) speed and pitch is constantly and automatically altered to maintain the desired value. Throttle changes (in fact, manifold pressure variations) can then be made by the pilot without reference to the propeller, which will adjust to the correct setting. However, the setting is changed manually for each stage of the flight (take-off, climb and cruise).

The availability of flight-adjustable and constant-speed mechanisms permits two further options:

FEATHERINGBlade pitch can be extended to neutral (edge-on to the airflow), reducing drag upon engine failure, or when deliberately gliding. The propeller may 'windmill' (turn slowly on account of residual pitch).

REVERSE PITCHChange of pitch beyond feathering angle to produce forward thrust for more rapid stopping or ground and water manoeuvring.

Manufacturer	Example designation	Explanation
Aerosila		
Aerosila NPP OAO ulitsa Metallistov 6 Stupino 142800 Moscovskoya oblast Russian Federation *Tel:* (+7 095) 333 22 72 *Fax:* (+7 095) 333 51 47 *e-mail:* vint@aerosila.ru *Web:* www.aerosila.ru	AV-17	Three-blade, variable pitch; diameter 3.60 m
	AV-24AN	Three-blade, variable pitch, Antonov An-28; diameter 2.80 m
	SV-27	8 + 8 contrarotating propfan; diameter 4.50 m
	SV-34	Six-blade, constant-speed; diameter 3.60 m
	AV-36	Six-blade, constant-speed; diameter 2.65 m
	SV-92	8 + 10 ducted fan; diameter 2.90 m
	AV-101	Two/three/four-blade, variable pitch; diameter 1.20 m
	AV-110	Four-blade, variable pitch; diameter 1.40 m
	AV-140	Six-blade, constant-speed; diameter 3.72 m
Airmaster		
Airmaster Propellers Ltd PO Box 374 Kumeu Auckland New Zealand *Tel:* (+64 9) 833 1794 *Fax:* (+64 9) 833 1796 *e-mail:* sales@propellor.com *Web:* www.propellor.com	AP332	Electric variable pitch (contant speed); feathering; three-blade; max diameter 72 in/1,830 mm
Avia		
Avia Propeller s.r.o. Beranových 666 CZ-199 02 Prague 9 Czech Republic *Tel:* (+420 266) 11 20 30 *Fax:* (+420 266) 11 20 31 *e-mail:* brunclik@aviapropeller.cz *Web:* www.aviapropeller.com	V 310	1,950 mm diameter. Two-blade; ground-adjustable pitch; (/P = 1,815 mm diameter)
	AV 723-5-B	Aluminium alloy; Avia; variable pitch (G = ground adjustable, F = fixed pitch); 72 mm blade shank diameter; 3 blades; constant-speed, non-feathering, non-counterweighted (1 = constant speed, non-feathering, counterweighted, 2 = CS, feathering, 3 = CS, feathering, reversing, 4 = constant speed, reversing, 6 = autonomous); SAE 2 flange with ½ in bolts (A = special flange, 80 mm bolts, C = SAE 2 $^{7}/_{16}$ in bolts, D = ARP 502 flange, E = ARP 880 flange, F = SAE 1 flange, G = Walter/LOM flange, H = PW115 flange)
	AV 803-3	Aluminium alloy; Avia; hydraulic variable pitch (constant-speed); three blade; diameter 99 in/2,500 mm; anticlockwise rotation (803-4J-E = clockwise)
	AV 842	Aluminium alloy; Avia; hydraulic variable pitch (constant-speed and optional feathering); two-blade; diameter 72–80 in/1,830–2,040 mm
	AV 843	Aluminium alloy; Avia; hydraulic variable pitch (constant-speed and optional feathering); three-blade; diameter 88 in/2,235 mm (843-5W-E = 84 in/2,080 mm diameter, reversing)
	AV 844-5W-E	Aluminium alloy; Avia; hydraulic variable pitch (constant-speed, optional feathering); four blade; diameter 82 in/2,080 mm
	AV 845	Aluminium alloy; Avia hydraulic variable pitch (constant speed); five blade; diameter 82 in/2,080 mm
	V 500A	2,000 mm diameter (/1690 = 1,690 mm diameter, /1905 = 1,905 mm diameter). Two-blade
	V 503A	As V 500, but autonomous pitch control by spinner windmill
	V 508D	2,500 mm diameter. Three-blade. Walter M601D engine. (508Z = Walter M601Z, 508E/84 = 84 in diameter, 508E-AG/99B = 99 in diameter, agricultural, 508E 106/2690 = 106 in/2,690 mm diameter, 508E 91/2300 = 91 in/2,300 mm diameter, 508H = 106 in/2,690 mm diameter, 633 kW/850 hp rating)
	V 510	2,300 mm diameter. Five-blade. Walter M601E-F. (510T = Walter M601F-T, 510AG agricultural.)
	V 520	2,700 mm diameter. Two-blade
Avtek		
Avtek Srl Via A Gramsci 18 I-20050 Zoccorino (MI) Italy *Tel:* (+39 0362) 60 20 77 *Fax:* (+39 0362) 80 26 20 *e-mail:* avtek@tiscalinet.it		Carbon fibre, two- or three-blade, flight-adjustable
Baoding		
Baoding Propeller Plant Box 609, PO Box 818 Baoding 072152 Hebei People's Republic of China *Tel:* (+86 312) 705 15 82 *Fax:* (+86 312) 705 14 54	J17-G13	Four-blade, constant-speed, fully feathering, metal; diameter 4.50 m

Manufacturer	Example designation	Explanation
Bolly		
The Propeller Company Pty Ltd Unit 8 100 Hewittson Road Elizabeth West, SA 5113 Australia *Tel:* (+61 08) 82 55 96 88 *Fax:* (+61 08) 82 55 96 66 *e-mail:* bolly@bolly.com.au *Web:* www.bolly.com.au	BOS1-54-24-N-L	Bolly Optima Series 1; 54 in diameter (60 = 60 in) ; 24 in nominal pitch (22 = 22 in); narrow aspect ratio blade (S = Standard, W = wide); left-hand (anticlockwise) rotation viewed from behind (R = clockwise). Composites, fixed pitch; two-blade
	BOS2-58-33-S-R	Series 2; 58 (55½, 59½, 62) in diameter; 33 (31, 34, 36, 38, 39, 42) in pitch; standard aspect ratio; clockwise rotation. Composites; individual, bolted, fixed pitch blades; two to five blades
	BOS3-62-52-S-R	Series 3; 62 (68, 72) in diameter; 52 (58, 60) in pitch; S, R as above. Composites, ground-adjustable pitch; two-, three- or four-blade
	BOS4-54-22-N-L	Series 4 (folding blades); 54 in diameter; 22 in pitch; N, L as above. Composites, ground-adjustable pitch; two-blade
EVRA		
EVRA 4 avenue de la Forêt d'Halatte F-60100 Creil France *Tel:* (+33 3) 44 25 50 31 *Fax:* (+33 3) 44 25 90 72 *Web:* www.helices.free.fr	160.150.136 D9.28 D11.29 6006 Merville DH.5220 180.170 Evolution	Wood or composites; various specific designations according to aircraft type
GT		
GT Propellers Viale del Commercio 7 I-47838 Riccione (RN) Italy *Tel:* (+39 0541) 69 33 99 *Fax:* (+39 0541) 69 33 31 *e-mail:* info@gt-propellers.com *Web:* www.gt-propellers.com		Wood, two- and three-blade, fixed pitch Wood, two-, three- and four-blade, fixed pitch, foldable Wood, two-, three- and four-blade, ground-adjustable pitch Wood, two-, three- and four-blade, electric or hydraulic variable pitch
Halter		
Helices Halter SARL F-05300 Saleon France *Tel:* (+33 4) 92 66 24 63 *Fax:* (+33 4) 92 66 29 36 *e-mail:* halter@uav-propellers.com *Web:* www.uav-propellers.com		Produced to customer's specification
Hamilton Sundstrand		
Hamilton Sundstrand Propulsion Systems One Hamilton Road Windsor Locks Connecticut 06096-1010 *Tel:* (+1 860) 654 27 72 *e-mail:* props.info@hs.utc.com *Web:* www.hamiltonsundstrandcorp.com	14SF-5	Four-blade, 13 ft diameter; aluminium spar with glass fibre blade shell; hydromechanical constant-speed; ATR 42 (7 = Dash 8 Q100, 11 = ATR 72, 11E = ATR 72 electronic pitch control, 15 = Dash 8 Q100/Q200/Q300, 17 = Canadair 215T, 19 = Canadair 215T/415, 23 = Dash 8 Q100/Q200/Q300)
	47F-1	Four-blade, 13 ft diameter, graphite spar and Kevlar shell; hydromechanical constant-speed; ATR 72 Srs 211/212 (1E = ATR 72 Srs 211/212 electronic pitch control; 3 = XAC MA-60)
	568F-1	Six-blade, 13 ft diameter, graphite spar and Kevlar shell; electromechanical constant-speed; ATR 42 Srs 400/500 (5 = CASA C-295, 7 = Ilyushin Il-114, 11 = previously assigned to Ayres Loadmaster)
Hartzell		
Hartzell Propeller Inc One Propeller Place Piqua Ohio 45356-2634 USA *Tel:* (+1 937) 778 42 00 *Fax:* (+1 937) 778 43 91 *e-mail:* sales@hartzellprop.com *Web:* www.hartzellprop.com	BHC-J2YF-1BF/F7694	Hartzell hub series B (blank = A, C = C, D = D); two-blade (3 = three, 4 = four); /; blades diameter 76 in; subtype 94 (7068 = 70 in, 7280 = 72/72½ in, 7663 = 76 in, 7666 = 76 in, 7681 = 76 in, 7692 = 76 in, 8052 = 80 in, 8459 = 84 in)
Helix		
Helix-Carbon GmbH Düserhofstraße 20 D-52074 Aachen *Tel:* (+49 241) 931 92 17 *Fax:* (+49 241) 931 92 18 *e-mail:* mail@helix-propeller.de *Web:* www.helix-propeller.de	H50F1, 75R-S-16-2	Helix; 50 kW compression strength; fixed pitch (A = adjustable, K = folding blade, V = variable pitch); 1.75 m diameter; right-hand rotation; narrow aerofoil section (C, CI, CS = sickle, I = very small, L = large, LS = large (glider tug), M = medium, XL = extra large); 16° pitch; two-blade (-3, -4)
Hoffmann		
Hoffmann Propeller GmbH Küpferlingstraße 9 D-83022 Rosenheim Germany *Tel:* (+49 8031) 187 80 *Fax:* (+49 8031) 18 78 78 *e-mail:* info@hoffmann-prop.com *Web:* www.hoffmann-prop.com	HO-V343K-V/S180GY-B+10	Hoffmann; Variable pitch; Type 34; three blades; AS 127D flange, SAE 2, ½ in bolts (F = ARP 502 Type 1, L= AS 127D SAE 2, $^{7}/_{16}$ in bolts, B = AS 127D SAE 1, G = ⅜ in bolts); hydraulic pitch change, oil pressure to decrease/counterweights to increase (blank = oil pressure increase/ no counterweights, F = oil pressure increase/counterweights, S = oil pressure decrease/ counterweights to increase up to feathering); /; feathering blades (blank = right hand, tractor, D = right hand, pusher, L = left hand, tractor, LD = left hand, pusher, V = pitch change pin position, altered to allow oil pressure to decrease pitch); 1,800 mm diameter; blade design GY; electrical de-icing; 10 cm over basic size
	HO27HM-180/138	Fixed pitch Hoffmann, 1,800 mm diameter
Kasparaero		
Kaspar a synove – strojírna Kalmar sro Nádražni 76 CZ-150 00 Praha 5-Smichov Czech Republic *Tel:* (+420) 257 32 01 39 *Fax:* (+420) 257 32 22 26 *e-mail:* kalmar@kasparaero.cz *Web:* www.kasparaero.cz	KA-1/2-PA	Flight adjustable (hydraulic); diameter 1,610 mm; Kasparaero; Type 1; two-blade (3 = three-blade); -; right-hand rotation (L = left-hand); tractor (T = pusher)
KievProp		
c/o ULM Europe Ch du Rié 4 CH-1053 Bretigny Switzerland *Tel:* (+41 21) 732 29 87 *e-mail:* prop@kievprop.com.ua *Web:* http//www.kievprop.com.ua	163,173	Composites; ground-adjustable pitch; three-blade; left-hand rotation; 1,710 mm diameter (183=1,810 mm; 263/273/283 = right-hand rotation; 165/175/185 = five-blade; 265/275/285 = five-blade, right-hand rotation)
	PV-173	Variable-pitch (mechanical), as 173 (273 = as 273), but 1,800 mm diameter

Manufacturer	Example designation	Explanation
McCauley McCauley Propeller Systems 7751 East Pawnee PO Box 7704 Wichita Kansas 67277-7704 *Tel:* (+1 316) 831 40 21 *Fax:* (+1 316) 831 38 58 *e-mail:* sales@mccauley.textron.com *Web:* www.mccauley.textron.com	D3AF32C72-A/S-82NC-0	Dowel (indexing hole) location 90° and 270° (blank = 60°/240°, B = 0°/180°, C = 30°/210°); three-blade; 4 in flange (D = SAE 2 flange, F = 4½ in flange); feathering; shank size 32; constant-speed; version change 72; minor change; / ; blade minor change; 82 in diameter; blade design characteristics; zero reduction from basic diameter
	1A100/MCM6950	Basic design (fixed pitch); / ; SAE 1 flange (SLM = SAE 2); 69 in diameter; 50 in pitch at ¾ radius
MT-Propeller MT-Propeller Entwicklung GmbH Flugplatzstraβe 1 D-94348 Atting Germany *Tel:* (+49 9429) 940 90 *Fax:* (+49 9429) 84 32 *e-mail:* sales@mt-propeller.com *Web:* www.mt-propeller.com	MTV-9-B-C/CL160-03	MT-Propeller; variable pitch; Type 9; SAE 2½ in bolts (A-F as for Avia propellers); counterweight moment towards high pitch position (blank = none or small counterweights with low pitch moment); blade pitch change pin moment towards high pitch (blank = low pitch); left hand rotation, tractor (blank = right tractor; RD = right, pusher, LD = left, pusher): 160 cm diameter; Type 3
	MT186R140-3D	MT-Propeller; two-blade, fixed pitch; 1,860 mm diameter
Neuform Neuform Composites GmbH & Co KG Ameke 63 D-48317 Dreinsteinfurt Germany *Tel:* (+49 2387) 940 26 *Fax:* (+49 2387) 940 28 *e-mail:* info@neuform-propeller.de *Web:* www.neuform-propeller.de	TR2	Composites, T-type blade (C, TX), 1,730 to 1,750 mm diameter, fixed pitch, two-blade (3 = three blade, 4 = four blade)
	CR3-V-70	Composites, C-type blade (T, TX); three-blade (2, 4); variable pitch; 1.70 m diameter
Powerfin Powerfin Inc 3808 North Sullivan Building 2-J Spokane Valley Washington 99216 *Tel:* (+1 509) 924 75 56 *Fax:* (+1 509) 924 73 38 *e-mail:* info@powerfin.com *Web:* www.powerfin.com	Model A	64 to 72 in diameter, three-blade, composites
	Model B	60 to 64 in diameter, three-blade, composites
	Model C	64 to 69 in diameter, three-blade, composites
	Model D	69 to 72 in diameter, three-blade, composites
	Model E	51 in diameter, three-blade, composites
	Model F	66 to 70 in diameter, three-blade, composites
Quinti Avio Via Cassia Zona PIP n 21 I-52040 Marciano della Chiana (AR) Italy *Tel:* (+39 0575) 84 21 29 *Fax:* (+39 0575) 84 23 74 *e-mail:* quintiavio@quintiavio.com *Web:* www.quintiavio.com	QA2WD00.R	Constant-speed (electric) hub; two-blade; 80 hp Rotax engine; blades as required, 1,000 to 1,800 mm
	QA2SE001.R	As above; 120 hp Rotax engine
	QA3WD00.R	Constant-speed (electric) hub; three-blade; Rotax engine; blades as required, 1,000 to 1,800 mm
	QA3WD00.S	Constant-speed (electric) hub; three-blade; SAE1 fitting; blades as required, 1,000 to 1,800 mm
	QA4WD000.S	Constant-speed (electric) hub; four-blade; SAE1 fitting; blades as required, 1,000 to 1,800 mm
Ratier-Figeac BP2 F-46101 Figeac Cedex France *Tel:* (+33 5) 65 50 50 50 *Fax:* (+33 5) 65 34 23 63	FH386	Composites; eight-blade; 5.33 m (17 ft 6 in) diameter; Airbus A400M
Sensenich Sensenich Wood Propeller Co Inc 2008 Wood Court Plant City Florida 33567 USA *Tel:* (+1 813) 752 37 11 *Fax:* (+1 813) 742 28 18 *e-mail:* donr@sensenichprop.com *Web:* www.sensenichprop.com	W70L-43	Wood; 70 in diameter; Lycoming engine (A = Aeronca, C = Continental, F = Franklin, J = Jacobs, R = Ranger, W = Warner); pitch angle
	2A1R5R64DN	Wood; 72 in diameter; Continental engine (AC/BR/BE/BS/BRCK/DK/EY/FK/GK/JR/RK Continental, AF/CF = Franklin, JA = Jacobs, AA/FE/FM/JB/LY/RM = Lycoming, BB/BS/RB = Ranger, CA/CB = Warner); pitch angle
	W72CK-42	Two-blade; 12 in spinner (A0 = 9 to 11 in); Rotax engine (J = Jabiru); (5 common designation); tractor installation (L = pusher); 64 in max diameter (62, 68, 70); long power sweep blade (E = low/medium airspeed, H = high speed, Z = high RPM); nickel leading edge protection
Sensenich Propeller Manufacturing Co 14 Citation Lane Lititz Pennsylvania 17543 USA *Tel:* (+1 717) 569 04 35 *Fax:* (+1 717) 560 37 25 *e-mail:* dianab@sensenich.com *Web:* www.sensenich.com	74DM6S5-2-60L	Metal; 74 in diameter; blade design D; hub design M6 for SAE 2 flange, ⅜ in bolts (C = ARP 502 flange, K = SAE 1, M7 = SAE 2, $^{7}/_{16}$ in bolts, M8 = SAE 2, ½ in bolts, R = SAE 3); integral dowled spacer 5 × ¼ in; 2 in reduction from basic diameter; blade pitch 60 in at 75% radius; design change
Smiths Smiths Aerospace Anson Business Park Cheltenham Road East Staverton Gloucester GL2 9QN United Kingdom *Tel:* (+44 1452) 71 60 00 *Fax:* (+44 1452) 71 61 01 *Web:* www.smiths-aerospace.com	R352/6-123-F/1	Rotol type 352; six-blade; blade shank size 123; engine flange mounted; first subvariant
	R381	Six-blade, constant-speed, feathering/reversing; Saab 2000 diameter 12 ft 6 in
	R391	Six-blade, constant-speed, feathering/reversing; composites; diameter 13 ft 6 in; Lockheed C-130J, Alenia C-27J
	R408	Six-blade, constant-speed, feathering/reversing; composites; diameter 13 ft 6 in; Dash 8 Q400, Y-8F600
	R414	Six-blade, constant-speed, feathering/reversing; composites; ShinMaywa US-1A Kai
Valex Helices Valex la Font du Clou F-16300 Barbezieux France *Tel:* (+33 5) 45 78 89 85 *Fax:* (+33 8) 75 90 54 45 *e-mail:* helices.valex@wanadoo.fr *Web:* www.helicesvalex.fr		Produced to customer's specification; wood; two-, three- and four-blade

Manufacturer	Example designation	Explanation
VPERED		
ooo VPERED pr Entuziastov 15 111024 Moskva Russian Federation *Tel:* (+7 495) 673 44 27 *Fax:* (+7 495) 673 36 18 *e-mail:* company@mmz-vpered.ru *Web:* www.mmz-vpered.ru	VM-3	Wood, two-blade, fixed pitch 1,850 mm diameter
	V-530TA-D35	Metal, two-blade, constant-speed (hydraulic) 2,400 m diameter
VZLU		
VZLU Beranových 130 Prague-Letňany CZ-199 05 Czech Republic *Tel:* (+420 225) 11 51 11 *Fax:* (+420 286) 92 05 18 *e-mail:* info@vzlu.cz *Web:* www.vzlu.cz	V230B	Wood, two-blade, fixed pitch; 1,625 mm diameter; Rotax 447/503 (C = Rotax 912/582/618, E = Rotax 912F) two-blade
	V234	Wood, two-blade, fixed pitch; 1,800 mm diameter
	V237	Wood, two-blade, fixed pitch; 1,600 mm diameter (237A 1,600 mm; 237DF 1,450 mm)
	V331	Wood, three-blade, ground-adjustable pitch; 1,650 mm diameter
	V534AD	Wood, two-blade, hydraulically controlled constant-speed; 1,613 mm diameter (BD = 1,650 mm)
Warp Drive		
Warp Drive Inc 1207 Highway 18 East Ventura Iowa 50482 USA *Tel:* (+1 641) 357 60 00 *Fax:* (+1 641) 357 75 92		Carbon fibre, ground-adjustable pitch; two-, three-, four-, five-blade
Woodcomp		
Woodcomp sro Vodoská 4 CZ-250 70 Czech Republic *Tel:* (+420) 283 97 13 09 *Fax:* (+420) 283 97 02 86 *e-mail:* info@woodcomp.cz *Web:* www.woodcomp.cz **Note:** Marketed under Junkers, Kremen and SportProp names	002 et seq	Specific applications. Wood, two- and four-blade, fixed pitch
	SR 14 et seq	Specific applications. Wood; two-blade; 1,200 to 1,800 mm; fixed pitch
	SR 114 et seq	Specific applications. Wood; or wood/composites; two-blade, 1,200 to 1,680 mm, ground-adjustable pitch
	SR 200	Wood or wood/composites; three-blade, 1,450 to 1,680 mm, ground-adjustable
	Varia	Carbon fibre; 1,600 to 1,700 mm diameter); mechanical flight-adjustable pitch, two-blade, optional feather
	SR 2000	Wood or wood/composites, three-blade; electrically variable pitch design; 1,450 to 1,700 mm diameter, optional reverse, feather and constant-speed
	SR 3000	Two- or three-blade; otherwise as SR 2000
	Winglet	Glass fibre; ground-adjustable pitch (Klassik 150R, Winglet 165, Speedy 165, Klassik 160, Speedy 175, Para 110, Para 137)

INDEXES

AIRCRAFT

AIRCRAFT APPEARING IN THIS EDITION ONLY. For those appearing in previous 10 editions, please see following index on tinted paper.
Index begins with aircraft generally identified only by numbers. Most were previously listed as 'Model 707' and so on under M

1RM (Poland) 431
1RMbis (Poland) 431
1TD (Poland) 431
3+2 (United States) 803
06A (Brazil) 41
7ECA (United States) 629
7EC Champ (United States) 628
7GCAA (United States) 629
7GCBC (United States) 630
8GCBC (United States) 630
8KCAB (United States) 631
010 (Brazil) 41
11E (United States) 862
12/19-seat transport (Iran) 352
17-30 Super Viking (United States) 664
40D Sky Dragon (United States) 616
100 (Germany) 229
(Russian Federation) 460
100M (Russian Federation) 460
100TD (Germany) 229
105 S (Italy) 384
105 UL (Italy) 384
114 Chinook (United States) 678
120 (New Zealand) 417
130 (Germany) 229
130TD (Germany) 229
135TDI (Canada) 91
152 (France) 189
172 Skyhawk (United States) 717
172 Skyhawk SP (United States) 717
180 (Germany) 229
180TD (Germany) 229
201AFS (Russian Federation) 449
201EM (Russian Federation) 449
201P (Russian Federation) 449
201RC (Russian Federation) 449
201REP (Russian Federation) 449
206B-3 (Canada) 46
212 Solo (Czech Republic) 138
228 (Dornier) (India) 251
250 (Canada) 91
256 (Russian Federation) 503
280FX (United States) 751
300C (United States) 875
300CB (United States) 875
300CBi (United States) 875
300C Sky Knight (United States) 875
300 Hawk (Italy) 368
300JS (Italy) 368
300L (Italy) 368
300S (Italy) 368
300T (Italy) 368
316 SpaceShipOne (United States) 873
318 White Knight (United States) 873
320 (Germany) 229
320TD (Germany) 229
320TDA (Germany) 229
330 (Italy) 368
330SP (United States) 876
400 (United States) 909
412CF (Canada) 49
412EP (Canada) 49
412EP Sentinel (Canada) 49
412HP (Canada) 49
412 Plus (Canada) 49
412SA (Canada) 49
412SP (Canada) 49
414 Chinook (United States) 678
415 (Canada) 74
415GR (Canada) 74
415MP (Canada) 74
417 (Canada) 51
427 (Canada) 51
427i (Canada) 51
429 (Korea, South) 410
429 Globalranger (Canada) 52
449 SuperCobra (United States) 656
450 Ultra (Poland) 423
495 Ultra (Poland) 423
510 Citation Mustang (United States) 723
525C citation CJ4 (United States) 727
540A (United States) 930
540T (United States) 930
550 Trener (Poland) 423
560XL Citation XLS+ (United States) 732
600B (United States) 898
601XL SLSA (United States) 928
619 (International) 309
620 (International) 309
(United States) 925
620-B (United States) 925
620-BTG (United States) 925
620-TP (United States) 925
665 Tiger (International) 315
665 Tigre (International) 315
717 (United States) 710
717-100 (United States) 710
717-100X Lite (United States) 710
717-200 (United States) 710
717-300X (United States) 710
717 Business Express (United States) 710
737-600 (United States) 689
737-700 (United States) 689
737-700C (United States) 689
737-700C/QC (United States) 689
737-700ER (United States) 689
737-700IGW (United States) 689
737-800 (United States) 689
737-800ERX (United States) 689
737-900 (United States) 689
737-900ER (United States) 689
750 (United States) 774, 776
767 AWACS (United States) 676
777 (United States) 703
777-100X (United States) 703
777-200 (United States) 703
777-200ER (United States) 703
777-200LR Worldliner (United States) 703
777-200LRXF (United States) 703
777-250ERX (United States) 703
777-300ER (United States) 703
777-300ER Stretch (United States) 703
777F (United States) 703
787 (United States) 707
787-3 (United States) 707
787-8 (United States) 707
787-9 (United States) 707
787-10X (United States) 707
800FI, SM, RA and SIG (United States) 774
800SP (United States) 774
800XP (United States) 774
800XPi (United States) 774
850XP (United States) 774
900 (Canada) 60
(France) 206
900ER (Canada) 60
900ER European (Canada) 60
900LR (Canada) 60
900XP (United States) 774, 776
912 ULS TW/TG (Czech Republic) 141
912 UL TG (Czech Republic) 141
912 UL TW (Czech Republic) 141
2000-3 (France) 173
2000-4 (France) 173
2000-5 (France) 173
2000-5 Mk 2 (France) 173
2000-8 (France) 173
2000-9 (France) 173
2000AT (France) 173
2000B (France) 173
2000BR (France) 173
2000C (France) 173
2000D (France) 173
2000E (France) 173
2000EX EASy (France) 184
2000N (France) 173
2000N' (France) 173
2000R (France) 173
2200 TW/TG (Czech Republic) 141
3300 TW/TG (Czech Republic) 141

A

A-1-50/Spector 42 (United States) 608
A-1A (International) 299
A-1B (International) 299
A-002 (Russian Federation) 466
A-16 (United States) 637
A-29A (Brazil) 31
A-29B (Brazil) 31
A-29RLD (Russian Federation) 468
A-35 Scanner (Russian Federation) 447
A-42 (Russian Federation) 451
A-60+ (United States) 607
A-60 (United States) 607
A-60R (United States) 607
A-60+/Spector 19 (United States) 608
A-67 Dragon (United States) 764
A 109 (International) 259
A 109K2 (International) 259
A 109K2 Law Enforcement (International) 259
A 109KM (International) 259
A 109KN (International) 259
A 109LOH (International) 259
A 109LUH (International) 259
A 109 Power (International) 259
A 109 Power Elite (International) 259
A 109S (International) 262
A 119 (International) 262
A 119 Military (International) 262
A-170/Spextor 48 (United States) 608
A 210 (Germany) 209
A300-600 (International) 271
A300-600 Convertible (International) 274
A300-600 Freighter (International) 274
A318 (International) 275, 278
A318-100 (International) 278
A318 Elite (International) 278
A319 (International) 275, 279
A319-100 (International) 279
A319 Executive (International) 279
A319LR (International) 279
A320 (International) 275
A320-100 (International) 275
A320-200 (International) 275
A320 Enhanced (International) 275
A320 Freighter (International) 275
A320 Prestige (International) 275
A320 research (International) 275
A321 (International) 275, 281, 295
A321-100 (International) 281
A321-200 (International) 281
A321CJ (International) 281
A321 Freighter (International) 281
A330 (International) 286
A330-100 (International) 286
A330-200 (International) 286
A330-200F (International) 286
A330-300 (International) 286
A330-500 (International) 286
A340 (International) 282
A340-300 (International) 282
A340-300 Awaitor (International) 282
A340-300E (International) 282
A340-400 (International) 282
A340-500 (International) 282
A340-600 (International) 282
A340-600 Enhanced (International) 282
A340-600F (International) 282
A350 (International) 286, 288
A350-800 (International) 288
A350-900 (International) 288
A350-900F (International) 288
A350-900R (International) 288
A350-1000 (International) 288
A350 XWB (International) 288
A380 (International) 289
A380-700 (International) 289
A380-800 (International) 289
A380-800F (International) 289
A380-900 (International) 289
A380 MRTB (International) 289
A400M (International) 301
A500 (United States) 610
A700 (United States) 612
AC4 (Switzerland) 560
AC4 Schlepp (Switzerland) 560
AC4 SPC (Switzerland) 560
AC8 (Switzerland) 560
AC-500 (China) 118
Accent (Bulgaria) 44
Accord-201 (Russian Federation) 449
ACJ (International) 279
Adel' (Russian Federation) 531
ADM (South Africa) 544
Advanced Flight Controls Demonstrator (United States) 772
Advanced Turbo Trainer (Switzerland) 564
Ae 270 (International) 341
Ae 270 FP and FW (International) 341

Ae 270 HP (International) 341
Ae 270 P (International) 341
Ae 270 W (International) 341
Aermacchi M-346 (Russian Federation) 532
Aerocat (Canada) 77
Aerocat-SR (Canada) 77
Aerocat-SRX (Canada) 77
Aerocat-TR (Canada) 77
Aerocat-TRX (Canada) 77
Aeromaster AG (United States) 615
Aeropract-27 (Russian Federation) 446
Aeropract-33 (Russian Federation) 443
Aeropract-37 (Russian Federation) 444
Aeroprakt-20R912 (Ukraine) 573
Aeroprakt-22 (Ukraine) 574
Aeroprakt-24 (Ukraine) 574
Aeroprakt-26 (Ukraine) 575
Aeroprakt-30 (Ukraine) 575
Aeroprakt-36 (Ukraine) 575
Aeropup (Australia) 15
Aeroskiff (United States) 615
Aeros-ML (United States) 617
Aerospace Ascender (United States) 788
Aerosphere SA-60 (United States) 912
Aerosphere SA-90 (United States) 913
Aero Trainer (United States) 923
AEW&C (International) 294
AEW/Mk 112 (International) 265
AG-5B (United States) 910
AG22U (Malaysia) 415
AG33mu (Malaysia) 415
AG45 (Malaysia) 415
AG90 (Malaysia) 415
AG90DB (Malaysia) 415
AG100L (Malaysia) 415
AG180 (Malaysia) 415
AG300 (Malaysia) 415
Agricultural aircraft 5 (China) 116
AGS (International) 295
Agusta-Bell 412 (International) 265
AH-1Z (United States) 656
AH-2A (South Africa) 544
AH-64 (United States) 683
AH-64A (United States) 683
AH-64B (United States) 683
AH-64C (United States) 683
AH-64D (United States) 683
AH-64DJP (Japan) 391
(United States) 683
AH-64DN (United States) 683
Ai-10 (Ukraine) 586
Ai-70 (United States) 587
Aircam (United States) 823
Air Car (China) 118
Aircraft Trials Programmes (United States) 841
Airdale Flyer (United States) 620
Airelle (France) 166
Air Epic Elite (United States) 619
Airframes (United States) 622
Airliner (International) 343
Air Tractor (United States) 622
Airtrainer CT/4E (New Zealand) 418
Airvan (Australia) 6
Aist (Russian Federation) 480
AK1-3 (Ukraine) 572
AK3 (France) 192
Akro (Czech Republic) 154
Aktai (Russian Federation) 478
Aktsent (Bulgaria) 44
AL-1A (United States) 677
AL3C-100 (United States) 632
AL-11C-100 (United States) 632
AL11C-100 (United States) 632
AL11J-120 (United States) 632
Alarus (United States) 627
Alaskan Bushmaster (United States) 640
Albatross (Korea, South) 412
ALEKS-251 (Russian Federation) 502
Alfa (Austria) 22
Allegro (Czech Republic) 146
Allegro 200 (Czech Republic) 146
Allegro 2000 (Czech Republic) 146
Allegro 2000 F (Czech Republic) 146
Allegro 2007 (Czech Republic) 146
Allegro ST (Czech Republic) 146
Allegro SW (Czech Republic) 146
Alligator (Russian Federation) 472
Alpha (New Zealand) 417
(United States) 901
Alpha 120T (New Zealand) 417
Alpha 230 (United States) 901
Alpha 310 (United States) 901
Altair (Russian Federation) 454
ALTO (Czech Republic) 141
ALX (Brazil) 31
Ambulance/EMS (International) 325
AMD Zodiac CH601XL SLSA
(United States) 627
AMD Zodiac CH601XLi SLSA
(United States) 627
Amigo (Austria) 23
AMT-600 Guri (Brazil) 29
AMV 211 (United States) 632
AMX (International) 299
AMX-ATA (International) 299
AMX-ATA 2 (International) 299
AMX-E (International) 299
AMX-MLU (International) 299
AMX-T (International) 299
An-7X (Ukraine) 578
An-38 (Ukraine) 577
An-38-100 (Ukraine) 577
An-38-110 (Ukraine) 577
An-38-120 (Ukraine) 577
An-38-200 (Ukraine) 577
An-38D (Ukraine) 577
An-38K (Ukraine) 577
An-70 (Ukraine) 578
An-70T (Ukraine) 578
An-70T-100 (Ukraine) 578
An-70T-200 (Ukraine) 578
An-70T-300 (Ukraine) 578
An-70T-400 (Ukraine) 578
An-70TK (Ukraine) 578
An-71 (Ukraine) 579
An-71P (Ukraine) 579
An-72 (Ukraine) 579
An-72-100 (Ukraine) 579
An-72P (Ukraine) 579
An-72R (Ukraine) 579
An-72S (Ukraine) 579
An-72V (Ukraine) 579
An-74 (Ukraine) 579
An-74-200 (Ukraine) 579
An-74-300 (Ukraine) 582
An-74-400 (Ukraine) 579, 582
An-74MP-300 (Ukraine) 582
An-74T-100 (Ukraine) 579
An-74T-200A (Ukraine) 579
An-74TK-100 (Ukraine) 579
An-74TK-100/200 Salon (Ukraine) 579
An-74TK-100C (Ukraine) 579
An-74TK-200 (Ukraine) 579
An-74TK-200A (Ukraine) 579
An-74TK-200S (Ukraine) 579
An-74TK-300 (Ukraine) 579, 582
An-74TK-300D (Ukraine) 582
An-76 (Ukraine) 579
An-77 (Ukraine) 578
An-79 (Ukraine) 579
An-88 (Ukraine) 579
An-128 (Ukraine) 583
An-140 (Ukraine) 583
An-140-100 (Ukraine) 583
An-140 Military (Ukraine) 583
An-140T (Ukraine) 583
An-140VIP (Ukraine) 583
An-142 (Ukraine) 583
An-148 (Ukraine) 585
An-148-100A (Ukraine) 585
An-148-100B (Ukraine) 585
An-148-100E (Ukraine) 585
An-148-100E1 (Ukraine) 585
An-148-100E2 (Ukraine) 585
An-148-200 (Ukraine) 585
An-148-C1 (Ukraine) 585
An-148-C2 (Ukraine) 585
An-148T (Ukraine) 585
An-170 (Ukraine) 578
An-171 (Ukraine) 578
An-174 (Ukraine) 579, 582
An-700-100 (Ukraine) 578
Angel (Italy) 375
Ansat (Russian Federation) 477
Ansat 3 (Russian Federation) 479
Anti-Ship (India) 251
Antonov (Ukraine) 583
AP.68TP 600 Viator (Italy) 388
Apache (United States) 683
Apache AH. Mk 1 (United States) 683
APM-20 Lionceau (France) 191
APM-21 Lion (France) 191
APM-22 Liondo (France) 191
APM-30 Lion (France) 191
Apollo Fox (Hungary) 242
Archer III (United States) 853
ARJ21 (China) 96
ARJ21-700 (China) 96
ARJ21-700B (China) 96
ARJ21-700F (China) 96
ARJ21-900 (China) 96
Armed Bell 407 (United States) 658
Arrow (Australia) 3
(United States) 854
Arrow M/G (Australia) 3
ARV Super2 (United States) 850
AS-3A (Russian Federation) 446
AS 105 GD (Germany) 220
AS 332L1 Super Puma (International) 318
AS 332L2 Super Puma Mk II (International) 318
AS 350 (International) 322
AS 352 Cougar 100 (International) 318
AS 355 (International) 324
AS 365N (International) 325
AS 365N3 Dauphin (International) 325
AS 365N4 Dauphin (International) 325
AS 366G1 (HH-65A Dolphin) (International) 325
AS 532AC Cougar (International) 318
AS 532AL Cougar (International) 318
AS 532SC Cougar (International) 318
AS 532U2/A2 Cougar Mk II (International) 318
AS 532UC Cougar (International) 318
AS 532UL Cougar (International) 318
AS 532UL Horizon (International) 318
AS 550 (International) 322
AS 555 (International) 324
AS 555AN Fennec (International) 324
AS 555MN Fennec (International) 324
AS 555SN Fennec (International) 324
AS 555UN Fennec (International) 324
AS 565 (International) 325
AS 565SB Panther (International) 325
AS 565UB Panther (International) 325
ASA Rapid 500 (Czech Republic) 151
Astra (Switzerland) 563
Astro (United States) 869
ASW/ASVW/Mk 110 (International) 265
AT 01 (Germany) 209
AT-3 (Poland) 424
AT-3AK (Poland) 424
AT-3 L100 (Poland) 424
AT-3 R100 (Poland) 424
AT-3SK (Poland) 424
AT-10 (United Kingdom) 605
AT-63 (Argentina) 1
AT-401 (United States) 622
AT-402 (United States) 623
AT-502 (United States) 624
AT-602 (United States) 625
AT-802 (United States) 625
ATEC 212 Solo (Czech Republic) 137
ATEC 321 Faeta (Czech Republic) 137
ATG-1A (United States) 635
ATG-1B Javelin (United States) 635
ATG-1 Javelin (United States) 635
ATR 42 (International) 305
ATR 42-300 (International) 305
ATR 42-320 (International) 305
ATR 42-400 (International) 305
ATR 42-500 (International) 305
ATR 42 F (International) 305
ATR 42 full freighter (International) 305
ATR 42 L (International) 305
ATR 42 MP Surveyor (International) 305, 307
ATR 42 Quick-Change (International) 305
ATR 72 (International) 308
ATR 72-200 (International) 308
ATR 72-210 (International) 308
ATR 72-500 (International) 308
ATR 72 Quick-Change (International) 308
ATR Calibration (International) 305
Au-11 (Russian Federation) 504
Au-12 (Russian Federation) 504
Au-12M (Russian Federation) 504
Au-23A Peacemaker (Switzerland) 562
Au-35 (Russian Federation) 448
Australian Lightwing Speed (Australia) 8
Australian Lightwing Sport 2000 (Australia) 9
AV-2 (Czech Republic) 152
AV-18 (United Kingdom) 602
AV-18A (United Kingdom) 602
AV-18B (United Kingdom) 602
AVA-202 (Iran) 347
AVA-303 (Iran) 348
AVA-404 (Iran) 348
AVA-606 (Iran) 348
Avantage A-29 (Russian Federation) 447
Avenger (United States) 756
AveoSport WD (Switzerland) 570
AveoX (United States) 637
AveoXT (United States) 637
AveoXTC (United States) 637
Avgur Au-29 Zyablik (Russian Federation) 448
Aviatika-MAI-890 (Russian Federation) 500
Aviatika-MAI-890S (Russian Federation) 500

Aviatika-MAI-890SKh (Russian Federation) 500
Aviatika-MAI-890U (Russian Federation) 500
Aviatika-MAI-910 (Russian Federation).....501
AVo 68-R100 (Germany) 230
AVo 68 R-115 (Germany) 230
AVo 68-R Samburo (Germany).....230
AW139 (International).....263
AW149 (International).....264
Azarakhsh (Iran) 353

B

B2-H4 (Switzerland).....562
Bü-133P (Poland).....438
B612 (Czech Republic).....147
BA609 (International).....309
Baron 58 (United States) 646
Basic Trainer (Turkey).....572
BBJ (United States).....711
BBJ 2 (United States).....712
BBJ 3 (United States).....713
BD-17 Nugget (United States) 642
BD-18 Nugget (United States) 642
BD-100 (Canada) 61
BD-100-1A10 (Canada).....61
BD-205 (Russian Federation).....456
BD-700 (Canada).....64
BD-700-1A11 (Canada).....66
Be-101 (Russian Federation).....451
Be-103 (Russian Federation).....451
Be-112 (Russian Federation).....453
Be-200 (Russian Federation).....454
Be-200ChS (Russian Federation).....454
Be-200M (Russian Federation).....454
Be-200P (Russian Federation).....454
Be-200PS (Russian Federation).....454
Be-210 (Russian Federation).....454
Be-220 (Russian Federation).....454
Be-250 (Russian Federation).....454
Bear 360 (Russian Federation).....508
Bearcat (United States).....616
Bearhawk (United States).....641
Beech 200 HISAR (United States) 649
Beech 390 (United States) 653
Beechcraft 3000 (United States).....643
Beech/Pilatus PC-9 Mk II (United States).....643
Bekas (Russian Federation).....451
(Ukraine) 587, 588
Bell 206L-4 (Canada).....47
Bell 407 (Canada).....48
Bell 412 (Canada).....49
Bell 430 (Canada).....53
Belyi Lebed (Russian Federation).....523
Benelos (France).....206
BF 16 (New Zealand).....418
BF 19 (Switzerland).....564
Bf 109G-2 (Germany).....233
Bielik (Poland).....428
Bifyter (United States).....927
Big Flapper (Canada).....93
Bikini (Korea, South).....413
Bingo 4T (Italy).....375
Bingo 503 (Italy).....375
BJH 2 (Switzerland).....562
BK 117 (International).....330
BK 117 C-1 (International).....330
BK 117 C-2 (International).....330
BK 117 P5 (International).....330
Blackjack (Russian Federation) 523
Black Kite (France).....168
Black Shark (Russian Federation).....470
Blended Wing-Body (International) 312
Blended Wing Body Large Commercial Transport
(United States) 711
Blue Bird (Iran) 351
BN2B (United Kingdom).....596
BN2T (United Kingdom).....598
BN2T-4S (United Kingdom) 598
BN2T-4S Defender 4000 (United Kingdom) 598
Boeing 737 (United States).....689
Boeing 737 AEW&C (United States) 674
Boeing 747-8 (United States).....693
Boeing 747-8F (United States).....697
Boeing 747-400 (United States) 693
Boeing 747-400F (United States) 697
Boeing 767 (United States).....698
Boeing 767-300 General Market Freighter
(United States).....702
Boeing 767 Military Versions (United States).....676
Boeing Business Jet (United States) 711
Boeing Business Jet 2 (United States) 712
Boeing Commercial Airplane Group Orders and
Deliveries
(United States).....689
Bonanza 36 (United States).....645
Bongo (Czech Republic).....154
Bravo DX (United States).....837
Bravo GX (United States).....837
Breezer (Germany).....208
Bright Star (Canada).....78
Brumby (Australia).....3
Bryza (Poland).....431
BS001/ZJ910 (International) 334
BT001/ZJ800 (International) 334
BT005/ZJ804 (International) 334
Bush Caddy (Canada).....76
Bushcub (United States) 713
BushCub SP (United States) 713
BushCub XP (United States).....713
Bush Hawk (Canada).....83
Bush Hawk-260 (Canada).....83
Bush Hawk-XP (Canada).....83
Bushwhacker (United States) 871
Bushwhacker Bushwhacker (United States).....713
Bushwhacker R (United States).....713
Bushwhacker RSP (United States).....713
Bushwhacker SP (United States) 713

C

C-12S (United States).....651
C.16 (International) 334
C-17A (United States) 671
C-26 (Italy).....379
C-27J (Italy) 364
C-37 (United States).....770
C-40A Clipper (United States) 689
C-41A (Spain).....550
C42 (Germany) 228
C42 B (Germany).....228
C42 Bison (Germany).....228
C42 Competition I/II (Germany) 228
C 104 (Czech Republic) 155
C-212 (Spain) 551
C-212 Series 400 (Spain).....550
C-295 (Spain) 551
C-295MSA/MPA Persuader (Spain).....551
C-400 (United States).....879
C-500T (United States).....879
C-700T (United States).....879
CA6AF (United States).....742
CA6G (United States).....742
CA6SF (United States) 742
CA6SHG (United States).....742
CA6TW (United States).....742
CA6TWHG (United States) 742
CA10 (United States) 744
CA10XLT (United States).....744
CA-80 (China).....127
CA 108 (United States).....926
CA-120 (China) 128
CA-J Jet (United States) 744
Calao (Czech Republic).....164
Camp (Italy) 356
CAP 10 (France) 171
CAP 10 B (France).....171
CAP 10 C (France).....171
CAP 232 (France) 172
Carat A (Slovenia).....540
Caravan (United States).....721
Caravan II (France).....196
Carla (United Kingdom) 603
CARLA-VLG (Germany) 228
CarteCopter CC1 (United States).....715
Carter PAV 2+2 (United States).....715
CC11 (United States).....746
CC-11-100 (United States).....746
CC18 (United States).....746
CC18-180 Top Cub (United States) 746
CC-144 (Canada) 62
CC-144B (Canada).....62
CE.16 (International) 334
CE-144A (Canada).....62
Centaur (United Kingdom).....606
Cessna 172 (United States) 717
Cessna 182 (United States) 718
Cessna 206 (United States) 719
Cessna 208 (United States) 721
Cessna 525 (United States) 724
Cessna 525A (United States).....725
Cessna 525B (United States).....726
Cessna 550 (United States) 729
Cessna 560 (United States) 730
Cessna 560XL (United States) 731
Cessna 680 (United States) 734
Cessna 750 (United States) 735
Cessna T206 (United States).....719
CGD/T (United States).....715
CH2T (United States).....627
CH-7 (Italy).....375
CH-47 (Japan).....396
CH-47 Chinook (United States).....678
CH-47D (United States).....678
CH-47J (United States).....678
CH-47JA (Japan).....396
(United States) 678
CH-53K (United States).....880
CH-53X (United States).....880
CH-146 Griffon (Canada) 49
CH-148 Petrel (International).....265
CH-149 Chimo (International).....265
CH-149 Cormorant (International).....265
CH 601DX (United States).....928
CH 601HD (United States) 928
CH 601HDS (United States) 928
CH 601XL (United States).....928
CH 601XL (United States).....627
CH 640 (United States) 929
CH 701 (United States) 930
CH 701-AG Stol (Czech Republic) 140
CH 801 (United States) 929
CH 2000 (United States).....627
Chalenger 601-3R (Canada).....62
Challenger (Canada).....62
Challenger 300 (Canada) 61
Challenger 600 (Canada) 62
Challenger 601-1A (Canada).....62
Challenger 601-3A (Canada).....62
Challenger 604 (Canada) 62
Challenger 605 (Canada) 62
Challenger 800/850 (Canada).....56
Challenger 870 (Canada) 58
Che-22 (Russian Federation) 459
Che-23 (Russian Federation).....456
Che-25 (Russian Federation).....456
Che-27 (Russian Federation).....457
Cheetah (India) 250
Cheetal (India) 250
Chernaya Akula (Russian Federation) 470
Chetak (India).....251
Chetan (India).....251
Chief (United States).....851
Chinook HC. Mk 2 (United States) 678
Chinook HC. Mk 2A (United States).....678
Chinook HC. Mk 3 (United States) 678
Choucas (France) 194
Chrysalis (Germany).....235
Chuji Jiaolianji-6A (China).....113
CH-X (International) 265
Cirrus Jet (United States).....739
Citabria Adventure (United States) 629
Citabria Aurora (United States) 629
Citabria Explorer (United States).....630
Citation Bravo (United States) 729
Citation CJ1 (United States).....724
Citation CJ2+ (United States).....725
Citation CJ2 (United States).....725
Citation CJ3 (United States).....726
Citation Encore (United States).....730
Citation Excel (United States).....731, 732
Citation Large Cabin Concept (LCC)
(United States) 736
Citation Sovereign (United States).....734
Citation X (United States).....735
Citation XLS (United States) 731, 732
Citation XLS+ (United States) 732
CITEC (France) 188
CJ-6A (China).....113
CJ80 (France) 169
CL-215-6B11 (Canada).....74
CL-600 (Canada).....62
CL-600-2B16 (Canada).....62
CL-600-2D24 (Canada) 60
Classic (Italy).....373
(United Kingdom) 600
Classic IV (United States).....792
Clipper II (United States).....869
Clippy (United States) 713
Club (Slovakia) 539
CMH (China).....107
CN-235 (International).....295
Coaler (Ukraine) 579
Cobra (Czech Republic).....144
Colibri (International).....329
Columbia 300 (United States) 739
Columbia 300X (United States).....739
Columbia 350 (United States) 739
Columbia 350i (United States) 739
Columbia 350SLX (United States) 739
Columbia 400 (United States) 739
Columbia 400i (United States) 739
Columbia 400SL (United States).....739
Columbia 400SLX (United States) 739
Columbia Columbia (United States) 739
Comet (Germany).....211

(Korea, South) 412
(United States) 770
Commander 447 (United States) 619
Commander 503 (United States) 619
Commander 582 (United States) 619
Commander Elite (United States) 619
Commander Elite 3202 (United States) 619
Commander Elite 3203 (United States) 619
Commercial freighter (International) 343
Comp Air 3 (United States) 741
Comp Air 4 (United States) 741
Comp Air 6 (United States) 742
Comp Air 7 (United States) 742
Comp Air 7P (United States) 742
Comp Air 7SL (United States) 742
Comp Air 7SLX (United States) 742
Comp Air 7T (United States) 742
Comp Air 8 (United States) 743
Comp air 8-52XL (United States) 743
Comp Air 8-SS52 (United States) 743
Comp Air 9 (United States) 743
Comp Air 10 (United States) 744
Comp Air 12 (United States) 744
Condor (Czech Republic) 158
(Germany) 235
Condor Plus (Czech Republic) 158
Condor S (Czech Republic) 158
Cormorant MHP (International) 265
Corone (Hungary) 241
Corvette (Russian Federation) 459
Corvette 503 (Russian Federation) 459
Corvette 582 (Russian Federation) 459
Corvette 912 (Russian Federation) 459
Corvette-L (Russian Federation) 459
Corvus I (Czech Republic) 160
Corvus IF (Czech Republic) 160
Corvus IP (Czech Republic) 160
Cougar Mk I (International) 318
Cougar Mk II (International) 320
Courier (United States) 865
CR80 (France) 169
CR100 (France) 169, 187
CR100T (France) 187
CR110 (France) 187
CR120 (France) 187
Crane (India) 244
C/RC/UC-12 (United States) 649
CRJ200 (Canada) 56
CRJ700 (Canada) 58
CRJ700 Series 705 (Canada) 59
CRJ700 Srs 701 (Canada) 58
CRJ700 Srs 705 (Canada) 58
CRJ900 (Canada) 58, 60
Cruiser (United States) 862
Cruiser Jet (United States) 830
CSeries (Canada) 68
CT (Germany) 218
CT2K (Germany) 218
CT/4E (New Zealand) 418
CT-156 (United States) 643
CTsw (Germany) 218
CTU (Germany) 218
Cubby (Austria) 23
CubSport (United States) 746
Culp's Special (United States) 748
Cumulus (United States) 914
C-X (Japan) 394
CY-1 (China) 107
Cyclone (Italy) 383

D

D4 BK (Switzerland) 570
D4 Fascination LSA (Switzerland) 570
D4 Fasination VLA (Switzerland) 570
D5 (Switzerland) 570
D 20 (France) 168
D-139 (Iran) 351
DA1/9829 (International) 334
DA2/ZH588 (International) 334
DA3/MMX602 (International) 334
DA4/ZH590 (International) 334
DA5/9830 (International) 334
DA6/XCE.16-01 (International) 334
DA7 (International) 334
DA20-A2 (Canada) 80
DA20-C1 (Canada) 80
DA20-W (Canada) 80
DA40 (Canada) 81
DA40-180 (Austria) 18
(Canada) 81
DA40-180 FP (Canada) 81
DA40D (Austria) 18
DA40-FP (Austria) 18
DA42 (Austria) 19
DA42-360 (Austria) 19
DA42 MPP Observer (Austria) 19
DA42-TDI (Austria) 19
DA50 (Austria) 22
Dakota Hawk (United States) 756
Dakota Super 18 (United States) 622
Dandy (Austria) 23
Dar-21 (Bulgaria) 43
Dar-21S (Bulgaria) 43
Dar-23 (Bulgaria) 44
Dash 8 (Canada) 70
Dash 8M (Canada) 69
Dash 8 Q (Canada) 69
Dash 8 Q100 (Canada) 69
Dash 8 Q200 (Canada) 69
Dash 8 Q300 (Canada) 69
Dash 8 Q400 (Canada) 69, 71
Dash 8 Series 100A (Canada) 69
Dash 8 Series 200A (Canada) 69
Dash 8 Series 200B (Canada) 69
Dauphin (France) 198
Dauphin 2 (International) 325
Defender 4000 (United Kingdom) 598
Defender AL. Mk I (United Kingdom) 598
Defiance (United States) 900
Devil (Chile) 96
DF02 (Germany) 227
DF 2000 (Italy) 369
DFH X 334 (Italy) 370
DHC-6 (Canada) 94
Dhruv (India) 249
Diamond Star (Austria) 18
(Canada) 81
Diesel (United States) 715
Diesel Twister (Germany) 234
Divine Thunder (France) 173
D-Jet (Austria) 21
Dolphin (China) 108
(France) 198
Dornier 328Jet (Germany) 208
DR109 (United States) 791
DR 400 (France) 198
DR 400/100 (France) 198
DR 400/120 Dauphin 2+2 (France) 198
DR 400/125i (France) 198
DR 400/140B Dauphin 4 (France) 198
DR 400/160 (France) 198, 199
DR 400/180 (France) 198, 200
DR 400/180R (France) 200
DR 400/180RD (France) 200
DR 400/180RP (France) 200
DR 400/180S (France) 200
DR 400/200R (France) 201
DR 500 (France) 201
DR 500C (France) 201
DR 500 Super Régent (France) 201
Dragon 334 (Italy) 370
Dragon 334 GP (Italy) 370
Dragonfly (Russian Federation) 482
(South Africa) 543
(United Kingdom) 595
(United States) 912
Dragon Fly 333 (Italy) 370
Dragon Fly 333AC (Italy) 370
Dragonfly Mark I (South Africa) 543
Dragonfly Mark II (South Africa) 543
Dragonfly Mark III (South Africa) 543
Dreamliner (United States) 707
Drifter (United States) 823
Dromader (Poland) 430
DS-2 (Switzerland) 558
DS-12 (Switzerland) 558
Dubna-2 Osa (Russian Federation) 457
Dubna-4 (Russian Federation) 458
DV-1 (Czech Republic) 142
Dynalifter (United States) 849
Dynamic (Slovakia) 539
Dynasty (United States) 618
DZ-9 (China) 108

E

E-2C (United States) 845
E-7 Bushplane (Russian Federation) 502
E-10 (United States) 848
E-10B (United States) 848
E-10C (United States) 848
EA-200 (Germany) 213
EA-300 (Germany) 213
EA-300/200 (Germany) 213
EA-300L (Germany) 213
EA-300LP (Germany) 213
EA-300L Touring Edition (Germany) 213
EA-300S (Germany) 213
EA-300SHP (Germany) 213
EA-300SP (Germany) 213
EA-330 (Germany) 213
EA-330LX (Germany) 213
EA-330XS (Germany) 213
EA-400 (Germany) 215
EA-400-500 (Germany) 216
EA-500 (Germany) 215, 216
Eagle (United States) 665
Eagle 150 (Malaysia) 414
Eagle ARV (Malaysia) 414
Eagle II (United States) 640
EC 120B (International) 329
EC 130B (International) 323
EC 130B4 (International) 323
EC 135 (International) 327
EC 135 ACT/FHS (International) 327
EC 135 APH (International) 327
EC 135P2 (International) 327
EC 135T1 (International) 327
EC 135T2 (International) 327
EC 145 (International) 331
EC 155B (International) 326
EC 155B1 (International) 326
EC 155B HTT (International) 326
EC 175 (International) 333
EC 225 (International) 320
EC 635 (International) 327
EC 725 (International) 320
EC-Futura BK117 (International) 330
ECH-51 (Chile) 96
Echo (Italy) 385
Echo 80 (Italy) 385
Echo 100S (Italy) 385
Eclipse 500 (United States) 750
Ecoflyer (France) 198
(Poland) 427
Ecureuil 2/TwinStar (International) 324
Ecureuil/AStar (International) 322
Edge 540 (United States) 930
EDM (South Africa) 544
EF2000 (International) 334
EF2000T (International) 334
EH101 (International) 265
EH101 BERP testbed (International) 265
Eitam (United States) 770
ELA-07 (Spain) 553
Electra-Plane (France) 187
Elevation (Iran) 350
Elitar-202 (Russian Federation) 458
Elite F-30 (United States) 619
Elite F-30ES (United States) 619
Elite Subaru (United States) 619
EM-10 (Poland) 428
EM-11 (Poland) 429
EMB-135BJ (Brazil) 33
EMB-135BJ Legacy 600 (Brazil) 33
EMB-145AEW&C (Brazil) 34
EMB-145AGS (Brazil) 34
EMB-145MP (Brazil) 34
EMB-145MP/ASW (Brazil) 34
EMB-145RS (Brazil) 34
EMB-202 (Brazil) 42
EMB-314 (Brazil) 31
Embraer 170 (Brazil) 36
Embraer 175 (Brazil) 36
Embraer 190 (Brazil) 36
Embraer 195 (Brazil) 36
Encore+ (United States) 730
Enhanced Gripen (Sweden) 554
Enstrom 480 (United States) 752
Envoy (United States) 904
Epic Jet (United States) 618
Epic LT (United States) 618
ERJ-135 (Brazil) 33, 34
ERJ-140 (Brazil) 34
ERJ-140ER (Brazil) 34
ERJ-140LR (Brazil) 34
ERJ-145 (Brazil) 34
ERJ-145EP (Brazil) 34
ERJ-145ER (Brazil) 34
ERJ-145LR (Brazil) 34
ERJ-145MP (Brazil) 34
ERJ-145MR (Brazil) 34
ERJ-145XR (Brazil) 34
ES-101 Raven (Italy) 369
Escapade (United Kingdom) 604
Esqual (Belgium) 25
Eurocub (Hungary) 241
Eurofox (Slovakia) 538
Eurofox Basic (Slovakia) 538
Eurofox Space (Slovakia) 538
Europa (United Kingdom) 600
Eurostar 2000 (Czech Republic) 143
EV-20 Vantage (United States) 753
EV-55 Outback (Czech Republic) 145

EV-97 (Czech Republic) 143
Evolution (Colombia) 132
(Switzerland) 570
Exec 162F (United States) 871
Exec 162 Pro (United States) 871
Executive/Air taxi (India) 251
Exel (France) 194
Experimental (United States) 760
Explorer (Australia) 3, 4
(United States) 834
E-Z Flyer (Canada) 54
E-Z Flyer Twin (Canada) 54
E-Z Kingcobra (Canada) 55
Ezhik (Russian Federation) 467
EzyCopter (Taiwan) 571

F

F1 (United States) 907
Flevo (United States) 907
F1 QB (United States) 907
F2 (United States) 907
F-2 (Japan) 397
F-2A (Japan) 397
F-2B (Japan) 397
F-7 (China) 99
F-7A (China) 99
F-7B (China) 99
F-7BS (China) 99
F-7M Airguard (China) 99
F-7MB (China) 99
F-7MF (China) 99
F-7MG (China) 99
F-7MP (China) 99
F-7N (China) 99
F-7NI (China) 99
F-7P Airguard (China) 99
F-7PG (China) 99
F-8 (China) 122
F-8 IIM (China) 122
F-10 (China) 102
F-15E (United States) 665
F-15F (United States) 665
F-15H (United States) 665
F-15K (United States) 665
F-15L (United States) 665
F-15MANX (United States) 665
F-15S (United States) 665
F-15SE (United States) 665
F-15SG (United States) 665
F-15U (United States) 665
F-16 (United States) 812
F22 (United States) 905
F-22A (United States) 804
F-22B (United States) 804
F-22 Raptor (United States) 804
F28 (Italy) 376
F28F (United States) 751
F-31 (Czech Republic) 136
F-35 Lightning II (United States) 819
F-151 Ra'am (United States) 665
F200 TSJ (Italy) 378
F300 FSJ (Italy) 378
F406 (France) 196
F406 Cartography (France) 196
F406 Mark II (France) 196
FA 01 Smaragd 80 (Germany) 217
FA 01 Smaragd 100 (Germany) 217
FA 01 Smaragd D (Germany) 217
FA 01 Smaragd J (Germany) 217
FA 01 Smaragd K (Germany) 217
FA 02 Smaragd VLA (Germany) 217
FA 03 Smaragd TMG (Germany) 217
F/A-18 (United States) 667
Faeta (Czech Republic) 137
Fajr F-3 (Iran) 352
Falco 95 (Slovakia) 540
Falco F.8L (United States) 878
Falcon (Poland) 434
(Russian Federation) 498
Falcon 7X (France) 185
Falcon 50 (France) 181
Falcon 50-40 (France) 181
Falcon 50EX (France) 181
Falcon 50M Surmar (France) 181
Falcon 50 Sigint (France) 181
Falcon 900 (France) 182
Falcon 900B (France) 182
Falcon 900C (France) 182
Falcon 900DX (France) 182
Falcon 900EX (France) 182
Falcon 900 MPA (France) 182
Falcon 2000 (France) 184
Falcon 2000DX (France) 184
Falcon 2000EX (France) 184
Falcon SMS (France) 186
Falke (Germany) 233
Falke 2000 (Germany) 233
Faraz (Iran) 350
Farmer (Russian Federation) 497
Farnborough FTC3 (International) 340
Fascination (Switzerland) 570
Fatman (Australia) 5
FB-22 (United States) 804
FBA-2C (Canada) 83
FBA-2C2 (Canada) 83
FBC-1 Flying Leopard (China) 128
FBC-1M Flying Leopard II (China) 128
FC-1 Xiaolong (China) 101
Fearless Albatross (China) 130
Fenix (Poland) 428
Fennec (International) 322, 324
Fermer (Russian Federation) 497
Festival (Romania) 440
FF-1080 (United States) 913
FHoenix (United States) 755
Fighting Falcon (United States) 812
Finback (China) 122
Firefighting amphibian (Japan) 401
Firefly (Korea, South) 411
(United States) 793
Fish Eagle (United States) 770
FK 9 (Germany) 210
FK 9 Club (Germany) 210
FK 9 Mark 3 (Germany) 210
FK 9 Mark 3B (Germany) 210
FK 9 Mark IV SW (Germany) 210
FK 9 Mark IV Utility (Germany) 210
FK 9 Mark IV (Germany) 210
FK 12 (Germany) 211
FK 14B (Germany) 211
FK 14 Polaris (Germany) 211
Flagman (Russian Federation) 445
Flamingo (Czech Republic) 135
Flanker (Russian Federation) 509, 513, 517
Flanker-F Variant 1 (Russian Federation) 512
FloatCub (United States) 632
Flyer Mark IV (United States) 620
Flying Lion (China) 115
FM 250 Vampire (Czech Republic) 148
Foxbat (Ukraine) 574
Foxjet II (United States) 837
Foxtrot (United States) 907
Freedom (Spain) 548, 549
(United States) 903
Fregata (Poland) 427
Freight Feeder (United States) 913
FSU Smaragd (Germany) 217
FT-7 (China) 99
FTC-2000 Shanying (China) 107
Fullback (Russian Federation) 515
Futura (Spain) 547
'Future Large Cabin Aircraft' (United States) 772
Future Lynx (International) 257
FW 190 (Germany) 219
FX-210 (United States) 759
FX-250T (United States) 759

G

G1 (France) 189
G2 Cabri (France) 190
G-3 (Germany) 232
G-3/600 (Germany) 232
G-3 RaLi (Germany) 232
G97 Spotter (Germany) 221
G97V Spotter (Germany) 221
G100 (United States) 766
G 120A (Germany) 222
G 120A-I Snunit (Germany) 222
G 120A Observer (Germany) 222
G 140TP (Germany) 223
G150 (United States) 766
G 160 (Germany) 224
G 180 SPn Utility Jet (Germany) 224
G-190 (France) 170
G200 (United States) 767
G-230 (France) 170
G300 (United States) 768
G350 (United States) 769
G400 (United States) 768
G450 (United States) 769
G500 (United States) 770
G550 (United States) 770
G 600 (Germany) 226
G 600 ER (Germany) 226
GA8 (Australia) 6
GA200 (Australia) 5
GA200 Ag-trainer (Australia) 5
GA200B (Australia) 5
GA200C (Australia) 5
GAH-64A (United States) 683
Gannet (Spain) 548, 549
GCH-47D (United States) 678
Gemini ST (Canada) 47
Genesis (United States) 900
GEN H-4 (Japan) 392
Ghibli (International) 299
GL 165 (Czech Republic) 156
GL 180 (Czech Republic) 156
Glasair III (United States) 762
Glasair III Turbo (United States) 762
Glasair Super II (United States) 761
Glasair Super III (United States) 762
Glass Goose (United States) 864
Glastar (United States) 763
Global 5000 (Canada) 66
Global Express (Canada) 64
Global Express XRS (Canada) 64
Globemaster III (United States) 671
GM-17 (Switzerland) 558
GM-19 (Switzerland) 560
Golden Butterfly (United States) 714
Golden Eagle (Korea, South) 409
Gorse Bush (Spain) 548
Goshawk (International) 311
GR-912-T (Australia) 8
Grach (Russian Federation) 444
Grand (International) 262
Great Flight (Korea, South) 407
Great Plains Easy Eagle (United States) 764
Griffin (Canada) 45
(Sweden) 554
Griffin HT. Mk 1 (Canada) 49
Griffin III (Canada) 45
Griffin IV (Canada) 45
Griffon (International) 265
Gripen (Sweden) 554
GS001/3006 (International) 334
GS002/9839 (International) 334
GS003/3008 (International) 334
GS004/3009 (International) 334
GT001/9831 (International) 334
GTX-SE (Canada) 89
GTX-SE FI (Canada) 89
Guepard (France) 167
Guepy (France) 167
Gull (Czech Republic) 152
Gyrolifter (United States) 765
Gzhel (Russian Federation) 498

H

H-1 (United States) 782
H2 (Belgium) 24
H-2 (United States) 783
H-6 (China) 128
H-6H (China) 128
H-6J (China) 128
H-92 Superhawk (United States) 893
H410A (China) 108
H425 (China) 108
H450 (China) 108
HA-420 Hondajet (United States) 783
Haitun (China) 108
HAI Z-15 (International) 333
HAL (France) 194
Halo (Russian Federation) 491
Hansa-2 (India) 253
Hansa-2RE (India) 253
Hansa-3 (India) 253
Hansa-S (India) 253
Hanuman (India) 255
HAR. Mk 2 (Canada) 49
Harmony (Czech Republic) 143
Harvard (Canada) 55
Harvard II (United States) 643
Havoc (Russian Federation) 493
Hawk 4 (United States) 765
Hawk 8 (United States) 765
Hawk 50 Series (United Kingdom) 589
Hawk 60 Series (United Kingdom) 589
Hawk 100 Series (United Kingdom) 589
Hawker 400 (United States) 773
Hawker 800 (Japan) 393
(United States) 774
Hawker 850 (United States) 774
Hawker 4000 (United States) 779
Hawkeye (United States) 845
HB 207 (Austria) 22
HB 207RG (Austria) 22
HB-FOG (Switzerland) 568
HB-FOL (Switzerland) 568
HD.21 (International) 318
Hedgehog (Russian Federation) 467

Helicycle (United States) 749
Hélios (Italy) 370
Helix-B (Russian Federation) 468
Hercules (United States) 808
HH-47D (United States) 678
HH-65A Dolphin (International) 325
Highlander (Czech Republic) 135
High Speed (Italy) 373
Hip (Russian Federation) 488
HJT-36 (India) 246
HJT-39 (India) 247
HK36 (Austria) 16
HK36TC 80 (Austria) 16
HK36TC 100 (Austria) 16
HK36TTC 115 (Austria) 16
HK36TTC-MPX (Austria) 16, 17
Hkp 14 (International) 344
Hkp 15A (International) 259
Hkp 15B (International) 259
Hokum (Russian Federation) 470
Hornet (United States) 783
HPA M1 (United States) 784
HT.17 (United States) 678
HT.21 (International) 318
HT-80 (Iran) 349
HTH (International) 318
Hudomik (Swift) (Switzerland) 564
Hummingbird (United States) 919
Husky A-1 (United States) 638
Husky A-1A (United States) 638
Husky A-1B (United States) 638
Husky A-1B160 (United States) 638
Husky A-1B200 (United States) 638
Husky Pup A-1B (United States) 639
HV-609 (International) 309
HX-1 (United States) 781

I

I-3 (Russian Federation) 466
I-3M (Russian Federation) 466
I-21 PAKFA (Russian Federation) 518
IA 61 Pampa (Argentina) 1
Iak-52 (Romania) 439
Iak-52TW (Romania) 439
Iak-52W (Romania) 439
IAR-99 Șoim (Romania) 441
IISC (United States) 757
IISL (United States) 757
IITB Indoor (India) 253
Ikar (Ukraine) 586
Il-76 (Russian Federation) 460
Il-78M (Russian Federation) 461
Il-96-300 (Russian Federation) 461
Il-96-300 Freighter (Russian Federation) 461
Il-96-300V (Russian Federation) 461
Il-96-400T (Russian Federation) 461
Il-96PU (Russian Federation) 461
Il-98 (Russian Federation) 461
Il-103 (Russian Federation) 462
Il-103-01 (Russian Federation) 462
Il-103-10 (Russian Federation) 462
Il-103-11 (Russian Federation) 462
Il-103LL (Russian Federation) 462
Il-103P (Russian Federation) 462
Il-103SKh (Russian Federation) 462
Il-112 (Russian Federation) 463
Il-112T (Russian Federation) 463
Il-112VT (Russian Federation) 463
Il-114 (Russian Federation) 464
Il-114-100 (Russian Federation) 464
Il-114FK (Russian Federation) 464
Il-114LL (Russian Federation) 464
Il-114M (Russian Federation) 464
Il-114MA (Russian Federation) 464
Il-114MP (Russian Federation) 464
Il-114-N200S (Russian Federation) 464
Il-114P (Russian Federation) 464
Il-114PR (Russian Federation) 464
Il-114PRP (Russian Federation) 464
Il-114T (Russian Federation) 464
Il-140 (Russian Federation) 464
Impuls (Netherlands) 416
Impulse (Germany) 229
Initial A340-200 (International) 282
Integrity (Australia) 10
Interfly (Russian Federation) 501
Interplane Falcon 2000L (Czech Republic) 148
Interplane Skyboy 2000L (Czech Republic) 148
Ion Ion (United States) 787
IPA1/ZJ699 (International) 334
IPA2/MMX614 (International) 334
IPA3/9803 (International) 334
IPA4/C.16-20 (International) 334
IPA5/ZJ700 (International) 334
Ipanema (Brazil) 42
Ir.An-140 (Ukraine) 583
Ir.An-140 (Iran) 350
Ir.An-140-100 (Iran) 350
Ir. An-140MPA (Iran) 350
Ir.An-140T (Iran) 350
Ir.An-140TC (Iran) 350
Irkut-850 (Germany) 235
IRTA-21 (International) 343
IS001/ISPA2/CSX7235 (International) 334
Isatis 01 (France) 165
Iskierka (Poland) 431
Islander (United Kingdom) 596
Istra (Russian Federation) 468
IT001/CSX55092 (International) 334

J

J6 (Poland) 427
J-7 (China) 99
J-7B (China) 99
J-7C (China) 99
J-7D (China) 99
J-7E (China) 99
J-7EB (China) 99
J-7FS (China) 99
J-7G (China) 99
J-7GB (China) 99
J-8 (China) 122
J-8 II ACT (China) 122
J-8A (China) 122
J-8B (China) 122
J-8C (China) 122
J-8D (China) 122
J-8F (China) 122
J-8H (China) 122
J-8I (China) 122
J-10 (China) 102
J-10A (China) 102
J-10B (China) 102
J-11 (China) 124
J160 (Australia) 10
J160-C (Australia) 13
J160 Series (Australia) 13
J170SP (Australia) 13
J200 (Australia) 10, 11
J230 (Australia) 11
J250 (Australia) 11
J.300 Series 4 (France) 168
J400 (Australia) 10, 11
J430 (Australia) 11
J450 (Australia) 11
J450A (Australia) 11
JA-177 (Colombia) 132
Jabiru (India) 254
Jabiru Calypso (Australia) 10
Jabiru Jabiru (Australia) 10
Jabiru LSA (Australia) 10
Jabiru SK (Australia) 10
Jabiru SP4 (Australia) 10
Jabiru SP6 (Australia) 10
Jabiru SP-480 (Australia) 10
Jabiru SP-T (Australia) 10
Jabiru ST (Australia) 10
Jaguar B(I) (India) 247
Jaguar International (India) 247
Jaguar Maritime (India) 247
Jaguar S(I) (India) 247
JAH-64A (United States) 683
Japan MSA (France) 182
JAS 39 (Sweden) 554
JAS 39A (Sweden) 554
JAS 39B (Sweden) 554
JAS 39C (Sweden) 554
JAS 39D (Sweden) 554
JAS 39 EBS HU (Sweden) 554
Jat Hawk 4T (United States) 765
Javelin Mk 5 Scout (United States) 635
Javelin Mk 10 (United States) 635
Javelin Mk 20 (United States) 635
Javelin Mk 30 AJT (United States) 635
Javelin Mk 40 HDI (United States) 635
Javelin Mk 50 UCAV (United States) 635
JB1 Seadragon (United States) 785
JCH-47D (United States) 678
JDM-8 (Canada) 87
JET 3 (United States) 713
JetExec (United States) 871
Jet Fox 97 (Italy) 371
Jet Fox Amphib (Italy) 371
Jet Fox GT (Italy) 371
JetRanger III (Canada) 46
JF-17 Thunder (China) 101
JG-803 (France) 170
JH-7 (China) 128
JH-7A (China) 128
Jianjiji-7 (China) 99
Jianjiji-8 (China) 122
Jianjiji-10 (China) 102
Jiaolianji 8 (China) 113
JJ-7 (China) 99
JK-01a Elf (Poland) 426
JK-03 (Poland) 427
JK-05 (Poland) 427
JK-05L Junior/Beetle (Poland) 427
JL-8 (China) 113
Joker (France) 168
Jungmann (Poland) 437
Jungmeister (Poland) 438
Junior (Poland) 427
Just Plane Passions Vampire (Australia) 13
J-X (China) 125
JZ-8 (China) 122

K

K0-1 (Korea, South) 407
K-8 (China) 113
K-8E (China) 113
K-8 Karakoram (China) 113
K-8VSA (China) 113
K-200 (United States) 879
K-300 (United States) 879
K-500T (United States) 879
K-1200 (United States) 789
Ka-29 (Russian Federation) 468
Ka-29TB (Russian Federation) 468
Ka-31 (Russian Federation) 468
Ka-32 (Russian Federation) 469
Ka-32-10 (Russian Federation) 469
Ka-32A (Russian Federation) 469
Ka-32A1 (Russian Federation) 469
Ka-32A11BC (Russian Federation) 469
Ka-32A12 (Russian Federation) 469
Ka-32M (Russian Federation) 469
Ka-33 (Russian Federation) 468
Ka-35 (Russian Federation) 468
Ka-50 (Russian Federation) 470
Ka-50-2 (Russian Federation) 470
Ka-50N (Russian Federation) 470
Ka-52 (Russian Federation) 470, 472
Ka-60 (Russian Federation) 472
Ka-60U (Russian Federation) 472
Ka-62 (Russian Federation) 473
Ka-226-50 (Russian Federation) 473
Ka-226A (Russian Federation) 473
Ka-226AG (Russian Federation) 473
Ka-226T (Russian Federation) 473
Ka-226U (Russian Federation) 473
Kasatka (Russian Federation) 472
Katana Xtreme (Austria) 16
Kestrel (Canada) 77
Kestrel 60 (Canada) 77
Kestrel 150 (Canada) 77
Kestrel JP100 (International) 340
KHI-01 (International) 265
(Japan) 396
King Air 90 (United States) 648
King Air 200 (United States) 649
King Air 350 (United States) 651
King Air 350C (United States) 651
King Air 350ER (United States) 651
King Air 350 Special Mission (United States) 651
King Air B200 (United States) 649
King Air B200C (United States) 649
King Air B200CT (United States) 649
King Air B200T (United States) 649
King Kolbra (United States) 794
Kitfox 4B (United States) 792
Kitfox 6 Convertible (United States) 792
Kitfox 7 (United States) 792
Kitfox Kitfox (United States) 792
Kitfox Lite (United States) 792
Kitfox Sport (United States) 792
Kitfox Super Sport (United States) 792
Kitty Hawk (China) 126
K-Max (United States) 789
Koala (International) 262
Kolbra (United States) 794
Kompress (Italy) 375
Kompress Charlie (Italy) 375
Korvet (Russian Federation) 459
KP-2U (Czech Republic) 150
KP 5 (Czech Republic) 151
KP-5 ASA Rapid 500 (Czech Republic) 150
KP-5 Kappa (Czech Republic) 151
KT-1 Woong-Bee (Korea, South) 407
KT-1B (Korea, South) 407
KT-1C (Korea, South) 407
KUH (Korea, South) 410

L

L-1 Malamut (Czech Republic) 153
L-15 (China) 115
L159 (Czech Republic) 134
L160 (Canada) 76
L162 (Canada) 76
L164 (Canada) 76
L-451 (Russian Federation) 482
L-471 (Russian Federation) 483
L-551 (Russian Federation) 484
L-572 (Russian Federation) 484
LA-8 (Russian Federation) 445
LakeStar (United States) 877
Lakota (International) 333
LAK-X (Lithuania) 413
LAK-XA (Lithuania) 413
LAK-XE (Lithuania) 413
Lambáda (Czech Republic) 158
Lancair ES (United States) 796
Lancair IV (United States) 795
Lancair IV-P (United States) 795
Lancair Sentry (United States) 795
Lancair Super ES (United States) 796
Lancer (India) 250
Landseair (Australia) 4
Larus (Czech Republic) 152
Laser 2 (United States) 794
LC40-550FG (United States) 739
LC41-550FG (United States) 739
LCH (India) 246
LE (United States) 844
LE-500 (China) 126
Leader (United States) 829
Leader 2 (United States) 829
Learjet 40 (United States) 799
Learjet 45 (United States) 798
Learjet 60 (United States) 800
Legacy (United States) 797
Legacy 600 (Brazil) 33
Legacy FG (United States) 797
Legend (United States) 801
Legend Cub (United States) 632
Levitation 4 (Canada) 92
LFC-16 (China) 107
LH-10 (France) 192
Liftium 250 (France) 193
Liftium 500 (France) 193
Liftium 1000 (France) 193
Liftium 6000 (France) 193
Liftium Fret 20T (France) 193
Liftium Fret 35T (France) 193
Liftium Fret 300T (France) 193
Liftium Series (France) 193
Light (Russian Federation) 477
Lightning (Iran) 353
(United States) 633
Lightship A-60+ (United States) 607
Lightship/Spector Series (United States) 608
Lightwing GR-912 (Australia) 8
Lightwing Truck (Australia) 8
Lineage 1000 (Brazil) 36
Lion Cub (France) 191
Litesport Classic (United States) 759
Litesport Ultra (United States) 759
Lite Star (Canada) 78
Little Eagle (China) 126
Lockheed Martin 382U/V (United States) 808
LongRanger IV (Canada) 47
LP-1 (United States) 626
LP-1 Fury (United States) 824
LR-2 (United States) 651
LRIP 00 (Italy) 362
LS1 (United States) 844
LSA (Czech Republic) 142
(United States) 760
LSA-8 (United States) 825
LSA-IVT (United States) 613
LSA-IVT Sport Aero (United States) 613
LSA-IVT Sport Cruiser (United States) 613
LSA Mk II (Australia) 14
LW-2 (United States) 803
LW-3 (United States) 803
LW-5 (United States) 803
Lynx (International) 257

M

M3-S100 (Spain) 548
M3-S110 (Spain) 548
M-4 (United States) 826
M-4-180V (United States) 826
M-7 (United States) 826
M-9 (United States) 826
M-12 (Russian Federation) 450
M-16 (Italy) 379
M18 (Poland) 430
M18B (Poland) 430
M18BS (Poland) 430
M20M Bravo (United States) 837
M20R Ovation (United States) 839
M20S Eagle2 (United States) 839
M20TN Acclaim (United States) 840
M-22 (Brazil) 29
M-22 Voyager (Italy) 379
M26 (Poland) 431
M28 05 (Poland) 432
M28B (Poland) 431
M28B/PT (Poland) 431
M28M Bryza E (Poland) 431
M-90 Enforcer (United States) 834
M-101T (Russian Federation) 498
M212-100 (Belgium) 26
M212-200 (Belgium) 26
M212-300 (Belgium) 26
M212-400 (Belgium) 26
M216 (Belgium) 26
M-309 (United States) 610
M-311 (Italy) 359
M-346 (Italy) 362
M500 (Belgium) 27
M2601 (Poland) 431
MA40 (China) 130
MA60 (China) 130
MA60-100 (China) 130
MA60-500 (China) 130
MA60M (China) 130
MA60-MPA (China) 130
Magnum (United Kingdom) 588
(United States) 621
Magnus (Slovenia) 541
MAI-205 (Russian Federation) 499
MAI-217 (Russian Federation) 499
MAI-217B (Russian Federation) 499
MAI-223 Kityonok (Russian Federation) 499
MAI-223SKh (Russian Federation) 499
Major (France) 199
Maksimum (Russian Federation) 479
Malibu Meridian (United States) 859
Malibu Mirage (United States) 858
Man-Powered Aircraft (Japan) 403
Manthos (Italy) 374
Mariner (Italy) 375
Maritime patrol B200T (United States) 649
Maritime Surveillance (India) 251
Mark III Xtra (United States) 794
Martin 3 (Spain) 548
Massaï (France) 195
Maverick (Canada) 85, 87
Maximum (Russian Federation) 479
MB-339 (Italy) 360
MB-339A (Italy) 360
MB-339AM (Italy) 360
MB-339B (Italy) 360
MB-339CB (Italy) 360
MB-339CD (Italy) 360
MB-339CE (Italy) 360
MB-339FD (Italy) 360
MB-339PAN (Italy) 360
MB-339RM (Italy) 360
Mccullocoupe (United States) 791
MCR01 (France) 187
MCR01 Club (France) 187
MCR01 ULC (France) 187
MCR01 ULM (France) 187
MCR01 VLA (France) 187
MCR2S Ibis (France) 188
MCR4S (France) 188
MCR M (France) 187
MD3 Rider (Italy) 372
MD 500 (United States) 831
MD 500/530 Defender (United States) 831
MD 500E (United States) 831
MD 500N (United States) 831, 832
MD 520N (United States) 832
MD 520N Defender (United States) 832
MD 530 (United States) 831
MD 530F Lifter (United States) 831
MD 600N (United States) 832, 833
MD Enhanced Explorer (United States) 834
ME-109 (Germany) 231
Me 262 (United States) 835
Me 262A-1c (United States) 835
Me 262A/B-1c (United States) 835
Me 262B-1c (United States) 835
Medium Combat Aircraft (MCA) (India) 244
Melos 3000 (Germany) 212
Merlin AEW (International) 265
Merlin GT (United States) 745
Merlin HC. Mk 3 (International) 265
Merlin HC. Mk 3/Mk 411 (International) 265
Merlin HM. Mk 1 (International) 265
Merlin HM. Mk 1/Mk III (International) 265
Merlin HM. Mk 2 (International) 265
Mermaid (Czech Republic) 138
MFI 9UL1 (Czech Republic) 153
MH-47 Chinook (United States) 678
MH-68A (International) 259
MH-68A Stingray (International) 259
MH-90 Enforcer (United States) 834
Mi-8M (Russian Federation) 488
Mi-8MT (Russian Federation) 488
Mi-8MT EW (Russian Federation) 488
Mi-8MTPB (Russian Federation) 488
Mi-17 (Russian Federation) 475, 488
Mi-17-1V (Russian Federation) 475
Mi-17V-5 (Russian Federation) 475
Mi-17V-7 (Russian Federation) 475
Mi-19 (Russian Federation) 488
Mi-26 (Russian Federation) 491
Mi-26A (Russian Federation) 491
Mi-26M (Russian Federation) 491
Mi-26MS (Russian Federation) 491
Mi-26NEF-M (Russian Federation) 491
Mi-26P (Russian Federation) 491
Mi-26PK (Russian Federation) 491
Mi-26PP (Russian Federation) 491
Mi-26S (Russian Federation) 491
Mi-26T (Russian Federation) 491
Mi-26TM (Russian Federation) 491
Mi-26TP (Russian Federation) 491
Mi-26TS (Russian Federation) 491
Mi-26TZ (Russian Federation) 491
Mi-28 (Russian Federation) 493
Mi-28A (Russian Federation) 493
Mi-28N (Russian Federation) 493
Mi-28NE (Russian Federation) 493
Mi-34 (Russian Federation) 495
Mi-38 (Russian Federation) 495
Mi-54 (Russian Federation) 496
Mi-60 (Russian Federation) 497
Mi-171 (Russian Federation) 488
Mi-172 (Russian Federation) 475, 488
Midas (Russian Federation) 461
Mifyter (United States) 927
MiG-29 (Russian Federation) 484
MiG-35 (Russian Federation) 484
MiG-201 (Russian Federation) 487
MiG-201M (Russian Federation) 487
MiG-201MT1 (Russian Federation) 487
MiG-201MT2 (Russian Federation) 487
MiG-AT (Russian Federation) 486
Military (United States) 715
Military 412 (Canada) 49
Mini Explorer (Canada) 88
Mirage (Germany) 232
Mirage 2000 (France) 173
Mirage ARF (Germany) 232
Mirage RS (Germany) 232
Mirage S (Germany) 232
Mission M106 (Belgium) 25
Mission M212 (Belgium) 26
Mk3 (Germany) 231
MK3-A (Germany) 231
MK3-J (Germany) 231
MK5 (Germany) 231
Mk 25 (Australia) 14
Mk 26 (Australia) 14
MK30 (Germany) 231
Mk 410 (International) 265
Mk 413 (International) 265
Mk 511 (International) 265
Mode; 12-540 (United States) 790
Model 12 (United States) 790
Model 15 (United States) 791
Model 269 (United States) 875
Model 300 (Russian Federation) 502
Model 400 (Russian Federation) 502
Model 750 Turbo (Russian Federation) 502
Modular Affordable Product Line (Canada) 54
Monoculp (United States) 748
Mooney speedster (Spain) 548
Moose (Canada) 86
Mosquito (Canada) 84
Mosquito Air (Canada) 84
Mosquito XE (Canada) 84
Motor Glider (France) 187
MPA 320 (International) 275
MQ-8A (United States) 876
MRH90 (International) 344
MRTT (International) 293
MS-21 (Russian Federation) 536
MSN001 (F-WWOW) (International) 289
MSN002 (F-WXXL) (International) 289
MSN003 (F-WWSA) (International) 289

MSN004 (F-WWDD) (International) 289
MSN005 (F-WWSB) (International) 289
MSN006 (F-WWSC) (International) 289
MSN007 (F-WWSD) (International) 289
MSN008 (F-WWSE) (International) 289
MSN009 (F-WWEA) (International) 289
MT-03 (Germany) 210
MU582 (United States) 823
Multirole Tanker-Transport (International) 293
Mushshak (Pakistan) 421
Mustang (United States) 911
MVEN-1 (Russian Federation) 497
MVEN-2 (Russian Federation) 497
MX2 (United States) 840
MXP-740 (Italy) 375
(Slovakia) 539
MXP-1000 Tayrona (Colombia) 132
Mystere (Canada) 79
Mystery (Canada) 79
Mystère Mark I (Canada) 79
Mystère Mark II (Canada) 79
Mystère Mark III (Canada) 79
MZ-3A (United States) 608

N

N-5 (China) 116
N500EA (United States) 750
N502EA (United States) 750
N503EA (United States) 750
N504EA (United States) 750
N505EA (United States) 750
N506EA (United States) 750
NA 40 (Czech Republic) 154
NA 42 Barracude (Czech Republic) 154
NA 44 Bion (Czech Republic) 154
NA 50 (Czech Republic) 154
NATF (United States) 804
National Defender (United Kingdom) 598
NBell-412 (Canada) 49
NBK-117 (International) 330
NEXST-1 (International) 314
Next Generation Regional Jet (Japan) 400
NGP (United States) 720
NH90 (International) 344
Nimrod MRA. Mk 4 (United Kingdom) 592
Nongye Feiji 5 (China) 116
Nordic 8 (Canada) 88
North Star (Canada) 78
North Star 4 (Canada) 78
North Star 6 (Canada) 78
NP1 (India) 243
NP2 (India) 243
NSMV (United States) 788
NSR (International) 275
NT (Germany) 239
NT 07-100 (Germany) 239
NT 14 (Germany) 239
NXT (United States) 843

O

Observer (United States) 923
OFW (United States) 848
OH-1 (Japan) 395
OH-1Kai (Japan) 395
Okhotnik (Russian Federation) 443
OMA SUD Skycar (Italy) 380
OMF-100-160 (Canada) 91
Orbital Ascender (United States) 788
Orka (Poland) 429
OSA (Russian Federation) 451
Osprey (United States) 660
Ovatio2 GX 60th Anniversary Edition (United States) 839
Ovation2 DX Freedom (United States) 839
Ovation2 GX (United States) 839
Ovation3 (United States) 839

P

P01 (Italy) 362
P.1XX (Italy) 382
P02 (Italy) 362
P-8A (United States) 675
P-51G (United States) 715
P.68 (Italy) 388
P.68C (Italy) 388
P.68C Jet (Italy) 388
P.68C TC (Italy) 388
P.68 Observer2 (Italy) 388
P.68 Observer Jet (Italy) 388
P.68 Observer TC (Italy) 388
P92 (Italy) 385
P92 Echo 2000 RG (Italy) 385
P92 Echo Short-Wing (Italy) 385
P92-ES Echo Super (Italy) 385
P92-ES Echo Super LSA (Italy) 385
P92-J (Italy) 385
P92-JS (Italy) 385
P92-S (Italy) 385
P92 Seasky (Italy) 385
P96 Golf (Italy) 386
P96 Golf 80 (Italy) 386
P96 Golf 100 (Italy) 386
P-99 (Brazil) 34
P.180 Avanti (Italy) 380
P2002-JF (Italy) 386
P2002-JR (Italy) 386
P2002 LSA (Italy) 386
P2002 Sierra (Italy) 386
P2004 Bravo (Italy) 387
P2004 Bravo LSA (Italy) 387
P2006T (Italy) 387
PA1/ZJ516 (United Kingdom) 592
PA2/ZJ518 (United Kingdom) 592
PA3/ZJ517 (United Kingdom) 592
PA-18-180 Top Cub (United States) 746
PA-28-161 (United States) 852
PA-28-181 (United States) 853
PA-28R-201 (United States) 854
PA-32-301FT 6X (United States) 855
PA-32-301XTC 6XT (United States) 856
PA-32R-301 (United States) 854
PA-32R-301T (United States) 856
PA-34-220T (United States) 857
PA-44-180 (United States) 857
PA-46-350P (United States) 858
PA-46-500TP (United States) 859
PAC 750XL (New Zealand) 419
PADD Airships (India) 253
PADD Demo (India) 253
PADD Micro (India) 253
PADD Mini (India) 253
PADD Paxcargo (India) 253
Pairadigm (United States) 921
Pampa (Argentina) 1
Pampa 2000 International (Argentina) 1
Pampa NG A (Argentina) 1
Pampa NG B (Argentina) 1
Panther (International) 325
Panzl S-330 (United States) 927
Panzl S-330 P (United States) 927
Papango (France) 168
Parrot (Czech Republic) 139
Pashosh (Lark) (France) 204
Pathmaker (Poland) 427
Patriot II (United States) 635
Patrullero (Spain) 551
PC-6 (Switzerland) 562
PC-7 Mk II M Turbo Trainer (Switzerland) 563
PC-9 (Switzerland) 564
PC-9/A (Switzerland) 564
PC-9B (Switzerland) 564
PC-9M (Switzerland) 564
PC-9 Mk II (Switzerland) 564
PC-12 (Switzerland) 567
PC-12M (Switzerland) 567, 568
PC-12Spectre (Switzerland) 568
PC-21 (Switzerland) 566
Pelican (Canada) 93
(Russian Federation) 459
Pelican PL (Canada) 93
Pelican Sport (Canada) 93
Pelican TuToR (Canada) 93
Phenom 100 (Brazil) 39
Phenom 300 (Brazil) 40
Pillàn 2000 (Chile) 96
Pioneer 200 (Italy) 367
Pioneer 300 (Italy) 368
Piperjet (United States) 860
Piper PA-18 Super Cub (Canada) 90
Pitts 14 (United States) 905
Pitts S-2C (United States) 639
Plateau Eagle (China) 107
Pocket Rocket (Australia) 9
Polaris (India) 249
Police Helicopter (United States) 869
PR-582 (Australia) 9
PR-Bipe (Australia) 9
PR-Breeze (Australia) 9
Premier I (United States) 653
Premier IA (United States) 653
President (France) 201
Pretty Flight (Romania) 442
Primary Trainer (Turkey) 572
Prop-Jet (United States) 760
Propjet IV-P (United States) 795
PSC-1 Freighter (United States) 849
PSC-2 Sightseer/Transport (United States) 849
PSC-3 (United States) 849
PSC-4 Dynalifter I (United States) 849
PT-6A (China) 113
Páturi (Brazil) 30
Pulsar XP (United States) 861
Pulsar XP-LSA (United States) 861
PV1 (India) 243
PV2 (India) 243
PV3 (India) 243
PV4 (India) 243
PV5 (India) 243
P-X (Japan) 394
Python (United States) 790
PZL-104M (Poland) 425
PZL-104MA (Poland) 425
PZL-104MF (Poland) 425
PZL-104MN (Poland) 425
PZL-104MW (Poland) 425

Q

Q-5J (China) 113
Q300 (Canada) 70
Quad Tiltrotor (United States) 660
Qualt (Czech Republic) 148
Qualt 200J (Czech Republic) 148
Qualt 200R (Czech Republic) 148
Qualt 200RS (Czech Republic) 148
Qualt 201J (Czech Republic) 148
Qualt 201R (Czech Republic) 148
Qualt 201R582 (Czech Republic) 148
Qualt 201RS (Czech Republic) 148
Qualt 201RS Super (Czech Republic) 148
Quasar Lite (Brazil) 27
Quiet Supersonic Business Jet (United States) 872

R

R22 Beta II (United States) 869
R44 (United States) 869
R60 (Canada) 76
R-80 (United States) 757
R80 (Canada) 76
R-99A (Brazil) 34
R-99B (Brazil) 34
R120 (Canada) 76
R 2160 (New Zealand) 418
Radial Rocket (United States) 844
Radiant (India) 243
RAF 2000 (Canada) 89
Rafale (France) 177
Rafale B (France) 177
Rafale C (France) 177
Rafale D (France) 177
Rafale M (France) 177
Rafale Mk 2 (France) 177
Rafale N (France) 177
Rafale R (France) 177
Rally (Italy) 384
Rampage (Italy) 376
Ranger (Germany) 224
RangeR (Netherlands) 415
Rapid (Czech Republic) 150
Rapid 200 (Czech Republic) 150
Raptor A S (United States) 791
Rassvet (Iran) 349
Raven I (United States) 869
Raven II (United States) 869
Ravin 500 (South Africa) 546
RB-1 (Australia) 2
RC-350 Guardian (United States) 651
Rebel (Canada) 85
Rebel Elite (Canada) 85
Red Kestrel (South Africa) 544
Refly Pelican (Russian Federation) 459
Regent (France) 200
Regional Airliner (India) 251
Regional Jet (Japan) 400
Remo 180 (France) 200
Remo 200 (France) 201
Renai (United States) 825
Renegade II (Canada) 85
Renegade Spirit (Canada) 85
Revelation (United States) 900
Revolution (Switzerland) 570
RG-8A (United States) 874
RH-70 (United States) 658
Ridge Runner (United States) 871
Ridge Runner I (United States) 871
Ridge Runner 2 (United States) 871
Ridge Runner 3 (United States) 871
R. Mk 1 (United States) 868
RoboCopter (United States) 875

Rooivalk (South Africa) 544
Rotax Falke (Germany) 233
Roto-Pup (United States) 803
Roto-Pup Ultralight (United States) 803
RQ-8A Fire Scout (United States) 876
RRJ (Russian Federation) 522
RS-80 (United States) 757
RT-700 (United States) 636
RU-38A/B Twin Condor (United States) 874
RV-4 (United States) 915
RV-7 (United States) 915
RV-7A (United States) 915
RV-8 (United States) 916
RV-8A (United States) 916
RV-9 (United States) 917
RV-9A (United States) 917
RV-10 (United States) 917
RV-11 (United States) 918
RV-12 (United States) 918

S

S-1RR Procjon (Poland) 434
S2R (United States) 909
S2RHG Thrush 510 (United States) 909
S-6 (United States) 865
S6 (Germany) 236
S-6ES (United States) 865
S-6L (Germany) 236
S-6R (Germany) 236
S6-RT (Germany) 236
S-6S Super (United States) 865
S-6T (Germany) 236
S-7 (United States) 865
S-7LS (United States) 865
S-7S (United States) 865
S8 (Germany) 236
S-8 (Germany) 236
S8-R (Germany) 236
S8-RT (Germany) 236
S8-Safari (Germany) 236
S8-T (Germany) 236
S10 (Germany) 235
S10-V (Germany) 235
S10-VC (Germany) 235
S10-VT (Germany) 235
S-12S Super Airaile (United States) 866
S-12XL Airaile (United States) 866
S15 (Germany) 235
S15-8 (Germany) 236
S-33 Independence (United States) 903
S45 (Canada) 79
S-70A (United States) 881
S-70B (United States) 887
S-76 (United States) 891
S-92 Superhawk (United States) 893
S-300 (United States) 927
S-300RG (United States) 927
S-600 (United States) 927
S-600F (United States) 927
SA2 (Italy) 376
SA 2-37 (United States) 874
SA 2-37A (United States) 874
SA 2-37B (United States) 874
SA 2-38 (United States) 874
SA 2-38A (United States) 874
SA 2-38B (United States) 874
SA-20P (Russian Federation) 451
SA-20P Osa (Russian Federation) 453
SA-26 Twin Vista (Ukraine) 575
SA-40 (United States) 903
SA155 (Germany) 234
SA 160 (Canada) 91
Saba (Iran) 354
Sabannah Hydro (Italy) 375
Saeghe (Iran) 353
SAMA CH2000 (United States) 627
Samba (Czech Republic) 159
Samba XXL (Czech Republic) 159
Sapphire Scenic (Australia) 14
Saras (India) 244
Saras-S (India) 244
Saratoga II HP (United States) 854
Saratoga II TC (United States) 856
Savage (Czech Republic) 164
Savage Cruiser (Czech Republic) 164
Savage Cub (Czech Republic) 164
Savage LSA (Czech Republic) 164
Savannah (Italy) 375
Savannah Advanced (Italy) 375
SB7L-360 (Jordan) 405
SB9 Stormer (Jordan) 405
SB100 (France) 202
SB427 (Canada) 51
SBJ (United States) 614, 772
Scaled Composites 311 Capricorn (United States) 872
Scepter (United States) 900
Schweizer 300C (United States) 875
Schweizer 330 (United States) 876
Schweizer 333 (United States) 876
Scout (United States) 630
SD912XL (United States) 823
SE (United States) 844
Seahawk II (Germany) 239
Sea Jet (United States) 830
Seamax (Brazil) 29
Seastar (United States) 877
SeaStar 400 (United States) 877
SeaStar 500 (United States) 877
SeaStar T-724 (United States) 877
SeaStar TSP-350 (United States) 877
SeaStar TSP-350P (United States) 877
SeaStorm (United States) 621
Sea Storm (Italy) 383, 384
Seawind 300C (United States) 878
Seeker (Jordan) 405
SE-FG (United States) 919
Seminole (United States) 857
Seneca V (United States) 857
Sentinel (United States) 868
Sentinel AGS (Canada) 64
Sentinel R. Mk 1 (Canada) 64
SE-RG (United States) 919
Sergei (Russian Federation) 473
Series 100 (Malaysia) 414
Series 150 (Malaysia) 414
SF 25C (Germany) 233
SF 41 (Germany) 234
SF 41 Zwwegfalke (Germany) 233
SF-260 (Italy) 358
SF-260E (Italy) 358
SF-260EA (Italy) 358
SF-260E Warrior (Italy) 358
SF-260F (Italy) 358
SF-260TP (Italy) 358
SH-2G (United States) 789
SH-60 (Japan) 398
SH-60J (Japan) 398
SH-60K (Japan) 398
Shafagh (Iran) 349
Shahbaz (Pakistan) 421
Shahed 274 (Iran) 353
Shahed 278 (Iran) 351
Shamsher (India) 247
Shanying (China) 107
Sharik (Ukraine) 574
Shavit (United States) 770
Shearwater (New Zealand) 420
Shen2B (China) 127
Shen3A (China) 127
Shen4T (China) 127
Shen Series (China) 127
Sherpa (United States) 879
Sigma (United States) 901
Sigma-4 (Russian Federation) 458
Sigma 230 (United States) 901
Sigma 250 (United States) 901
Sigma 310 (United States) 901
Sinus (Slovenia) 541
Sinus 447 (Slovenia) 541
Sinus 503 (Slovenia) 541
Sinus 582 (Slovenia) 541
Sinus 912 (Slovenia) 541
Sitara (India) 246
SJ-1 (United States) 830
SJ-2 (United States) 830
SJ30-2 (United States) 896
Sky Arrow (Italy) 376
Skyboy (Czech Republic) 149
Skyboy EX (Czech Republic) 149
Skyboy LSA-F (Czech Republic) 149
Skyboy S (Czech Republic) 149
Skyboy SK-F (Czech Republic) 149
Skyboy UL (Czech Republic) 149
SkyCat 20 (United Kingdom) 605
SkyCat 220 (United Kingdom) 605
SkyCat 1000 (United Kingdom) 605
SkyCat Skycat (United Kingdom) 605
Sky Cruiser (Ukraine) 573
Skylander (France) 202
Skylane (Czech Republic) 136
(United States) 718
Skylark (Czech Republic) 142
SKY-MAXX (Germany) 221
Sky Raider (United States) 899
Sky Ranger (France) 171
Skyship 500HL (United States) 897
Skyship 600 (United States) 898
Skyship 1000 (United States) 899
Sky Skooter (United States) 786
Skytruck (Poland) 432
Skywalk (Czech Republic) 156
SLA100 Executive (United Kingdom) 603
Slam Eagle (United States) 665
Sling Shot (United States) 794
SM-92T Turbo Finist (Russian Federation) 506
SM-2000 (Russian Federation) 506
Smaragd Experimental (Germany) 217
Smartjet (United States) 830
SMG-92 (Switzerland) 557
Snipe (Ukraine) 587, 588
Sonet (Czech Republic) 136
Sonex (United States) 902
Sonex ST (United States) 902
Sonáta (Czech Republic) 137
Sopwith Pup (United States) 749
SP-55M (Russian Federation) 507
SP-91/95 (Russian Federation) 466
Sparrowhawk (United States) 607
Sparrowhawk APV (United States) 607
Sparrowhawk I (United States) 607
Sparrowhawk II (United States) 607
Spartan (Italy) 364
Spectre (Switzerland) 567, 568
Speed 2000-S (Australia) 8
Speed 3000 (Australia) 8
Speed 4000 (Australia) 8
Speedcruiser (United States) 784
Speedglass (Colombia) 133
Speed GT (Australia) 8
Spirit (International) 341
Spitfire (Australia) 14
Spitfire Elite (United States) 824
Sport (United States) 716, 905
Sport 150 (United States) 861
Sport Cruiser (Czech Republic) 140
Sport Cub (United States) 746
Sport Falcon (United States) 637
Sport-Jet (United States) 754
Sportlite 103 (United States) 760
Sportsman 2+2 (United States) 763
SportStar (Czech Republic) 144
SportStar II (Czech Republic) 144
Sportster (United States) 925
Sport Trainer (United States) 923
Sporty (Italy) 372
Spyder (United States) 758
Squall (France) 177
SR20 (United States) 736
SR20-G2 (United States) 736
SR20-GTS (United States) 736
SR21 tdi (United States) 738
SR22 (United States) 738
SR22-G2 (United States) 738
SR22-GTS (United States) 738
SR22-SE (United States) 738
Srs 100/Naval (International) 265
Srs 300 (International) 265
Srs 400 (International) 265
Srs 500 (International) 265
SRV (United States) 736
SRV-G2 (United States) 736
SS001/C.16-20 (International) 334
SS-2A (Japan) 401
SST 2000 (United States) 921
ST001/CE.16-01 (International) 334
Star (Czech Republic) 157
(India) 246
Stationair (United States) 719
STD-SE (Canada) 89
Stela (Spain) 547
Sting Carbon (Czech Republic) 157
Sting RG (Czech Republic) 157
STOL (United States) 930
Stolglass SG70 (Colombia) 133
Storch (Italy) 373
Storch 'Criquet' (Serbia) 536
Storch Moose (Serbia) 536
Storch 'Muster' (Serbia) 536
Storch SS-FP (Serbia) 536
Storch SS Mk 4 (Serbia) 536
Storch 'Ultra' (Serbia) 536
Stork (Russian Federation) 480
Storm (Italy) 383
Storm 500 (Italy) 383
Storm Rally (Italy) 384
(United States) 621
Storm RG (Italy) 383
Strekoza (Russian Federation) 481
Stretched version (Iran) 350
Su-27 (Russian Federation) 509
Su-27IB (Russian Federation) 515
Su-27KUB (Russian Federation) 515
Su-27PD (Russian Federation) 509

Su-27PU (Russian Federation) 512
Su-27R (Russian Federation) 515
Su-27RV (Russian Federation) 509
Su-27SK (China) 124
(Russian Federation) 509
Su-27SM (Russian Federation) 509
Su-27SM2 (Russian Federation) 517
Su-27SMK (Russian Federation) 509
Su-27UB (Russian Federation) 509
Su-27UBM (Russian Federation) 509
Su-27UBM1 (Russian Federation) 509
Su-29 (Russian Federation) 519
Su-29AR (Russian Federation) 519
Su-29KS (Russian Federation) 519
Su-29M (Russian Federation) 519
Su-30 (Russian Federation) 512
Su-30I (Russian Federation) 512
Su-30K-2 (Russian Federation) 512
Su-30KI (Russian Federation) 509, 512
Su-30KN (Russian Federation) 512
Su-30KNM (Russian Federation) 512
Su-30M (Russian Federation) 512, 513
Su-30MK (Russian Federation) 513
Su-30MKA (Russian Federation) 513
Su-30MKI (Russian Federation) 513
Su-30MKK (Russian Federation) 513
Su-30MKK2 (Russian Federation) 513
Su-30MKK3 (Russian Federation) 513
Su-30MKM (Russian Federation) 513
Su-31 (Russian Federation) 520
Su-31ChM (Russian Federation) 520
Su-31M (Russian Federation) 520
Su-31M2 (Russian Federation) 520
Su-31T (Russian Federation) 520
Su-31U (Russian Federation) 520
Su-31X (Russian Federation) 520
Su-32 (Russian Federation) 515
Su-32 'Escort Jammer' (Russian Federation) 515
Su-32FN (Russian Federation) 515
Su-32FN/MF (Russian Federation) 515
Su-33UB (Russian Federation) 515
Su-34 (Russian Federation) 515
Su-35 (Russian Federation) 517
Su-35UB (Russian Federation) 517
Su-37 (Russian Federation) 517
Su-38L (Russian Federation) 520
Su-49 (Russian Federation) 519
Su-80 (Russian Federation) 521
Su-80GP (Russian Federation) 521
Su-80M (Russian Federation) 521
Su-80P (Russian Federation) 521
Su-80PT (Russian Federation) 521
Su-80TD (Russian Federation) 521
Su-27IB Interceptor (Russian Federation) 515
Su-27IBP (Russian Federation) 515
S-UAV (Germany) 235
Summit (United States) 788
Supapup Mk 4 (Australia) 16
'Super-10' (China) 102
Super AMX (International) 299
Super Bingo (Italy) 375
Super Coyote II (United States) 865
Super Cruiser (Ukraine) 573
(United States) 862
Super Cyclone (Canada) 90
Super Decathlon (United States) 631
Super Dimona (Austria) 16
Super Drifter (United States) 823
Super Hornet (United States) 667, 783
Super Kiowa (Canada) 51
Super Lynx Series 100 (International) 257
Super Lynx Series 200 (International) 257
Super Lynx Series 300 (International) 257
Super Mushshak (Pakistan) 421
Super Pétrel (Brazil) 30
Super Pulsar 100 (United States) 861
Super Pulsar-LSA (United States) 861
Super Puma Mk I (International) 318
Super Puma Mk II (International) 320
Super Rebel (Canada) 85, 86
Superschlepper (Germany) 233
SuperScooper (Canada) 74
Super Seasprite (United States) 789
Super Sky Car (United States) 714
Super Sky Cycle (United States) 714
Super Speed (Italy) 373
Super Sport (United States) 923
Super Stallion (United States) 613, 880
Super Star (Austria) 22
Super STOL (United States) 929
Super Storch Mk 4 (Serbia and Montenegro) 536
Super Tucano (Brazil) 31
SV-2 (Australia) 13
SW-4 (Poland) 436
SW-5 (Poland) 434
Swan (India) 253
Swisscopter (Switzerland) 569
Sycamore (South Africa) 542
Sycamore Mk 1 (South Africa) 542
Sycamore Mk 2000 (South Africa) 542

T

T-6 (United States) 643
T-6A (United States) 643
T-6B (United States) 643
T-7 (Japan) 391
T10V-1 '42' (Russian Federation) 515
T10V-2 '43' (Russian Federation) 515
T10V-3 (Russian Federation) 515
T10V-4 '44' (Russian Federation) 515
T10V-5 '45' (Russian Federation) 515
T10V-6 '46' (Russian Federation) 515
T10V-7 '47' (Russian Federation) 515
T10V-8 '48' (Russian Federation) 515
T.16 (France) 181
T.19A (International) 295
T.19B (International) 295
T.21 (Spain) 551
T-35A (Chile) 96
T-35B (Chile) 96
T-35C (Chile) 96
T-35D (Chile) 96
T-35DT Turbo Pillán (Chile) 96
T-35 Pillán (Chile) 96
T-35S (Chile) 96
T-45 (International) 311
T-45A (International) 311
T-45C (International) 311
T-50 (Korea, South) 409
(Russian Federation) 517, 518
T-51 (United States) 911
T-101 (Russian Federation) 444
T-131 (Poland) 437
T182T (United States) 719
T-205 (Russian Federation) 480
T-207 (Russian Federation) 480
T-260 (Italy) 358
T350 (New Zealand) 418
T-411 (Russian Federation) 480
T-411A (Russian Federation) 480
T-411F (Russian Federation) 480
T-411L (Russian Federation) 480
T-411LY (Russian Federation) 480
T-411P (Russian Federation) 480
T-411 Turbo (Russian Federation) 480
T-419 (Russian Federation) 481
T-421 (Russian Federation) 480
T-501 (Russian Federation) 482
Tactical transport (International) 343
TAG AG Series (Malaysia) 415
Tampico (France) 203
Tandem Trainer (Italy) 379
Tango II (United States) 908
Tazarve (Iran) 354
TB 9 (France) 203
TB 10 (France) 203
TB 20 (France) 204
TB 21 (France) 204
TB 200 (France) 203
T-Bird II (Italy) 360
TBM 700 (France) 204
TBM 700B Freighter (France) 204
TBM 700C (France) 204
TBM 850 (France) 204
TD (United States) 861
TD1 (India) 243
TD2 (India) 243
TE (United States) 844
Teameurostar (Czech Republic) 143
teamEurostar 2001 (Czech Republic) 143
teamEurostar 2002 (Czech Republic) 143
teamEurostar 2005 (Czech Republic) 143
Tejas (India) 243
Tejas Navy (India) 243
Tejas Trainer (India) 243
Terrier 200 (Australia) 5
Terrier 200C (Australia) 5
Tetras (France) 191
Tetras B (France) 191
Tetras BS (France) 191
Texan (Italy) 373
Texan II (United States) 643
TG-11A (Germany) 235
TG-14 (Brazil) 28
TH-28 (United States) 752
TH-300C (United States) 875
The light before dawn (Iran) 349
Thorpedo (United States) 786
Three-seat (France) 188
Thrush 660 (United States) 909, 910
Thunder Dragon (China) 101
Tiger (United States) 910
Tiger Moth (United States) 757
TJ80 (France) 169
TL-96 (Czech Republic) 157
TL-232 (Czech Republic) 158
TL-2000 (Czech Republic) 157
T-Moose (Canada) 86
Tobago GT (France) 203
Top Cub (United States) 746
Toxo (Spain) 548
Toxo Cruiser (Spain) 548
Toxo II (Spain) 548
Toxo IV (Spain) 548
Toxo Speedster (Spain) 548
Toxo Trainer (Spain) 548
Tp 101 (United States) 649
TR-1 (United States) 861
TR80 (France) 169
TR100 (France) 169
Transatmospheric Ascender (United States) 788
Transition (United States) 908
Trener Baby (Czech Republic) 154
Trinidad (France) 204
Triton (Canada) 69
Tropic (Bulgaria) 43
Tsofit (Thrush) (United States) 649
TST-13 Junior 2005 (Czech Republic) 156
TT62 Alekto (Germany) 227
Tu-160 (Russian Federation) 523
Tu-160M (Russian Federation) 523
Tu-160P (Russian Federation) 523
Tu-160PP (Russian Federation) 523
Tu-160R (Russian Federation) 523
Tu-160sK (Russian Federation) 523
Tu-204 (Russian Federation) 525
Tu-214 (Russian Federation) 525
Tu-324 (Russian Federation) 528
Tu-330 (Russian Federation) 528
Tu-330K (Russian Federation) 528
Tu-334 (Russian Federation) 529
Tu-334-100 (Russian Federation) 529
Tu-334-100C (Russian Federation) 529
Tu-334-100D (Russian Federation) 529
Tu-334-100DS (Russian Federation) 529
Tu-334-100M (Russian Federation) 529
Tu-334-120 (Russian Federation) 529
Tu-334-120D (Russian Federation) 529
Tu-334-200 (Russian Federation) 529
Tu-334-200C (Russian Federation) 529
Tu-334-220 (Russian Federation) 529
Tu-334-220D (Russian Federation) 529
Tu-334C (Russian Federation) 529
Tu-334K (Russian Federation) 529
Tu-336 (Russian Federation) 529
Tu-338 (Russian Federation) 528
Tu-354 (Russian Federation) 529
Tu-414 (Russian Federation) 528
Tu-444 (Russian Federation) 531
Tundra (Canada) 82
Tundra Boss (Canada) 90
Turbine Defender (United Kingdom) 598
Turbine Islander (United Kingdom) 598
Turbine Legend (United States) 801
Turbine Stallion (United States) 613
Turbo (United States) 624
Turbo Air Tractor (United States) 623
Turbo Finist (Switzerland) 557
Turbo Porter (Switzerland) 562
Turbo Skylane (United States) 719
Turbo Stationair (United States) 719
Turbo-Thrush (United States) 909, 910
Twin Otter 400 (Canada) 94
Twin Panda (China) 111
TwinRanger (Canada) 47
Twin Star (Austria) 19
Twin Viking (Ukraine) 574
Twin Vista SS (Ukraine) 575
Twister (Germany) 234
Twister Kit (Germany) 234
TXL-RG-5 (United States) 919
Typhoon (International) 334

U

U-28A (Switzerland) 567
U-125 (United States) 774
U-125A (United States) 774
UAV (United States) 919
UC-35B (United States) 730
UC-35D (United States) 730
UFM-10 (Czech Republic) 159
UFM-13 (Czech Republic) 158
UH-1Y (United States) 654

UH-60 (Japan) 399
UH-60J (Japan) 399
UH-60JA (Japan) 399
UH-72A (International) 333
UL (Italy) 372
UL1 (United States) 914
UL2 (United States) 914
UL-2000 (Czech Republic) 135
UL-2000 A Flamingo Aerobatic (Czech Republic) 135
UL-2000 B Business Flamingo (Czech Republic) 135
UL-2000 D Flamingo De Luxe (Czech Republic) 135
UL-2000 S Flamingo Sport (Czech Republic) 135
UL-2000 T Flamingo Trainer (Czech Republic) 135
Ul Cubby (Czech Republic) 155
Ul Dandy (Czech Republic) 155
Ul Piper (Czech Republic) 155
Ultra (France) 195
Ultralight (Czech Republic) 142
(United Kingdom) 602
Ultra S (France) 195
Ultrasport 254 (United States) 634
Ultrasport 331 (United States) 634
Ultrasport 333H (United States) 634
Ultrasport 496 (United States) 634
Ul Tulák (Czech Republic) 155
UMF (United States) 922
UMR-1 (United States) 912
US-1A (Japan) 401
US-2 (Japan) 401
US101 (International) 265
Utility Transport (India) 251
Utva-96 (Serbia and Montenegro) 537
UV-20A Chiricahua (Switzerland) 562
UV-609 (International) 309

V

V-22 (United States) 660
V-80 (Russian Federation) 470
V-80Sh-1 (Russian Federation) 470
VA 300 (Italy) 390
Vajra (France) 173
Valor (Ukraine) 574
VAM-1 (Vietnam) 932
Vantageship (China) 127, 128
Varlet (Ukraine) 573
Vayager (Russian Federation) 502
Vector (Bulgaria) 43
Vectored Thrust Ducted Propeller (VTDP) (United States) 851
Vega 3000 (France) 169
VF 600w Mission (Italy) 390
Vigilant (France) 196
Vigilant Comint/Imint (France) 196
Vigilant Frontier (France) 196
Vigilant Imint (France) 196
Vigilant Polmar II (France) 196
Vigilant Polmar III (France) 196
Vigilant Surmar (France) 196
Vigilant Surpolmar (France) 196
Vigorous Dragon (China) 102
Viking (Ukraine) 574
Vimana (Italy) 376
Viper (Switzerland) 558
ViperFan (United States) 920
ViperJet (United States) 920
ViperJet Mk II (United States) 920
Virus (Slovenia) 542
Virus 582 (Slovenia) 542
Virus 912 (Slovenia) 542
Vision (Ukraine) 574
Vista Cruiser (Ukraine) 573
VL-3 (Czech Republic) 151
VM-1 (Belgium) 25
VNS-41 (Vietnam) 932
Votec 322 (Switzerland) 561
Votec 351 (Switzerland) 561
VR 202 (Italy) 370
VR 202 F 80 (Italy) 370
VR 202 F 100 (Italy) 370
VR 202 FS 80 (Italy) 370
VR 202 FS 100 (Italy) 370
Vulcan (Ukraine) 575
VUT 100 (Czech Republic) 144
VUT 100-120i Cobra (Czech Republic) 144
VUT 100-120TDi (Czech Republic) 144
VUT 100-131i Super Cobra (Czech Republic) 144

W

W-3A (Poland) 434
W-3A2 (Poland) 434
W-3AM (Poland) 434
W-3AS (Poland) 434
W-3H (Poland) 434
W-3PPD Gipswka (Poland) 434
W-3RM Anakonda (Poland) 434
W-3 Sokół (Poland) 434
W-3W (Poland) 434
W-3WA (Poland) 434
W-3WB (Poland) 434
Wag-A-Bond (United States) 923
Wag-Aero 2+2 Sportsman (United States) 924
Wallaby (Italy) 374
Warrior III (United States) 852
Wasp (Russian Federation) 453
(United States) 781
Wega (United States) 861
Whale Calf (Russian Federation) 499
Whisper Whisper (South Africa) 546
White Colt (Russian Federation) 478
White Swan (Russian Federation) 523
Whitney Boomerang (Australia) 4
Whoshan Jiaolian (China) 131
Wild Thing (Germany) 238
Wilga 2000 (Poland) 425
WJ (China) 131
Wolf (United States) 782
WT-01 (Germany) 238
WT-02 (Germany) 238
WT-9 (Slovakia) 539
WZ-9 (China) 108
WZ-10 (China) 107

X

X2 (United States) 895
X-32 (Ukraine) 587
X-34 (Ukraine) 588
X-49A (United States) 851
X-Air (India) 254
X-Air F Gumnam (India) 254
X-Air Hanuman 602T (India) 255
X-Air H Hanuman 804TJ (India) 255
X-Air H Hanuman 912 (India) 255
XDM (South Africa) 544
Xenon (France) 165
Xenos (United States) 902
X-Hawk (Israel) 355
Ximango (Brazil) 28
Xinzhou-60 (China) 130
XL-2 (United States) 802
XL-2R (United States) 802
XL-2 Surveillance Platform (United States) 802
XL-5 (United States) 919
XL-FG (United States) 919
XL-RG (United States) 919
XS (United Kingdom) 600
Xtreme (Germany) 229
(United States) 760

Y

Y-5 (China) 125
Y-5B (China) 125
Y-5B-100 (China) 125
Y-5B(D) (China) 125
Y-5B(K) (China) 125
Y-5B(T) (China) 125
Y-8 (China) 118, 120
Y-8A (China) 118
Y-8B (China) 118
Y-8C (China) 118
Y-8CB (China) 118, 120
Y-8D (China) 118
Y-8(DZ) (China) 120
Y-8 (DZ) (China) 118
Y-8E (China) 118
Y-8F (China) 118
Y-8F100 (China) 118
Y-8F200 (China) 118
Y-8F300 (China) 118
Y-8F400 (China) 118
Y-8F600 (China) 118
Y-8F800 (China) 118
Y-8H (China) 118, 120
Y-8J (China) 118, 120
Y-8X (China) 122
Y-8X (China) 118
Y-9 (China) 120, 122
Y-12 (China) 111
Y-12AEW (China) 111
Y-12E Harbinger (China) 111
Y-12F (China) 111
Y-12G (China) 111
Yak-3M (Russian Federation) 534
Yak-9U-M (Russian Federation) 534
Yak-52M (Romania) 439
Yak-52TD (Romania) 439
Yak-54 (Romania) 439
(Russian Federation) 535
Yak-56 (Russian Federation) 535
Yak-57 (Russian Federation) 535
Yak-130 (Russian Federation) 532
Yak-130D (Russian Federation) 532
Yak-130UBS (Russian Federation) 532
Yak-133 (Russian Federation) 532
Yak-133IB (Russian Federation) 532
Yak-133PP (Russian Federation) 532
Yak-133R (Russian Federation) 532
Yak/AEM-130 (Russian Federation) 532
YMF Super (United States) 922
Young Champion (Poland) 438
Youngster (United States) 757
Youngster V (United States) 757
YPX (Japan) 397
YSX (Japan) 393
Yukon (Canada) 88
Yuma (Italy) 367
Yunshuji-8 (China) 118
Yunshuji-9 (China) 122
Yunshuji-12 (China) 111

Z

Z2 (United States) 621
Z4 (United States) 621
Z-8 (China) 104
Z-8A (China) 104
Z-8F (China) 104
Z-9 (China) 108
Z-9A (China) 108
Z-9A-100 (China) 108
Z-9B (China) 108
Z-9EC (China) 108
Z-9EW (China) 108
Z-9G (China) 108
Z-9W (China) 108
Z-10 (China) 107
Z-11 (China) 106
Z-11J (China) 106
Z-11MB1 (China) 106
Z-11W (China) 106
Z 143 (Czech Republic) 163
Z 143 L (Czech Republic) 163
Z 143 LSi (Czech Republic) 163
Z 143 MAF (Czech Republic) 163
Z 242 L (Czech Republic) 161
Z 242 LA (Czech Republic) 161
Zenith (United States) 627
Zephyr (Czech Republic) 137
Zephyr 2000 (Czech Republic) 137
Zhishengji (China) 106
Zhishengji-8 (China) 104
Zhishengji-9 (China) 108
Zhishengji-10 (China) 107
Zhishengji-15 (International) 333
Zodiac (United States) 928, 929
Zwergfalke (Germany) 234
Z-X (China) 111

AIRCRAFT—PREVIOUS TEN EDITIONS

Index begins with aircraft generally identified only by numbers. Most were previously listed as 'Model 707' and so on under M

Note that many aircraft deleted from *All the World's Aircraft* at the end of their production runs continue to be described and updated in *Jane's Aircraft Upgrades*.

* Indicates aircraft or companies which have subsequently returned to *All the World's Aircraft*, possibly under different ownership or a slightly changed name.

½ Tun (Joplin) ..... (2006–07) 774
03 Bateleur (Germany) ..... (2006–07) 216
1S-2 (Il) ..... (2001–02) 319
1-04 Baby Huey (Hillberg) ..... (2004–05) 674
1-25 As-2 (Il) ..... (2001–02) 319
1.42/44 MFI (MiG) ..... (2001–02) 398
2.5\ST Freighty (NIAT) ..... (1997–98) 428
4.3 Baron (Kappa) ..... (2005–06) 112
6-650 Genesis (Gevers) ..... (1999–2000) 648
11 (Unikomtranso) ..... (1997–98) 469
11E Spartan (Luscombe) ..... (2002–03) 652*
18A (Air & Space) ..... (1997–98) 556
20 (Aeroprakt) ..... (2006–07) 497
20XX (Boeing) ..... (2002–03) 565
25 Impuls (DAR) ..... (2006–07) 42
28 (Aeroprakt) ..... (2006–07) 562
44 (Angel) ..... (2006–07) 628
50 Metre (Blenntec) ..... (2006–07) 657
70, Model (Bombardier) ..... (1998–99) 35
082 Hercules (Lockheed Martin) ..... (1998–99) 665
Cargo Airship System (Pan Atlantic) ..... (2002–03) 750
100B Individual Lifting Vehicle (PAM) ..... (2006–07) 840
110 Special (Aviat) ..... (2000–01) 576
111 (Irkut (Aviastep)) ..... (2006–07) 455
111 (Russian Federation) ..... (2005–06) 399
114B Commander (Commander) ..... (2000–01) 660
115 (Aero Boero) ..... (1999–2000) 1
150 (Aero Boero) ..... (1997–98) 1
180 AG (Aero Boero) ..... (1999–2000) 1
180 RVR (Aero Boero) ..... (1999–2000) 1
180 PSA (Aero Boero) ..... (1997–98) 2
182 Hercules (Lockheed Martin) ..... (1998–99) 665
184 Tempest (Jaran) ..... (1999–2000) 658
185 Orion (Lockheed Martin) ..... (2000–2001) 695
200 (Robin) ..... (1999–2000) 132
200 HISAR (Raytheon) ..... (2000–01) 754
200 King Air, Military versions (Raytheon) ..... (2002–03) 693
202 (Contender) ..... (1998–99) 634
206LT TwinRanger (Bell) ..... (1998–99) 25
212 Twin Two-Twelve (Bell) ..... (1998–99) 27
228 Maritime Patrol Aircraft (HAL) ..... (1998–99) 162
228 Maritime Pollution Surveillance (HAL) ..... (1997–98) 160
228-212 (HAL) ..... (1997–98) 159
260 AG (Aero Boero) ..... (1997–98) 2
281 Proteus (Scaled) ..... (2004–05) 71
282 Hercules (Lockheed Martin) ..... (1998–99) 665
287 IHSRC (A10) ..... (2002–03) 261
303 (Contender) ..... (1998–99) 634
328 (Dornier) ..... (2000–01) 153
340B (Saab) ..... (1999–2000) 477
358 EL-1 (Gavilán) ..... (2004–05) 95
382 Hercules (Lockheed Martin) ..... (1998–99) 665
406 (Bell) ..... (2001–02) 568
419 Express (Avtek) ..... (1999–2000) 557
428JET (Dornier) ..... (2000–01) 155
442 (Bell) ..... (1998–99) 31
450, Hawker (Hawker) ..... (2004–05) 632
508T (Gavilán) ..... (2004–05) 95
528JET (Fairchild Dornier) ..... (1997–98) 137
560 Citation Ultra (Cessna) ..... (2001–02) 638
560XL Citation Excel (Cessna) ..... (1997–98) 617
606 (Contender) ..... (1998–99) 634
645 (Lockheed Martin) ..... (1998–99) 661
650 Citation VII (Cessna) ..... (2001–02) 640
685 Orion (Lockheed Martin) ..... (2000–01) 695
700 Turbo Thrush (Ayres) ..... (1997–98) 570
737 'Classic' (Boeing) ..... (2000–01) 614
737-300 (Boeing) ..... (1999–2000) 591
737-400 (Boeing) ..... (1999–2000) 593
737-500 (Boeing) ..... (1999–2000) 594
757-200 (Boeing) ..... (2006–07) 690
763 (Boeing) ..... (2001–02) 588
767 AWACS (Boeing) ..... (2001–02) 588
800 F Hawker (Raytheon) ..... (2002–03) 700
800 RA Hawker (Raytheon) ..... (2002–03) 700
800 SIG Hawker (Raytheon) ..... (2002–03) 700
800 SM, Hawker (Hawker) ..... (2004–05) 631
1125 Astra SPX (IAI) ..... (2002–03) 264
1126 Galaxy (IAI) ..... (2002–03) 264
2000 (Load Ranger) ..... (1999–2000) 670
2000 Panther (Ullmann) ..... (2006–07) 908
2000 (Saab) ..... (1999–2000) 480
2061 IHSRC (AIO) ..... (2004–05) 289
2091 IHSRC (AIO) ..... (2004–05) 289
9000T (Avtekair) ..... (2004–05) 523

A

A3XX (Airbus) ..... (2000–01) 205*
A-5M (NAMC) ..... (1997–98) 68*
A-16, SKB-1 (SGAU) ..... (2001–02) 425
A-27 (EMBRAER) ..... (2000–01) 17
A31X/AE-100 (AVIC/AIA/STPL) ..... (1997–98) 823
A-36 Halcón (ENAER) ..... (1997–98) 54
A-40 Albatross (Beriev) ..... (1999–2000) 356
A-45 (Beriev) ..... (1998–99) 347
A-50 Mainstay (Beriev) ..... (2001–02) 351
A-100 Lightship (ABC) ..... (2002–03) 762
A 129 International (AgustaWestland) ..... (2005–06) 210
A 129 Mangusta (AgustaWestland) ..... (2006–07) 242
A 149 (Agusta) ..... (2004–05) 301
A200 King Air, Military versions (Beech) ..... (2002–03) 698
A-209 (Aero-M) ..... (1999–2000) 343
A-211 (Alfa-M) ..... (1999–2000) 349
A-230 (Aero-M) ..... (1999–2000) 344
A 300-600 Multi Role Tanker Transport (Airbus) ..... (1998–99) 190
A300-608 ST Super Transporter (SATIC) ..... (2001–02) 253
A310 (Airbus) ..... (2004–05) 214
A316 (Airbus) ..... (1998–99) 177
A317 (Airbus) ..... (1998–99) 177
AASI (see Advanced Aerodynamics and Structures Inc) ..... (2004–05) 497
AAT (see Ameur Avion Technologie) ..... (2001–02) 108
ABS Aircraft AG (Switzerland) ..... (2004–05) 452
AC-130 (Lockheed Martin) ..... (1998–99) 665
AC-500 Aircar (NLA) ..... (2004–05) 90
ACJ (Airbus) ..... (2004–05) 203
AD-100 (NAI) ..... (2001–02) 71
AD-200 (BKLAIC) ..... (2002–03) 63
ADC (CPCA) ..... (1998–99) 329
ADI (see Aero Designs Inc) ..... (1997–98) 554
ADVANCED AERODYNAMICS AND STRUCTURES INC (US) ..... (2004–05) 497
Advanced Mobility Aircraft (Lockheed Martin) ..... (2006–07) 804
AE-100 (AVIC/AIA/STPL) ..... (1997–98) 201
AE 206 Mistral (Aviasud) ..... (1998–99) 98
AE 207 Mistral Twin (Avaisud) ..... (1998–99) 98
AE 209 Albatros (Aviasud) ..... (1998–99) 99
AE 316 (AVIC/AIA/STPL) ..... (1998–99) 202
AE 317 (AVIC/AIA/STPL) ..... (1998–99) 202
AE 318 (AVIC/AIA/STPL) ..... (1998–99) 202
AEROSTAR (US) ..... (2006–07) 614
AEROSTATICA (Russian Federation) ..... (2006–07) 433
AEROTEK (see Aeronautical Systems Technology) ..... (1998–99) 460
AERO-M (see Aktsionernoe obstictestvo Aero-M) ..... (2001–02) 342
AF-18A (Boeing) ..... (2001–02) 577
AFI (see Aviation Franchising International) ..... (1997–98) 556
AH-1RO Dracula (IAR) ..... (2000–01) 348
AH-1RO SuperCobra (IAR) ..... (1997–98) 343, 826
AH-1S SuperCobra (Bell) ..... (2000–01) 297
AH-6 (MD) ..... (2001–02) 703
AH-12 King Cobra (TAI) ..... (2005–06) 496
AH-X (KAI) ..... (2002–03) 311
AIEP (see Aeronautical Industrial Engineering and Project Management Company Ltd) ..... (1997–98) 315
AI(R) (see Aero International (Regional)) ..... (1999–2000) 177
AI(R) 58 (AI(R)) ..... (1997–98) 171
AI(R) 70 (AI(R)) ..... (1997–98) 171
AI(R) Jet (AI(R)) ..... (1997–98) 171
AK-21 (Delta-V) ..... (1999–2000) 308
ALA-40 (Thermoplane) ..... (1997–98) 782
ALCLH (IPTN) ..... (1997–98) 168
ALLIANCE AIRCRAFT CORPORATION (US) ..... (2004–05) 510
AMH (Fuji) ..... (1999–2000) 290
An-2 Colt (Antonov) ..... (2004–05) 466
An-2 Colt (PZL) ..... (2000–01) 331
An-3 (Antonov) ..... (2001–02) 498
AN4 (Campana) ..... (1998–99) 100
An-12 Cub (Antonov) ..... (2001–02) 498
An-24 Coke (Antonov) ..... (2001–02) 498
An-26 Curl (Antonov) ..... (2001–02) 498
An-28 (see PZL) (Antonov) ..... (2004–05) 466
An-32 (Antonov) ..... (2004–05) 466
An-32 Cline (Antonov) ..... (2001–02) 498
An-71 Madcap (Antonov) ..... (1997–98) 513
An-72P Coaler (Antonov) ..... (2001–02) 504
An-124 (Antonov) ..... (2006–07) 569
An-180 (Antonov) ..... (1997–98) 518
An-225 Mriya (Antonov) ..... (2004–05) 476
AP 68TP-600 Viator (TAAL) ..... (1998–99) 166
A.P 68TP-600 Viator (Vulcanair) ..... (2001–02) 290*
ARCHEDYNE AEROSPACE (US) ..... (2004–05) 516
ARDC (see Air Force Research and Development Center) ..... (2000–01) 320
AR 96B (Flug Werk) ..... (2004–05) 178
ARL-1 (CSIST) ..... (2001–02) 493
AS-2 (Il) ..... (1999–2000) 319
AS-2 (Albatros) ..... (2001–02) 346
AS-3 (Albatros) ..... (2001–02) 346
AS 202 Bravo (FFA Bravo) ..... (2004–05) 453
AS 202/32TP Turbine Bravo (FFA) ..... (1997–98) 495
AS 332 Super Puma Mk I (Eurocopter) ..... (1998–99) 213
As 350BA Ecureuil (IAR) ..... (2004–05) 351
AS 352 Cougar Mk I (Eurocopter) ..... (1998–99) 213
AS 355N Ecureuil 2 (IAR) ..... (2004–05) 351
AS 532 Cougar Mk I (Eurocopter) ..... (2001–02) 226
AS 565 Panter (navy) ..... (2001–02) 234
AST (see Aviaspetstrans) ..... (2000–01) 356
AT-04 (ATG) ..... (2001–02) 805
AT-92 (Pilatus) ..... (2002–03) 445
ATE-18A (Boeing) ..... (2001–02) 577
ATR (see Avions de Transport Regional) ..... (2000–01) 215
ATR 52C (ATR) ..... (1997–98) 199
ATT (Boeing) ..... (1998–99) 574
ATT/SSTOL 'Super Frog' (Boeing) ..... (2001–02) 590
ATX (CASA) ..... (2001–02) 475
AU-23A Peacemaker (Pilatus) ..... (2002–03) 443
Au-30 (Rosaerosystems) ..... (2006–07) 489
AV-1 (Kubicek) ..... (2001–02) 799
AV-1R (Avgur) ..... (1998–99) 767
AV-8B (McDonnell Douglas (Boeing)/BAe) ..... (1997–98) 229
AV-8B II Plus (McDonnell Douglas (Boeing)/BAe) ..... (1997–98) 234
AVA-404 (AII) ..... (2002–03) 259
AVA-505 Thunder (AII) ..... (2002–03) 259
AVIC (see No 605 Research Institue of Avic) ..... (1998–99) 767
AVo 68-R Samburo (Philipp) ..... (2002–03) 167
Accord (Avia) ..... (1998–99) 340
ACE (Rusalen & Rusalen) ..... (2002–03) 290
ACEAIR SA (Switzerland) ..... (2006–07) 544
Acro G115TA (Grob) ..... (2000–01) 162
Acrobat, Aviatika-900 (Aviatika) ..... (1997–98) 364
AD AEROSPACE LTD (UK) ..... (2002–03) 466
ADD (Israel) ..... (2005–06) 302
Advanced Aircraft Studies (BAE) ..... (2004–05) 514
Advanced Light Helicopter (HAL) ..... (2002–03) 177
Advanced Military Programmes (MiG) ..... (2000–01) 414
Advanced Supersonic Airliner (International) ..... (2001–02) 255
Advanced Theatre Transport (Lockheed Martin) ..... (2001–02) 686
Advanced Transport Studies (Lockheed Martin) ..... (2001–02) 686
ADVENTURE AIR (US) ..... (1997–98) 555
Adventurer (Adventure Air) ..... (1997–98) 555
AEA RESEARCH (Australia) ..... (1998–99) 795
AERALL (France) ..... (2005–06) 125
Aeriks A-200 (Aceair) ..... (2005–06) 483
AERO BOERO SA (Argentina) ..... (1999–2000) 1
AEROCOPTER (US) ..... (2005–06) 544
AEROCOURIER (US) ..... (2005–06) 544
Aerocourier (Aerocourier) ..... (2004–05) 538
Aerocraft (Lockheed Martin) ..... (2004–05) 660
AERO DESIGNS INC (US) ..... (1997–98) 554
AERODYN (France) ..... (1997–98) 97
AERO HOLDING AS (Czech Republic) ..... (2004–05) 96
AERO INTERNATIONAL (REGIONAL) SAS (International) ..... (1999–2000) 177
AERONAUTICA MACCHI (Italy) ..... (2006–07) 346
AERONAUTICAL INDUSTRIAL ENGINEERING AND PROJECT MANAGEMENT COMPANY LTD (Nigeria) ..... (1997–98) 315
AERONAUTICAL SYSTEMS TECHNOLOGY (South Africa) ..... (1998–99) 460
AERONAUTIQUE SERVICE SA (France) ..... (1999–2000) 104
Aeropony (KNR) ..... (2002–03) 617
Aeroprakt-20 SKh (Aeroprakt) ..... (2001–02) 496
Aeropract-21M (Aeroprakt) ..... (2001–02) 342
Aeropract-23M (Aeroprakt) ..... (2001–02) 342
Aeropract-25 (Aeroprakt) ..... (2001–02) 343
AERORIC NAUCHNO-PROIZVODSTVENNOYE PREDPRIYATIE (Russian Federation) ..... (2000–01) 355
Aeros 40A (Aeros) ..... (2004–05) 774
Aeros 40C (Aeros) ..... (2004–05) 775
Aeros-50 (Aeros) ..... (1998–99) 774
Aero-Spaceplane studies (NAL) ..... (2000–01) 306
AEROSPATIALE MATRA (France) ..... (2001–02) 130
AEROSPORT (Australia) ..... (2001–02) 2
AEROSTAR AIRCRAFT CORPORATION LLC (US) ..... (2006–07) 614
Aerostatica-01 (Aerostatica) ..... (1998–99) 766
Aerostatica-02 (Aerostatica) ..... (1999–2000) 785
Aerostatica-200 (Aerostatica) ..... (2004–05) 766
Aerostatica-300 (Aerostatica) ..... (2004–05) 766
AeroTiga MD3-160 (SME) ..... (2002–03) 313
AG-CAT CORPORATION (US) ..... (1997–98) 556
AGROLOT (Poland) ..... (2006–07) 413
AGUSTA (Italy) ..... (2000–01) 273*
Aiglon R1180 (Robin) ..... (2000–01) 143
Aimak II-87 (Ilyushin) ..... (1999–2000) 365
AIR & SPACE AMERICA INC (US) ..... (2002–03) 497
AIRBORNE INNOVATIONS LLC (US) ..... (2001–02) 544

Airborne Standoff Radar (Astor) (RAF) ..... (2000–01) 547*
AIRBUS INDUSTRIE ASIA (International) . (2001–02) 200
Aircar S-12 E (Spencer) ..... (2000–01) 791
AIRCRAFT DESIGNS (US) ..... (2001–02) 545
AIRCRAFT PHILIP GmbH (Germany) ..... (2004–05) 173
Aircrane CL 75 (CargoLifter) ..... (2004–05) 762
AirCruiser M9-200 (Millicer) ..... (2001–02) 8
AIR FORCE RESEARCH AND DEVELOPMENT CENTRE (Philippines) ..... (2000–01) 320
Airjet (ATR) ..... (2000–01) 218
AIR-LIGHT FLUGZEUGVERTRIEB (Germany) ..... (1997–98) 818
AIR LIGHT GmbH (Germany) ..... (2004–05) 152
Airone F.220 (General Avia) ..... (2000–01) 285
AIRSHIP TECHNOLOGIES (UK) ..... (2001–02) 805
Airstar 2500 (Romaero) ..... (1997–98) 345
AirTourer M10 (Millicer) ..... (2001–02) 8
Aist T-201 (Aeroprogress/ROKS-Aero) ..... (1997–98) 350
AKAFLIEG MÜNCHEN Ev (Germany) ..... (2004–05) 152
Akef (Boeing) ..... (2002–03) 528
AKROTECH AVIATION (US) ..... (2002–03) 502
AKROTECH EUROPE (France) ..... (1998–99) 96
AKTSIONERNOE OBSCHESTVO AERO-M (Russian Federation) ..... (2001–02) 342
Albatross A-40 (Beriev) ..... (1999–2000) 356
Albatros AE 209 (Aviasud) ..... (1998–99) 99
ALBERTA AEROPSACE COPORATION (Canada) ..... (2002–03) 27
Alca L 159 (Aero) ..... (1999–2000) 86
ALFA-M NAUCHNO-PROIZVODSTVENNOYE PREDPRIYATIE (Russian Federation) ... (2000–01) 356
Alflex (NASDA) ..... (1997–98) 298
Allegro M20J (Mooney) ..... (2000–01) 722
ALLIANCE AIRCRAFT CORPORATION (US) ..... (2004–05) 510
Alligator Ka-52 (Kamov) ..... (2001–02) 377
Allround SF-40C (Scheibe) ..... (2001–02) 164
Altajet (AMEUR) ..... (2006–07) 153
Altania (AMEUR) ..... (2006–07) 152
AMERICAN REGIONAL AIRCRAFT INDUSTRIES (US) ..... (2000–01) 571
AMERICAN SPORTSCOPTER INTERNATIONAL (Taiwan) ..... (1998–99) 486
AMERICAN HOMEBUILTS' INC (US) ..... (2006–07) 626
AMF ENTERPRISES (UK) ..... (2000–01) 525*
Amigo (ICP) ..... (2004–05) 314
Amphibian (Ross) ..... (1998–99) 522
AMX (International) ..... (2005–06) 254
Anaconda T-710 (Aeroprogress/ROKS-Aero) ..... (1997–98) 357
Anafa (Bell) ..... (1998–99) 27
ANGEL (US) ..... (2006–07) 628
APEC AEROSPACE (Singapore) ..... (1998–99) 460
AQUASTAR (US) ..... (2004–05) 552
ARCHEDYNE AEROSPACE (US) ..... (2004–05) 516
ARCTIC AIRCRAFT COMPANY (US) ..... (1997–98) 564
Arcturus CP-140A (Lockheed Martin) .... (1999–2000) 676
Ariel 212 (Zaitsev) ..... (1999–2000) 465
ARROWTIME AVIATION SDN BHD (Malaysia) ..... (1997–98) 304
ARV Super2 (Skycraft) ..... (2004–05) 732*
Asso Vs (Rusalen & Rusalen) ..... (2002–03) 290
ASSOCIATION ZEPHYR (France) ..... (2006–07) 153
Astra, PC-7 Mk II M Turbo-Trainer (Pilatus) ..... (2004–05) 454*
Astra SP, 1125 (IAI) ..... (1997–98) 254
Astra SPX, 1125 (IAI) ..... (2002–03) 264
Atalef (Eurocopter) ..... (2001–02) 234
Atlantic 3 (Dassault) ..... (2002–03) 122
Atlantique 2 (Dassault) ..... (1998–99) 112
Diamond Star DA-40-180 (Diamond) ..... (2002–03) 11*
AUC (US) ..... (2005–06) 563
Avanti developments (Piaggio) ..... (2004–05) 298
AVIA BALTIKA AVIATION (Lithuania) ..... (2000–01) 313*
AVIABELLANCA (US) ..... (2005–06) 565
AVIAKIT (France) ..... (2002–03) 111*
AVIAKOR MEZHDUNARODNAYA AVIATSIONNAYA KORPORATSIYA (Russian Federation) .. (2001–02) 348
AVIAMPEX (Ukraine) ..... (2006–07) 578
AVIASPETSTRANS (Russian Federation) ... (2000–01) 356
AVIASUD INDUSTRIES (France) ..... (1998–99) 98
AVIATEHNOLGIA (Moldova) ..... (2000–01) 315
Aviatika-900 Acrobat (Aviatika) ..... (1997–98) 364
Aviatika-MAI-890 (MAI) ..... (2002–03) 376
AVIATIKA KONSTERN (Russian Federation) ..... (2001–02) 348
AVIATION FARM LIMITED (Poland) ..... (2001–02) 317
AVIATION FRANCHISING INTERNATIONAL (US) ..... (1997–98) 556
AVIATSIONNYI KOMPLEKS IMENI S.V ILYUSHINA (Russian Federation) ..... (2000–01) 369
AVIC/AIA/STPL (International) ..... (1999–2000) 208
AVID (US) ..... (2005–06) 567
Aviocar, NC-121-200 (IPTN) ..... (1999–2000) 176
AVIONS FOURNIER (France) ..... (1999–2000) 126
AVIONS MUDRY et CIE (France) ..... (1997–98) 121, 817
AVIONS PHILIPPE MONIOT (France) . (1999–2000) 128
AVIONS PIERRE ROBIN (France) ..... (1998–99) 125
AVIOTECHNICA LTD (International) ..... (1998–99) 203
AVOCET (US) ..... (2005–06) 569
Avro RJ (BAE) ..... (2002–03) 473
Avro RJX (BAE) ..... (2002–03) 473
AVTEKAIR INC ..... (2004–05) 523
Aya EC-130 (Lockheed Martin) ..... (1998–99) 665
Ayres 7000 (Let) ..... (2002–03) 99
Astek (Letov) ..... (2002–03) 102
AUC(US) ..... (2006–07) 632

B

B-2 Spirit (Northrop Grumman) ..... (1999–2000) 705
B-2B (Brantly) ..... (2006–07) 707
B-6 (XAC) ..... (2002–03) 85
B-7 (XAC) ..... (1998–99) 73
B200 SE King Air (Raytheon) ..... (1998–99) 712
B200T Maritime Patrol (Raytheon) ..... (1998–99) 713
BC-17X Globemaster (Boeing) ..... (2004–05) 580
BCI (see Buoyant-Copter) ..... (1998–99) 775
BD-12 (Bede) ..... (2002–03) 518
Be-10 (Beriev) ..... (2006–07) 442
Be-32 Cuff (Beriev) ..... (2001–02) 352
Be-32K (IAR) ..... (1997–98) 343
Be-42 Mermaid (Beriev) ..... (2002–03) 349
Be-132 (Beriev) ..... (2004–05) 383
B-150 (Vozdukh) ..... (2004–05) 769
BKLAIC (China) ..... (2001–02) 799
Be-210 (Beriev) ..... (2004–05) 361
Be-310 (Beriev) ..... (2006–07) 442
Be-976 Il-76 SKIP (Beriev) ..... (2001–02) 356
BERKUT ENGINEERING (US) ..... (2004–05) 545
Bird of Prey (Boeing) ..... (2004–05) 580
BJH 2 (Pilatus) ..... (2002–03) 443
BKLAIC (see Beijing Keyuan Light Industrial Aircraft Company Ltd) ..... (2004–05) 72
BN2A Mk III Trislander (BNG) ..... (2006–07) 590
BN2T-4R Defender (Pilatus Britten-Norman) ..... (1997–98) 541
BO 105 (Eurocopter) ..... (2004–05) 249
BO 105 CBS-5 (KAI) ..... (2001–02) 306
BRJ-X (Bombardier) ..... (2000–01) 41
BA (UK) ..... (2005–06) 515
Backfire, Tu-22M (Tupolev) ..... (2001–02) 453
Badger, M-203PW (Myasishchev) ..... (2001–02) 422
BAE SYSTEMS ADVANCED AIRCRAFT STUDIES (UK) ..... (2004–05) 514
BAE SYSTEMS AIRBUS (UK) ..... (2001–02) 521
BAE SYSTEMS AUSTRALIA (Australia) ..... (2002–03) 2
BAE SYSTEMS REGIONAL AIRCRAFT (UK) ..... (2001–02) 518
Bahadur, MiG-27 (HAL) ..... (1997–98) 161
Balbuzard L235 (AAT) ..... (1998–99) 95
Baljims 1A (AAT) ..... (2001–02) 108
Bandit (Avid) ..... (2000–01) 577
BARR AIRCRAFT (US) ..... (2006–07) 636
Barracuda NA-42 (NA-Design) ..... (2002–03) 528
Barrsix (BARR) ..... (2006–07) 636
Barsuk, M-203PW (Myasishchev) ..... (2001–02) 422
Bat (TAI) ..... (1998–99) 487
Baz (Boeing) ..... (2002–03) 528
Bear, TU-95 (Tupolev) ..... (2001–02) 454
Bear, TU-142 (Tupolev) ..... (2001–02) 454
Bee M-16 (BUAA) ..... (2002–03) 64
Bee T-203 (Aeroprogress/ROKS-Aero) ..... (1997–98) 350
Beech 1900D (Raytheon) ..... (2004–05) 572
BEIJING KEYUAN LIGHT AIRCRAFT INDUSTRIAL COMPANY LTD (China) ..... (2004–05) 73
BEIJING KEYUAN LIGHT AIRCRAFT INDUSTRIAL COMPANY (China) ..... (2001–02) 799
Bellaire (Liberty) ..... (2001–02) 675
Bel-Aire 2000 ..... (2002–03) 519
BEL-AIRE AVIATION (US) ..... (2002–03) 519
Beluga (SATIC) ..... (2001–02) 253
Berkut (Berkut) ..... (2002–03) 525
BERKUT ENGINEERING (US) ..... (2004–05) 545
Bestmann (KNR) ..... (2002–03) 617
BILLIE AERO MARINE (France) ..... (2000–01) 113
Bird of Prey (Boeing) ..... (2004–05) 580
BLENNTEC (US) ..... (2006–07) 656
Blue Eagle AD-200 (BKLAIC) ..... (2002–03) 63
Blue Sky 91 (KAL) ..... (1997–98) 302
Boeing Business Jet 3 (Boeing) ..... (2002–03) 572*
BOEING MILITARY AIRCRAFT AND MISSILE SYSTEMS (US) ..... (2002–03) 526
BOEING PHANTOM WORKS (Boeing) ..... (2002–03) 569
BOEING SIKORSKY (US) ..... (2005–06) 633
BOEING SPACE AND COMMUNICATIONS GROUP (US) ..... (2002–03) 570
Bohem 3 (Bohemia Air) ..... (1998–1999) 83
BOHEMIA AIR (Czech Republic) ..... (1999–2000) 88
Bonanza F33A (Raytheon) ..... (19[illegible]–98) 722
Bora (KARI) ..... (2006–07) 400
Brasilia EMB-120 (EMBRAER) ..... (2001–02) 19
Bravo 3000 (FFA Bravo) ..... (2002–03) 442
Bravo AS202 (FFA Bravo) ..... (2004–05) 453
Breeze, Aeropract-25 (Aeroprakt) ..... (2001–02) 343
Breitling Orbiter 2 (Cameron) ..... (1998–99) 771
Breitling Orbiter 3 (Cameron) ..... (2002–03) 760
Brigantine, T-274 (Khrunichev) ..... (1997–98) 393
BRITISH AEROSPACE ASSET MANAGEMENT (UK) ..... (1998–99) 514
BRITTEN-NORMAN (UK) ..... (2000–01) 537
BUL (France) ..... (2006–07) 155
Bumble Bee, Dubna-1 (Dubna) ..... (2001–02) 358
BUOYANT-COPTER (US) ..... (1998–99) 771
Buoyant-Copter 18 (BCI) ..... (1997–98) 790
Bush Hawk FBA-2E (Found) ..... (1998–99) 48*
Bush Hawk-300, FBA-2C (Found) ..... (2000–01) 58*
Business Jet (Piper) ..... (2000–01) 741
BUSSARD (Germany) ..... (2006–07) 195
Buzz (Avid) ..... (2004–05) 560

C

C-12 (Raytheon) ..... (2002–03) 693
C.15 (Boeing) ..... (2001–02) 577
C-26A/B (Fairchild Aerospace) ..... (1999–2000) 644
C-27A Spartan (Alenia) ..... (2000–01) 279
C-29A (Raytheon) ..... (2002–03) 700
C-130 (Lockheed Martin) ..... (1998–99) 665
C-130 (Lockheed Martin) ..... (1998–99) 665
C-130H (Lockheed Martin) ..... (1998–99) 665
C-130H-30 (Lockheed Martin) ..... (1998–99) 665
C-130H-MP (Lockheed Martin) ..... (1998–99) 665
C-212 Series 300 (CASA) ..... (2001–02) 475
C-5WA Airtruck (IAI) ..... (2005–06) 302
CA-6 Criquet (Carlson) ..... (2006–07) 710
CA-22 Eland (Skyfox) ..... (1997–98) 10
CA-25 Impala (Skyfox) ..... (1999–2000) 9
CA-25N Gazelle (Skyfox) ..... (1999–2000) 9
CA-100 Century Jet100 (Century) ..... (2001–02) 629
CAG (see Canadian Aerospace Group International ..... (2004–05) 58
CAP 10B (CAP) ..... (2001–02) 111
CAP 222 (CAP) ..... (2004–05) 129
CAP 231 EX (Mudry) ..... (1997–98) 122
CAP 231X (CAP) ..... (2004–05) 120
CATA (see Construction Aeronautique de Technologie Avancée ..... (2000–01) 115
CC/03 (C+C Flying) ..... (2006–07) 195
CC/04 (C+C Flying) ..... (2006–07) 195
CC-130 Hercules (Lockheed Martin) ..... (1998–99) 665
CC-130T (Lockheed Martin) ..... (1998–99) 665
CE-15 (Boeing) ..... (2001–02) 577
CF-188A/B (Boeing) ..... (2001–02) 577
CH-47C Chinook (Meridionali) ..... (1997–98) 279
CH-53E (Sikorsky) ..... (2002–03) 713*
CH-135 (Bell) ..... (1998–99) 27
CH 601HD Zodiac (Derazona) ..... (1997–98) 165
CH 601 HDS Super Zodiac (Zenith) ..... (1997–98) 771*
CH 601 (UL) Zodiac (Zenith) ..... (1997–98) 770*
CH 620 Gemini (Zenith) ..... (2001–02) 793
CH 2000 Zenith (Zenair) ..... (1999–2000) 56*
Che-15 (Chernov) ..... (2001–02) 356
Che-15 (SGAU) ..... (1999–2000) 421
Che-22 (Corvette) (SGAU) ..... (1999–2000) 422*
Che-25 (SGAU) ..... (1999–2000) 422*
Che-40 (SGAU) ..... (1999–2000) 423
CHK-91 Chang-Gong 91 (KAL) ..... (1997–98) 302
CJ-6A (NAMC) ..... (2001–02) 75
CKB-1, S302 (SGAU) ..... (2001–02) 426
C/KC-130 Karnaf (Lockheed Martin) ..... (1998–99) 665
CL-75 Aircrane (CargoLifter) ..... (2004–05) 762
CL-160 (CargoLifter) ..... (2004–05) 763
CMC (see Chichester-Miles Consultants) ... (2004–05) 488
CN-235M (TAI) ..... (2005–06) 496
CN-245 (Airtech) ..... (1998–99) 195
CP140 Aurora (Lockheed Martin) ..... (1999–2000) 676
CP140A Arcturus (Lockheed Martin) ..... (1999–2000) 676
CPCA (see Centrul de Proiectare SI Consulting Pentru Aviatie SA) ..... (1999–2000) 341
C-Prop, cryogenic transport (Tupolev) ..... (1998–99) 452
CR600 (Dyn' Aero) ..... (1998–99) 120
CRJ100 (Bombardier) ..... (2001–02) 41
CSH-2 Rooivalk (Denel) ..... (1998–99) 461
CSIST (see Chung Shan Institute of Science and Technology) ..... (2002–03) 451
CT-142 (de Havilland) ..... (2004–05) 58
CAMPANA AVIATION (France) ..... (1998–99) 100
CANADA AIR (Canada) ..... (2002–03) 51
CANADIAN AEROSPACE GROUP INTERNATIONAL (Canada) ..... (2004–05) 58
Candid, Il-76 (Ilyushin) ..... (2001–02) 361*
Canguro SF-600A (Vulcan/Air) ..... (2002–03) 297
Captain SKB-1 S-400 (SGAU) ..... (2001–02) 426
Carat TFK-2 (Technoflug) ..... (2004–05) 178*
Careless, Tu-154C (Tupolev) ..... (1999–2000) 452
Careless, Tu-154M (Tupolev) ..... (2004–05) 426
Cargo Airship System (Pan Atlantic) ..... (2002–03) 750
CARLSON (US) ..... (2006–07) 710
Carthorse GM-01 (Yalo/Aviata) ..... (2001–02) 336
C-CRAFT WOZLMSAYER (Austria) ..... (2000–01) 9
CENTRUL DE PROIECTARE SI CONSULTING PENTRU AVIATIE SA (Romania) ..... (1999–2000) 341
CENTURY AEROSPACE CORPORATION (US) ..... (2004–05) 588
Century Jet100, CA-100 (Century) ..... (2001–02) 629
CENZIN FOREIGN TRADE ENTERPRISE (Poland) ..... (2001–02) 317
CFM (UK) ..... (2005–06) 526
Champion (Avid) ..... (2004–05) 560
Chang-Gong 91, CHK-91 (KAL) ..... (1997–98) 302
Chanute (Cadcor) ..... (2006–07) 708
Cheetah (HAL) ..... (1997–98) 157
CHEREAU, ARNO, AERONAUTIQUE (France) ..... (2001–02) 112

Chetak (HAL) ... (1997–98) 158*
Chevvron 2-32 (AMF) ... (2000–01) 525
CHICHESTER-MILES CONSULTANTS LTD (UK) ... (2004–05) 488
CHINA NATIONAL AERO TECHNOLOGY IMPORT AND EXPORT CORPORATION (China) ... (1999–2000) 67
Ching-Kuo, F-CK-1 (AIDC) ... (2000–01) 504
Chinook CH-47C (Meridionali) ... (1997–98) 279
Chirok (L11/Pegas) ... (2001–02) 388
Chiricahua UV-20A (Pilatus) ... (2002–03) 443
CHRIS SAUR (Switzerland) ... (2002–03) 451
Chuji Jiaolianji-6A (NAMC) ... (2001–02) 75
CHUNG SHAN INSTITUTE OF SCIENCE AND TECHNOLOGY (Taiwan) ... (2002–03) 451
Cirstel Alouette (Denel) ... (1998–99) 463
Citation Ultra 560 (Cessna) ... (2001–02) 638*
Citation VII, 650 (Cessna) ... (2001–02) 640*
CityHawk (Urbanaero) ... (2006–07) 486
Cityliner (Saab) ... (1999–2000) 477
CityStar, Yak-42 (Yakolev) ... (2001–02) 468
CLARK-NORMAN AIRCRAFT LTD (UK) ... (1997–98) 535
CLASSIC AIRCRAFT CORPORATION (US) ... (1997–98) 621
CLASSIC FIGHTERS INDUSTRIES INCORPORATED (US) ... (2002–03) 590
Cline, An-32 (Antonov) ... (2004–05) 466
Clobber, Yak-42 (Yakolev) ... (2001–02) 468
Close Support Aircraft project (Sibnia) ... (1998–99) 416
Coke, An-24 (Antonov) ... (2001–02) 408
Colt An-2 (Antonov) ... (2004–05) 466
Colt An-2 (PZL) ... (2000–01) 331
Commander 114B (Commander) ... (2000–01) 660
Commander 147A (Air Command) ... (2001–02) 544
Commander 618 (Air Command) ... (2001–02) 545
Commercial Hercules (Lockheed) ... (1999–2000) 680
Common Support Aircraft (Lockheed Martin) ... (1999–2000) 681
Comp Monster (Aerocomp) ... (2001–02) 540
Concordino (SAAB) ... (1999–2000) 480
Coke, An-24 (Antonov) ... (2001–02) 498
Condor TL-132 (TL Ultralight) ... (2001–02) 103
CONSTRUCTION AERONAUTIQUE DE TECHNOLOGIE AVANCEE (France) ... (2000–01) 115
CONTENDER AIRCRAFT LTD (US) ... (1999–2000) 640
Coot (Ilyushin) ... (2001–02) 360
Coot-A, Il-20M (Ilyushin) ... (2001–02) 360
Coot-B (Ilyushin) ... (2001–02) 360
Coot-C (Ilyushin) ... (2001–02) 360
Cora (Fantasy Air) ... (2000–01) 96
Corriedale SD27 (Sivel) ... (1997–98) 281
Corvette Che-22 (SGAU) ... (1999–2000) 422
Corvette T-471 (Khrunichev) ... (1997–98) 398
Cossack An-225 Mriya (Antonov) ... (2004–05) 476
Cougar Mk 1 (TAI) ... (2005–06) 496
Cougar Mk I AS 352 (Eurocopter) ... (1998–99) 213
Cresco (PAC) ... (2006–07) 407
Criquet (Carlson) ... (2006–07) 710
CRO HOLDING (Czech Republic) ... (2000–01) 94
Crosspointer TW-18 (Skyline) ... (1997–98) 482
Cryoplane (DAA/Tupolev) ... (2000–01) 223
CSIST (Taiwan) ... (2006–07) 557
Cub, An-12 (Antonov) ... (2001–02) 498
Cuff, Be-32 (Beriev) ... (2001–02) 352
Curl, An-26 (Antonov) ... (2001–02) 498
Cygnet SF-2A (Viking) ... (2000–01) 798

D

D-4 (Flight Exploration) ... (1997–98) 783
DA 20-A1 Katana (Diamond) ... (2004–05) 60*
DA 20-C1 Speed Katana (Diamond) ... (1997–98) 809
DA 40-180 Diamond Star (Diamond) ... (2002–03) 11*
DAC (see Danubian Aircraft Company) ... (1997–98) 153
DASA (see DaimlerChrysler Aerospace) ... (2000–01) 152
DC-130 Hercules (Lockheed Martin) ... (1998–99) 665
DEP-140 (Augur) ... (1998–99) 768
DHC-8 Dash 8M (de Havilland) ... (2004–05) 58*
DHC-8 Dash 8 Series 100 (de Havilland) ... (1997–98) 45*
DHC-8 Triton 300 (de Havilland) ... (2004–05) 58
DHI (see Daewoo Heavy Industries ... (1999–2000) 302
DJ2 (DJ) ... (2001–02) 53
DK10 Dracula (CPCA) ... (1998–99) 329
DKBA (see Dolgoprudnenskoe Kovarnyi Byuro Avtomatiki) ... (1998–99) 769
DP-800 Ecologiya (DKBA) ... (1997–98) 781
DP-6000 Vityaz (DKBA) ... (1997–98) 782
DPD-5000 ... (1998–99) 768
DR 400 V6 (Robin) ... (1997–98) 128
DR400/180R Remo (Robin) ... (2000–01) 142*
DR 400/200R Remo 200 (Robin) ... (1997–98) 128*
DV 20 Katana (Diamond) ... (2004–05) 61*
DV 20 Katana Xtreme (Diamond) ... (1997–98) 11
DV 22 Speed Katana (Diamond) ... (1997–98) 11
D'LONG (Germany) ... (2006–07) 196
DAEWOO HEAVY INDUSTRIES (Korea South) ... (2001–02) 303
DAIMLERCHRYSLER AEROSPACE (Germany) ... (2000–01) 52
DAIMLERCHRYSLER AEROSPACE AIRBUS (Germany) ... (2000–01) 153
DAIMLERCHRYSLER AEROSPACE AIRBUS/TUPOLEV (International) ... (2001–02) 214
DALLACH, W.FLUGZEUG LEICHBAU (Germany) ... (1999–2000) 143
DANUBIAN AIRCRAFT COMPANY (Hungary) ... (1997–98) 153
Darling (Phoenix) ... (1998–99) 342
Darling M-12 (Aviacor) ... (2001–02) 348
Dash 8 8M, DHC-8 (de Havilland) ... (2004–05) 58
Dash 8 Series 100 DHC-8 (de Havilland) ... (1997–98) 45
DASA/DENEL/HYUNDAI (International) ... (1999–2000) 212
DASSAULT AEROSPATIALE (France) ... (1998–99) 120
Daya (Northrop Grumman) ... (2002–03) 666
DEA (Italy) ... (2005–06) 313
Deer, M-202 PW (Myasishchev) ... (2001–02) 422
Defender (MD) ... (2001–02) 703
Defender BN2T-4R (Pilatus Britten-Norman) ... (1997–98) 541
Defender (Romaero) ... (2004–05) 351
Delfin (Refly) ... (2001–02) 423
DELTA (Czech Republic) ... (2005–06) 107
Delta Dart II (Richter) ... (1998–99) 153
Delta (Pegass) ... (2004–05) 107
DELTA-V (Moldova) ... (2000–01) 315
DERAZONA AVIATION INDUSTRY (Indonesia) ... (1998–99) 167
DERRINGER AIRCRAFT COMPANY LLC (US) ... (2004–05) 606
Diamond Future Developments (Diamond) ... (2004–05) 15
Diamond DA 20-W (Diamond) ... (2005–06) 12
Diamond Star DA-40-180 (Diamond) ... (2002–03) 11*
Dingo (AeroRIC) ... (2000–01) 355
DJ AIRCRAFTS INTERNATIONAL (Canada) ... (2001–02) 53
DOLGOPRUDNENSKOE KOVARNYI BYURO AVTOMATIKI (Russian Federation) ... (1998–99) 769
Don (Unikomtranso) ... (2006–07) 509
Dornier 228 (Fairchild Dornier) ... (2004–05) 205*
Dornier 228 Maritime Patrol (HAL) ... (1998–99) 162
Dornier 228 Maritime Pollution Surveillance (HAL) ... (1997–98) 160
Dornier 228-212 (Dornier) ... (1997–98) 159
Dornier 328 (Dornier) ... (2000–01) 153*
Dornier 428JET (Dornier) ... (2000–01) 155
DORNIER SEASTAR MALAYSIA SDN BHD (Malaysia) ... (1997–98) 305
DOUGLAS AIRCRAFT COMPANY (US) ... (1997–98) 691
DPD-5000 (Rosaerosystems) ... (2006–07) 489
Dracula AH-1RO (IAR) ... (2000–01) 348
Dracula DK-10 (CPCA) ... (1998–99) 329
Dragon (Aeroprakt) ... (2001–02) 342
Dragon (Skyspan) ... (2006–07) 13
Dragonfly (Slipstream) ... (2005–06) 803
Dream, An-225 (Antonov) ... (2004–05) 476
DREAMWINGS (US) ... (2002–03) 593
DTS-N1 (Rosaerosystems) ... (2006–07) 489
Dubna-1, Shmel (Dubna) ... (2001–02) 358
Dubna-2, Osa (Dubna) ... (2001–02) 358*
Dubna-4 (Dubna) ... (2004–05) 387
Duet/Saras M-102 (Myasishchev/NAL) ... (1997–98) 238

E

E-1 (Sat Saviat) ... (2000–01) 436
E2E Speed twin (Speedtwin) ... (2001–02) 531
E-5 (Sat Saviat) ... (1999–2000) 420
E-8 Joint Stars (Northrop Grumman) ... (2006–07) 837
E-9A (de Havilland) ... (2004–05) 58
E-767 (Boeing) ... (2001–02) 588
EAeS (see European Aerosystems Limited ... (2004–05) 232
EAL (see Ethiopian Airlines Enterprise) ... (2004–05) 16
EAM (see Eagle Aircraft Malaysia) ... (1998–99) 297
E & K sp zoo (Poland) ... (2004–05) 334
EC-130 Hercules/Aya/Sapeer (Lockheed Martin) ... (1998–99) 665
EC 165 (Eurocopter) ... (2004–05) 251
EC 175 (Eurocopter) ... (2004–05) 323*
ECH-023 Namcu (ENAER) ... (1999–2000) 57
EE 10 Eaglet (Euro-ENAER) ... (2002–03) 314
EH 1-01 (Hillberg) ... (2006–07) 769
EH 1-02 (Hillberg) ... (2006–07) 769
EH-6 (MD) ... (2001–02) 703
EL-1 Gavilan 358 (Gavilan) ... (2004–05) 95
EMB-120 Brasilia (EMBRAER) ... (2001–02) 19
EMB-135 (EMBRAER) ... (1997–98) 811
EMB-312 Tucano (EMBRAER) ... (2000–01) 17
EMB-312H Super Tucano (EMBRAER) ... (1997–98) 16*
ERJ-170 (EMBRAER) ... (2001–02) 24*
ERJ-190 (EMBRAER) ... (2001–02) 24*
EV97 Eurostar (EV-AT) ... (2001–02) 94*
EADS ATR (see Avions de Transport Regional) ... (2001–02) 214
EADS CASA (Spain) ... (2001–02) 475
EADS DEUTSCHLAND AIRBUS (Germany) ... (2001–02) 148
EADS FRANCE (France) ... (2006–07) 173
EADS MILITARY AIRCRAFT (Germany) ... (2004–05) 155
EADS SOCATA (France) ... (2001–02) 130*
Eagle 150 (Eagle Aircraft) ... (2004–05) 3*
EAGLE AIRCRAFT PTY LTD (Australia) ... (2004–05) 3
Eagle F-15E (Boeing) ... (2002–03) 528
Eagle F-15J (Mitsubishi) ... (2000–01) 288
Eagle H-76 (Sikorsky) ... (1997–98) 755
Eagle M-99 Orkan (PZL-Mielec) ... (1997–98) 324
Eagle, PC-12 (Pilatus) ... (2001–02) 491*
Eagle T208 (Khrunichev) ... (1998–99) 375
EAGLE AIRCRAFT (Malaysia) ... (1998–99) 297
Eaglet EE 10 (Euro-ENAER) ... (2002–03) 314
Eastern Caravan, T-205 (Aeroprogress/ROKS-Aero) ... (1997–98) 351
Easy Raider (Reality) ... (2006–07) 595
Ecoblimp (Interface) ... (1999–2000) 795
ECOLE SUPERIEURE DES TECHNIQUES AERO TECHNIQUES ET CONSTRUCTION AUTOMOBILE (France) ... (1999–2000) 126
Ecologiya DP-800 (DKBA) ... (1997–98) 781
Ecureuil AS 350BA (IAR) ... (2004–05) 351
Ecureuil AS 355N (IAR) ... (2004–05) 351
Egrett II G-520 (Grob) ... (1997–98) 144
Eland CA-22 (Skyfox) ... (1997–98) 10
Electric Airplane (Boeing) ... (2004–05) 578
Elitar IE-101 (Elitar) ... (2004–05) 387
Ellipse (Explorer Aviation) ... (2001–02) 651
Embraer EMB-120 Brasilia (Neiva) ... (2005–06) 30
Encore M20K (Mooney) ... (2001–02) 709
ENDEAVOUR (Australia) ... (2005–06) 3
Erica (Agusta) ... (2001–02) 275
Eshet (EAL) ... (1997–98) 96
Esquilo (Helibras) ... (2000–01) 26
ETHIOPIAN AIRLINES ENTERPRISE (Ethiopia) ... (2004–05) 116
ETRURIA TECHNOLOGY (Italy) ... (2001–02) 278
EURAVIAL (France) ... (2001–02) 134
EUROCOPTER CANADA (Canada) ... (2004–05) 64
EUROCOPTER/CATIC/STAero (International) ... (2001–02) 238
EUROCOPTER/KAWASAKI (International) ... (2001–02) 239
EURO-ENAER HOLDING BV (Netherlands) ... (2004–05) 321
EUROFAR (International) ... (2001–02) 247
Eurofighter 2000 (Eurofighter) ... (1998–99) 229, 803
Eurofox (Evektor-Aerotechnik) ... (2000–01) 95
EUROMIL (International) ... (2005–06) 288
EUROPATROL (International) ... (2004–05) 260
EUROPEAN AEROSYSTEMS LIMITED (International) ... (2004–05) 232
EUROPEAN MILITARYAIRCRAFT COMPANY (International) ... (2004–05) 238
European Future Advanced Rotorcraft (International) ... (2000–01) 247
EUROSPACE COSTRUZIONI AERONAUTICHE (Italy) ... (1999–2000) 278
Eurostar EV97 (EV-AT) ... (2001–02) 94*
Eurostar VLA (EV-AT) ... (2001–02) 94*
Excalibur F-15-F (Eurospace) ... (1998–99) 268
EXCLUSIVE AVIATION (US) ... (2000–01) 666
Expediter 23 (Fairchild Dornier) ... (1999–2000) 644
EXPERIMENTAL AVIATION INC (US) ... (1997–98) 626
Experimental Crew Return Vehicle, X-38 (NASA) ... (2001–02) 712
EXPLORER AIRCRAFT CORPORATION (Australia) ... (2001–02) 4
EXPLORER AVIATION (US) ... (2002–03) 597
Explorer (Merlin) ... (1997–98) 698
Explorer (Explorer Aircraft) ... (2006–07) 742
Explorer MD 902 (McDonnell Douglas) ... (1997–98) 685
EXPRESS (US) ... (2006–07) 743

F

F-2 (Aerostar) ... (1997–98) 342
F-11B Fergy (Precision Tech) ... (2006–07) 851
F-15 A/B Baz (Boeing) ... (2002–03) 528
F-15 C/D Eagle (Boeing) ... (2002–03) 528
F-15 C/D Akef (Boeing) ... (2002–03) 528
F-15-F 300M (Eurospace) ... (1998–99) 268
F-15-F Excalibur (Eurospace) ... (1998–99) 268
F-15J (Mitsubishi/Boeing) ... (2000–01) 304
F-16 A/B Netz (Lockheed Martin) ... (2002–03) 642
F.16C/D Fighting Falcon (KAI) ... (2006–07) 399
F.22 (General Avia) ... (2001–02) 280
F33A Bonanza (Raytheon) ... (1997–98) 722
F.220 Airone (General Avia) ... (2000–01) 285
F.1000 (Frati) ... (2006–07) 363
F.2500 (Frati) ... (2006–07) 364
FA. MK2 Sea Harrier (BAE) ... (1999–2000) 515
F/A-18 Hornet (Boeing) ... (2001–02) 577
F/A-18A, B, C, D Hornet (Boeing) ... (2001–02) 577
FBA-2C Bush Hawk-300 (Found) ... (2000–01) 58*
F-CK-1 Ching-Kuo (AIDC) ... (2000–01) 504
FK 11(B8F) ... (1999–2000) 142
FK-100 (Avic) ... (1998–99) 762
FNJ (Fuji) ... (1998–99) 280
FT-300 (NAI) ... (2001–02) 72
FTT Vector (DASA) ... (1999–2000) 144
FU24-954 (PAC) ... (2001–02) 311
F-X (KAI) ... (2002–03) 310
FAIRCHILD AEROSPACE CORPORATION (US) ... (2000–01) 668
FAIRCHILD DORNIER CORPORATION (US) ... (2001–02) 653
FAIRCHILD DORNIER (Germany) ... (2006–07) 199

FAIRCHILD DORNIER GERMANY DORNIER LUFTFAHRT (Germany) (1998–99) 138
Fairchild Dornier 528, 728 and 928 (D'Long) (2004–05) 170
Falcon FNX (Dassault) (2004–05) 133
Falcon (PAC) (1997–98) 315
Falcon, M-201 (Myasishchev) (2001–02) 421
Falcon SST (Dassault) (1999–2000) 124
Falcon T-401 (Aeroprogress/ROKS-Aero) (1997–98) 353
Farmer T-517 (Khrunichev) (2002–03) 374
Favorit (Aviatehnologia) (1999–2000) 308
Favorit SKB-I (SGAU) (2001–02) 425
FEDERALNOYE GOSUDARSTVENNOYE UNITARNOYE PREDPRIYATIE (Russian Federation) (2000–01) 400
Fencer, Su-24 (Sukhoi) (2001–02) 427
Feniks GM-17 (Intracom) (2002–03) 254*
Fennec (Helibras) (2000–01) 26
Fergy F-IIB (Precision Tech) (2006–07) 851
FFA Bravo AG (Switzerland) (2004–05) 453
FFA FLUGZEUGWERKE ALTENRHEIN (Switzerland) (2001–02) 483
Fighting Falcon F-16C/D (TAI) (2001–02) 494
Finist SM-92 (Smolensk) (2006–07) 491
Firebird (Intora) (2000–01) 546
Firefly (Kari) (2005–06) 349
Firefly T67M Mk 2 (Slingsby) (1999–2000) 532
First 1A (EADS France) (2006–07) 173
Flaming, PZL-105L (PZL Warszawa-Okecie) (1999–2000) 333
Flamingo, PZL-105L (PZL Warszawa) (1999–2000) 333
Flamingo, T-433 (Aeroprogress/ROKS-Aero) (1999–2000) 347
Flamingo T-433 (Khrunichev) (2001–02) 386
FLIGHT EXPLORATION ASSOCIATION(UK) (1998–99) 771
FLIGHT TEAM ULTRALEICHTFLUGZEUGE und FLUGSCHULE (Germany) (2004–05) 64
Flogger-J (HAL) (1997–98) 161
FLS AEROSPACE (UK) (2000–01) 546
FLUGTECHNIK DAMME (Germany) (2004–05) 165
FLYING K (US) (2004–05) 655
FLYING POWER SDN BHD (Malaysia) (2004–05) 321
Fokker 50 (Fokker) (1997–98) 308
Fokker 60 (Fokker) (1997–98) 310
Fokker 70 (Fokker) (1997–98) 312
Fokker 100 (Fokker) (1997–98) 310
FOKKER AVIATION (Netherlands) (2002–03) 315
FOURNIER, AVIONS (France) (1999–2000) 126
Foxbat MiG-25 (MiG) (1998–99) 380
Foxhound, MiG-31 (MiG) (2001–02) 396
FREEBIRD SPORT AIRCRAFT (US) (2000–01) 669
FREEDOM LITE (Canada) (2001–02) 55
Fregat T-130 (Aeroprogress/ROKS/Aero) (1998–99) 335
Fregat T-230 (Khrunichev) (1998–99) 375
Fregata J6 (J&AS) (2001–02) 320*
Freighty 2.5 (NIAT) (1997–98) 428
Fresh TL-532 (TL Ultralight) (2001–02) 104
Friendship FS 200 (Evolution) (2006–07) 196
Frigate T-130 (Aeroprogress/ROKS-Aero) (1997–98) 349
Frigate Bird (J&AS) (2001–02) 320
Frigate Bird T-230 (Khrunichev) (1998–99) 375
Frogfoot Su-25 (Sukhoi) (2004–05) 402
Frogfoot Su-28 (Sukhoi) (2004–05) 402
Fuel Less Aircraft (Hunt) (2005–06) 690
Fury, LP-1 (Lopresti) (2002–03) 651*
Future Aircraft Technology Enhancement (USAF) (2000–01) 794
Future Amphibious Support Helicopter (RN) (2000–01) 547
Future Cargo Aircraft (Reims) (2004–05) 141
Future Carrier-Borne Aircraft (RN) (2001–02) 529
Future Joint Combat Aircraft (RN) (2004–05) 492
Future Large Aircraft A-400 (Airbus) (2001–02) 200*
Future Light Aircraft (Diamond) (1999–2000) 12
Future Offensive Air System (RAF) (2004–05) 491
Future Organic Airborne Early Warning (RN) (2004–05) 492

G

G-4 Velocity (Remos) (2005–06) 185
G 109B (Grob) (1997–98) 141
G 115 (Grob) (2006–07) 203
G 115TA Acro (Grob) (2000–01) 162
G 164B Super-B Turbine (Ag-Cat) (1997–98) 556
G-200 Giles (Aerotech) (2001–02) 549
G-202 Giles (Aerotech) (2001–02) 549
G222 (Alenia) (2000–01) 279
G-300 Giles (Aerotech) (2001–02) 550
G 350 (Grob) (2004–05) 167
G 520 Egrett II (Grob) (1997–98) 144
G-750 Giles (Aerotech) (2001–02) 550
G 850 Strato 2C (Grob) (1997–98) 146
GADC (see Global Aero Design Centre) (1998–99) 460
GF 200 (Grob) (1999–2000) 153
GF 250 (Grob) (1999–2000) 153
GF 300 (Grob) (1999–2000) 153
GF 350 (Grob) (1999–2000) 153
GM-01 Gniady (Yalo/Aviata) (2001–02) 336
GM-11 (Intracom) (2001–02) 251
GM-12 (Intracom) (2001–02) 251
GM-16 (Intracom) (2001–02) 251
GM-19 (Intracom) (2001–02) 251
GM-28 (Intracom) (2002–03) 255
GP-60 (Myasishchev) (2000–01) 435
GR-582 Light Wing (Hughes) (2001–02) 6
GSI (US) (2004–05) 777
GT-1 Trainer (Goair) (2005–06) 5
Gadfly (Vitek) (2002–03) 424
Gajaraj, Il-76 (Ilyushin) (2001–02) 361
Galaxy 1126 (AIA) (2002–03) 264
GALAXY AEROSPACE CORPORATION (US) (2002–03) 601
GARRISON (US) (2004–05) 656
Gavilan 358, EL-1 (Gavilan) (2004–05) 95
Gavilan 508T (Gavilan) (2004–05) 95
Gazelle CA-25N (Skyfox) (1999–2000) 9
GEGASI INDUSTRIES SDN BHD (Malaysia) (1997–98) 306
Gemini CH-620 (Zenith) (2001–02) 793
Gemini M-20 (PZL) (2001–02) 323
Gemini Ultra (Remus) (1999–2000) 160
GENERAL AVIA COSTRUZIONI AERONAUTICHE (Italy) (2002–03) 284
Genesis 6-650 (Gevers) (1999–2000) 648
GEVERS AIRCRAFT (US) (2000–01) 670
GLASTAR (US) (2005–06) 670
GLOBAL AERO DESIGN CENTRE (Singapore) (1998–99) 460
Global Challenger (Cameron) (2000–01) 819
GLOBAL SKYSHIP INDUSTRIES INC(US) (2004–05) 777
Globemaster BC-17X (Boeing) (2004–05) 580
Gniady GM-01 (Yalo/Aviation) (2001–02) 336
GOAIR (Australia) (2005–06) 5
Goair Trainer (Goair Products) (1997–98) 6
Goblin (Aviotechnika) (1997–98) 202
Golden Eagle (Sukhoi) (2001–02) 444
Golden Eagle 600 (Csist) (2005–06) 495
GOMOLZIG INGENIEURBURO, HERBERT (Germany) (2000–01) 161
Grand 51 (Exclusive Aviation) (2000–01) 666
GREAT PLAINS AIRCRAFT SUPPLY CO (US) (2002–03) 604
Greyhound 21 (Northrop Grumman) (2000–01) 731
GRIFFON AEROSPACE INC (US) (2004–05) 619
Griffon 103 (Interplane) (2004–05) 110
Griffon T-204 (Aeroprogress/ROKS-Aero) (1997–98) 351
GROSSO (US) (2005–06) 674
Gyrfalcon (MAI-Avgur) (1999–2000) 387
Gryfalcon SKB-1 (SGAU) (2001–02) 426
Gulfstream IV-MPA (Gulfstream) (2001–02) 659
Gulfstream IV-SP (Gulfstream) (2001–02) 659
Gulfstream V-SP (Gulfstream) (2001–02) 661
Gull M-20 (PZL) (2001–02) 323
GUNASEKERA AIRCRAFT (US) (2000–01) 677
GUT WORKS LLC (US) (2004–05) 629
Gyroliner (Groen) (2006–07) 753

H

H-1 (Hamilton) (1997–98) 635
H2X Hawk III (Groen) (1999–2000) 650
H-6 (XAC) (2002–03) 85*
HA-44 (Hamilton) (2000–01) 817
H-76 Eagle (Sikorsky) (1997–98) 755
HA 132 (Hamilton) (1998–99) 769
HA 140 (Hamilton) (1999–2000) 787
HAIG (see Hongdu Aviation Industry Group) (1999–2000) 64*
HAL 100-seat Transport (HAL) (2002–03) 183
HARI (see Hangzhou Airship Research Institute (1998–99) 763
HAT (see Hellenic Aeronautical Technologies) (2004–05) 181
HB-2 (He-Ro's) (2001–02) 317
HB 204 (Tornado) (HB Flugtechnik) (2006–07) 20
HC-2 (He-Ro's) (1999–2000) 316
HC-130 Hercules (Lockheed Martin) (1998–99) 665
HD 19 (TAI) (1997–98) 505
HD 21 (Eurocopter) (1998–99) 213
HD-XX (TAI) (1998–99) 487
HGM-2 Ladybird (He-Ro's) (2001–02) 318
Hkp 10 (Eurocopter) (1998–99) 213
HM-1 (Eurocopter) (2001–02) 234
HOPE-X (NASDA) (2001–02) 302
HR 100/250 (Robin) (1997–98) 129
HR 200 (Robin) (2004–05) 141*
HS 110 (Lindstrand) (2002–03) 760
HS 748 ASP (HAL) (1998–99) 161
HT 21 (Eurocopter) (1998–99) 213
HTT-38 (HAL) (2000–01) 179
HU-1 Seagull (SSLF) (1998–99) 72
HU-2B Petrel 650.B (SSLF) (1999–2000) 77
HU-2C Petrel 650C (SSLF) (2000–01) 83
HU-2D Petrel 650D (SSLF) (2000–01) 83
HX-300 Surprise (Hepp) (2000–01) 163
HX-321 (Hamilton) (1997–98) 635
Halcón, A-36 (ENAER) (1997–98) 54
HAMILTON AEROSPACE (US) (1997–98) 635
HAMILTON AIRSHIP COMPANY, THE(US) (2000–01) 817
HANGZHOU AIRSHIP RESEARCH INSTITUTE(China) (1998–99) 763
Hansa-2 NALLA (NAL) (1997–98) 162
Harrier II, (McDonnell Douglas (Boeing)/BAe) (1997–98) 229
Harrier II Plus (McDonnell Douglas (Boeing)/BAe) (1997–98) 234
Harrier GR. Mk 5, 5A and 7, and T. Mk 10 (McDonnell Douglas (Boeing)/BAe) (1997–98) 229
Hawk III, H2X (Groen) (1999–2000) 650
Hawk 200 series (BAE) (2004–05) 481
Hawker 450 (Hawker) (2004–05) 632
Hawker 450 (Raytheon) (2004–05) 668
Hawker 800 F1 (Raytheon) (2002–03) 700
Hawker 800 RA (Raytheon) (2002–03) 700
Hawker 800 SIG (Raytheon) (2002–03) 700
Hawker 800SM (Hawker) (2004–05) 631
Hawker 1000 (Raytheon) (1997–98) 733
Haze, Mi-14 (Mil) (2001–02) 406
Heavy Lift Replacement (Sikorsky) (2006–07) 874
Helibus S-92A (Sikorsky) (2002–03) 722
Helicopter Mk 11 (MK) (2001–02) 159*
Heliplane Transport (Carter) (2004–05) 625
Helix-A, Ka-27 (Kamov) (2001–02) 371
Helix-D, Ka-28 (Kamov) (2001–02) 371
HELLENIC AERONAUTICAL TECHNOLOGIES (Greece) (2004–05) 181
HENDERSON AERO SPECIALTIES INC (US) (2004–05) 633
HEPP, AUGUST (Germany) (2001–02) 157
Heracles Molniya-1000 (Molniya) (1997–98) 425
Hercules C. Mk 1K, C. Mk 1W, Mk 2 and C, Mk 3 (Lockheed Martin) (1998–99) 665
Hercules, commercial (Lockheed Martin) (1999–2000) 680
Hercules T.10, TK.10, TL.10 (Lockheed Martin) (1998–99) 665
Hermes (Aviakit) (2001–02) 110*
Heron (AD&D) (2001–02) 261
Heron (General Avia) (2000–01) 285
HE-RO'S DESIGN LUBLIN (Poland) (2004–05) 334
HESA (Iran) (1998–99) 249
HIGHLANDER AIRCRAFT CORPORATION (US) (1999–2000) 656
HighLander (HighLander) (1999–2000) 656*
High Speed Commercial Transport (Boeing) (1999–2000) 618
HILLBERG HELICOPTERS (US) (2006–07) 769
HILLER AIRCRAFT CORPORATION (US) (2000–01) 678
Hind Mi-24 (Mil) (2002–03) 384
Hind Mi-25 (Mil) (2002–03) 384
Hind Mi-35 (Mil) (2002–03) 384
Hip, Mi-8 (V-8) (Mil) (2001–02) 404
Hip-G, Mi-9 (Mil) (2001–02) 406
HIRT AIRCRAFT CORPORATION (US) (1997–98) 637
HISAR 200 (Raytheon) (2000–01) 754
HK AIRCRAFT TECHNOLOGIE AG (Germany) (2004–05) 168
Holland Millennium Navigator(Rigid Airship) (1998–99) 766
HONGDU AVIATION INDUSTRY GROUP (China) (1999–2000) 64*
Hoodlum-B, Ka-126 (Kamov) (1997–98) 390
Hook, Mi-6 (Mil) (2001–02) 403
Hook-C, Mi-22 (Mil) (2001–02) 410
Hongzhaji-6 (XAC) (2002–03) 85
Hornet F/A-18 (Boeing) (2001–02) 577
Huorpe (LAVIASA) (2000–01) 1
Humming (AeroCopter) (2004–05) 537
Hummingbird (Aerotek) (1997–98) 477
Hummingbird PZL-111 (PZL Warszawa) (2004–05) 333
Hummingbird (VAT) (2001–02) 786
Hummingbird RPX-Alpha (PADC) (1999–2000) 314
Hummingbird T-311 (Aeroprogress/ROKS/Aero) (2001–02) 345
HUNT (US) (2005–06) 690
Hydro 2000 (Hydro) (1997–98) 119
HYDRO 2000 INTERNATIONAL (France) (1999–2000) 127
Hydroplane (Yalo/Aviata) (2001–02) 337
HYDROPLANE COMPANY (Russian Federation) (1998–99) 350
Hyflex (NASDA) (1997–98) 298
Hypersonic Flight Programmes (NASA) (2004–05) 684
Hyper X, X-34 (NASA) (2004–05) 684
HYUNDAI SPACE AIRCRAFT COMPANY (Korea, South) (2001–02) 304

I

I-IL (Interavia) (2001–02) 370
I-3 (Interavia) (2001–02) 370
I-25 AS-2 (IL) (2001–02) 319
IA 63 Pampa (LMAASA) (1998–99) 2*
IA 63 Pampa NG (LMAASA) (2001–02) 1*
IAIO (See Iran Aviation Industries Organisation) (2001–02) 259
IAMI (see Iran Aircraft Manufacturing Industries Company) (2001–02) 259
IAMI (Hesa) Sanjaghak (AIO) (2006–07) 340
IAR-330L Puma (IAR) (1998–99) 329
IAR-46S (IAR) (2006–07) 430

IAR-93 (Soko/Avioane) ... (1997–98) 249
IAR-501 (INAV) ... (1999–2000) 342
Il-18 Coot (Ilyushin) ... (2001–02) 360
Il-18D-36 (Ilyushin) ... (2001–02) 360
Il-20 Coot (Ilyushin) ... (2001–02) 360
Il-20 M Coot A (Ilyushin) ... (2001–02) 360
Il-22 M-11 (Ilyushin) ... (2001–02) 360
Il-24-N (Ilyushin) ... (2001–02) 360
Il-38 May (Ilyushin) ... (2001–02) 360
Il-76 Candid (Ilyushin) ... (2001–02) 361
Il-76 SKIP, Be-976 (Beriev) ... (2001–02) 356
Il-76A (Beriev) ... (2001–02) 351
Il-76A-50 (Beriev) ... (2001–02) 351
Il-78M Midas (Ilyushin) ... (2001–02) 364
Il-82 (Ilyushin) ... (1999–2000) 365
Il-87 Maxdome (Ilyushin) ... (1999–2000) 365
Il-96M (Ilyushin) ... (2002–03) 358*
Il-96T (Ilyushin) ... (2002–03) 358*
Il-98 (Ilyushin) ... (2001–02) 366
Il-100 (Ilyushin) ... (2005–06) 394
Il-106 (Ilyushin) ... (1998–99) 358
Il-114FK (Ilyushin) ... (2001–02) 370*
Il-114P (Ilyushin) ... (2001–02) 369*
Il-140 (Ilyushin) ... (2004–05) 369
INAV (see Institutul de Aviatie) ... (2000–01) 350
IPTN (see Industri Pesawat Terbang Nusantara) ... (2001–02) 180*
IR-02 (AII) ... (1997–98) 252
IR-12 (AII) ... (1998–99) 248
IR-H5 (AII) ... (1998–99) 247
IS-2 (Il) ... (2001–02) 319
IS-2 (IL) ... (2004–05) 334
IS-28M2/GR (IAR) ... (2001–02) 340
ISAE (see Integrated Systems Aero Engineering) ... (1997–98) 637
I/U-27A Caravan 208 (Cessna) ... (2001–02) 634
IAPO (Russian Federation) ... (2006–07) 448
IAR/AEDECO (International) ... (1997–98) 229
IAROM SA. SC (Romania) ... (2004–05) 346
IHSRC Sanjaqak (AIO) ... (2005–06) 299
IKARUSFLUG LEICHTFLUGZEUGBAU (Germany) ... (2000–01) 165
Impala CA-25 (Skyfox) ... (1999–2000) 9
Individual Lifting Vehicle (PAM) ... (2006–07) 840
INDUSTRI PESAWAT TERBANG NUSANTARA (Indonesia) ... (2001–02) 180
INSTITUTUL DE AVIATIE (Romania) ... (2000–01) 350
INTEGRATED SYSTEMS AERO ENGINEERING INC (US) ... (1997–98) 637
INTERAVIA RADONEZH (Russian Federation) ... (2002–03) 362
INTERFACE AIRSHIPS (US) ... (2001–02) 814
INTORA-FIREBIRD (US) ... (2000–01) 546
IRAN AVIATION INDUSTRIES ORGANISATION (Iran) ... (2001–02) 259
Iridium I-22 (PZL Mielec) ... (1998–99) 308
Iridium M-93 (PZL Mielec) ... (2001–02) 324
Iridium M-95 (PZl Mielec) ... (1998–99) 309
Iridium M-96 (PZL Mielec) ... (2001–02) 324
Iridium M-97 (PZL Mielec) ... (1997–98) 324
Iryda I-22 (PZL Mielec) ... (1998–99) 308
Iryda M-93 (PZL Mielec) ... (2001–02) 324
Iryda M-95 (PZL Mielec) ... (1998–99) 309
Iryda M-96 (PZL Mielec) ... (2001–02) 324
Iryda M-97 (PZL Mielec) ... (1997–98) 324
ISATIS (France) ... (2006–07) 175*
Islander (Romaero) ... (2004–05) 351

J

J-5 Marco (Aviation Farm) ... (2000–01) 322
J6 Fregata (J&AS) ... (2001–02) 320*
J-22 Orao (Soko/Avioane) ... (1997–98) 249
JASDF (see Nihon Koku Jieitai) ... (2004–05) 307
JC-130 Hercules (Lockheed Martin) ... (1998–99) 665
JJ-7 (GAIC) ... (2004–05) 84*
JGSDF (see Nihon Rikujyo Jieitai) ... (2004–05) 307
JMSDF (see Nihon Kaijyo Jieitai) ... (2004–05) 307
JABIRU ASIA (Sri Lanka) ... (2004–05) 447
JAG (US) ... (2005–06) 691
Jag (Jag) ... (2004–05) 676
Jaguar (SEPECAT) ... (2001–02) 254
JAMMAERO/STARCORP (US) ... (2000–01) 678
J & AS AERO DESIGN (Poland) ... (2002–03) 324
JARAN AEROSPACE CORPORATION (US) ... (2000–01) 678
Jetcruzer 500 (AASI) ... (2002–03) 490
JetCruzer 650 (AASI) ... (1997–98) 554
Jet Defender (Modus Verticraft) ... (2004–05) 461
Jetstream 41 (Jetstream) ... (1997–98) 532
JETSTREAM AIRCRAFT (UK) ... (1998–99) 514
JK-04 RS Albatros (Ekolot) ... (2006–07) 414
Joey (CargoLifter) ... (2004–05) 751
John Doe (American Homebuilts') ... (2006–07) 626
JOINT-STOCK COMPANY AVIASPETSTRANS CONSORTIUM (Russian Federation) ... (1997–98) 360
Joint Strike Fighter (McDonnell Douglas/Northrop Grumman/BAe) ... (1997–98) 237
JOPLIN (US) ... (2006–07) 774
Jumbolino Avro RJ (BAE) ... (2002–03) 473
JUNKERS FLUGZEUG BAU (Germany) ... (1999–2000) 156

K

K-51 Peregrino (Kovacs) ... (2004–05) 28
K-250 (Kestrel) ... (2000–01) 680
Ka-27 Helix (Kamov) ... (2001–02) 371
Ka-28 Helix (Kamov) ... (2001–02) 371
Ka-29 (Kamov) ... (2006–07) 455
Ka-31 (Kamov) ... (2006–07) 455
Ka-40 (Kamov) ... (2000–01) 385
Ka-52 Alligator (Kamov) ... (2001–02) 377
Ka-64 Sky Horse (Kamov) ... (2001–02) 379
Ka-115 (Kamov) ... (2001–02) 402
Ka-126 Hoodlum-B (Kamov) ... (1997–98) 390
Ka-215 (Kamov) ... (2004–05) 402
KC-130 (Lockheed Martin) ... (1998–99) 665
KC-130H (Lockheed Martin) ... (1998–99) 665
KCDC (see Korean Commercial Aircraft Development Consortium) ... (2000–01) 312
KMH (KAI) ... (2006–07) 399
KMH (KAL) ... (2006–07) 399
KNR AIRCRAFT CO INC (US) ... (2004–05) 639
KR-2PM Swift (Radwan) ... (2000–01) 343
KR-860 (Sukhoi) ... (2001–02) 450
KT-2 (SSA) ... (1999–2000) 305
KT-112 Yanhol (Aviampex) ... (1998–99) 576
KADDB (Jordan) ... (2006–07) 392
KAMERTON-N LTD (Russian Federation) ... (1997–98) 383
Kangaroo (VulcanAir) ... (2002–03) 297
Kania (PZL Swidnik) ... (2001–02) 326
Kapitan, SKB-1, S-400 (SGAU) ... (2001–02) 426
KAPPA 77 A. S. (Czech Republic) ... (2006–07) 137
Kasatik M-12 (Phoenix) ... (1998–99) 342*
Katana 100 (Diamond) ... (2004–05) 61
Katana DA 20-A1 (Diamond) ... (2004–05) 60*
Katran (GADC) ... (1997–98) 477
Katty IAR-46S (IAR) ... (2006–07) 430
KESTREL AIRCRAFT COMPANY (US) ... (2000–01) 680
KINETIC (US) ... (2006–07) 780
King Air 200 Military Versions (Raytheon) ... (2002–03) 693
King Air B200 SE (Raytheon) ... (1998–99) 712
Kiowa OH-58D (Bell) ... (2001–02) 568
Kiowa Warrior, OH-58D(1) (Bell) ... (2001–02) 568
KIS (Tri-R) ... (1999–2000) 764
Kite T-620 (Aerospace/ROKS/Aero) ... (1999–2000) 347
Kitty Hawk (PZL Swidnik) ... (2001–02) 326
Kittiwake (Kazan) ... (2001–02) 381
KLS (US) ... (2005–06) 696
Knight (Molniya) ... (1998–99) 406
Koala P220S (Evektor-Aerotechnik) ... (2000–01) 96
Kobra 2000 (IL) ... (1997–98) 319
Koliber 160 (PZL-110) (US) ... (2006–07) 774
Koliber 235A PZL-111 (EADS PZL) ... (2004–05) 333
Kolibri, T-311 (Aeroprogress/ROKS-Aero) ... (2001–02) 345
KOREA AEROSPACE RESEARCH INSTITUTE (Korea, South) ... (1999–2000) 305
KOREAN COMMERCIAL AIRCRAFT DEVELOPMENT CONSORTIUM (Korea) ... (2000–01) 312
Korshun T-620 (Aerospace/ROKS/Aero) ... (1999–2000) 347
Kos SBM-03 (E & K) ... (2004–05) 334
Krechet (MAI-Avgur) ... (1999–2000) 387
Krechet, SKB-1 (SGAU) ... (2001–02) 426
Kruk PZL-106B (PZL Warszawa-Okecie) ... (1998–99) 323
KULON-2 (Russian Federation) ... (2006–07) 468
KUMERTAU AIRCRAFT PRODUCTION ENTERPRISE (Russian Federation) ... (1997–98) 398
Kuryer T-910 (Aeroprogress/ROKS-Aero) ... (1997–98) 357

L

L-06 (SGAU) ... (2001–02) 425
L-6 (Aero-Volga) ... (2004–05) 378
L11/Pegas (Russian Federation) ... (2002–03) 375
L-13 Super Vivat (Aerotechnik) ... (1998–99) 82
L20J Allegro (Mooney) ... (2000–01) 722
L20T Predator (Mooney) ... (2000–01) 723
L-39 Albatros (Aero) ... (2004–05) 102
L-39 MS (Aero) ... (2004–05) 98
L-59 (Aero) ... (2004–05) 98
L-139 Albatros (Aero) ... (2004–05) 102
L 100J Commercial Hercules (Lockheed) ... (1999–2000) 680
L 235 Balbuzard (AAT) ... (1998–99) 95
L-410 UVP-E (LZ) ... (2004–05) 109
L-420 (LZ) ... (2004–05) 109
LAH-01 (Laflamme) ... (2006–07) 82
LAK-X (Avia Baltica) ... (1999–2000) 306
LAVIASA (see Latin Americana de Aviacion) ... (2001–02) 1
LAVP-OZE (Aviacor) ... (2000–01) 358
LC-40 (Lancair) ... (1997–98) 642
LC-130 Hercules (Lockheed Martin) ... (1998–99) 665
LFS (Sukhoi) ... (2004–05) 417
LK-2M Sluka (Letov) ... (2002–03) 102
LK-3 Nova (Letov) ... (2002–03) 102
LM 200 Loadmaster (Ayres) ... (2002–03) 517
LM 250 Loadmaster (Ayres) ... (1999–2000) 560
LMK.1 Oryx (CATA) ... (1999–2000) 107
LMZ (Russian Federation) ... (2002–03) 375
LS2 (HAT) ... (2002–03) 172
LT-11M Swati (BHEL) ... (2004–05) 182
LZ (Czech Republic) ... (2006–07) 140
Ladoga-6 (Molniya) ... (1997–98) 425
Ladoga-9 (Molniya) ... (1997–98) 425
Ladybird HGM-2 (He-Ro's) ... (2001–02) 318
LAFLAMME (Canada) ... (2006–07) 82
LAKE AIRCRAFT INC (US) ... (1997–98) 641
Lake LA-250 (Lanshe) ... (2006–07) 784
Lambáda UFM 11 (Urban) ... (2001–02) 104*
Lancair 320 Mark II (Lancair) ... (2000–01) 682
Lancair 360 Mk II (Lancair) ... (1999–2000) 682
Lancair 360 Turbo (Lancair) ... (1999–2000) 682
LANSHE (US) ... (2006–07) 784
LARON AVIATION TECHNOLOGIES INC (US) ... (1999–2000) 664
Laser (Kolb) ... (2002–03) 619*
Lasta 2 (LOLA Utva) ... (1999–2000) 776
LATIN AMERICANA de AVIACION (Argentina) ... (2001–02) 1
Layang Project (ARDC) ... (1999–2000) 313
Legend (Performance) ... (2002–03) 671
LEGEND LITE (Canada) ... (2005–06) 68
LEGKIE VERTOLETY MI NAUCHNO-PROIZVODSTVENNOYE OBEDINENIE (Russian Federation) ... (1999–2000) 387
Leopard (CMC) ... (2004–05) 488
Leshii SL-90 (Aviotechnica) ... (1997–98) 202
LET AS, KUNOVICE (Czech Republic) ... (2002–03) 98
LETECKE OPRAVOVNE TRENCIN SP (Slovak Republic) ... (2002–03) 430
LETECKE VYROBA s.r.o. (Czech Republic) ... (2004–05) 107
LETNO-ISSLEDOVATELSKY INSTITUT IMENI M.M. GROMOVA GOSUDARDSTVENNYI NAUCHNYI TSENTR (Russian Federation) ... (2002–03) 355
LIBERTY AERONAUTICAL (US) ... (2001–02) 675
LIBERTY AIRCRAFT (UK) ... (2001–02) 529
LIGHTNING BUG AIRCRAFT CORPORATION (US) ... (1997–98) 647
Lightning Bug (RFW) ... (2004–05) 706
LIGHT'S AMERICAN SPORTSCOPTER (Taiwan) ... (2001–02) 493
Lightship A-100 (ABC) ... (2002–03) 762
Liftmaster (Atlas) ... (2004–05) 555
LightWing GR-582 (Hughes) ... (2001–02) 6
Light Observation Helicopter (HAL) ... (2004–05) 202
Lincoln SV28 (Sivel) ... (1997–98) 282
Lionheart (Griffon) ... (2004–05) 619
Little Bear (Henderson) ... (2002–03) 611
LMZ (Russian Federation) ... (2002–03) 375
Loadmaster, LM 200 (Ayres) ... (2002–03) 517
Loadmaster, LM 250 (Ayres) ... (1999–2000) 560
Louit Ultralight (Louit) ... (2004–05) 149
LOAD RANGER (US) ... (2000–01) 689
LOLA UTVA FABRIKA AVIONA (Yugoslavia) ... (2001–02) 796
LOPORESTI INC (US) ... (2004–05) 671
LUKHOVITSY MASHINOSTROITELNYI ZAVOD (Russian Federation) ... (2002–03) 375
LUSUS (Czech Republic) ... (2004–05) 108

M

M9-200 AirCruiser (Millicer) ... (2001–02) 8
M-10 AirTourer (Millicer) ... (2001–02) 8
M-12 (Aviacor) ... (2001–02) 348*
M-12 Kasatik (Phoenix) ... (1998–99) 342
M-16 Mifeng (BUAA) ... (2002–03) 64
M 19 Shark (Magni) ... (2004–05) 317
M-10 Revenge (Fly Line) ... (2006–07) 361
M-20 Mewa (PZL) ... (2001–02) 323
M-20 Talon (Magni) ... (2005–06) 321
M-20K Encore (Mooney) ... (2001–02) 709
M-21 (Magni) ... (2006–07) 368
M28 03/04 Skytruck Plus (PZL) ... (2004–05) 363
M-28 03/04 Skytruck Plus (PZL) ... (2000–01) 328
M58 (Masquito) ... (1998–99) 11
M80 (Masquito) ... (2004–05) 18
M-70 (Myasishchev) ... (2004–05) 424
M-90 Samson (Myasishchev) ... (1997–98) 428
M-93 Iryda (PZL-Mielec) ... (2001–02) 324
M-95 Iryda (PZL Mielec) ... (1998–99) 309
M-96 Iryda (PZL-Mielec) ... (2001–02) 324
M-97 Iryda (PZL Mielec) ... (1997–98) 324
M-99 Orkan (PZL Mielec) ... (1997–98) 324
M-101T Gzhel (Myasishchev) ... (1999–2000) 416*
M-112 (Myasishchev) ... (1998–99) 407
M-150 (Myasishchev) ... (1999–2000) 417
M-201 Sokol (Myasishchev) ... (2001–02) 421
M-202 PW Olen (Myasishchev) ... (2001–02) 422
M-203 PW Barsuk (Myasishchev) ... (2001–02) 422
M-290TP Redigo (Aermacchi) ... (1999–2000) 265
M-300 (Micco) ... (1998–99) 684
M-500 (Myasishchev) ... (2004–05) 425
MA-55 (Avgur) ... (1998–99) 767
MAI (Russian Federation) ... (2004–05) 384
MAPO (see Federalnoye Gosudarstvennoye Unitarnoye Predpriyatie) ... (2000–01) 400
MB-300 (Morrow) ... (2004–05) 726
MB-300 SkyTaxi (Morrow) ... (2002–03) 663
MC-130 Hercules (Lockheed Martin) ... (1998–99) 665
MD3-160 AeroTiga (SME) ... (2002–03) 313
MD-10 (McDonnell Douglas) ... (1997–98) 695
MD-11 (Boeing) ... (2001–02) 618

MD-17 (Boeing) ..... (2000–01) 636
MD-20 (McDonnell Douglas) ..... (1997–98) 698
MD-80 Series (Boeing) ..... (1999–2000) 613
MD-90 (Boeing) ..... (2000–01) 633
MD-90-30T (SAMF/Boeing) ..... (2000–01) 82
MD-95 (McDonnell Douglas) ..... (1997–98) 694
MD 500D (Kawasaki) ..... (2002–03) 302
MD 530 Defender (MD) ..... (2001–02) 703
MD 900 (Rosaerosystems) ..... (2006–07) 489
MD 902 Explorer (McDonnell Douglas) .... (1997–98) 685
MEAA (Malaysia) ..... (2002–03) 313
MGS-6 (Myasishchev) ..... (1997–98) 428
MGS-8 (Myasishchev) ..... (1997–98) 428
MH-6 (MD) ..... (2001–02) 703
MH-53E Sea Dragon (Sikorsky) ..... (2002–03) 713*
MH 2000 (Mitsubishi) ..... (2006–07) 306
Mi-6 Hook (Mil) ..... (2001–02) 403
Mi-8 (V-8) Hip (Mil) ..... (2001–02) 404
Mi-9 Hip-G (Mil) ..... (2001–02) 406
Mi-14 Haze (Mil) ..... (2001–02) 406
Mi-17KF Kittiwake (Kazan) ..... (2001–02) 381
Mi-18 (see Mi-17) (Mil) ..... (2001–02) 410
Mi-22 Hook (Mil) ..... (2001–02) 410
Mi-22 Hook-C (Mil) ..... (2002–03) 384
Mi-24 Hind (Mil) ..... (2002–03) 384
Mi-25 Hind (Mil) ..... (2002–03) 384
Mi-27 (Mil) ..... (2002–03) 386
Mi-34 VAZ (Mil) ..... (1997–98) 421*
Mi-35 Hind (Mil) ..... (2002–03) 384
Mi-38 (Euromil) ..... (2004–05) 278*
Mi-40 (Mil) ..... (1998–99) 405
Mi-52 (Mil) ..... (1998–99) 405
Mi-54 (Mil) ..... (1997–98) 423*
Mi-58 (Mil) ..... (1998–99) 405
Mi-234 (Mil) ..... (2002–03) 389
MiG 1-2000 LFS (MiG) ..... (2000–01) 411
MiG 1.42 (1.44) MFI (MiG) ..... (2001–02) 398
MiG-25 Foxbat (MiG) ..... (1998–99) 380
MiG-27M (HAL) ..... (1997–98) 161
MiG-31 Foxhound (MiG) ..... (2001–02) 396
MiG 33 (MiG) ..... (1999–2000) 397
MiG 35 (MiG) ..... (2001–02) 398
MiG-110 (MAPO MiG) ..... (2006–07) 407
MiG 115 (MiG) ..... (2001–02) 403
MiG 125 (MiG) ..... (2000–01) 415
MJ5 Sirocco (Jurca) ..... (2004–05) 137
MkII (MK Helicopter) ..... (2001–02) 159
MOTOR-SICH (Ukraine) ..... (2006–07) 578
MPA-X (JMSDF) ..... (2001–02) 293
Mü 30 Schlacro (AkaFlieg München) ..... (2001–02) 144
MY-102/200 (Mylius) ..... (1999–2000) 157
MY-103 (Mylius) ..... (2004–05) 171
MY-104 (Mylius) ..... (2004–05) 171
Mach 10 Aircraft (Boeing) ..... (1999–2000) 569
Madcap An-71 (Antonov) ..... (1997–98) 513
Magic (Kaiser) ..... (2004–05) 70
Magnajet (Phoenix) ..... (2002–03) 60
Magnus 60 (Pan Atlantic) ..... (1998–99) 762
MAI-AVGUR VOZDUKHOPLAVATELNYITSENTR (Russian Federation) ..... (2000–01) 399
Mainstay, A-50 (Beriev) ..... (2001–02) 351
Mako (EADS) ..... (2006–07) 304
MALAYSIAN EXPERIMENTAL AIRCRAFT ASSOCIATION (Malaysia) ..... (2002–03) 313
Mantha X 001 (AMSAT) ..... (2004–05) 127
MAPO 'MiG' (Russian Federation) ..... (2000–01) 400
Maraudeur (PJB) ..... (2004–05) 151
Marco J-5 (Aviation Farm) ..... (2000–01) 322
MARK FLUGZEUGBAU (Germany) ..... (2002–03) 163
Martlet (C-Craft) ..... (2000–01) 9
Martin T-420 (Khrunichev) ..... (1999–2000) 385
Martin T-501 (Aeroprogress/ROKS-Aero) .. (1997–98) 355
MASQUITO (Belgium) ..... (2005–06) 18
Matador II, VA.2 (McDonnell Douglas (Boeing/BAe) ..... (1997–98) 229
Maxdome II-87 (Ilyshin) ..... (1999–2000) 365
May, Il-38 (Ilyushin) ..... (2001–02) 360
MCDONNELL AIRCRAFT AND MISSILE SYSTEMS (US) ..... (1998–99) 559
MCDONNELL DOUGLAS (Boeing)/BAE (International) ..... (1997–98) 229
MCDONNELL DOUGLAS AEROSPACE (US) ..... (1997–98) 669
MCDONNELL DOUGLAS CORPORATION (US) ..... (1998–99) 683
MCDONNELL DOUGLAS HELICOPTER SYSTEMS (US) ..... (1997–98) 678
MCDONNELL DOUGLAS MILITARY TRANSPORT AIRCRAFT (US) ..... (1997–98) 687
McGuire 11 (Gunasekera) ..... (1999–2000) 656
MD HELICOPTERS (Netherlands) ..... (1999–2000) 310
Melmoth 2 (Garrison) ..... (2004–05) 656
Mercury (Aviation) ..... (1999–2000) 353
Mercury T-440 (Khrunichev) ..... (2001–02) 386
MERIDIONALI, ELICOTTERI (Italy) ..... (1997–98) 278
Merkury (Aviaton) ..... (1999–2000) 353
Merkury T-440 (Khrunichev) ..... (2001–02) 386
Merlin 23 (Fairchild Dornier) ..... (1999–2000) 644
MERLIN AIRCRAFT (US) ..... (1998–99) 683
Merlin E-Z (Aerocomp) ..... (1998–99) 533
Mermaid A-40 (Beriev) ..... (1999–2000) 356
Mermaid B-42 (Beriev) ..... (1998–99) 347
Messenger T-910 (Aeroprogress/ROKS-Aero) ..... (1997–98) 357
Metallica LG2 (CRO) ..... (1998–99) 83
Metro 23 (Fairchild Dornier) ..... (1999–2000) 644
Metro 23 Special Mission Aircraft (Fairchild) ..... (1997–98) 629
Mewa, M-20 (PZL) ..... (2001–02) 323
Midas, Il-78 (Ilyushin) ..... (2001–02) 364*
MIDWEST AEROSPORT (US) ..... (2006–07) 827
Mifeng M-16 (BUAA) ..... (2002–03) 64
Military Scout (Modus) ..... (2002–03) 452
Millennia (ABC) ..... (1997–98) 788
Millennium Navigator (Rigid Airship) ..... (1998–99) 766
Millennium Swift (Aviat) ..... (2002–03) 512
MILLICER AIRCRAFT INDUSTRIES (Australia) ..... (2002–03) 8
Mini-500 Bravo (Revolution) ..... (2000–01) 763
MINI-IMP (US) ..... (2006–07) 827
Mini-Imp (Mini-Imp) ..... (2005–06) 741
Minuano EMB-720D (NEIVA) ..... (1999–2000) 26
Mistral AE-206 (Aviasud) ..... (1998–99) 98
Mistral Twin AE-207 (Aviasud) ..... (1998–99) 98
Mlesa (Kari) ..... (2005–06) 349
MOSKOVSKOGO GOSUDARSTVENNOGO, AVIATSIONNOGO INSTITUTA (Russian Federation) ..... (2004–05) 384
Module (Aviastar) ..... (1999–2000) 352
MODUS VERTICRAFT CORPORATION (Taiwan) ..... (2004–05) 461
MOLLER INTERNATIONAL (US) ..... (1997–98) 699
MOLNIYA (Russian Federation) ..... (2005–06) 423
Molniya-1 (Molniya) ..... (2001–02) 419
Molniya-100 (Molniya) ..... (1997–98) 424
Molniya-300 (Molniya) ..... (1997–98) 424
Molniya-400 (Molniya) ..... (1997–98) 425
Molniya-1000 Heracles (Molniya) ..... (1997–98) 425
MONIOT, AVIONS PHILIPPE (France) . (1999–2000) 128
MONTAGNE (US) ..... (2006–07) 826
MOSKOVSKOGO GOSUDARSTVENNOGO, AVIATSIONNOGO INSTITUTA (Russian Federation) ..... (2004–05) 384
Moskvich, Ka-115 (Kamov) ..... (2001–02) 379
Mountain Goat (Montagne) ..... (2006–07) 828
MPA (Airbus) ..... (2006–07) 286
Mriya, An-225 (Antonov) ..... (2004–05) 476
MS Light Aircraft (Socata) ..... (2005–06) 161
MUDRY et CIE, AVIONS (France) ..... (1997–98) 121, 817
Multimission Maritime Aircraft (US) ..... (2005–06) 816
Multirole Transport Aircraft (ADA) ..... (2004–05) 182
Muscovite (Kamov) ..... (2001–02) 379
MYASISHCHEV/NAL (International) ..... (1998–99) 234
MYLIUS (Germany) ..... (2005–06) 182

N

N2XXM (Airtech) ..... (1998–99) 195
N2XXM (IPTN) ..... (1998–99) 169
N-5A (NAMC) ..... (2002–03) 77
N-63 (LOLA Utva) ..... (1999–2000) 776
N-250 (Dirgantara) ..... (2004–05) 193
N-270 (IPTN/AMRAI) ..... (1999–2000) 551
NA42 Barracuda (NA Design) ..... (2002–03) 103
NAC-100 (Nexus) ..... (1998–99) 689
NAI (China) ..... (2002–03) 75
NAL (see National Aerospace Laboratory .. (2004–05) 313
NAMC (see Nanchang Aircraft Manufacturing Company) ..... (1998–99) 62
NAS-332 Super Puma (Dirgantara) ..... (2006–07) 241
NASDA (Japan) ..... (2002–03) 306
NBELL-407 (IPTN) ..... (1997–98) 170
NBELL-412 (Dirgantara) ..... (2004–05) 193
NBELL-430 (IPTN) ..... (1997–98) 170
NBO-105 (Dirgantara) ..... (2004–05) 193
NBO 105 (IPTN) ..... (1999–2000) 176
NC-130 Hercules (Lockheed Martin) ..... (1998–99) 665
NC-212-200 Aviocar (IPTN) ..... (1999–2000) 176
NC-212-200 (Dirgantara) ..... (2004–05) 193
NGA (see Nanjing Groen Aviation Industry) ..... (2004–05) 86
NH2 ALCLH (IPTN) ..... (1997–98) 168
NH5 (IPTN) ..... (1997–98) 168
NIAT (see JSC National Institute of Aviation Studies) ..... (1998–99) 411
NRJ (China) ..... (2002–03) 78
NUAA (see Nanjing University of Aeronautics and Astronautics) ..... (2004–05) 87
NUAA/XALAC (see Nanjing University of Aeronautics and Astronautics) ..... (1998–99) 66
NANCHANG AIRCRAFT MANUFACTURING COMPANY (China) ..... (1998–99) 62
NANJING AERONAUTICAL INSTITUTE (China) ..... (2002–03) 75
NANJING GROEN AVIATION INDUSTRY LTD (China) ..... (2004–05) 86
NANJING UNIVERSITY OF AERONAUTICS AND ASTRONAUTICS (China) ..... (2004–05) 87
NATIONAL AEROSPACE LABORATORIES (India) ..... (2002–03) 183
NATIONAL AEROSPACE LABORATORY (Japan) ..... (2004–05) 313
NATIONAL INSTITUTE FOR AVIATION TECHNOLOGIES (Russian Federation) . (1998–99) 411
NATIONAL SPACE DEVELOPMENT AGENCY OF JAPAN (Japan) ..... (2002–03) 306
Nauticair 450 (Archedyne) ..... (2002–03) 507
Netz F-16A/B (Lockheed Martin) ..... (2002–03) 642
NEW BRITISH AEROSPACE (UK) ..... (1999–2000) 510
New Derringer (Derringer) ..... (2001–02) 646
New Light Aircraft (Lockheed Martin) ..... (1998–99) 624
New Light Aircraft (Socata) ..... (1997–98) 818
NEW MYERS AIRCRAFT COMPANY, THE (US) ..... (1997–98) 704
NEW REGIONAL JET PROGRAMME MANAGEMENT COMPANY (China) ..... (2002–03) 78
New Small Airplane (Boeing) ..... (1997–98) 588
New Strategic Aircraft (Lockheed Martin) . (1998–99) 670
New Tanker Programme (USAF) ..... (2004–05) 744
New Ultralight (BULAERO) ..... (1998–99) 100
NEXUS (US) ..... (1998–99) 689
Nimrod MRA. Mk 4 (BAE) ..... (2004–05) 512
Nihon Kaijyo Jieitai (Japan) ..... (2004–05) 307
Nihon Koku Jieitai (Japan) ..... (2004–05) 307
Nihon Rikujyo Jieitai (Japan) ..... (2004–05) 307
NITSCHE FLUGZEUGBAU (Germany) ..... (2001–02) 161
NOGATEC INTERNATIONAL (France) ..... (2000–01) 136
Nongye Feiji 5 (NAMC) ..... (2002–03) 77
Nova LK-3 (Letov) ..... (2002–03) 102
NOVOSIBIRSKOYE AVIATSIONNOYE-PROIZVODSTVENNOYE OBEDINENIE IMENI VP CHKALOVA GUP (Russian Federation) . (2000–01) 435
NUVENTURE (US) ..... (2006–07) 839

O

OH-6D (Kawasaki) ..... (2002–03) 302
OH-6DA (Kawasaki) ..... (2002–03) 302
OH-58D Kiowa (Bell) ..... (2001–02) 568
OH-58D Kiowa Warrior (Bell) ..... (2001–02) 568
OT-47B (Cessna) ..... (2001–02) 638
Olen, M-202PW (Myasishchev) ..... (2001–02) 422
Omega 2 (ISAE) ..... (1997–98) 637
OMEGA AEROSPACE CORPORATION (US) ..... (1997–98) 712
OMF (Germany) ..... (2006–07) 215
ONAGO AIRCRAFT COMPANY (US) ..... (2000–01) 825
One-Eleven (Romaero) ..... (1997–98) 345
Optica OA7-300 (FLS) ..... (1997–98) 538
OPYTNYI KONSTRUKTORSKOYE BURO FENIX (Russian Federation) ..... (2002–03) 347
Orao J22 (SOKO/Avioane) ..... (1997–98) 249
Orel T-208 (Khrunichev) ..... (1998–99) 375
Oriole PZL-104 (PZL Warszawa-Okecie) ..... (1999–2000) 332
Orion (Lockheed Martin) ..... (2000–01) 695
ORION-AVIA (Russian Federation) ..... (2006–07) 483
Orkan M-99 (PZL Mielec) ..... (1997–98) 324
Orlik PZL-130 (EADS PZL) ..... (2004–05) 329
Orlik 2000 PZL-140 (PZL-Warszawa) ..... (2001–02) 334
Oryx (Denel) ..... (1999–2000) 469
Oryx LMK.1 (CATA) ..... (1999–2000) 107
Osa Dubna-2 (Dubna) ..... (2001–02) 338*
Osprey V-22 (BAe) ..... (1997–98) 528
Ovod (Vitek) ..... (2002–03) 424

P

P-3 Orion (Lockheed Martin) ..... (1999–2000) 676
P-3C (Kawasaki) ..... (1999–2000) 282
P.68 Observer 2 (TAAL) ..... (1998–99) 165
P.68 Observer 2TC (TAAL) ..... (1998–99) 165
P.68 C (TAAL) ..... (1998–99) 165
P.68 Series (TAAL) ..... (2004–05) 325
P.68 TC (TAAL) ..... (1998–99) 165
P.166 (Piaggio) ..... (2005–06) 322
P 200 Series (Pottier) ..... (2004–05) 151
P220S Koala (Evektor-Aerotechnik) ..... (2000–01) 96
P305 (Airbus) ..... (2001–02) 200
PACI (see Philippine Aircraft Company Inc) ..... (1999–2000) 314
PADC (Philippines) ..... (2006–07) 410
PAI (Phillippines) ..... (2006–07) 410
PC-6 Turbo-Porter (Pilatus) ..... (2002–03) 443*
PC-7 Turbo-Trainer (Pilatus) ..... (2002–03) 445*
PC-7CH Turbo-Trainer (Pilatus) ..... (2002–03) 445
PC-7 Mk II M Turbo-Trainer (Pilatus) ..... (2004–05) 454*
PD-160 (Avgur) ..... (1998–99) 768
PD-220 (Avgur) ..... (2000–01) 816
PIG (see Promotional Ideas Group) ..... (1998–99) 772
PIG 3 (PIG) ..... (1997–98) 784
PT-6A (NAMC) ..... (2001–02) 75*
PZL-104 Wilga 35 (PZL Warszawa-Okecie) ..... (1999–2000) 332
PZL-104 Wilga 80 (PZL Warszawa-Okecie) ..... (1999–2000) 332
PZL-105L Flaming (PZL Warszawa-Okecie) ..... (1999–2000) 332
PZL-106B Kruk (PZL Warszawa-Okecie) ... (1998–99) 323
PZL-111 Koliber 235A (EADS PZL) ..... (2004–05) 333
PZL-130 Orlik (EADS PZL) ..... (2004–05) 329
PZL-140 Orlik (PZL Warszawa) ..... (2001–02) 334
PZL-140 Orlik 2000 (PZL Warszawa) ..... (2001–02) 335

PZL-230F Skorpion (PZL Warszawa-Okecie) ... (1997–98) 335
PZL-MIELEC (Poland) ... (2002–03) 328
PZL-WARSZAWA-OKECIE (Poland) ... (2002–03) 332
Pampa, IA 63 (LMASA) ... (1998–99) 2*
Pampa 2000 International (LAASA) ... (1997–98) 3*
PAN ATLANTIC (Canada) ... (2005–06) 72
PANAVIA AIRCRAFT (International) ... (2000–01) 257
PANSTWOWE ZAKLADY LOTNICZE WARSZAWA-OKECIE (Poland) ... (2002–03) 332
Panther 2000 (Ullmann) ... (2006–07) 908
Panther AS 565 (army/air force) (Eurocopter) ... (2001–02) 234
Panther AS 565 (navy) (Eurocopter) ... (2001–02) 234
PAPA 51 LTD (US) ... (2001–02) 719
PARTENAVIA COSTRUZIONI AERONAUTICHE SpA (Italy) ... (1997–98) 279
PAXMAN'S NORTHERN LITE AEROCRAFT (Canada) ... (2004–05) 67
Pchel T-203 (Aeroprogress/ROKS-Aero) ... (1997–98) 350
Peacemaker AU-23A (Pilatus) ... (2002–03) 443
Pegass (Delta) ... (1999–2000) 90
Pegasus T-507 (Khrunichev) ... (2001–02) 386
Pelican PZL-240 (PZL-Warszawa) ... (2001–02) 335
Pelikan PZL-240 (PZL-Warszawa) ... (2001–02) 335
PEREGRINE FLIGHT INTERNATIONAL (US) ... (1997–98) 713
Peregrine (Kovacs) ... (2004–05) 28
Peregrino K-51 (Kovacs) ... (2004–05) 28
PERFORMANCE AIRCRAFT INC (US) ... (2004–05) 691
Petrel 650C, HU-2C (SSLF) ... (2000–01) 83
Petrel 650D, HU-2D (SSLF) ... (2000–01) 83
PEZETEL (Poland) ... (2001–02) 320
Phalcon 707 (AIA) ... (1998–99) 252
PHILIPP, AIRCRAFT GmbH (Germany) ... (2004–05) 173
PHILIPPINE AIRCRAFT COMPANY (Philippines) ... (1999–2000) 314
Phillicopter Mk 1 (Veetol Helicopters) ... (1997–98) 10
Phoenix (Endeavour) ... (2005–06) 3
PHOENIX FANJET CORPORATION (Canada) ... (2004–05) 68
PhoenixJet (Vortex) ... (2000–01) 800
Phoenix Fanjet (Alberta) ... (2002–03) 27
Phoenix GM-17 (Intracom) ... (2002–03) 254
Phoenix Kasatik M-12 (Aviakor) ... (2001–02) 348*
PHOENIX OKB (Russian Federation) ... (1999–2000) 352
PILATUS BRITTEN-NORMAN (UK) ... (1998–99) 518
Pinguino F.22 (General Avia) ... (1997–98) 276
Piper New Projects (Piper) ... (2004–05) 698
Piranha (Sadler) ... (2000–01) 767
PJB (France) ... (2006–07) 178
Pocket Rocket (Hughes) ... (2002–03) 7
PONY JSC (Russian Federation) ... (1999–2000) 419
Pony (Pony) ... (1998–99) 411
PRECEPTOR AIRCRAFT CORPORATION (US) ... (2000–01) 741
PRECISION TECH (US) ... (2006–07) 851
Predator M20T (Mooney) ... (2000–01) 723
Président, DR (Robin) ... (1997–98) 818
PRIVATE EXPLORER (US) ... (2002–03) 679
Prize (Riola) ... (1998–99) 412
Projet (Avocet) ... (2005–06) 569
PROMAVIA (Belgium) ... (1998–99) 11
PROMOTIONAL IDEAS GROUP (UK) ... (1998–99) 772
Propbike (Parabounce) ... (2006–07) 841
PROSPORT (US) ... (2005–06) 764
Proteus 281 (Scaled Composites) ... (2004–05) 711
Puelche (LAVIASA) ... (2001–02) 1
Puma, IAR-330L (IAR) ... (1998–99) 329
Pursuit II, S-15 (Rans) ... (2000–01) 745
PZL-106BT Turbo-Kruk (EADS PZL) ... (2005–06) 363
PZL-110 Koliber 160 (EADS PZL) ... (2006–07) 414
PZL-112 Junior (EADS PZL) ... (2004–05) 358
PZL-MIELEC DO BRAZIL FABRICA D'AVOIES (Brazil) ... (1998–99) 22

Q

QUESTAIR INC (US) ... (1997–98) 718
QSP (Northrop Grumman) ... (2006–07) 838

R

R-02 Robert (SAU) ... (1998–99) 413
R-50 Robert (SAU) ... (2000–01) 437
R90-230 RG (Ruschmeyer) ... (1997–98) 149
R90-420 AT (Ruschmeyer) ... (1997–98) 149
R95 (Ruschmeyer) ... (1997–98) 149
R1180 Aiglon (Robin) ... (2000–01) 143
R2120 Alpha (Robin) ... (2005–06) 154*
R2160 (Robin) ... (2005–06) 154*
R 3000 series (Robin) ... (1999–2000) 136
RA-180 (Rigidair) ... (2002–03) 754
RAF (see Royal Air Force) ... (2004–05) 491
RAH-66 Comanche (Boeing Sikorsky) ... (2005–06) 633
RC-130 Hercules (Lockheed Martin) ... (1998–99) 665
RF-9 (ABS) ... (2004–05) 452
RF-47 (Eurovial) ... (2000–01) 134
RFW (see Reflex Fiberglass Works) ... (2004–05) 706
RJ (Avro) ... (2002–03) 473
RJ 70 (Avro) ... (2002–03) 473
RJ 85 (Avro) ... (2002–03) 473
RJ 100 (Avro) ... (2002–03) 473
RJ 115 (Avro) ... (1997–98) 528
RJX (Avro) ... (2002–03) 473
RMX-4 (MEAA) ... (2001–02) 307
RN (see Royal Navy) ... (2004–05) 492
RP-1 (Mitsubishi) ... (1997–98) 296
RPX-Alpha Hummingbird (PADC) ... (1999–2000) 314
RU-38A Twin Condor (Schweizer) ... (2001–02) 756
RV-6 (Van's) ... (2002–03) 736
RV-6A (Van's) ... (2002–03) 736
RADWAN (Poland) ... (2000–01) 343
Rainbow Chaser (Jammaero/Starcorp) ... (2000–01) 678
Ratnik (Kamerton-N) ... (1997–98) 383
Raven, PZL-106B (PZL Warszawa-Okecie) ... (1998–99) 323
Redigo M-290TP (Aermacchi) ... (1999–2000) 265
REFLEX FIBERGLASS WORKS INC (US) ... (2004–05) 706
Regional Jet (Alliance) ... (2001–02) 550
Regional Jet Series 100 & 200 (Canadair) ... (1999–2000) 41
Regional Jet Series 700 (Canadair) ... (1999–2000) 44
Remo 180, DR 400/180R (Robin) ... (2000–01) 142
Remo 200, DR 400/200R (Robin) ... (1997–98) 128
RENAISSANCE COMPOSITES (US) ... (2002–03) 703
Replacement Interdictor Aircraft (RIA) (US Air Force) ... (2005–06) 815
RESEARCH INSTITUTE, No 605 of AVIC (China) ... (1998–99) 762
Reusable Launch Vehicle X-33 (NASA) ... (2001–02) 711
Reusable Launch Vehicle X-34 (NASA) ... (2001–02) 711
Revcon 6 (Groen) ... (2006–07) 753
REVOLUTION HELICOPTER CORPORATION (US) ... (2000–01) 763
Rhapsody (Dreamwings) ... (2001–02) 647
RICHTER FLUGZEUGBAU (Germany) ... (1998–99) 153
RIDA-MDT LTD (Russian Federation) ... (1999–2000) 420
Rigid Airship (AHA) ... (2001–02) 813
RIGID AIRSHIP DESIGN NV (Netherlands) ... (2004–05) 765
Robert R-02 (SAU) ... (1998–99) 413
Robert R-50 (SAU) ... (2000–01) 437
Robin 200 (Robin) ... (1999–2000) 132*
ROCKWELL/DASA (International) ... (1997–98) 248
ROMASHKA AGROTECHNICAL COMPANY (Russia) ... (1997–98) 430
ROMEO YANKEE LTD (Israel) ... (2004–05) 275
ROSS AIRCRAFT COMPANY (UK) ... (1998–99) 522
Rotormouse (Hillberg) ... (2006–07) 769
ROYAL AIR FORCE (UK) ... (2004–05) 491
ROYAL NAVY (UK) ... (2004–05) 492
Rozière balloons (Cameron) ... (2004–05) 771
RUSALEN & RUSALEN SdF (Italy) ... (2004–05) 298
RUSCHMEYER LUFTFAHRTTECHNIK (Germany) ... (1998–99) 153
RUSSKOE VOZDUKHOPLAVATELNOE COBSHCHESTVO (Russian Federation) ... (2004–05) 769

S

RS-1-11B Super Stinker (Aviat) ... (1998–99) 544
S-1T Pitts Special (Aviat) ... (1999–2000) 554
S-2B Pitts (Aviat) ... (2001–02) 558
S-2S Pitts (Aviat) ... (2000–01) 575
S-12 (Safire) ... (2000–01) 768
S-12-E Air Car (Spencer) ... (2000–01) 791
S-14 (Safire) ... (2000–01) 768
S-15 Pursuit (Rans) ... (2000–01) 745
S-16 Shekari (Rans) ... (2006–07) 856
S-17 Stinger (Rans) ... (2006–07) 857
S-18 Stinger II (Rans) ... (2006–07) 857
S-21 (Sukhoi) ... (1998–99) 435
S-26 (Safire) ... (2004–05) 710
S-32 (Sukhoi) ... (1997–98) 448
S-37 Berkut (Sukhoi) ... (2001–02) 444
S-70C (Sikorsky) ... (2004–05) 725
S-51 (Sukhoi) ... (1997–98) 448
S-54 (Sukhoi) ... (2001–02) 446
S-55 (Sukhoi) ... (2001–02) 447
S-56 (Sukhoi) ... (2001–02) 447
S-70C (Sikorsky) ... (2004–05) 767
S-76B (Sikorsky) ... (1997–98) 753
S-76 Military versions (Sikorsky) ... (1998–99) 740
S-76N (Sikorsky) ... (1998–99) 740
S-80 (Sukhoi) ... (2002–03) 412*
S-80E (Sikorsky) ... (1997–98) 745*
S-80/H-53E (Sikorsky) ... (2002–03) 713*
S-80M (Sikorsky) ... (1997–98) 745*
S-84 (Sukhoi) ... (1997–98) 450
S-86 (Sukhoi) ... (1998–99) 436
S-96 (Sukhoi) ... (1998–99) 436
S 100B Argus (Saab) ... (1999–2000) 477
S-202 (SGAU) ... (1998–99) 415
S-302 (SGAU) ... (1998–99) 416
S.211 (Aermacchi) ... (1997–98) 263*
S-300 (Staudacher) ... (2004–05) 738
S-302 (CKB-1) (SGAU) ... (2001–02) 426
S-400, SKB-1, Kapitan (SGAU) ... (2001–02) 426
S-986 (Sukhoi) ... (1997–98) 450
SA-2-38A (Schweizer) ... (2001–02) 756*
SA 7 (STI) ... (1998–99) 8
SA-227-CC Metro 23 (Fairchild Aerospace) ... (2000–01) 668
SA 227-DC Metro 23 (Fairchild Aerospace) ... (2000–01) 668
SAC F-8 11M (SAC Shenyang) ... (2004–05) 93
SAMF (see Shanghai Aircraft ManufacturingCompany) ... (2000–01) 82
SAMC (see Shijiazhuang Aircraft Manufacturing Corporation) ... (2001–02) 81
SAP (CSIST) ... (1998–99) 486
SATIC (International) ... (2002–03) 258
SAR 42 (ATR) ... (1998–99) 201
SARI (See Shanghai Aircraft Research Institute) ... (1997–98) 777
SAU (see Nauchno-Proizvodstvennaya Korporatsiya Samoloty-Amfibyi Universalnyye (Russian Federation) ... (2000–01) 436
SB7L-360A Seeker (Seabird) ... (1997–98) 8*
SB-582 (SFLC) ... (2001–02) 82
SBM-03 Kos (E&K) ... (2004–05) 334
SD27 Corriedale (Sivel) ... (1997–98) 281
SECC (see Shanghai Energy and Chemicals Corporation) ... (1998–99) 71
SF-2A Cygnet (Viking) ... (2000–01) 798
SF 25C Falke 1700 (Scheibe) ... (1999–2000) 161*
SF 36 R (Scheibe) ... (1997–98) 150
SF 40C Allround (Scheibe) ... (2001–02) 164
SF 45 SA Spirit (US) ... (2004–05) 175
SF.260TP (Aeromacchi) ... (2002–03) 272
SF.600A Canguro (VulcanAir) ... (2002–03) 297
SFLC (see Shanghai Feiteng Light Plane Company) ... (2001–02) 82
SGAC (see Shenzen General Aviation Company) ... (1997–98) 75
SH-4 Silvercraft (Sauer) ... (2002–03) 451
SH-5 (HAMC) ... (1997–98) 62
SK-12 Orion (Orion-Avia) ... (2006–07) 483
SK-500 (StarKraft) ... (1998–99) 745
SK-700 (StarKraft) ... (1998–99) 745
SKB-1, Favorit (SGAU) ... (2001–02) 425
SKB-1, A16 (SGAU) ... (2001–02) 425
SK-1, Krechet (SGAU) ... (2001–02) 426
SKB-1, S-400, Kapitan (SGAU) ... (2001–02) 426
SKh-S (Kulon-2) ... (2006–07) 468
SL-39 (RSK MIG) ... (2001–02) 424
SL-90 Leshii (Aviotechnica) ... (1997–98) 202
SLAC (see Shenyang Light Aircraft Company) ... (1999–2000) 77
SM-92 Finist (Smolensk) ... (2006–07) 491
SM-94 (Technoavia) ... (2004–05) 423
SM-2000P (Smolensk) ... (2006–07) 434
SMA (SkyMedia) ... (2004–05) 777
SMAN (see Société Morbihannaise d'Aéro Navigation) ... (1997–98) 129
SOGEPA (see Société de Gestion de Participations Aéronautiques ... (2000–01) 148
SP-20 and SP-26 (Lanshe) ... (2006–07) 784
SP-95 (Technoavia) ... (1999–2000) 445
SPAS-13 (21st Century) ... (2004–05) 759
SPAS-70 (21st Century) ... (2004–05) 759
SPAS-75 (21st Century) ... (2001–02) 798
SRA-4 (Gulfstream) ... (2001–02) 660
SSA-Kari (SSA) ... (1997–98) 303
ST-4 Aztek (Letov) ... (2002–03) 102
ST-50 (Israviation) ... (1998–99) 253
STI (see Sadleir Technology and Innovation) ... (1998–99) 7
STOL CH801 (Zenith) ... (2001–02) 794*
Su-24 Fencer (Sukhoi) ... (2001–02) 427
Su-25 Frogfoot (Sukhoi) ... (2004–05) 402
Su-25TM (Su-39) (Sukhoi) ... (2004–05) 405
Su-26 (Sukhoi) ... (2001–02) 447
Su-28 Frogfoot (Sukhoi) ... (2004–05) 402
Su-32 (Sukhoi) ... (2004–05) 410*
Su-32FN and MF (Su-27 IB) (Sukhoi) ... (2004–05) 413*
Su-33 (Sukhoi) ... (1999–2000) 435
Su-33 (Su-27K)(Sukhoi) ... (2004–05) 413
Su-34 (Sukhoi) ... (2004–05) 410*
Su-38 (Sukhoi) ... (1997–98) 445
Su-39 (Su-25TM) (Sukhoi) ... (2004–05) 416
Su-47 Berkut (Sukhoi) ... (2004–05) 446
Su-49 (Sukhoi) ... (2004–05) 446
Su-52 (Sukhoi) ... (2004–05) 446
Su-XX (Sukhoi) ... (2004–05) 451
SV28 Lincoln (Sivel) ... (1997–98) 282
SW-5 (PZL Swidnik) ... (2002–03) 330
Saab 340 B (Saab) ... (1999–2000) 477
Saab 2000 (Saab) ... (1999–2000) 480
SAAB AEROSPACE (Sweden) ... (2004–05) 451
SADLER AIRCRAFT CORPORATION (US) ... (2000–01) 767
SAFIRE (US) ... (2006–07) 863
Samburo AVo 68-R (Philipp) ... (2002–03) 167*
Samson M-90 ... (1997–98) 428

SAMSUNG AEROSPACE INDUSTRIES (Korea, South) ... (2001–02) 307
Samurai Sword DA 20-A1 (Diamond) ... (2004–05) 60
Samurai Sword (Diamond) ... (1997–98) 11
Sanjaghak (IAMI (HESA)) ... (2006–07) 340
Sapeer EC-130 Hercules (Lockheed Martin) ... (1998–99) 665
Sarohale TBM 60,000 (SOCATA) ... (1997–98) 134
SAUER, CHRIS (Switzerland) ... (2002–03) 451
Savasan Sahin (TAI) ... (2001–02) 494, 689
Saviat E-1 (SAT Saviat) ... (2000–01) 436
Saviat E-5 (SAT Saviat) ... (1999–2000) 420
Scaled 311 (Scaled) ... (2004–05) 754
Schlucro Mü 30 (AkaFlieg München) ... (2001–02) 144
Scub (Aerokuhlmann) ... (2006–07) 150
SEABIRD AVIATION AUSTRALIA PTY LTD (Australia) ... (1997–98) 8
Sea Dragon MH-53E (Sikorsky) ... (2002–03) 713*
Seagull, HU-1 (SSLF) ... (1998–99) 72
Sea Harrier FRS. Mk 1 (BAe) ... (1997–98) 524
Sea Harrier FRS. Mk 51 (BAe) ... (1997–98) 524
Seahawk-UL II (Mark) ... (2002–03) 163*
Sea King (GKN Westland) ... (1997–98) 547
Seaquest (Omega) ... (1997–98) 712
Sea Wing T-431 (Khrunichev) ... (2001–02) 385
Sea Wolf (Flying Power) ... (2002–03) 312
Seeker SB7L-360A (Seabird) ... (1997–98) 8*
Senator IE-201 (Elitar) ... (2004–05) 388
Sentinel 1000 (GSI) ... (1999–2000) 795
Sentinel 1240 (GSI) ... (1999–2000) 795
Sentinel 5000 (Skyship) ... (1997–98) 785
Sentinel 8500 (Skyship) ... (1997–98) 786
Shabaviz 2-75 (IHSRC) ... (2004–05) 289
Shadow II (CFM) ... (1997–98) 535
Shadow Series C (CFM) ... (1998–99) 514
Shahbaz (IAMI) ... (2004–05) 287
Shahbaz (PAC) ... (1997–98) 315
SHANGHAI AIRCRAFT MANUFACTURING FACTORY (China) ... (2000–01) 82
SHANGHAI AIRCRAFT RESEARCH INSTITUTE (China) ... (1997–98) 777
SHANGHAI ENERGY AND CHEMICALS CORPORATION (China) ... (1998–99) 71
SHANGHAI FEITENG LIGHTPLANE COMPANY (China) ... (2001–02) 82
Sharkmouse (Hillberg) ... (2006–07) 769
SHENYANG LIGHT AIRCRAFT COMPANY (China) ... (1999–2000) 77*
SHENYANG SAILPLANE AND LIGHTPLANE FACTORY (China) ... (2002–03) 84
SHENZHEN GENERAL AVIATION COMPANY LTD (China) ... (1997–98) 75
SHERPA AIRCRAFT MANUFACTURING (US) ... (1997–98) 743
SHIJIAZHUANG AIRCRAFT MANUFACTURING CORPORATION (China) ... (2001–02) 81*
Schmel, Dubna 1 (Dubna) ... (2001–02) 358
Sahdow Series D and E (BA) ... (2005–06) 516
SHORT BROTHERS PLC (UK) ... (1997–98) 544
Shrike (Millicer) ... (1998–99) 796
SIBERIAN AERONAUTICAL RESEARCH INSTITUTE SA CHAPLYGIN (Russian Federation) ... (1997–98) 432
Sigma-4 (Albatros) ... (2001–02) 346
Sigmajet (Phoenix) ... (2002–03) 60
Silvercraft SH-4 (Sauer) ... (2002–03) 451
Sirocco MJ5 (Jurca) ... (2004–05) 137
SIVEL (Italy) ... (1998–99) 274
Skorpion PZL-230F (PZL Warszawa-Okecie) ... (1997–98) 335
Skvorets T-407 (Aeroprogress/ROKS-Aero) ... (1998–99) 336
Sky Arrow (Rotox 914) (III) ... (2001–02) 282*
Skycycle (Carlson) ... (2002–03) 576
Skyfox (Skyfox) ... (1998–99) 304
SKYFOX AVIATION (Australia) ... (2000–01) 9
SKYGEAR (Korea, South) ... (2004–05) 345*
Sky Horse, Ka-64 (Kamov) ... (2001–02) 379
Skyjumper (Skyjumper) ... (2006–07) 533
Skylark, T-420 (Khrunichev) ... (2001–02) 384
Skylifter (Yakolev) ... (2001–02) 471
SKYLINE AVIATION TECHNOLOGIES (South Africa) ... (1998–99) 464
SKYMEDIA (US) ... (2005–06) 801
Skyquest (US) ... (2005–06) 804
Skyranger (Aerodyn) ... (1997–98) 97
Sky Rocket II (Flying K) ... (2000–01) 669
Skyship 600 (Skyship) ... (1997–98) 785*
SKYSPAN (Australia) ... (2006–07) 13
SKYSHIP/SENTINEL (UK) ... (1998–99) 772
SkyTaxi MB-300 (Morrow) ... (2002–03) 663
Skytruck Plus M-28 03/04 (PZL) ... (2000–01) 328
Skywatch SS-11/A (Legend Lite) ... (2004–05) 66
SLEPCEV, NESTOR (Australia) ... (2001–02) 9*
Sling Shot (Kolb) ... (2004–05) 682
Sluka LK-2M (Letov) ... (2002–03) 102
Smartfish Business Jet (Smartfish) ... (2004–05) 492
Smartfish Sportplane (Smartfish) ... (2004–05) 492
SOCATA GROUP AEROSPATIALE MATRA (France) ... (2001–02) 130*
SOCIETE DE GESTION DE PARTICIPATIONS AERONAUTIQUES (France) ... (2000–01) 148
SOCIETE MORBIHANNAISE D'AERO NAVIGATION (France) ... (1997–98) 129
Soko 2 (Soko) ... (2001–02) 14
SOKO AIR MOSTAR (Bosnia-Herzegovina) ... (2002–03) 15
Sokol M-20 (Myasishchev) ... (2001–02) 421
SOKO/AVIOANE (International) ... (1997–98) 249
Sokol T-401 (Aeroprogress/ROKS-Aero) ... (1997–98) 353
Solo Aeropract-21M (Aeropract) ... (2001–02) 342
Sonerai I (Great Plains) ... (2001–02) 656
Sonerai II Series (Great Plains) ... (2001–02) 656
Sonic Cruiser (Boeing) ... (2004–05) 578
Space Shuttle (NAL) ... (2001–02) 301
Sparrowhawk (Gavilán ... (2004–05) 95
Spartan 11E (Luscombe) ... (2002–03) 652*
Spartan C-27A (Alenia) ... (2000–01) 279
Diamond Star DA-40-180 (Diamond) ... (2002–03) 11
SPAS-R1 (21st Century) ... (2004–05) 34
SPECIAL AIRCRAFT TRANSPORT INTERNATIONAL COMPANY GIE (International) ... (2002–03) 258
Special Mission Aircraft (Fairchild) ... (1997–98) 629
Special S-1T Pitts (Aviat) ... (1999–2000) 554
Spectra (PJB) ... (2004–05) 151
Speed Arrow 750TCI (III) ... (2004–05) 316
Speed Katana, DA 20-C1 (Diamond) ... (1997–98) 809
Speed Katana, DV22 (Diamond) ... (1997–98) 11
SPEEDTWIN DEVELOPMENTS LTD (UK) ... (2004–05) 463
SPEEDTWIN DEVELOPMENTS (UK) ... (2001–02) 531
Speedtwin E2E (Speedtwin) ... (2001–02) 531
SPENCER AMPHIBIAN AIRCRAFT (US) ... (2001–02) 780
Spirit (Questair) ... (1997–98) 718
Spirit B-2 (Northrop Grumman) ... (1999–2000) 705
Spirit SF 45 SA (US) ... (2004–05) 179
Spirit VA-12C (VisionAire) ... (2002–03) 740
Spotted Eaglet, PZL-140 (PZL Warszawa) ... (2001–02) 334
Sprinter T-430 (Khrunichev) ... (1997–98) 397
ST AERO (Serbia and Montenegro) ... (2005–06) 466
Stallion (Aircraft Designs) ... (2000–01) 544
Starboy 912 (Interplane) ... (2000–01) 98
STARKRAFT (US) ... (1998–99) 745
Starling T-407 (Aeroprogress/ROKS-Aero) ... (1998–99) 336
Starliner (Alliance) ... (2002–03) 502
Star Streak (Airborne Innovations) ... (2000–01) 561
Star Streak (BA) ... (2005–06) 517
Sterkh T-201 (Khrunichev) ... (1999–2000) 384
Stiletto T-9 (Terzi) ... (1998–99) 277
STODDARD HAMILTON AIRCRAFT (US) ... (2001–02) 780
Storch Replica (Preceptor) ... (1999–2000) 718
STORK AEROSPACE (Netherlands) ... (2004–05) 322
Stork-2 T-411 (Aeroprogress/ROKS-Aero) ... (1997–98) 354
Stork T-201 (Aeroprogress/ROKS-Aero) ... (1997–98) 350
Strato I (Grob) ... (1997–98) 144
Strato 2C G 850 (Grob) ... (1997–98) 146
Stratocruzer 1250-ER (AASI) ... (1997–98) 554
Streak (BA) ... (2005–06) 516
Strizh T-501 (Aeroprogress/ROKS-Aero) ... (1997–98) 355
SUA-7 (KLS) ... (2004–05) 681
SUPAPUP AIRCRAFT (Australia) ... (2004–05) 11*
Super AMX (AMX) ... (2001–02) 208
Super Chevvron 2-45CS (AMF) ... (1998–99) 500
SUPER-CHIPMUNK (Canada) ... (2005–06) 72
Super-Chipmunk (Super-Chipmunk) ... (2004–05) 72
SuperCobra AH-1RO (IAR) ... (1997–98) 343
Super Efficient Airliner (Boeing) ... (2004–05) 578
Super Frog (Boeing) ... (2002–03) 570
Super Puma Mk 1 AS 332 (Eurocopter) ... (1998–99) 213
Super Shadow Series D and D-D (CFM) ... (1997–98) 535
Supersonic Airliner Studies (International) ... (2001–02) 255
Super Stallion CH-53E (Sikorsky) ... (2002–03) 713*
Super Stinker S-1-11B (Aviat) ... (1998–99) 544
Super Transporter A300-608ST (SATIC) ... (2001–02) 253
Super Tucano EMB-312H (EMBRAER) ... (1997–98) 16*
Super Vivat L-13 (Aerotechnik) ... (1998–99) 82
Super Zodiac CH 601 HDS (Zenith) ... (1997–98) 771*
Support, Amphibious and Battlefield Rotorcraft (RAF) ... (2004–05) 491
Surprise HX-300 (Hepp) ... (2000–01) 163
Sutlej, An-32 (Antonov) ... (2001–02) 499
Swallow, Lasta 2 (LOLA Utva) ... (1999–2000) 776
Swati LT-11M (BHEL) ... (2004–05) 182
Swift KR-2PM (Radwan) ... (2000–01) 343
S-WING (Czech Republic) ... (2002–03) 104
Swing (S-Wing) ... (2001–02) 102
SWISS AIRCRAFT AND SYSTEMS ENTERPRISE CORPORATION (Switzerland) ... (2001–02) 492

T

T-4 (Kawasaki) ... (2005–06) 335
T-5 (Fuji) ... (2001–02) 292
T-9 Stiletto (Terzi) ... (1998–99) 277
T-10 (Lockheed Martin) ... (1998–99) 665
T-21 Sapsan (Khrunichev) ... (2004–05) 408
T-27 (EMBRAER) ... (2000–01) 17
T-67 Firefly (Slingsby) ... (2006–07) 596
T-106 (Aeroprogress/ROKS-Aero) ... (1998–99) 335
T-60S (Sukhoi) ... (1997–98) 447
T67M Mk 2 Firefly (Slingsby) ... (1999–2000) 532
T-130 Fregat (Aeroprogress/ROKS-Aero) ... (1998–99) 335
T-201 Aist (Aeroprogress/ROKS-Aero) ... (1997–98) 350
T-201 Sterkh (Khrunichev) ... (1999–2000) 384
T-203 Pchela (Aeroprogress/ROKS-Aero) ... (1997–98) 350
T-204 Griffon (Aeroprogress/ROKS-Aero) ... (1997–98) 351
T-205 Eastern Caravan (Aeroprogress/ROKS-Aero) ... (1997–98) 351
T-208 Orel (Krunichev) ... (1998–99) 375
T-230 Fregat (Khrunichev) ... (1998–99) 375
T-274 Brigantine (Krunichev) ... (1997–98) 393
T-274 Titan (Aerospace/ROKS-Aero) ... (1997–98) 351
T-311 Kolibri (Aeroprogress/ROKS-Aero) ... (2001–02) 345
T-401 Sokol (Aeroprogress/ROKS-Aero) ... (1997–98) 353
T-407 Skvorets (Aeroprogress/ROKS-Aero) ... (1998–99) 330
T-411 Wolverine (Khrunichev) ... (1997–98) 394
T-411 Wolverine (Washington Aeroprogress) ... (1997–98) 770
T-415 Snegir (Khrunichev) ... (2004–05) 409
T-417 (Khrunichev) ... (2000–01) 396
T-420 Skylark (Khrunichev) ... (2001–02) 384
T-421 Wolverine (Khrunichev) ... (2001–02) 385
T-422 Yastreb (Khrunichev) ... (1997–98) 396
T-430 Sprinter (Khrunichev) ... (1997–98) 397
T-431 Sea Wing (Khrunichev) ... (2001–02) 385
T-433 Flamingo (Aeroprogress/ROKS-Aero) ... (1999–2000) 347
T-433 Flamingo (Khrunichev) ... (2001–02) 386
T-440 Merkury (Khrunichev) ... (2001–02) 386
T-471 Corvette (Khrunichev) ... (1997–98) 398
T-501 Strizh (Aeroprogress/ROKS-Aero) ... (1997–98) 355
T-507 Skvorets (Khrunichev) ... (2004–05) 409
T-517 Fermer (Khrunichev) ... (2002–03) 374
T-610 Voyage (Aeroprogress/ROKS-Aero) ... (1997–98) 356
T-620 Korshun (Aeroprogress/ROKS-Aero) ... (1999–2000) 347
T-710 Anaconda (Aeroprogress/ROKS-Aero) ... (1997–98) 357
T-910 Kuryer (Aeroprogress/ROKS-Aero) ... (1997–98) 357
TA16 Seafire (Aquastar) ... (2004–05) 552
TAC (see Taiwan Aerospace Corporation) ... (2001–02) 494
TASA (see Tbilisi Aviation State Association ... (2001–02) 142
TAV-8B (McDonnell Douglas (Boeing)/BAe) ... (1997–98) 229
TB 360 Tangara (SOCATA) ... (2000–01) 147
TBM 60,000 Sarohale (SOCATA) ... (1997–98) 134
TC-130 Hercules (Lockheed Martin) ... (1998–99) 665
TFK-2 Carat (Technoflug) ... (2004–05) 178
TG-XI Yarasa (TAI) ... (1998–99) 487
TJ-500 (Maverick Air) ... (2002–03) 655
TK-10 (Lockheed Martin) ... (1998–99) 665
TL-10 (Lockheed Martin) ... (1998–99) 665
TL-32 Typhoon (TL Ultralight) ... (2001–02) 103
TL-132 Condor (TL Ultralight) ... (2001–02) 103
TL-232 Condor Plus (TL Ultralight) ... (2001–02) 103
TL-532 Fresh (TL Ultralight) ... (2001–02) 104
Tp 84 Hercules (Lockheed Martin) ... (1998–99) 665
Tp 100 (Saab) ... (1999–2000) 477
Tu-22M Backfire (Tupolev) ... (2001–02) 453
Tu-24 (Tupolev) ... (1998–99) 443
Tu-34 (Tupolev) ... (1998–99) 444
Tu-54 (Tupolev) ... (2001–02) 457
Tu-95 and Tu 142 Bear (Tupolev) ... (2001–02) 454
Tu-130 (Tupolev) ... (1998–99) 444
Tu-136 (Tupolev) ... (2000–01) 469
Tu-144LL (Tupolev) ... (1998–99) 445
Tu-154 Careless (Tupolev) ... (1999–2000) 452
Tu-154M (Tupolev) ... (2004–05) 426
Tu-160SK (Tupolev) ... (2001–02) 457*
Tu-204C Freighter (Tupolev) ... (1999–2000) 455*
Tu-204 Freighter Ovel Avia (Tupolev) ... (2001–02) 461*
Tu-206 (Tupolev) ... (2001–02) 462
Tu-216 (Tupolev) ... (2001–02) 462
Tu-224 (Tupolev) ... (2004–05) 428
Tu-234 (Tupolev) ... (2004–05) 428
Tu-244 (Tupolev) ... (2001–02) 462
Tu-230 (Tupolev) ... (1998–99) 449
Tu-244 (Tupolev) ... (1999–2000) 456
Tu-304 (Tupolev) ... (1999–2000) 456
Tu-306 (Tupolev) ... (1999–2000) 456
Tu-324 (Tupolev) ... (2001–02) 462
Tu-330 (Tupolev) ... (2001–02) 462
Tu-338 (Tupolev) ... (2001–02) 462
Tu-344 (Tupolev) ... (2001–02) 462
Tu-414 (Tupolev) ... (2001–02) 464
Tu-414 (Tupolev) ... (1997–98) 468
Tupolev C-Prop (Tupolev) ... (1998–99) 452
TW-18 Crosspointer (Skyline) ... (1997–98) 482
TAGANROGSKY AVIATSIONNYI NAUCHNO-TEKHNICHESKY KOMPLEKS (Russian Federation) ... (2004–05) 422
Tail-less Aircraft Concepts (Lockheed Martin) ... (1998–99) 671
TAIWAN AEROSPACE CORPORATION (Taiwan) ... (2001–02) 494
TAIWAN AEROSPACE INDUSTRY ASSOCIATION (Taiwan) ... (2002–03) 452
Tangara TB 360 (SOCATA) ... (2000–01) 147
TBILISI AVIATION STATE ASSOCIATION (Georgia) ... (2001–02) 142
Teal (L11/Pegas) ... (2001–02) 388
TECHNOAVIA (Russian Federation) ... (2006–07) 509
Tempest 184 (Jaran) ... (1999–2000) 658

TERZI, PIETO (Italy) ... (1998–99) 277
THERMOPLANE DESIGN BUREAU, MOSCOW AVIATION INSTITUTE (Russia) ... (2004–05) 769
Thompson airship (Thompson) ... (1997–98) 790
THOMPSON, JAMES, AIAA (US) ... (1997–98) 790
Thrust-Vectoring Control Programme (NASSA) ... (2004–05) 684
Thunder AVA-505 (AII) ... (2002–03) 259
Thunder Mustang (TBG) ... (2004–05) 785
THURSTON AEROMARINE CORPORATION (US) ... (1997–98) 762
Tigress (Lancair) ... (2000–01) 683
Tiltrotor Concept (Bell Boeing) ... (2000–01) 586
Titan T-274 (Aeroprogress/ROKS-Aero) ... (1997–98) 351
TOMAIR AIRCRAFT SALES (Australia) ... (2004–05) 12
Tornado (Mylius) ... (1999–2000) 157
Tornado ADV (Panavia) ... (1999–2000) 250
Tornado ECR (Panavia) ... (1999–2000) 249
Tornado F Mk 2, 2A, 83 (Panavia) ... (1999–2000) 250
Tornado GR Mk 1, 1A, 1B, 484A (Panavia) ... (1999–2000) 246
Tornado IDS (Panavia) ... (1999–2000) 246
Tornado HB 204 (HB Flugtechnik) ... (2006–07) 20
Toucan (EMBRAER) ... (2000–01) 17
Toyota TAA-1 (Scaled) ... (2004–05) 753
Transport Helicopter (IRGC) ... (2006–07) 343
TREK-TREK AEROSPACE INC (US) ... (2004–05) 742
Trek (Trek-Aerospace) ... (2004–05) 742
TRI-R TECHNOLOGIES (US) ... (2000–01) 794
TrisLander, BN2A Mk III (B-N) ... (2001–02) 523
Triton, DHC-8 (de Havilland) ... (2004–05) 58
Tucano EMB-312 (EMBRAER) ... (2000–01) 17
Tundra (Joplin) ... (2006–07) 774
Tundra (Laron) ... (1998–99) 655
Turbine Bravo, AS 202/32TP (FFA) ... (1997–98) 495
TURBINE DESIGN (US) ... (2005–06) 814
TD-2 Tempest (Turbine Design) ... (2005–06) 814
Turbine Exec (Hillberg) ... (2000–01) 678
Turbo Bonanza B36TC (Beech) ... (2005–06) 574*
Turbo Javelin PZL-106B (PZL Warszawa-Okecie) ... (1997–98) 338
Turbo-Porter PC-6 (Pilatus) ... (2002–03) 443*
Turbo-Thrush 700 (Ayres) ... (1997–98) 570
Turbo-Trainer PC-7 (Pilatus) ... (2002–03) 445*
Turbo-Trainer PC-7 Mk II M (Pilatus) ... (2004–05) 445*
TUSHINSKY MASHINOSTROITELNYI ZAVOD AO (Russian Federation) ... (2002–03) 416
Twinbee (KARI) ... (1998–99) 294
Twin Condor, RU-38A (Schweizer) ... (2001–02) 756*
Twinjet 1200 (Maverick Air) ... (1999–2000) 693
Twinjet 1500 (Maverick Air) ... (2002–03) 655
Twin Ranger, 206LT (Bell) ... (1998–99) 25
Twinstarr (Air & Space) ... (2001–02) 544
Typhoon TL-32 (TL Ultralight) ... (2001–02) 103

U

U-125A (Raytheon) ... (2002–03) 700
UC-26C (Fairchild Aerospace) ... (1999–2000) 644
UC-35A (Cessna) ... (2001–02) 638
UC-35C (Cessna) ... (2001–02) 638
UFM 11 Lambáda (Urban) ... (2001–02) 104*
UH-1N (Bell) ... (1998–99) 27
UH-12E3 (Hiller) ... (1998–99) 649
UH-12E3T (Hiller) ... (1998–99) 649
UH-12E5 (Hiller) ... (1997–98) 637
UH-60P (KA) ... (2004–05) 315
UHCA/VLCT (see Ultra-High Capacity Airliner/Very Large Commercial Transport ... (2001–02) 256
UH-60X Black Hawk (Sikorsky) ... (2002–03) 713
USA (see Ultraleichtflugzeugwerke Sachsen Anhalt ... (2004–05) 179
US-LTA (see US Lighter Than Air Corporation) ... (1998–99) 777
US-LTA 185M (US-LTA) ... (1997–98) 791
UV-20A Chiricahua (Pilatus) ... (2002–03) 443
ULLMANN (US) ... (2006–07) 908
Ultima (Junkers) ... (1999–2000) 156
Ultimate (Junkers) ... (1999–2000) 156
Ultra-High Capacity Airliner/Very Large Commercial Transport (UHCA/VLCT) ... (2001–02) 256
ULTRALEICHTFLUGZEUGWERKE SACHSEN-ANHALT (Germany) ... (2004–05) 179
Ultra Sport family (LASI) ... (2001–02) 493
UNIKOMTRANSO (Russian Federation) ... (1998–99) 453
UNIS OBCHODNI (Czech Republic) ... (2001–02) 104
UNITED STATES AIR FORCE (US) ... (2005–06) 815
UNITED STATES NAVY (US) ... (2006–07) 909
UPship 001 (Upship) ... (2004–05) 779
UPship 50 Metre (Blenntec) ... (2006–07) 657
UPship CORPORATION (US) ... (2004–05) 779
Utility Transport (PADC) ... (1997–98) 317
US LIGHTER THAN AIR CORPORATION (US) ... (1998–99) 777

V

V-22 Osprey (BAe) ... (1997–98) 528
VA.2 Matador II (McDonnell Douglas (Boeing)/BAe) ... (1997–98) 229
VA-10 Vantage (VisionAire) ... (2004–05) 749
VA-12C Spirit (VisionAire) ... (2002–03) 740
VC-32A (Boeing) ... (2001–02) 660
VC-97 (EMBRAER) ... (2001–02) 191
VC-130H Hercules (Lockheed Martin) ... (1998–99) 665
VM1 Esqual (Vol Mediterrani) ... (2006–07) 539
Vagabond (Etruria) ... (2001–02) 278
Valkyrie (Dreamwings) ... (2001–02) 647
Vantage VA-10 (VisionAire) ... (2004–05) 749
Vector FTT (DASA) ... (1999–2000) 144
VEETOL HELICOPTERS (Australia) ... (1998–99) 8
Vega (HK) ... (2004–05) 168
Venture (Nuventure) ... (2006–07) 839
VENTURE LIGHT AIRCRAFT RESOURCES LLC (US) ... (2004–05) 748
Venture Star (NASA) ... (2001–02) 711
Verticraft (Modus) ... (2004–05) 461
Vertijet (Modus) ... (2002–03) 452
Viator AP 68TP 600 (TAAL) ... (1998–99) 166
Viator AP 68TP 600 (VulcanAir) ... (2001–02) 290
Vigilant T.Mk 1 (Grob) ... (1997–98) 141
VIKING AIRCRAFT LIMITED (US) ... (2001–02) 786
Viper P3/A (Paxman) ... (2004–05) 67
VISIONAIRE CORPORATION (US) ... (2004–05) 749
Vitaz (Molniya) ... (1998–99) 406
V-Jet-II (Scaled Composites) ... (1999–2000) 742
VORONEZHSKOYE AVIATSIONNOYE PROIZVODSTVENNOYE OBEDINENIE OAO (Russian Federation) ... (2004–05) 434
VORTEX AIRCRAFT COMPANY (US) ... (2001–02) 789
Voyage T-610 (Aeroprogress/ROKS-Aero) ... (1997–98) 356
Voyager-500 (Revolution) ... (2000–01) 763
VOYENNO-PROMYSHLENNYI KOMPLEKS MAPO (Russian Federation) ... (2000–01) 400
VOZDUKH AERONAUTICAL ENTERPRISE (Russian Federation) ... (2004–05) 769
VTOL airliner studies (NAL) ... (2001–02) 301
VTOL Concept (STI) ... (1998–99) 8

W

W-3 SEP (PZL Swidnik) ... (2004–05) 342
WAF 96 (Nogatec) ... (1999–2000) 129
WAI (see Westinghouse-Airship Industries) ... (1997–98) 791
MASQUITO (Belgium) ... (2005–06) 18
WAH-64D Apache AH.Mk 1 (AgustaWestland) ... (2005–06) 210*
WDL 1B (WDL) ... (1997–98) 778
WDL LUFTSCHIFFGESELLSCHAFT mbH (Germany) ... (2004–05) 764
WLAC-1 White Lightning (RFW) ... (2004–05) 706
WASHINGTON AEROPROGRESS (US) ... (1997–98) 770
Wasp, Dubna-2 (Dubna) ... (2001–02) 358
Waverider Projects (NASA) ... (2001–02) 713
Wega (HK) ... (2004–05) 168
WESTINGHOUSE-AIRSHIPS INC (US) ... (1997–98) 774
Whisper (Kaiser) ... (2004–05) 170
White Lightning WLAC-1 (RFW) ... (2004–05) 706
Wilga 35 PZL-104 (PZL Warszawa-Okecie) ... (1999–2000) 332
Wilga 80 PZL-104 (PZL Warszawa-Okecie) ... (1999–2000) 332
WINDEAGLE AIRCRAFT CORPORATION (Canada) ... (2002–03) 62
Wizard (Airborne Innovations) ... (2000–01) 561
WOJSKOWE ZAKLADY LOTNICZE NR3 (Poland) ... (2002–03) 338
WOLFSBERG-EVEKTOR (Czech Republic) ... (2001–02) 105
Wolverine T-411 (Khrunichev) ... (1997–98) 394
Wolverine T-411 (Washington Aeroprogress) ... (1997–98) 770
Wolverine T-421 (Khrunichev) ... (2001–02) 385
World Airlifter (Lockheed Martin) ... (1997–98) 658
WORLD QUEST (US) ... (2000–01) 826
Wright Flyer (Wright) ... (2004–05) 802
WYTWORNIA SPRZETU KOMUNIKACY JNEGO (Poland) ... (1999–2000) 319

X

X4 (Robin) ... (1997–98) 129
X-32 (Boeing) ... (2002–03) 527
X-32 (Lockheed Martin) ... (1999–2000) 681
X-33 (NASA) ... (2001–02) 711
X-34 (NASA) ... (2001–02) 711
X-35 Joint Strike Fighter (Lockheed Martin) ... (2001–02) 687*
X-36 (McDonnell Douglas) ... (1997–98) 677
X-38 (NASA) ... (2001–02) 712
X-43 Hyper-X (NASA) ... (2004–05) 684
X-44A (NASA) ... (2004–05) 684
XXJ (CAC) ... (1998–99) 57
XIAMEN LIGHT AIRCRAFT COMPANY (China) ... (1998–99) 66
Xihu-5 (HARI) ... (1998–99) 763

Y

Y-7 (XAC) ... (2002–03) 86
Y7H (XAC) ... (2000–01) 86
YALO/AVIATA (Poland) ... (2002–03) 338
YEZ-2A (Skyship) ... (1997–98) 785
Yak-18T (Russian Federation) ... (2006–07) 521
Yak-42 Clobber (Yakolev) ... (2001–02) 468
Yak-46-1 (Yakovlev) ... (1997–98) 473
Yak-52 (Yakovlev) ... (2004–05) 438
Yak-55M (Yakovlev) ... (1998–99) 456*
Yak-58 (Yak Alacon) ... (2006–07) 394
Yak 112 (Yakolev) ... (2001–02) 471
Yak 131 (Yakolev) ... (2001–02) 467
Yak-142 (Yakovlev) ... (1997–98) 472
Yak-152 (Yakolev) ... (2001–02) 470
Yak-242 (Yakovlev) ... (1997–98) 472
YALO ZAKLAD NAPRAWY I BUDOWY SPRZETU LATAJACEGO YALO (Poland) ... (2002–03) 338
Yak-SKH (Yakovlev) ... (2005–06) 464
Yamal (AST) ... (2000–01) 356
YANAGISAWA (Japan) ... (2006–07) 392*
Yanhol (Aviaimpex) ... (2004–05) 506
Yavasa TG-XI (TAI) ... (1998–99) 487
Yastreb T-422 (Khrunichev) ... (1997–98) 396
Young Man T-131 (SSH) ... (2001–02) 335
Yula (Polyot) ... (2004–05) 428
Yunshuji-7 (XAC) ... (2002–03) 86
Yunshuji-11B (I)(HAMC) ... (1998–99) 60

Z

Z-8 (CHAIC) ... (1998–99) 57
Z10 (CHRDI) ... (2001–02) 67
Z-10 (HAI) ... (2002–03) 73
Z-10 (Onago) ... (2000–01) 825
Z-142 (ZLIN) ... (1997–98) 93
Z-142C (ZLIN) ... (2001–02) 106
Z 400 Rhino (Czexh Republic) ... (2005–06) 124
ZA-6 San'ka (Aerokopter) ... (2006–07) 558
ZLAC (see Zhongmeng Light Aircraft Corporation) ... (1997–98) 80
ZAITSEV (Russian Federation) ... (2000–01) 484
ZAKLAD NAPRAWY I BUDOWY SPRZETU LATAJACEGO YALO (Poland) ... (2002–03) 338
ZAKLAD LOTNICZY PZL-MIELEC (Poland) ... (2002–03) 328
Zenith CH 200 (Zenair) ... (1999–2000) 56
Zhishengji-8 (CHAIC) ... (1998–99) 57
Zhishengji-10 (HAI) ... (2002–03) 73
Zhonghuai (BKLAIC) ... (2000–01) 811
ZHONGMENG LIGHT AIRCRAFT CORPORATION (China) ... (1997–98) 80
Ziu (TAI) ... (2002–03) 453
Zodiac CH 601 HD (Derazona) ... (1997–98) 165
Zodiac CH 601 (UL) (Zenith) ... (1997–98) 770
Zulu (BUL) ... (2006–07) 155
ZYGMUNTA PULAWSKIEGO-PZL SWIDNIK (Poland) ... (2001–02) 326

NOTES

NOTES